Published in final edited form as:

Neurorehabil Neural Repair. 2007 ; 21(4): 302–306. doi:10.1177/1545968306298937.

Comparison of Speeds Used for the 15.2-Meter and 6-Minute Walks Over the Year After an Incomplete Spinal Cord Injury: The SCILT Trial

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Abstract

Background—Timed walking speed for 6 to 15 m and the distance walked in 2 to 12 minutes are frequently used outcome measures in rehabilitation trials, presumably reflecting different aspects of walking ability. The database from the Spinal Cord Injury Locomotor Trial (SCILT), which tested 2 interventions for mobility upon admission for initial rehabilitation of an incomplete traumatic spinal cord injury (SCI), was used to compare the walking speed employed for each test.

Methods—From 66 to 70 patients with upper motor neuron lesions from C-5 to T-10 performed a 15.2-m and a 6-minute walk as fast as the patient deemed safe at 3 months (end of the trial intervention) and 6 and 12 months after entry. The means, standard errors, and quartiles were calculated for the speed used for each task.

Results—The mean speed for the 15.2-m walk did not differ from that used for the 6-minute walk at 3 and 6 months but was significantly faster at 12 months. Differences became apparent at each assessment in patients in the highest quartiles (>1.0 m/s) for the 15.2-m walk. Their speed was from 14% to 24% higher than the speed used for the 6-minute walk.

Conclusion—The speed of the 15.2-m walk as a measure of walking ability compared to the distance walked in 6 minutes may not represent separable domains of mobility. Differences were apparent only in the most highly functional patients, who could ambulate in the community. Any difference in the walking speed used for these 2 tasks does not make enough of a clinical distinction to encourage including both a 6-minute walk and a 15.2-m walk as outcome measures in clinical trials of locomotor interventions for SCI.

Keywords

Walking speed; Rehabilitation; Stroke; Spinal cord injury; Multiple sclerosis; Fatigue; Randomized clinical trial

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Walking speed is often used in clinical trials to evaluate the effects of rehabilitation interventions such as locomotor training, lower extremity exercise, and functional electrical stimulation. Two frequently employed measures of efficacy that subsume walking velocity include the speed used over a short distance and the distance walked over a fixed time.^{1,2} Walking speed over a 6-to-15-m walkway is considered to serve as an overall measure of walking ability^{1,2} and has some predictive value for the ability to ambulate with or without restrictions in the home and community after stroke.³ Walking distance in 2 to 12 minutes has been considered as a measure of functional endurance, fatigability, conditioning, and cardiorespiratory fitness, although recent studies have challenged this.⁴ Greater detail about change in the motor control for walking associated with a rehabilitation therapy may be derived from other measures of the gait cycle during these tests, such as single-limb stance time, stride length, and cadence.⁵

Normative data⁶ and results from patients in rehabilitation trials with walking outcomes after stroke⁷ have not revealed clinically apparent differences in the speed used by patients for the 2 tests. For patients with stroke, then, the short distance speed and distance walked may represent similar domains of functional mobility. This possible redundancy suggests the need for a reinterpretation of the utility of the 2 measurement tools for clinical trials. This study examined whether the walking speed differed for a 15.2-m and 6-minute walk in ambulatory patients with incomplete traumatic spinal cord injury (SCI). The patients represent a unique population for this comparison in that they were consecutively recruited from all patients who had an incomplete SCI and were unable to walk at the time of admission to the 6 centers that participated in the Spinal Cord Injury Locomotor Trial (SCILT).⁸ Three assessments were available over the course of the trial—3 months after entry (end of intervention), 6 months, and 12 months—which allowed us to assess the effects of time after injury on the walking speed for the 2 tasks. In addition, the speed for each test may differ based on walking ability at the time of assessment, so a comparison was made of the slowest, median, and fastest walkers and at 3 different times over the course of recovery.

METHODS

The SCILT was a multicenter, randomized clinical trial that compared 12 weeks of step training with body weight support on a treadmill (BWSTT) combined with overground practice to a defined overground mobility intervention (CONT) for patients with incomplete traumatic SCI within 8 weeks of onset.⁹ The trial entered 107 patients graded on the American Spinal Injury Association (ASIA) scale as C (motor incomplete but no useful movement) and D (sensorimotor incomplete with useful movement) and 38 patients graded ASIA B (motor complete with some sensation below the lesion). All had lesions between C-5 and L-3 and were unable to walk on admission for rehabilitation at a mean of 4.5 weeks after onset. The tests for walking speed and distance, among other measures, were performed by blinded assessors and collected at 3, 6, and 12 months after entry. No significant differences were found in the outcomes, which included the Functional Independence Measure's scoring system for level of dependence in locomotion (FIM-L), walking speed, walking distance, and lower extremity motor score at 3, 6, and 12 months

after entry.^{8,10} Given the lack of differences, the patients with upper motor neuron lesions assigned to BWSTT and to CONT were combined for this analysis of walking speed.

