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

Background and Purpose. Walk tests provide essential outcome information when assessing ambulation of individuals with lower-limb amputation and a prosthetic device. Existing tests have limitations such as ceiling effects or insufficient challenge. The objective of this study was to assess the reliability and validity of data for a clinical measure of basic mobility, the L Test of Functional Mobility (L Test). Subjects. For this methodological study, 93 people with unilateral amputations (74% transtibial, 26% transfemoral; 78% male, 22% female; mean age = 55.9 years) were consecutively recruited from an outpatient clinic. Twenty-seven subjects returned for retesting. Methods. To assess concurrent validity, subjects completed the L Test, Timed “Up & Go” Test (TUG), 10-Meter Walk Test, and 2-Minute Walk Test, followed by the Activities-specific Balance Confidence scale, Frenchay Activities Index (FAI), and mobility subscale of the Prosthetic Evaluation Questionnaire (PEQ-MS). Amputation cause and level, walking aid use, automatic stepping, and age variables were used to assess discriminant validity. Results. Intraclass correlation coefficients were .96 for interrater reliability and .97 for intrarater reliability, and minimal bias existed upon retesting. The magnitude of concurrent validity correlations (r) was very high between the L Test data and data for other walk tests and fair to moderate between the L Test data and data for self-report measures. The L Test discriminated between all groups as hypothesized. Discussion and Conclusion. The L Test is a 20-m test of basic mobility skills that includes 2 transfers and 4 turns. It demonstrated excellent measurement properties in this study. [Deathe AB, Miller WC. 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. Phys Ther. 2005;85:626–635.]

Key Words: Ambulation, Amputation, Outcome measure, Reliability, Validity.

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he need for measures of outcome in health care is well-recognized, yet no consensus exists as to what outcome should be emphasized or which tool should be used in rehabilitation for individuals who have a lower-extremity amputation. One of the primary goals of rehabilitation programs for people with a lower-extremity amputation is to assist them in returning to and maintaining normal living activities with prosthetic devices. To monitor program success, it is therefore necessary to evaluate the skills required for mobility using prosthetic devices. According to the World Health Organization, the ability to change body position and the ability to walk are key components of mobility. In general, basic mobility using prosthetic devices should allow safe household ambulation, and includes the skill set of transfers, level walking, and turns.

Performance walk tests used in rehabilitation with a prosthetic device include measures of fixed walking time, such as the 2-Minute Walk Test, and measures of fixed walking distance, such as the Timed “Up & Go” Test (TUG), the 10-Meter Walk Test, and gradations of a 100-m walk. Studies have shown that objective performance-oriented tests have excellent measurement properties and are able to predict future function.

In our Regional Amputee Program, we use the TUG and the 2-Minute Walk Test to assess inpatient and outpatient prosthetic training. We have observed a ceiling effect with respect to the short version of the TUG (6-m total distance), particularly for elderly people who are more fit and for younger people with amputations. The longer 2-Minute Walk Test, however, is difficult to administer in the outpatient clinic setting, given that a 20-m hallway that is relatively free of other patients and staff is needed and given that clinics are required to conduct the test without distraction. Therefore, our need was to find or develop a test that could be easily and quickly administered concurrent with each patient visit that assisted with determining ability to walk with prosthetic devices. Our preference was to retain the transfer skill set of the TUG. Observation of a patient’s gait during clinics showed that we usually asked the patient to get up and walk out of the room, turn and go down the hall, then return to the room and sit down. This walking path, representing an “L” configuration, required turns to both the right and the left. Standardizing the distance (3 x 7 m) 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).

We believe that the L Test may be a useful indicator of mobility that will distinguish change in status for not only older people with amputations who are more disabled and have frail health, but also for fit older and younger individuals who are less disabled. The objectives of this study were to assess the reliability and the validity of data obtained with the L Test.

