William C Miller, PhD, FCAOT

Professor
Occupational Science & Occupational Therapy
University of British Columbia
Vancouver, BC, Canada

THE L TEST

MANUAL

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Introduction

For individuals with lower limb amputation, walking ability is a primary concern. Walking enables efficient functional performance in the majority of daily and social activities, particularly when encountering physical barriers (e.g., stairs) in the environment. Walking offers one of the most effective and economic forms of physical activity which can influence cardio-respiratory, bone and mental health (just to name a few areas). Impaired walking is the leading cause of disability in this population which may have an increasing economic and social impact.

For these reasons a valid and reliable method to measure mobility for rehabilitation and intervention is needed. Previous tests have been reported to take substantial time and space. Others, that are time and space efficient, lack the necessary assessment of transfers and turning in both directions which are important for mobility.[1] Moreover, some have ceiling effects experienced by elderly people who are more fit, and younger people with amputations.[2] Thus the L test has been developed to meet these needs by assessing two turns, two transfers and a totalled 20 meter walk in a timely, efficient manner.[1]

Development of the L Test

In the Regional Amputee Program, we use the Timed "Up and Go" Test (TUG) and the 2-Minute Walk Test to assess inpatient and outpatient prosthetic training.[1] We observed a ceiling effect with respect to the short version of the TUG (6-meter total distance) for, as mentioned above, elderly people who are more fit and for younger people with amputations.[1-2] The longer 2-Minute Walk Test, however, is difficult to administer in the outpatient clinic setting, given that a 20-meter hallway that is relatively free of other clients and staff is needed, and clinics are required to conduct the test without distraction.[1] Therefore, we needed to find or develop a test that could be easily and quickly administered at each client visit that assisted with determining ability to walk with prosthetic devices.[1] Our preference was to retain the transfer skill set of the TUG.[1] Observation of a client's gait during clinics showed that we usually asked the client to get up and walk out of the room, turn and go down the hall, then return to the room and sit down.[1] This walking path, representing an "L" configuration, required turns to both the right and the left. Standardizing the distance (3 x 7 meters) led to the development of a potentially more demanding, yet practical, modification of the TUG that we have titled the L Test of Functional

Mobility (L Test).[1] We believe that the L Test is a useful indicator of mobility that will distinguish change in mobility status for not only older people who are more disabled and have frail health, but also for fit older and younger individuals who are less disabled.[1-2] The L Test was initially tested for reliability (how consistent it is) and validity (how accurate it is) against multiple walking tests including, the Timed "Up & Go" Test (TUG), 10-Meter Walk Test, and 2-Minute Walk Test, followed by the Activities specific, Balance Confidence scale (ABC), Frenchay Activities Index (FAI), and mobility subscale of the Prosthetic Evaluation Questionnaire (PEQ-MS) concerning rehabilitation with prosthetic device.[1] Its reliability and validity were then further tested regarding its use for the assessment of basic walking skills in older adults.[1] A further study has also analyzed the predictability of the L test.[3]

Research

Four studies have been completed in order to determine the validity, reliability, and responsiveness of the L test.[1-4] The first study was conducted to test the psychometric properties (the administration, design, and interpretation of scores) of the L Test when testing people with lower-limb amputation, and the second study concentrated on a sample of hospitalized elderly inpatients. In a third study, the predictive validity of the L Test was established (in other words, its accuracy in predicting a client's score on another similar test).[3] Finally, the fourth pilot study, examined the minimal clinically important difference of the L Test for individuals with lower-limb amputation.[4] Here we will present brief reviews of each of the studies and results.

Study One: The L Test of Functional Mobility: Measurement Properties of a Modified Version of the Timed "Up & Go" Test Designed for People with Lower-Limb Amputations
The objective of this study was to assess the reliability and validity of the L Test. The researchers recruited 93 people with unilateral amputations (74% transtibial, 26% transfemoral; 78% male, 22% female; average age of 55.9 years) from an outpatient clinic to complete all of the tests over two visits. Twenty seven subjects returned for retesting a third time.

Study Two: Measurement Properties of the L test for Gait in Hospitalized Elderly
The objective of this study was to evaluate the reliability, validity, and predictive value of the L Test, among older inpatients. This study involved a sample of 50 older adults (average age

85.5 years) who were admitted to the geriatric unit of a tertiary care hospital. The L Test was conducted twice along with a single testing of the TUG and the Frailty and Injuries Cooperative Studies of Intervention Techniques (FICSIT-4) balance scale.[1]

Results from Study 1 and 2

For both studies, the researchers found that the L Test showed high levels of reliability. In study 1, the L Test had a statistically significant correlation with all other measures (TUG, 2-Minute Walk Test, ABC Scale, and the FAI). In study 2, the results also demonstrated a statistically significant positive correlation between the L Test and the TUG test, with high scores on one test correlating with high test scores on the other, and a statistically significant negative correlation between the L Test and the FICSIT-4. Further information regarding the study results is outlined in the table below.