Outcome Measures

Walking tests were performed by trained blinded observers after a brief warm-up in the morning when patients were not fatigued.⁹ Braces and assistive devices were used if required to enable reciprocal stepping with moderate or less help. Patients who required more than moderate physical assistance based on the criteria of the FIM-L were not included in this analysis. Patients who were able to participate in the 50-foot (15.2 m) walk and the 6-minute walk were timed over a flat tiled surface. The start and stop points were shown to the patient. The patient was given the instruction, "Walk as fast as you can safely walk." The patient started from a standing position 2 steps behind the start line. The instruction to begin to walk was "ready and go." As the lead foot crossed the start line, the stopwatch was started. The blinded observer walked alongside the patient, provided encouragement at each turn for the 6-minute walk with contact guarding as needed, and graded the level of assistance given by the therapist. The 15.2-m walk ended when the lead foot crossed the finish line. For the 15.2-m walk, 2 trials were performed with a 5-minute rest between tests. Distance was assessed by measuring the total number of meters that patients walked back and forth with 180-degree turns along a 30-m walkway in 6 minutes. A standing rest was permitted but not encouraged.

Statistics

The average speed of the two 15.2-m walks was used at each data collection. The walking speed for the 6-minute walk was calculated as the distance covered divided by 360 seconds. A linear mixed model was employed to compare the walking speed for the 15.2-m and 6-minute walks within patients from the combined trial groups (BWSTT and CONT). This model accounts for within-subject correlations and unbalanced data. A linear mixed model was also used to compare the 2 walking speeds at each time of data acquisition for the slowest, middle (25th percentile to 75th percentile), and fastest 15.2-m walking speed quartiles.

RESULTS

From 66 to 70 patients were able to complete both walking tests at each assessment. The 15.2-m walking speed for the 2 trials was highly reproducible for each patient. Only an occasional patient was reported to stop during the 6-minute walk, which would have slowed the calculated walking speed. Table 1 shows the means and standard errors of the walking speed for the 2 tests at each assessment. No significant difference was found at 3 and 6 months. At 12 months, the 15.2-m walk was performed faster than the 6-minute walk by approximately 18%.

Table 2 compares these patients at each assessment by quartiles (lower 25%, middle, and upper 25%) to search for differences in walking speed used for the 15.2-m walk and the 6-minute walk in patients who walked at the slowest versus fastest speeds. No difference was found for the slowest quartile, which included the smallest number of patients. A difference

was found at assessments in which the speed for the 15.2-m walk reached approximately 0.9 m/s. At that threshold, the 15.2-m speed exceeded the speed used for the 6-minute walk by 14% to 24%, depending on the quartile and time of assessment.

DISCUSSION

These data revealed that patients who were able to perform both a 15.2-m and a 6-minute walk used very similar speeds at 3 and 6 months after entry into the SCILT, then walked faster over the short distance at 12 months. On average, the patients entered the trial 4.5 weeks after onset of an incomplete cervical or thoracic SCI. The overall group data at each assessment suggest that until a threshold speed is exceeded, which for SCILT patients was about 0.9 m/s, patients will tend to use a similar speed (Table 1). In addition, no significant difference was found in the slowest quartile at each interval, whereas the fastest quartile for the 15.2-m walk consistently used a higher speed compared to their 6-minute walk. The turns every 30 m during the 6-minute walk, however, may have diminished the distance walked over time, thus reducing the calculated speed. This analysis also suggests that slower walkers (<0.8 m/s) may have less capacity to increase their walking speed over a short distance compared to more functional walkers who can achieve speeds of 1 m/s (Table 2). The results support the possibility that even higher functioning patients with paraparesis due to a myelopathy may fatigue when performing a 6-minute walk and will employ a slower speed when timed over a shorter 15.2-m walk. Where the mean differences were statistically significant within a quartile for walking speed for each task, however, the percentage difference and the clinical significance of this difference appear rather modest. For example, the average patient who walked at >0.8 m/s in SCILT required no physical help and used no more than one ankle brace and a cane for assistance. At that speed and level of independence, most of the patients would be capable of unrestricted walking in the community.³

The data previously published from the SCILT revealed high internal consistency. For example, a better lower extremity motor score and FIM-L, along with the need for less bracing and upper extremity support, correlated with faster walking speed and longer walking distance regardless of the mobility intervention.^{8,10} In addition, the SCILT data were collected within a reliable, prospective protocol during a multicenter trial with inclusion and exclusion criteria that primarily aimed to identify nonwalkers with incomplete SCI at the time of admission for rehabilitation. Thus, it seems likely that the findings for walking speed are representative of patients who become able to walk.