Method

Design/Participants

A total of 102 subjects attending their regularly scheduled appointment between June and December 2001 who met the study criteria were consecutively sampled from the regional outpatient clinic for people with amputations. To be included, subjects had to be older than 19 years of age, have a unilateral transfibial (TT) or transfemoral (TF) amputation related to vascular or traumatic etiology, and have had their prosthesis a minimum of 6 months. Subjects were excluded if they were unable to speak or read English or follow verbal
instructions, did not complete all necessary scales and walk tests, had a prosthetic device or medical problem such as a residual limb ulcer, or had claudication in their contralateral lower limb, active heart failure, unstable diabetes, or chronic obstructive lung disease that would prevent completion of the study. The team physiatrist determined medical and prosthetic stability status at the time of the subject’s appointment. Prosthetic stability was defined as ensuring a comfortable fit, suspension in transfers, and weight bearing.

Protocol
Subjects attending their regularly scheduled appointment who met the study criteria were identified, and the study process was explained. After completing their visit with the outpatient rehabilitation program team, individuals who consented to participate were taken to a quiet room beside the clinic. After demographic data were collected, all subjects completed a set of walk tests (time 1) and then completed a set of self-report questionnaires. Finally, a different rater conducted a second set of walk tests (time 2) in order to determine intrarater reliability.

All of the walk tests were conducted according to the assigned standardized protocol. Walking aids were permitted, and the type of aid was recorded if used. A minimum of 2 minutes of rest between walk tests was provided. The order of the walk tests was not randomized in order to allow the raters to assess whether subjects who were more frail would have difficulty completing the longer and potentially more taxing 2-Minute Walk Test. All subjects completed testing in the same progression, starting with the walk tests (the TUG, followed by the 10-Meter Walk Test, the L Test, and the 2-Minute Walk Test), followed by completion of the self-report questionnaires (which took approximately 15 minutes to complete). Three trials of the L Test were completed during the time 1 and time 2 walk tests to determine whether a learning effect was observed when performing the test. Subjects who agreed to retesting returned 2 weeks later (time 3), when 3 consecutive L Test trials and a single trial of the other walk tests were conducted.

Measurement
A number of different measures were used to assess validity. Investigation of a variety of relationships from different perspectives enhances the support for the validity. The measures included clinically important variables (amputation cause and level), indicators of adaptation to the prosthesis and amputation (balance confidence), and variables that assess higher levels of function (social activity participation), as well as measures of mobility capability and performance (walk) tests.

Walk Tests
The L Test is a modified version of the TUG. The L Test incorporates 2 transfers and 4 turns, of which at least 1 would be to the opposite side. The total distance covered is a 20-m walk. Standardized instructions were developed and given to the subjects to ensure successful completion of the test. The L Test was demonstrated for each subject, and all subjects performed a practice trial. Additionally, we standardized the amount and type of encouragement based on findings by Guyatt et al., suggesting that these factors can enhance performance. The time (in seconds, to the nearest 10th of a second) that it took for the subject to stand from an armless chair, walk 10 m (in the shape of an L) at the subject’s usual walking speed, turn 180 degrees, and return 10 m (in the shape of an L) to a seated position was recorded.

