ORIGINAL ARTICLE

An Evaluation of the Wolf Motor Function Test in Motor Trials Early After Stroke

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ABSTRACT. Edwards DF, Lang CE, Wagner JM, Birkenmeier R, Dromerick AW. An evaluation of the Wolf Motor Function Test in motor trials early after stroke. Arch Phys Med Rehabil 2012;93:660-8.

Objective: To examine the internal consistency, validity, responsiveness, and advantages of the Wolf Motor Function Test (WMFT) and compare these results to the Action Research Arm Test (ARAT) in participants with mild to moderate hemiparesis within the first few months after stroke.

Design: Data were collected as part of the Very Early Constraint-Induced Therapy for Recovery from Stroke (VECTORS) trial, an acute, single-blind randomized controlled trial of constraint-induced movement therapy. Subjects were studied at baseline (day 0), after treatment (day 14), and after 90 days (day 90) poststroke.

Setting: Inpatient rehabilitation hospital; follow-up 3 months poststroke.

Participants: Hemiparetic subjects (N=51) enrolled in the VECTORS trial.

Intervention: None.

Main Outcome Measures: At each time point, subjects were tested on (1) the WMFT and ARAT, (2) clinical measures of sensorimotor impairments, (3) reach and grasp movements performed in the kinematics laboratory, and (4) clinical measures of disability. Blinded raters performed all evaluations. Analyses at each time point included calculating effect size as indicators of responsiveness, and correlation analyses to examine relationships between WMFT scores and other measures.

Results: The WMFT is internally consistent, valid, and responsive in the early stages of stroke recovery. Sensorimotor and kinematic measures of reach and grasp support the construct validity of the WMFT.

Conclusions: In an acute stroke population, the WMFT has acceptable reliability, validity, and responsiveness to change over time. However, when compared with the ARAT, the higher training and testing burdens may not be offset by the relatively small psychometric advantages.

Key Words: Outcome assessment (health care); Paresis; Rehabilitation; Treatment outcome.

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PERSISTENT LOSS OF upper-extremity (UE) motor function is found in 45% of all stroke survivors, and contributes substantially to stroke-related disability.[1] Although there are many scales developed to assess UE function after stroke, there is no consensus regarding which measure is best suited for routine assessment of patients across the stages of recovery.[2,3] The most common standardized measures used in UE treatment studies are the Fugl-Meyer Assessment (FMA),[4] the Action Research Arm Test (ARAT),[5] and the Wolf Motor Function Test (WMFT).[6] The majority of research examining these measures has been conducted in patients in subacute or chronic stages of stroke recovery.[7-9] Although several studies have examined the reliability and validity of the ARAT and FMA in acute stroke patients,[2,10] the psychometric characteristics of the WMFT in patients in the acute stage of stroke recovery have not been extensively studied.[11]

The WMFT is widely used in UE treatment studies of persons in the subacute and chronic stages of stroke recovery.[9,12-14] This scale consists of a series of tasks sequenced according to the joints involved and level of difficulty.[15] Two items measure strength; the remaining 15 items are rated on the speed of performance and quality of motor ability. The WMFT was developed specifically for the assessment of the effects of constraint-induced movement therapy (CIMT).[14] Since that time the WMFT has been used in more than 20 studies.[9] Interrater reliability, internal consistency, content, construct validity, and responsiveness to change have been established for stroke patients in the subacute and chronic stages of recovery.[6,15,16] The psychometric properties of the scale have not been reported in acute populations studied prior to the 90-day time point used to define subacute stroke.

The purpose of this study is to examine the responsiveness and validity of the WMFT in a population of hemiparetic subjects within the first weeks and months after stroke. We

List of Abbreviations

ARAT	Action Research Arm Test
CIMT	constraint-induced movement therapy
FA	functional ability
FMA	Fugl-Meyer Assessment
NIHSS	National Institutes of Health Stroke Scale
UE	upper extremity
VECTORS	Very Early Constraint-Induced Therapy for Recovery from Stroke
WMFT	Wolf Motor Function Test

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asked (1) how well do the test items measure the same construct of UE function (internal consistency), (2) how responsive is the WMFT to change in the first weeks after stroke and in the first months after stroke, (3) what is the relationship between the WMFT and the ARAT (concurrent validity), and (4) how do WMFT scores relate to sensorimotor impairment measures typically measured by rehabilitation professionals, objective measures of movement quality obtained via kinematic analyses, and disability scores as measured by the FIM (construct validity). The sensorimotor impairment, kinematic, and disability data collected as part of the Very Early Constraint-Induced Therapy for Recovery from Stroke (VECTORS) trial provided the information needed to assess construct validity of the WMFT.

We used both clinimetric and psychometric approaches. Although there is considerable overlap between clinimetric and psychometric methods, clinimetric analyses place greater stress on issues such as sensitivity or responsiveness to clinically relevant change, as well as on clinical utility.[17,18] Clinical utility refers to ease and efficiency of use, burden on the patient, and meaningfulness of the information that it provides.

