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Scientific/Clinical Article

Timed activity performance in persons with upper limb amputation: A preliminary study

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ABSTRACT

Study Design: 55 subjects with upper limb amputation were administered the T-MAP twice within one week.
Purpose: To develop a timed measure of activity performance for persons with upper limb amputation (T-MAP); examine the measure's internal consistency, test-retest reliability and validity; and compare scores by prosthesis use.
Introduction: Measures of activity performance for persons with upper limb amputation are needed The time required to perform daily activities is a meaningful metric that implication for participation in life roles.
Methods: Internal consistency and test-retest reliability were evaluated. Construct validity was examined by comparing scores by amputation level. Exploratory analyses compared sub-group scores, and examined correlations with other measures.
Results: Scale alpha was 0.77, ICC was 0.93. Timed scores differed by amputation level. Subjects using a prosthesis took longer to perform all tasks. T-MAP was not correlated with other measures of dexterity or activity, but was correlated with pain for non-prosthesis users.
Discussion: The timed scale had adequate internal consistency and excellent test-retest reliability.
Conclusions: Analyses support reliability and construct validity of the T-MAP.
Level of Evidence: 2c "outcomes" research.

Introduction

The goals of rehabilitation therapy after upper limb amputation are largely focused on improving activity function in the areas of self-care as well as household and everyday activities, so that ultimately the patients with an amputation can return to full participation in all aspects of their life roles and responsibilities.[1] Prosthetic training is widely recognized as a key component of amputation rehabilitation; however, the relative value of specific approaches to prosthetic training or of specific training protocols has not been well established.[2] Current evidence-based guidelines explain that prosthetic training should include education, controls training, and functional training.[1] Most of the information available to clinicians is based on expert opinion[1]; and information sources consist of protocols published in textbooks,[3,4] a handful of peer-reviewed articles,[5,6] and information provided by prosthetic companies and manufacturers. The ideal frequency of prosthetic training, to maximize functional outcomes as well as the intensity and duration of therapy sessions, is unknown.[1] Furthermore, there is little evidence available to guide prescription of prosthetic devices and components as well as a dearth of research comparing device types.[7] Clinicians and researchers need validated outcome measures to assess patient functional performance, compare performance with different types of devices, and track progress over the course of therapy. These kinds of outcomes data can be used for clinical decision making, and when pooled across patients and clinics can be used to generate evidence about the effectiveness of amputation.

Unfortunately, there are few measures of daily activity performance that were designed for and/or tested with adults with upper limb amputation. In 2009, the Upper Limb Prosthetic Outcomes Measure Working Group highlighted the need for new objective tests of function for adults with upper limb amputation.[8] Since that time, one new measure, the Activities Measure for Adults with Amputation (activities measure for upper-limb amputees [AM-ULA]) was developed and tested.[9] A recent systematic review of the literature did not identify any other measures of activity

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performance that had been validated for use with adults with upper limb amputation.[10] The AM-ULA is an observational measure of activity performance for prosthesis users that is scored using a scoring rubric, which takes a variety of aspects of activity performance into account, including task completion, skillfulness of prosthesis use, movement quality, independence, and overall time to perform that activity. The AM-ULA is not a timed test, and the rater must make a subjective judgment about the relative speed of task performance as compared with a person without a disability. The test has 18 items and can take approximately 35 minutes to administer depending on the patient's level of amputation and their skill level. The AM-ULA has several limitations. First, it is only appropriate for prosthesis users because skillfulness of prosthesis use is a key element of the grading rubric; thus, it cannot be used to assess activity performance in persons with amputation who do not use a prosthesis. Second, it is a lengthy test. There is a clear need for a briefer measure of activity performance for persons with amputation that can be used regardless of whether the patient is a prosthesis user or not. The length of time that takes a person with amputation to perform daily activities is a metric that we believe is meaningful because it has implications for participation in life roles.

Purpose

Therefore, the purposes of this study were to develop a new timed performance measure of daily activities for persons with upper limb amputation, which we called the T-MAP; to examine internal consistency, test-retest reliability, and validity of the new measure; and to compare T-MAP scores for prosthesis users and nonusers.