The 2-Minute Walk Test is a measure of the distance (in meters) that an individual is able to walk at his or her “usual” pace. Starting from a standing position, subjects walked around pylons placed 25 m apart for 2 minutes. The distance covered was measured to the nearest 10th of a meter using a walk wheel. This test, which is often used clinically to determine the progress of walking endurance using a prosthetic device, is a shortened version of the original 12-Minute Walk Test. Six- and 2-minute versions of the 12-Minute Walk Test were developed and tested to provide clinicians with a test that took less time to complete. Data for the 2-Minute Walk Test have been found to be highly correlated with data for the 12-minute (r = .86) and 6-minute (r = .89) versions. The TUG assesses many of the components of basic mobility, including balance, transfers, walking, and turning while walking. The time (in seconds) that it takes for an individual to stand from a sitting position, walk a 3-m distance, turn, walk back to the chair, and sit down is recorded. The TUG was found to have excellent intrarater (r = .93) and interrater (r = .96) reliability, and evidence of convergent and divergent validity among a sample of people with lower-limb amputations has been reported. The 10-Meter Walk Test has principally been used to test individuals with neurologic impairment and lower-extremity amputation. The time taken to walk a distance of 10 m at the usual pace from a standing start was recorded. For this study, we embedded the 10-Meter Walk Test into the start of the 2-Minute Walk Test as other researchers also have done. Support for concurrent validity of data for the 10-Meter Walk Test among a sample of 53 people with either a TT or TF lower-limb amputation has been reported. Also have demonstrated intrarater reliability of data for
A number of clinical variables were included to further assess the validity of the L Test data. These variables included: (1) amputation level (TF or TT), (2) amputation cause (vascular or traumatic), (3) mobility device use (cane, crutches, or walker), (4) automatic walking (automatism), and (5) age. Measurement of mobility device use was ascertained by asking the participants whether they used crutches, a walker, or a cane while ambulating indoors or outdoors, or no device at all. Automatic walking (automatism) was determined by asking the participants whether they had to concentrate on each step while walking. Individuals responded to this question, which was taken from the Prosthetic Profile of the Amputee (PPA), by indicating “yes” or “no.” Age was partitioned into a binary variable using the median score to facilitate analyses.

**Self-report Variables**

The Activities-specific Balance Confidence (ABC) scale asks subjects to rate their balance confidence on a scale of 0% to 100% on each of 16 mobility-related activities. Responses are summed and divided by 16 to provide an overall mean balance confidence score. Internal consistency (Cronbach alpha=.93), 4-week retest reliability (intraclass correlation coefficient [ICC]=.91), and minimal bias between the repeat measurements have been reported for a sample of subjects with lower-limb amputations. The 15-item Frenchay Activities Index (FAI) was used to measure the frequency of participation in activities ranging from preparing meals to working over the past 3 to 6 months. The individual item responses of the FAI capture frequency, with responses ranging from 0 (“never or none”) to 3 (“daily or weekly”). A summary score is derived by adding the total items, which range from 0 (“no activity”) to 45 (“very high participation”). Internal consistency (Cronbach alpha=.84), intrarater reliability (ICC=.78), and support for validity based on correlations with the TUG, 2-Minute Walk Test, ABC scale, and the mobility subscale of the Prosthetic Evaluation Questionnaire (PEQ-MS) have been demonstrated among individuals with lower-limb amputations.

The mobility capability of the subjects was assessed using the 13-item self-report PEQ-MS. The PEQ-MS evaluates the perceived potential for mobility using prosthetic devices over the past 4 weeks. The mobility scale is the combination of the ambulation and transfer subscales from the full PEQ. Although the original questionnaire uses a visual analog scale (VAS), we modified the responses to a numerical scale ranging from 0 (“cannot do activity”) to 10 (“no problem”). A summary score was derived by adding the responses and then dividing by the number of items to which the subjects responded. Internal consistency (Cronbach alpha=.95), retest reliability (ICC=.77), and support for validity based on correlations with data for the TUG (r = —.5), the 2-Minute Walk Test (r = .85) have been reported among individuals with lower-limb amputations. Furthermore, the PEQ-MS was found to discriminate among individuals based on gait aid use and self-reported walking distance, among other factors.

A number of clinical variables were included to further assess the validity of the L Test data. These variables included: (1) amputation level (TF or TT), (2) amputation cause (vascular or traumatic), (3) mobility device use (cane, crutches, or walker), (4) automatic walking (automatism), and (5) age. Measurement of mobility device use was ascertained by asking the participants whether they used crutches, a walker, or a cane while ambulating indoors or outdoors, or no device at all. Automatic walking (automatism) was determined by asking the participants whether they had to concentrate on each step while walking. Individuals responded to this question, which was taken from the Prosthetic Profile of the Amputee (PPA), by indicating “yes” or “no.” Age was partitioned into a binary variable using the median score to facilitate analyses.