Table 1. Reliability of the L Test

Reliability	Test-Retest ICC	Inter-rater ICC
Study 1	.97 (.93-.98)	.96 (.94-.97)
Study 2	.95 (.91-.97)	1.0

Values in parenthesizes are 95% Confidence Intervals

Table 2. Validity of the L Test

Validity	Study 1	Study 2
Activities-Specific Balance Confidence Scale	-.48	
Timed 'Up & Go'	.93	.96
2 Minute Walk Test	-.86	
10-Meter Walk Test	.97	
Frenchay Activities Index	-.54	
Prosthetic Evaluation Questionnaire – Mobility Subscale	-.22	
Frailty and Injuries: Cooperative Studies of Intervention Techniques-4		-.45

*r = Pearson Correlation Coefficient. All r values significant at $p<.05$

The results from study 1 suggest that the validity of the L Test is strong and that it meets the necessary requirements for functional mobility in the home. As described above, in an attempt to eliminate the ceiling effect observed in the TUG, the distance in the L Test was increased to 20 meters. This study provides evidence that the L Test does indeed minimize the ceiling effects that occur in walking tests like the TUG.

The findings from study 2 suggest that the L Test provides reliable, valid data when assessing basic walking skills among older adults in a hospital environment. They also show that the L Test may be used as an important clinical and research tool to assess the mobility function of older inpatients as they transition back to the community.

In summary, the L Test incorporates the basic mobility skill set with a prosthetic device necessary for independent living, at least in level households. The psychometric properties, with respect to reliability and validity, tested in these studies were found to be acceptable.

Study Three: The Influence of Balance Confidence on Social Activity after Discharge from Prosthetic Rehabilitation for First Lower Limb Amputation

The objective of this study was to test how well the L Test could predict balance confidence after discharge from prosthetic rehabilitation, and to determine if balance confidence changes after discharge. For this study, a sample of 65 participants (average age 59.1 years) with unilateral lower limb amputations was used. The researchers found that balance confidence did not change significantly from discharge, one-month post-discharge, and three months-post discharge. The regression analysis of this study found that the L Test was the strongest predictor of social activity when controlling for balance confidence, gait aid use, amputation level, sex and age 3 months post discharge.

This study provided further support for the theory that balance confidence plays an important role in predicting social activity. Further details regarding the multiple regression are detailed in the table below.

Table 3. Regression Analysis of Social Activity on Balance Confidence, Walking Ability, and Control Variables

	Beta	B	95% CI for B
Age	-0.09	-0.07	-.26, 0.13
Sex	-0.23	-7.76	-14.66, -0.86
Amputation Level	0.21	8.78	-0.88, 18.44
Gait Aid Used	-0.09	-0.16	-.032, -.0.01
Basic Walking Ability	-0.37	-0.16	-.032, -0.01
Balance Confidence	.34	.25	0.08, 0.43

Adjusted R^2=0.39%. Beta is the standardized regression coefficient; B is the unstandardized regression coefficient; CI = confidence interval

Study Four: Minimal Clinically Important Difference of the L Test for Individuals with Lower Limb Amputation: A Pilot Study

The objective of this study was to determine how well the L Test identified individuals who have undergone an important change. In this study, researchers recruited 33 participants with unilateral lower limb amputations who had been identified by their physiatrists as requiring a major intervention (such as a new prosthesis socket or additional therapy). The participants were tested before they underwent interventions and at their follow up appointments. The sample of participants was mostly male (84.8%) with an average age of 60 years. The researchers were able to confirm that individuals who rated themselves as having higher rates of change, also scored higher on the L Test. The study also showed that the L Test has a weak, but significant capacity to predict people who have or have not undergone an important change. Finally, the study produced the first estimate of a minimal clinically important difference value for the L Test of 4.5 seconds. This benchmark, with further research, may prove useful for clinicians in assessing and monitoring change.

These four studies demonstrate the validity, reliability, and responsiveness of the L test, and further support the important role it can play in clinical practice.

