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Test-retest reliability of Motricity Index strength assessments for lower extremity in post stroke hemiparesis

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Abstract

Background: The Motricity Index was used to measure strength in upper and lower extremities after stroke. The weighted score based on the ordinal 6 point scale of Medical Research Council was used to measure maximal isometric muscle strength. There is dearth of articles dealing with the reliability of this method. Therefore, the aim of this study was to determine the test retest reliability of Motricity Index strength assessments for paretic lower limb in 20 chronic stroke patients with one week interval.

Methods: In a cross sectional study, intrarater reliability of lower extremity Motricity Index strength assessments with one week interval were measured.

Result: The SPSS 18 was used for analysis of data. Two-way random-consistency model of ICC was used for assessment of test-retest reliability. The ICC values showed high reliability of strength measurement of Motricity Index (ICC=0.93).

Conclusion: The Motricity Index can be a reliable instrument for measuring the strength of involved lower extremity when assessment is done by one rater following chronic stroke.

Keywords: Reliability, Motricity Index, Hemiparesis, Chronic stroke.

Introduction

The most important motor deficit after stroke is the paresis of the affected side, contralateral to vascular lesion in the brain (1). Muscle weakness, as one of the negative features of upper motor neuron syndrome is characterized by the loss of ability to generate normal levels of muscle force. It is also associated with physiological changes as abnormal force coupling with agonists and antagonists and abnormal muscle activation patterns. Due to such deficits the capacity of the paretic lower limb to maintain normal functions such as balance, initiation and control of movement would decrease (2). However, weakness happens on the ipsilateral side as early as one week following stroke. Post stroke weakness and its accompanying motor impairments result in diminished performance of daily living and loss of independence (3). Therefore, it is important for clinicians to identify hemiparetic weakness. In other words, there is a need to have a reliable tool to assess muscle strength in the clinical basis. Among many experimental and clinical tools such as isokinetic dynamometer and handheld dynamometer which are expensive and time consuming for measuring

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muscle force, Motricity Index is a more feasible measure that can demonstrate the overall patients' impairment. It is a simple, brief measure of general motor function that can predict the mobility outcomes post-stroke (4). In 1980, Demeurisse et al developed a new method to assess isometric muscle strength on post stroke hemiparesis. They studied thirty one movements at proximal, middle and distal joints of upper and lower extremities. They decided to reduce many movements to just one essential movement at each joint that was the representative of general strength at that joint. In upper extremity the movements were shoulder abduction, elbow flexion and pinch grip. In lower limb the three movements were hip flexion, knee extension and ankle dorsiflexion (4). In order to grade muscle force, they used the ordinal six points scale of Medical Research Council (5). The MRC grades were converted into modified weighted scores according to patients' difficulty in progressing from one grade to the next (Table1). The three scores were summed and added by one, and total score was ranged from 0 (complete paresis) to 100 (normal strength).

Collen et al (1990) assessed the inter rater reliability of Motricity Index. Their results implicated reliability and sensitivity of motricity index (6). In another study, they investigated the reliability of six impairment measures and disability of Motricity Index (leg score) in 25 patients suffered from a chronic stroke. Quantification was done by 3 therapists on 3 sessions over 5 weeks. All six measures were reliable in statistical terms (7). It seemed that there is dearth of articles dealing with the reliability of strength measurement with Motricity Index. Therefore, the purpose of this study was to estimate the test-retest reliability of Motricity Index strength measurement in the affected lower limb muscles in two sessions over one week in chronic stroke patients.

Methods

In a cross sectional-analytical study, 20 subjects (10 female and10 male) with age range of 37 to 76 years and post stroke duration of 3 months to 4 years who could follow instructions, were participated in this study. All of them had referred to neurological Physical therapy Clinic in Rehabilitation Faculty of Tehran University of Medical Sciences from May to July of 2011. Those who had the experience of articular pain as a result of arthrosis, surgery or trauma on their lower extremity were excluded. Initially, a written consent was obtained from each participant. Then they became familiar with the procedure. One physical therapist assessed the strength of hip flexor, knee extensor and ankle dorsiflexor muscles in two sessions over one week. All the assessments were performed at the same time of day on two sessions. The rater was blind to total Motricity Index score and to data analysis on two sessions conducted with someone else. It took less than five minutes to perform Motricity Index. The participants were placed in a chair that had back support. Hip flexion was tested with the hip joint with a 90˚bent. The

Table 1. The lower extremity scores for muscle strength using the Motricity index.