**Data Analysis**

Means, standard deviations, and proportions were derived in order to facilitate description of the sample and scores for L Test and retest results. A repeated-measures analysis of variance (ANOVA) using Bonferroni post hoc analyses was used to determine whether statistically significant differences existed on L Test times over the 3 measurement periods (time 1, 2, and [retest] 3). Data from trial 3 of each measurement period were used in the analysis.

Reliability was calculated using 2-way ANOVAs to derive intrarater ICCs (2,1) and interrater ICCs (2,2). The third L Test trials from time 1 and time 3 were used for calculating the intrarater ICC, and the third L Test trials from time 1 and time 2 were used for calculating the interrater reliability. The standard error of measurement (SEM) was used to assess how an individual score varied on repeated measurement. The SEM was derived by multiplying the standard deviation by the square root of 1 minus the reliability coefficient derived from the interrater reliability analysis. Finally, the Bland-Altman or Limits of Agreement method was used to provide a visual assessment of within-test repeated measurement of the agreement between raters and to identify any bias that might exist. Rankin and Stokes have advocated this approach as being easier to understand and interpret. The mean of the third trial in each of the time 1 and time 2 L Test times were plotted against the difference between the time 1 and time 2 L Test times for the Bland-Altman method, and a t test was used to assess mean differences. Furthermore, the mean and standard deviation of the mean difference as well as the true value of the mean using 95% confidence intervals (CIs) were calculated to further assess the existence of bias. The Bland-Altman procedure was not done for intrarater reliability because the sample size was smaller than 50 subjects.

Validity was assessed by testing several a priori hypotheses related to whether the L Test data correlated with data for the other walk tests and the self-report scales. A positive correlation was anticipated between the L Test and both the TUG and 10-Meter Walk Test because...
Table 1.
Sample Demographics and Descriptive Statistics for the L Test

<table>
<thead>
<tr>
<th>Total Sample (n=93)</th>
<th>Retest Sample (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>73</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
</tr>
<tr>
<td>Amputation level</td>
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</tr>
<tr>
<td>Transtibial</td>
<td>69</td>
</tr>
<tr>
<td>Transfemoral</td>
<td>24</td>
</tr>
<tr>
<td>Amputation cause</td>
<td></td>
</tr>
<tr>
<td>Traumatic</td>
<td>56</td>
</tr>
<tr>
<td>Vascular</td>
<td>37</td>
</tr>
<tr>
<td>Age (y)</td>
<td>55.9 ± 14.2</td>
</tr>
<tr>
<td>Years since amputation</td>
<td>11.8 ± 14.5</td>
</tr>
<tr>
<td>L Test (time 1)*</td>
<td>32.6 ± 14.9</td>
</tr>
<tr>
<td>L Test (time 2)</td>
<td>32.9 ± 16.8</td>
</tr>
<tr>
<td>L Test (time 3)</td>
<td></td>
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</tbody>
</table>

*The group mean for the third trial at each measurement period is presented in the table.

these are all measures of gait speed. A negative correlation was expected between the L Test and the 2-Minute Walk Test because those individuals who are more likely to complete the L Test quickly would be expected to walk farther on the 2-Minute Walk Test. Finally, we hypothesized that the L Test data would correlate negatively with data for the self-report scales based on previous research we have done. That is, individuals who scored better (higher) on the FAL, PEQ-MS, and ABC scales would have scores that correlate negatively with the scores on the L Test.

Pearson product moment correlation coefficients were calculated in all cases. Our clinical experience suggested that the L Test should be able to discriminate between those with TT and TF amputations and those with vascular versus traumatic amputations. Furthermore, we expected that the mean time to complete an L Test would be higher among older individuals, among individuals who used a mobility device, and among those who had to think about stepping.

In order to assess whether the L Test would reduce the number of subjects experiencing a possible ceiling effect, we operationally defined the ceiling as being within the 95% confidence limit of the fastest overall time recorded by any subject on the L Test and the TUG. To calculate the 95% confidence limit, we first derived the SEM (SEM = standard deviation of the test/square root of the sample size) for each test and then multiplied it by 1.96. Next, we used the McNemar test to determine whether there were fewer subjects within the range of the ceiling effect for the L Test than for the TUG because the data are not independent (the same subjects provided information for both tests). Times for the L Test from trial 3 of time 1 were used for this determination.