Methods

Study overview

The data analyzed in this study were from subjects who enrolled in the Veteran Affairs Home Study of an Advanced Upper Limb Prosthesis (home study), a multisite study involving 3 data collection sites. Subjects were eligible to enroll if they were at least 18 years old, had an upper limb amputation at the transradial (TR), transhumeral (TR), shoulder disarticulation or scapulothoracic level (shoulder), and had sufficient control sites available to operate a DEKA arm. Subjects were excluded if their amputation level or skin conditions prohibited socket fitting or they had serious health conditions that the study staff believed might limit their future participation.

Data collection

At study baseline, the study occupational therapists administered a set of self-report and performance-based measures (described later) to subjects. These tests were administered twice within 1 week. In most cases, persons who were prosthesis users completed testing while wearing their own prosthesis, and nonprosthesis users completed testing without a prosthesis. However, there were several subjects who owned and regularly used a prosthesis who did not use their devices for baseline testing because it was unavailable or broken.

Tests and measures

A timed measure of activity performance

The T-MAP consists of 5 items adapted from the Rivermead Extended Activities Index, an instrumental activities of daily living (ADL) measure.[11] The 5 selected items were drink, wash face, food preparation, eating, and dressing activities. The first author developed standardized instructions to ensure consistency across subjects and sites (Appendix A). The site therapist read a standardized script instructing subjects to perform the test activity (Appendix A). Therapists refrained from giving subjects additional instructions on how to perform requested activities.

Therapists scored subjects' independence and time to complete each activity. The independence rating used the same 3-point rating as the original Rivermead items (1 = dependent, 2 = requires verbal assistance, and 3 = independent with and/or without aid). Independence ratings and time to perform each task were summed to obtain an overall rating score and an overall timed score. Higher ratings indicate more independence, and shorter times indicate greater speed. Summary scores were calculated only when all 5 items were completed.

Additional measures

Several other performance-based and self-report measures were collected during baseline testing. These included the modified Jebsen-Taylor Hand Function Test (JTHFT), a 7-part performance measure of dexterity and simple functional activities. JTHFT hand function subtasks involve writing, page turning, lifting small objects, feeding, lifting large lightweight objects, lifting large heavy objects, and stacking checkers. The modified version caps maximal allowable time for each subtask at 2 minutes and scores the number of items completed per second.[12] The 18-item AM-ULA is an

Table 1
Characteristics of subjects and scores of other measures at baseline

Characteristics	*N* = 55
Age (y), Mean (SD)	44.5 (14.9)
Gender, *N* (%)	
Male	47 (85.5)
Female	12 (14.6)
Race, *N* (%)	
White	45 (81.8)
Black	7 (12.7)
Other	3 (5.5)
Amputation level, *N* (%)	
Transradial	27 (49.1)
Transhumeral	21 (38.2)
Shoulder disarticulation/forequarter	7 (12.7)
Used a prosthesis during testing, *N* (%)	
No	18 (32.7)
Yes	37 (67.3)
Device type used in testing, *N* (%)	
No device	18 (32.7)
Body powered	12 (21.8)
Myoelectric	23 (41.8)
Hybrid	2 (3.6)
Cosmetic	0 (0.0)
Terminal device degrees of freedom, *N* (%)	
Single	23 (41.8)
Multiple	13 (23.6)
NA (cosmetic or none)	19 (34.6)
Other outcome measures	Mean (SD)
JTHFT: writing items/s	0.37 (0.22)
JTHFT: page turning items/s	0.09 (0.08)
JTHFT: small items/s	0.07 (0.08)
JTHFT: feeding items/s	0.11 (0.08)
JTHFT: light cans items/s	0.21 (0.15)
JTHFT: heavy cans items/s	0.24 (0.17)
AM-ULA	2.1 (0.9)
UEFS	41.2 (10.8)
QuickDASH	32.1 (15.5)
Wong-Baker Pain Scale	0.9 (1.3)

SD = standard deviation; NA = not available; JTHFT = Jebsen-Taylor Hand Function Test; AM-ULA = activities measure for upper-limb amputees; UEFS = Upper-Extremity Functional Scale; QuickDASH = Disabilities of the Arm, Shoulder and Hand Score.