Quality of muscle contraction	*Motricity scores*	*MRC Grade*
No Movement	0	0
Palpable contraction in muscle, but No Movement	9	1
Visible Movement, but not full range against Gravity	14	2
Full range of Movement against Gravity, but not against resistance	19	3
Full Movement against gravity, but weaker than the other side	25	4
Normal Power	33	5

Demeurisse (1990)

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rater instructed the patients to bring the knee towards the chin, while she monitored the contraction of hip flexors by placing her hand on the anterior of the distal of thigh. Then the therapist resisted the movement. According to the quality of muscle contraction the score was recorded. Rater was also aware of any trick motion such as leaning the back during the movement by placing one hand on their back. The knee extension was examined while it was bent at 90˚ flexion with the unsupported foot, followed by the examiner asked the subjects to extend the knee and touch her hand which was held at the level of the knee. Meanwhile, she monitored the contraction of quadriceps with the other hand which gave resistance to movement. Then the score was recorded. Furthermore, the movement of dorsiflexion was assessed as the ankle relaxed in a plantar flexed position, then the examiner placed her hand on the forefoot, while the patient was asked to dorsiflex the foot, the examiner palpated and also resisted the contraction of tibialis anterior with the other hand on the forefoot (5). Finally, all three scores were summed and the Motricity Index for lower extremity was calculated. Retest was done with one week interval, and hand placement was identical on two sessions.

Statistical Analysis

Data analysis was done using the SPSS v. 18. Two way random-consistency model of ICC (2,1) was used for assessment of test-retest reliability. Table 2 demonstrated the suggested interpretation of statistical value for reliability testing (8).

Table 2. Interpretation of statistical value for reliability testing.

Strength of agreement	Statistical value
Poor	0/2<
Fair	0/21-0/40
Moderate	0/41-0/60
Good	0/61-0/80
Very good	0/81-1

Paul Brennan(1992)

Table 3. Subject baseline characteristics of 20 chronic stroke patients

Characteristics	Subject (n= 20)	Freq. (%)
Age (Years)		
Mean ± SD	55.58±13.45	
Range	37-76	
Gender		
M*ale*	10	50
Female	10	50
Type of Stroke		
Ischemic	17	85
Hemorrhagic	3	15
Side of involvement		
Right	8	40
Left	12	60
Duration of illness (months)		
Mean ± SD	19.41±17.37	
Range	3 – 48	

Table 4. Descriptive values for Motricity Index value .

Variable	Mean	Std. Deviation
Motricity Index (first session)	58.20	17.683
Motricity Index (second session)	56.60	19.632

Results

Table 3 is shown the characteristics of all 20 participants and descriptive statistics shown in Table 4. Two-way random-consistency model of ICC was used for assessment of test-retest reliability. As Table 5 is indicated, all scores of Motricity Index in lower limbs of 20 patients on two sessions assessments were strongly reliable(8).

Discussion

Although reliability of strength assessments in neurologic conditions have been suspected by many researchers, our results showed that Motricity Index has high reliability on two session assessment by one rater. Despite the fact that manual muscle testing is the most common approach in clinical assessment, traditional manual

Table 5. Test- retest reliability of Motricity Index on the involved side of 20 chronic stroke patients.

	ICC Value	95% CI	SEM	Significance level
Motricity Index	0.93	0.84 – 0.97	4.66	0.000

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muscle testing (MMT) could not be a valid indicator of muscle strength in neurologic patients in acute phase due to presence of strong spasticity and synergistic movement pattern and loss of selective contractions. In chronic stage of neurologic conditions when some improvement had occurred in motor control, MMT could provide precise information about muscle strength (9). Many factors affect on strength evaluations by manual muscle testing in neurologic patients such as position changes, altered muscle tone, variations in producing force in rater's hand over two sessions. Despite all these confounding factors, Motricity Index based on manual testing of strength, could provide the overall estimation of lower extremity strength. In addition, it seemed that this index was a better representative of gross changes of motor recovery than MMT overtime, because it used the weighted scores. The result of this study was further supported by the Collen et al (r=0.87)(6), but with the difference that we investigated the reproducibility of strength measures by one rater because using another rater introduced another source of variation while Collen et al measured interrater reliability that could be expected to reduce correlations between tests. These studies mainly focused on "break test" in which the examiner pushes against the subject maximal effort to hold the position. Accordingly the results of these studies could not be generalized to ones which incorporated "make test" like handheld dynamometry that was held stationary while the patients exerted the maximal force required. Bohannon (2000) found that Motricity Index in the comparison with the dynamometer, have high criterion validity. Hence, he suggested that in the absence of such tools, clinicians could implement this index for strength testing of lower extremity (10). Therefore it seemed that the Motricity Index is a simple and reliable measure of muscle strength post stroke that can be applied readily and does not need any especial equipment and training. Further reliability testing in upper extremity is recommended.

Conclusion

Motricity Index strength assessments for involved lower extremity in chronic stroke can be highly reliable when assessment is done by one rater following chronic stroke.

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