Correlations were considered statistically significant at $P<.05$, and significance for all other tests was set at $P<.01$ in order to reduce the potential for type I errors that may result from multiple testing. Analyses were conducted using SPSS for Windows, version 8.*

**Results**

A total of 93 of 102 eligible subjects (91%) completed all of the tests (time 1 and time 2), with a total of 27 subjects returning for retest (time 3). A full description of the sample and the various L Test times are presented in Table 1. There were no differences based on sex, age, or the cause of the amputation between the final sample (93 of 102 individuals recruited) and those who failed to complete all of the walk tests. However, the 9 subjects who were dropped were more likely to have had a TF amputation. The mean time to complete the L Test at time 1 was 32.6 seconds. The mean time increased slightly at time 2 (30ths of a second, to 32.9) and decreased by approximately 3 seconds (to 29.7) among the subjects who agreed to return 2 weeks later for retesting (time 3). As evidenced by the standard deviations, the variation also was smaller at time 3. The L Test means for times 1, 2, and 3 were not different.

* SPSS Inc, 233 S Wacker Dr, Chicago, IL 60606.
Reliability
The ICC for intrarater reliability for the L Test was .97 (95% CI = .93–.98), and the ICC for interrater reliability was .96 (95% CI = .94–.97). Neither of the F values—3.8 ($df=26$, $P=.063$) for intrarater reliability and 0.46 ($df=92$, $P=.50$) for interrater reliability—were significant, suggesting no statistical difference in the means. The interrater SEM for the L Test at time 1 was 3.0 seconds.

Additional results for intrarater reliability using the Bland-Altman plot (Fig. 1) demonstrated a roughly equal distribution above and below the 0 line. Slightly more data points above the line for the interrater plot suggested that times were slightly faster during the first test session (time 1) than during the second test session (time 2). The distribution of the points was not equal along the line; therefore, reliability was not perfect (because of clustering around the left-hand side of the plot). This finding also suggests that a ceiling effect may be evident in the L Test. The mean difference was −0.31 (SD=4.4), with a 95% CI of −1.2 to 0.59. The inclusion of 0 in the CI suggests minimal bias among the measurement sessions. Only 3 of the data points out of a possible total of 93 data points were found to lie outside of the 95% CI (2 standard deviations of the mean difference), further suggesting that the error in reliability readings for the interrater reliability was not statistically significant.\cite{27,28} A t-test of the mean values demonstrated there was no statistical difference ($t=-0.678$, $P=.499$).

Validity
The L Test data correlated with data for all of the other measures in the hypothesized direction. A range of Pearson correlation coefficients were observed between the L Test data and data for the other measures (Tab. 2).

Table 2. Correlations of L Test Data With Data for Other Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pearson r</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timed &quot;Up &amp; Go&quot; Test</td>
<td>.93</td>
<td>.00</td>
</tr>
<tr>
<td>2-Minute Walk Test</td>
<td>−.86</td>
<td>.00</td>
</tr>
<tr>
<td>10-Meter Walk Test</td>
<td>.97</td>
<td>.00</td>
</tr>
<tr>
<td>Activities-specific Balance</td>
<td>−.48</td>
<td>.00</td>
</tr>
<tr>
<td>Confidence scale</td>
<td>−.54</td>
<td>.00</td>
</tr>
<tr>
<td>Frenchay Activities Index</td>
<td>−.22</td>
<td>.04</td>
</tr>
</tbody>
</table>