METHODS

Participants

All study participants were enrolled in the VECTORS study. VECTORS is a single-center randomized controlled trial of the early application of CIMT; the purpose of VECTORS is to gather the information necessary to design a definitive multicenter trial of CIMT administered in the immediate poststroke period. Study and treatment procedures are similar to those described elsewhere.[19] VECTORS used a single-blind randomized controlled design. Subjects were randomized to 1 of 3 groups: (1) 2 h/d of conventional treatment, (2) 2 h/d of shaping treatment plus 6 hours of constraint, and (3) 3 h/d of shaping plus constraint 90% of waking hours. The study protocol was approved by the Human Studies Committee at Washington University, and all subjects provided informed consent prior to participation.

Persons admitted to the acute neurology stroke service at Barnes-Jewish Hospital in St. Louis, MO, were screened for study eligibility; 1117 individuals were screened for this study. Subjects were included if they had (1) an ischemic or hemorrhagic stroke (with confirmatory neuroimaging) within 28 days of admission to inpatient rehabilitation; (2) persistent hemiparesis, generally as indicated by a score of 1 or 2 on the motor arm item of the National Institutes of Health Stroke Scale (NIHSS); (3) the presence of proximal UE voluntary movement as indicated by a score of 3 or more on the upper arm item of the Motor Assessment Scale (wrist and finger movement were not required); (4) evidence of preserved cognitive function; (5) the ability to follow 2-step commands; and (6) no UE injuries or conditions that limited use prior to the stroke. Subjects were excluded if they (1) could not give informed consent; (2) had clinically significant fluctuations in mental status in the 72 hours prior to enrollment; (3) were not independent prior to the index stroke as measured by scores <95 on the Barthel Index scale or >1 on the Modified Rankin Scale; (3) had hemispatial neglect; and/or (4) were not expected to survive 1 year due to other illnesses (eg, cardiac disease, malignancy). Fifty-one subjects with hemiparesis poststroke are included in this study.

Procedures

All evaluations were performed by trained study personnel blinded to the treatment type. Prior to collection of baseline data, evaluators were trained to properly administer the WMFT, ARAT, and NIHSS scales. Interrater reliability of more than .95 was established for all measures for all study evaluators. The data in this article include the evaluations performed before randomization (day 0), after treatment (day 14), and at 90 days after stroke onset (day 90). The day 90 time point is the primary study endpoint because most acute stroke intervention trials assess efficacy at 90 days after onset, when the majority of stroke patients are at or near their clinical plateau.[20]

Clinical Scale Evaluations

Wolf Motor Function Test. The WMFT is a laboratory-based evaluation designed for use in UE stroke rehabilitation studies.[6,15] The Extremity Constraint-Induced Therapy Evaluation trial version of the WMFT is a 17-item measure used to quantify UE functional limitations.[9] It is comprised of 2 strength items and 15 timed task performance items. The task performance items begin with the measurement of simple proximal movements and progress to more complex distal and whole limb movements. The WMFT yields 3 scores: a functional ability (FA) score, which quantifies quality of performance; a timed (time) score, quantifying speed of performance in seconds; and a grip strength (strength) score. The FA score uses a 6-point ordinal scale to rate movement quality on 15 items, where 0 indicates no attempt to use the more affected UE and 5 indicates that movement of the affected UE appears to be normal. The time score is the mean time to complete the same 15 items; scores were truncated at 120 seconds. The strength score is the strength of the grip in kilograms. The test has published reliability and validity in both chronic and subacute populations of stroke patients.[20,21] In the VECTORS study, the key use task was not collected owing to the challenges of constructing and transporting the testing materials; results reported in this study do not include this item.

Action Research Arm Test. The ARAT assesses functional limitations of the UE. It uses a 4-point ordinal scale on 19 items, where 0 indicates no movement and 3 indicates normative movement.[5] Item scores are summed to create 4 subscale scores—gross motor (9 point maximum), grasp (18 point maximum), grip (12 point maximum), and pinch (18 point maximum)—and a total scale score with a maximum score of 57, indicating normative performance. The ARAT has now been shown to be reliable, valid, and responsive to change across a variety of time points poststroke.[7,8,10,22-24]

FIM. The FIM is an 18-item global disability measure incorporating concepts and items of functional performance including activities of daily living, bowel and bladder function, social cognition, functional communication, and functional mobility.[25] The FIM is scored on a 7-point ordinal scale, where a score of 1 indicates dependence and a score of 7 indicates independence. In this study, the FONE-FIM interview was administered to the participant as a measure of self-perceived disability.[26] The 15 items requiring motor function were summed to create a FIM activity of daily living, while a subset of 5 items relating to UE use were summed to create a FIM UE score.

National Institutes of Health Stroke Scale. The NIHSS assesses cognitive, sensory, and motor impairments as an indicator of stroke severity.[27] This 13-item test results in scores ranging from 0 (no deficit) to 46 (severe deficit). Scores of 6 to 22 are generally considered to be in the moderate range. The NIHSS scores reported here were collected on the acute hospital service.

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