A literature search for recent clinical studies with walking outcomes that included adequate information to calculate the equivalent of a 15.2-m walking speed and the speed used during a 2- to 6-minute walk in patients with a myelopathy revealed no group differences in the walking speed for the 2 tests.¹¹⁻¹⁴ Not enough information was provided in the reports to determine whether significant differences were present for slower and faster walkers. A recent report from the European Multicenter Study of Human Spinal Cord Injury found no difference in the preferred walking speed for a 10-m and 6-minute walk in patients with incomplete SCI.¹⁵ A high correlation for the speed used on an 8-m walkway and the maximum distance walked for up to 500 m ($r = .79$, $P < .0001$) was found in patients with

multiple sclerosis.¹⁶ In another study, the interrater reliability of the 6-minute walking distance and the 10-m walking time in 62 patients with SCI (most graded ASIA D) also found a significant correlation between the 2 measures.¹⁷ The mean 10-m walking speed was 0.33 ± 0.36 m/s, and the 6-minute speed was 0.56 ± 0.3 m/s. In support of the present trial, however, the Pearson correlation coefficient for the 19 patients who were more dependent walkers and for the 43 who were more independent was about .92. These findings support the difference between the higher and lower quartiles found in the SCILT patients for the 15.2-m and the 6-minute walking speeds.

Patients who walk at nearly the same speed over a short distance and during a so-called endurance walk in a laboratory setting presumably find a comfortable walking speed that does not induce the perception of overwork or tax the physiologic cost of exercise. This pace may also lessen centrally mediated fatigability of the affected limbs due to impaired central conduction and recruitment of motor pools for the trunk and leg muscles.¹⁸ Formal tests of cardiovascular conditioning, then, are probably better suited for evaluating fitness than a test of the distance walked in a fixed time.¹⁹ A study in patients after stroke, for example, found a strong relationship between the speeds used for a 5-m and 6-minute walk, but the relationship between the peak oxygen utilization and 6-minute walking distance was modest.⁴

Walking speed is a valuable interim measure to probe the dose-response effects of a new intervention for walking and as a continuous outcome measure.²⁰ In future trials, investigators could test the utility of instructing patients to walk at their usual and then fastest paces over 15.2 m.^{4,7,15} The ability to increase walking speed by as much as 25%, as when trying to get safely along a cross-walk, which is quite feasible for healthy patients and community walkers after stroke, may be a better test to predict functional ability in the community.²¹ This test may come to replace the distance walked in a fixed time. Indeed, the SCILT patients in the fastest quartiles, when instructed to “walk as fast as you can safely walk,” did increase their speed for the short distance walk by 14% to 24% over the 6-minute walk despite receiving the same instructions. It is possible that they chose their usual speed for the longer walk but increased their speed for the shorter walk.

CONCLUSION

Based on the SCILT study, subacute and chronically impaired patients after SCI who are able to perform a 15.2-m and 6-minute walk may ambulate modestly faster over the short distance once their speed exceeds approximately 0.8 to 1.0 m/s. However, little clinical significance can be attributed to the difference in the speed used for each test when both are employed as outcome measures for interventional trials to improve walking. At that threshold speed over 0.8 m/s, patients generally require no assistance and can function in the community. For patients with high and low walking speeds, then, the 2 tasks bear a high correlation and probably do not reflect different aspects of walking ability. One or the other may be sufficient, at least for patients like those followed in the SCILT.

Acknowledgments

This study was funded by the National Institutes of Health at the National Institute for Child Health and Development RO1 H37439, R24 HD39629. We thank the staff of each rehabilitation center for its cooperation and La Fondation Québécoise Sur La Moelle Epinière.

APPENDIX

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Table 1

Comparison of Walking Speed Within Subjects With Upper Motor Neuron Lesions During the SCILT for the 2 Walking Outcome Measures

Time After Entry (months)	Number of Patients	Walking Speed (m/s), 15.2 Meters	Walking Speed (m/s), 6 Minutes	<i>P</i> Value
3	66	0.72 (0.05)	0.64 (0.06)	.14
6	69	0.92 (0.06)	0.79 (0.05)	.29
12	70	1.08 (0.06)	0.88 (0.06)	.001

Table 2

Walking Speeds (Mean, Standard Error) Used for the 15.2-m Versus 6-Minute Walk by the Slowest, Middle (25%-75%), and Fastest Patients at Each Data Collection

Table 2A. End of Therapy, 3 Months				
Variable	Quartile	Number of Patients	Mean (m/s) (Standard Error)	P Value
15.2-m	Lower	14	0.20 (0.06)	.15
6-minute			0.16 (0.06)	
15.2-m	Middle	33	0.74 (0.05)	.07
6-minute			0.62 (0.29)	
15.2-m	Upper	19	1.55 (0.06)	.01
6-minute			1.33 (0.41)	

Table 2B. Primary SCILT Outcome, 6 Months				
Variable	Quartile	Number of Patients	Mean (m/s) (Standard Error)	P Value
15.2-m	Lower	10	0.18 (0.06)	.84
6-minute			0.16 (0.09)	
15.2-m	Middle	39	0.86 (0.04)	.53
6-minute			0.82 (0.04)	

Table 2C. Final SCILT Outcome, 12 Months				
Variable	Quartile	Number of Patients	Mean (m/s) (Standard Error)	P Value
15.2-m	Lower	16	0.32 (0.07)	.56
6-minute			0.27 (0.08)	
15.2-m	Middle	34	1.01 (0.06)	.03
6-minute			0.87 (0.05)	
15.2-m	Upper	20	1.88 (0.06)	<.001
6-minute			1.46 (0.07)	