The highest correlation was observed with the other walk test measures, followed by the FAI, ABC, and PEQ-MS, respectively. Scattergram plots of the L Test with the other walk tests are presented in Figure 2. All of the scattergrams demonstrate a linear relationship among the walk tests, although in Fig. 2A, the data points depicting the relationship between the L Test and the 2-Minute Walk Test appear to curve slightly in the bottom right corner. Analysis of data for the 9 subjects who could be considered "outliers" (data points to the bottom right corner of Fig. 2A) revealed that those individuals had an average age of 75.9 years (range= 67–88). In addition, 4 of these subjects used walkers, and 4 subjects used canes to complete the walk tests. The median ABC score for these subjects was 66/100, suggesting a limitation in balance confidence. These subjects likely reflect individuals who can be considered to be frail walkers, given the time taken to complete the L Test and the minimal distance covered in the 2-Minute Walk Test.

We hypothesized that there would be differences among groups on important clinical variables. As shown in Table 3, all group differences were significant ($P<.001$), as predicted. Higher mean times were observed for those subjects who: (1) were older, (2) used a walking aid, (3) had to concentrate on each step they took, (4) had a vascular amputation, and (5) had a TF amputation.

The McNemar test revealed that data for 66 subjects did not fall within the defined ceiling effect for the L Test and TUG, whereas data for 10 subjects were within the ceiling effect. Fourteen subjects recorded a ceiling effect time for the TUG, but they did not record a ceiling effect time for the L Test. Conversely, 3 subjects recorded a ceiling effect for the L Test but not for the TUG ($P<.005$). The 3 subjects who had a ceiling effect on the L Test but not the TUG were younger men (aged 40, 60, and 64 years) with TT amputations who had amputations due to traumatic causes and used their prosthesis for 8 or more years.
**Discussion**

Walk tests provide essential information about ambulation with prosthetic devices during the rehabilitation and follow-up of individuals who have had a lower-limb amputation. We developed the L Test to capture quantitative information that may indicate change using a design that replicates common practice during inpatient and outpatient assessment.

Other walk tests exist; however, the premise behind the development of the L Test was that it would require a higher level of skill with turns to both the left and the right as well as a sit-to-stand transfer. Face validity suggests that this test reflects the minimal needs for functional mobility in the home. For example, the L Test would indicate whether person would be able to rise from a couch in the living room and ambulate to the washroom. Another advantage of the L Test is that it incorporates a pragmatic design that allows testing in an outpatient hospital clinic setting. For example, upon examination in a typical small office, the patient is commonly asked to rise from the chair or plinth, walk forward out of the office door, turn, walk down the hallway, and then return and sit down. This activity enables the clinician to visually assess the biomechanics and prosthesis-limb interface. The 20-m distance covered by the L Test is twice that of the 10-Meter Walk Test, and 3 times that of the TUG. The distance was increased with the intent that the L Test would be more responsive than the other tests and, therefore, more useful when used with younger individuals who have a lower-limb amputation. Although we cannot comment specifically on the true nature of responsiveness of the L Test, we have shown that it does minimize the ceiling effect observed in the TUG.
The time taken to complete the L Test is generally twice that of the TUG and commonly approaches the 2-minute duration of the 2-Minute Walk Test, especially among the older, frailer population (Fig. 2A). This finding suggests that the L Test may serve as a tool that assesses the transition between room ambulation reflected by the TUG and community ambulation reflected by the 2-Minute Walk Test. Five out of 9 of the recruited subjects who were excluded from this study were unable to complete the L Test, further suggesting that the L Test might require additional physical resources for these individuals.

In the present study, we found the L Test to have excellent interrater and intrarater reliability, as demonstrated by the ICC values. Consequently, this finding suggests that overall there is minimal measurement error resulting when this measure is used in a standardized fashion by different raters or by the same rater over time. We had anticipated such results, given that other authors have reported similar findings with comparable walk tests among people with amputations. The greatest variation in the scores was seen among subjects who had very slow times on the L Test, and 3 of these “slower” subjects recorded scores that were more than 2 standard deviations different when tested by the different raters. It is unclear why the scores of these subjects were so different between tests. An increase in time was observed when 2 individuals were tested by the second rater, which may have been the result of fatigue associated with multiple walk tests conducted during the session. Additional evidence for this hypothesis can be drawn from the fact that both the standard deviation and the range of times for the L Test increased between time 1 (range=17.4–95.2 seconds) and time 2 (range=17.1–108.7 seconds). Time 3 L Test times (range=20.1–48.7 seconds) improved considerably, perhaps suggesting a learning effect; however, no statistical difference was observed in L Test times among testing times 1, 2, and 3.