Instructions for the L Test

Below are instructions for how to administer the L Test. For this test, you will need a **tape measure, stopwatch, standard hardback chair, tape, and cones.**

Instructions

1. Decide on a left or right turn for the "L" configuration. Mark a line on the floor with tape for the starting point. Mark an "x" or use a cone on the floor 3 meters from the starting line (this indicates the inside corner of the turn). Mark a line on the floor with tape or a cone for the turn around point. This should be a distance of 7 meters from the "x" to form an "L" configuration.
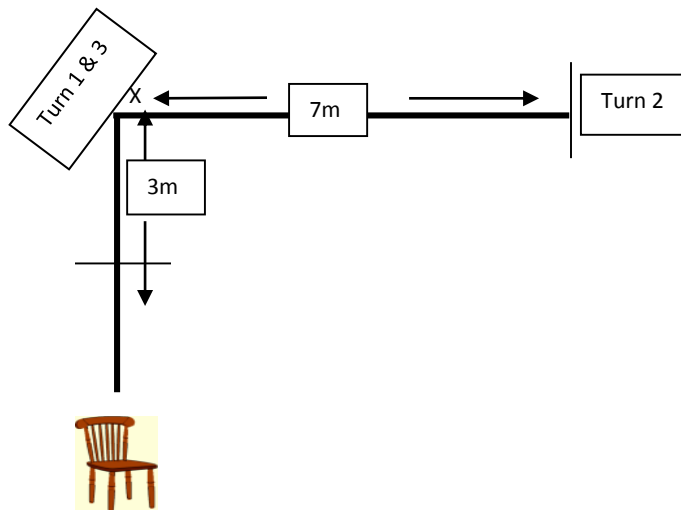
2. Position the chair at the starting point

3. Ask the client to stand at the "x" in order to visualize the test while you provide the instructions and demonstrate the test. Say the following to the client:

   "This is a test of your walking ability. When you begin walking, I want you to walk at a comfortable and safe pace. You will be walking in an "L" shape. You begin by sitting in the chair. When I say 'Go', I want you to stand up from the chair and walk around the "x" on the floor. Continue walking to that line on the floor. You can turn when both feet cross over the line. After you turn, walk back around the "x", return to the chair and sit down. I will demonstrate this for you."

NOTE: In our opinion, cones work best particularly for older adults or individuals with visual impairments. The following is instructions to use if you choose to use cones:

> **"This is a test of your walking ability. When you begin walking, I want you to walk at a comfortable and safe pace. You will be walking in an "L" shape. You begin by sitting in the chair. When I say 'Go', I want you to stand up from the chair and walk towards that first cone turn** *(right or left depending on direction)* **and then continue walking to the second cone. When you get to the second cone walk around it and return to the chair and sit down. I will demonstrate this for you."**

4. Demonstrate the test repeating the appropriate instructions.

5. Ask the client the following:

> **"If you have any problems or need assistance during the test, please let me know. Do you have any questions?"**

6. Pull the chair away from the line. Ask the client to stand with his or her toes behind the starting line. If applicable, ask the client to ensure that his or her prosthesis is in its optimal position and to adjust it as necessary. Assist the client as required.

7. Instruct the client to use his or her usual gait aid for the test.

8. Bring the chair back and put it behind the client. Ask him or her to sit in the chair with his or her gait aid at hand.

9. Instruct the client to begin the test with the following command:

> **"When you are ready…go."**

10. Use a stopwatch to time the client from the moment he or she leaves the seat to the moment that he or she first touches the seat surface to sit back down.

11. Provide directions and encouragement throughout the test.

12. Record the test time to the first decimal point (e.g., 0.0) and record any observations regarding the client's risk of falling or gait abnormalities.

Assessing L Test Performance

In assessing the L Test, one should document both the objective and subjective scores.

Objective Scoring / Time Taken

Objective scoring is straightforward. The time taken to the nearest 1/10th of a second to complete a single test is recorded. Studies of similar tests suggest to take the average time of 3 consecutive tests[5] allowing for short breaks in between to eliminate any improvements that occur from learning. We agree that this would be the ideal method for data collection if there is sufficient time to do so. If there is not time to do this, a single test will suffice after providing the client with a demonstration.

Subjective Scoring

The L Test can also provide important observational information regarding the quality of gait particularly when the individual is turning around.

References

1. Death BA, Miller WC. The L test of functional mobility: measurement properties of a modified version of the timed up and go test designed for people with lower-limb amputations. Phys Ther 2005;85(7):626-35

2. Nguyen VC, Miller WC, Asano M, Wong RY. Measurement properties of the L test for gait in hospitalized elderly. Am J Phys Med Rehabil 2007;86(6):463–8

3. Miller WC, Deathe AB. The influence of balance confidence on social activity after discharge from prosthetic rehabilitation for first lower limb amputation. Prosthet Orthot Int 2011;35(4):379-85.

4. Rushton PW, Miller WC, Deathe AB. Minimal clinically important difference of the L Test for individuals with lower limb amputation. Prosthet Orthot Int 2014 Aug 18 [Epub ahead of print].

5. Green J, Forster A, Young J. Reliability of gait speed measured by a timed walking test in patients one year after stroke. Clin Rehabil. 2002;16:306–14.