Given that fewer than 5% of the subjects recorded such different scores and that 0 were captured within the 95% CI for the mean difference in recorded times (as reflected in the Bland-Altman analyses), we are confident that the L Test is robust with respect to reliability in people with lower-extremity amputations. However, because reliability is population-specific, assessment for repeatability in other diagnostic groups is encouraged.

Additional analysis of reliability was conducted using the limits-of-agreement approach advocated by Bland and Altman. The data points across the Bland-Altman zero line (Fig. 1) tended to concentrate at the left end, indicating that a large percentage of the subjects completed the test relatively quickly (ranging between 20 and 40 seconds). This concentration of data points near the left end may be explained by the number of subjects whose amputation was related to traumatic etiology or because the inclusion criterion for the study essentially focused on experienced prosthesis users who were not having problems with respect to pain and likely had reached a plateau or were confident in their ability to use the prosthesis. Ideally, the data points would be evenly distributed along and on either side of the line. The findings suggest that the L Test might not differentiate between various subgroups of the population of people with amputations. Despite this finding, the discriminant validity was observed to be quite good. All of the projected differences were observed according to our a priori hypotheses. It is particularly encouraging that amputation level is discriminated. Tests of functional mobility that do not distinguish among amputation levels are highly suspect regarding their utility, given the clinical observation that individuals with TF amputations face many more challenges than those with TT amputations.

The L Test data were correlated with data for all of the self-report measures in the hypothesized direction. Given the similarities, we expected to find a stronger relationship between the PEQ-MS and the L Test, because a previous study demonstrated covariance of up to 25% (r=.5) between the PEQ-MS and the TUG. We anticipated greater overlap between the self-evaluation measure of skill capability (PEQ-MS) and the objective measurement captured by the L Test.
The interrater SEM of the sample (3.0) provides a platform toward thinking about values that may demonstrate a relevant level of responsiveness given a change at the group level.\(^\text{30,31}\) For instance, we can be 68% sure that a “true” change has occurred if the group value shifts ±2.6, and 95% sure that a statistically relevant change has occurred with a shift in score of greater than ±6.2 seconds. Although this information might provide some preliminary information for future studies using the L Test, additional trials are needed to better investigate other aspects of responsiveness such as minimally important clinical change.\(^\text{30}\)

In the present study, the walk tests were sequenced in order—progressing from the TUG, to the 10-Meter Walk Test, to the L Test, and finally to the 2-Minute Walk Test—which enabled us to watch for subjects who might be compromised in terms of their cardiovascular capacity and therefore not be able to proceed to the next level of walk test. Despite this approach, 9 of the 102 recruited subjects were unable to complete the walk tests. Ideally, the order should have been randomized to minimize bias related to order effects. Using a randomly selected sample versus a convenience sample would have led to more confidence in the findings, because the population seen during the data collection period may have been systematically different. Furthermore, based on the L Test scores at time 3, which tended to be faster and had a tighter range of times (eg, the standard deviation was smaller), our intrarater subsample also may have been different than our total sample, despite having very similar demographics related to age, years since the amputation, and amputation level. The generalizability of the study results also is limited to people with unilateral amputations who had had their prosthesis for at least 6 months who were medically stable and experienced users of prosthetic limbs. Replication studies that compensate for these limitations are encouraged.

**Conclusion**

The L Test incorporates the basic mobility skill set with a prosthetic device necessary for independent living, at least in level households. Our experience using the L Test demonstrates that it provides practical and useful clinical information for inpatients and outpatients. The psychometric properties, with respect to reliability and validity, tested in the present study were observed to be sound.

**References**


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