BRIEF REPORT

Physical Disability After Severe Lower-Extremity Injury

Kristin R. Archer, DPT, Renan C. Castillo, MS, Ellen J. MacKenzie, PhD, Michael J. Bosse, MD, and the LEAP Study Group

ABSTRACT. Archer KR, Castillo RC, MacKenzie EJ, Bosse MJ, and the LEAP Study Group. Physical disability after severe lower-extremity injury. Arch Phys Med Rehabil 2006; 87:1153-5.

Objective: To investigate the use of a combined measure of decreased walking speed and gait deviation to identify high physical disability in patients with lower-limb salvage.

Design: Longitudinal study of patients with severe lower-extremity trauma.

Setting: Eight level I trauma centers.

Participants: Patients (N=276) with lower-limb salvage from the Lower Extremity Assessment Project.

Interventions: Not applicable.

Main Outcome Measures: Disability from the physical dimension of the Sickness Impact Profile (SIP), walking speed, and gait deviation were measured at 24 months of follow-up. A 1-way analysis of variance and planned comparisons compared mean SIP scores across and between the following 3 outcome groups: no impaired speed and no gait deviation, impaired speed or gait deviation, and impaired speed and gait deviation.

Results: Mean SIP scores for the physical dimension and its 2 categories of ambulation and body care and movement differed statistically across the planned comparisons. The mobility category showed that the impaired speed or deviation group was statistically similar to the group without impaired speed and gait deviation.

Conclusions: The combination of decreased walking speed and gait deviation appears to provide a valid measure of physical disability among patients with lower-limb salvage.

Key Words: Lower extremity; Outcome assessment (health care); Rehabilitation; Trauma.

THE RECOVERY OF PHYSICAL mobility is among the primary goals of rehabilitation after lower-limb saving surgery.[1] Mobility is essential for independent living and daily functioning.[2] Although health status instruments, such as the Sickness Impact Profile (SIP), are useful measures of physical functioning, they are too complex and time consuming for regular clinical use. Instead various physical performance tests, which have been associated with self-reported disability, are used to assess mobility.[3]

One of the most common physical performance measures is the walking test.[1,4] Research has shown that a gait speed assessment is comparable to a full performance battery in predicting disability.[2,4] However, walking speed is limited in its ability to reflect a person's quality of movement.[4] In this study, we combined walking speed and presence of gait deviation into 1 outcome measure and examined its relation to physical disability. We hypothesized that the combination of measures would have a stronger association with self-reported physical disability than either decreased walking speed or gait deviation alone.

METHODS

Participants

At 24 months, 330 patients who underwent lower-limb reconstruction after severe high-energy trauma were enrolled in the Lower Extremity Assessment Project (LEAP). High-energy trauma was defined as Gustillo grade IIIB and IIIC fractures, selected grade IIIA fractures, dysvascular limbs, major soft-tissue injuries to the tibia, and severe foot injuries.[5] Previous results[5] found a minimal association between the characteristics of the injury and functional outcomes. The current analysis included 276 LEAP patients for whom complete data from the physical dimension of the SIP and a 46-m walking test were available.

Outcome Measures

The SIP has been found useful in evaluating the functional outcome of trauma patients.[6]

The physical dimension includes the mobility, ambulation, and body care and movement categories.[7] Mobility comprises items relating to the level of control over one's body, ambulation consists of items relating to walking and stair climbing, and body care and movement encompasses activities of daily living. A score from 10 to 19 represents moderate disability and a score greater than or equal to 20 represents severe disability.[7]

In the LEAP study, 14 physical therapists measured walking speed with a 46-m independent walking test on a level surface. The time it took for subjects to complete the task was measured with a stop watch and recorded in meters per minute. Subjects were also monitored for the presence of 1 or more gait deviations. The distribution was as follows: Trendelenburg gait (8%), trunk asymmetry (10%), leg circumduction (6%), hip hike (8%), knee hyperextension (3%), no heel strike (7%), toe drag (13%), uneven step length (20%), and a noticeable limp not accounted for by one of the other deviations (12%).

Walking speed less than or equal to 73m/min and presence of at least 1 gait deviation were combined into a primary outcome measure. Seventy-three meters per minute was considered an appropriate cutoff for impaired speed, because 77m/min is an approximate gait velocity for adults 20 to 59 years old.[8]

From the Center for Injury Research and Policy, Department of Health Policy and Management, Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD (Archer, Castillo, MacKenzie); and Department of Orthopaedic Surgery, Carolinas Medical Center, Charlotte, NC (Bosse).

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Reprint requests to Kristin R. Archer, DPT, Center for Injury Research and Policy, Johns Hopkins Bloomberg School of Public Health, 624 N Broadway, Rm 545, Baltimore, MD 21205, e-mail: *karcher5@comcast.net.*

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Table 1: Overall Mean SIP Subscores and Planned Comparisons With Bonferroni Adjustment for 3 Groups* at 24 Months

Group	n	Physical Dimension	Mobility	Ambulation	Body Care and Movement
Group 1	110	5.1±7.4	4.2±12.4	8.5±10.1	4.0±7.3
Group 2	96	10.1±8.6	5.9±12.0	19.0±12.5	7.6±8.9
Group 3	70	14.8±11.3	11.4±15.4	24.6±14.6	11.8±10.9
F statistic		25.56	6.67	40.57	16.65
P value (ANOVA)		<.001	.002	<.001	<.001
Planned Comparisons		Effect Size	Effect Size	Effect Size	Effect Size
Group 1 vs group 2		5.0 (<.001)	1.7 (1.00)	10.5 (<.001)	3.6 (.012)
t statistic		3.97	.93	6.14	2.91
Group 1 vs group 3		9.7 (<.001)	7.2 (.001)	16.1 (<.001)	7.8 (<.001)
t statistic		7.07	3.59	8.57	5.75
Group 2 vs group 3		4.7 (.003)	5.5 (.024)	5.6 (.012)	4.2 (.009)
t statistic		3.35	2.67	2.90	3.01

NOTE. Values are mean ± SD, effect size (Bonferroni adjusted *P* value), and *t* statistic.
*Group 1 is no impaired speed and no gait deviation; group 2 is impaired walking speed or gait deviation; and group 3 impaired walking speed and gait deviation (N=276).

Data Analysis

Subjects were separated into 3 groups for analysis: group 1, those without impaired speed and gait deviation (n=110); group 2, those with either impaired speed (n=18) or gait deviation (n=78); and group 3, those with both impaired speed and gait deviation (n=70). A 1-way analysis of variance (ANOVA) at *P* less than .05 was used to compare mean SIP scores from the physical dimension and its 3 categories across the 3 groups. Planned comparisons were performed using a Bonferroni adjustment for 3 groups. These results were confirmed using a Kruskal-Wallis test. Results were consistent across tests and only the ANOVA results are shown.

RESULTS

At 24 months, the overall mean physical dimension SIP subscore ± standard deviation (SD) was 9.4±9.8, and the mean scores for mobility, ambulation, and body care and movement were 6.7±13.5, 16.7±14.3, and 7.2±9.4, respectively. Fifty-four percent of subjects had at least 1 gait deviation and 32% had a walking speed less than 73m/min.

Mean SIP scores for the physical dimension and each of its categories differed statistically across the 3 groups, with group 3 consistently having higher disability scores (table 1). The mean difference between group 3 and group 2 differed statistically at *P* less than .05 for the physical dimension and the ambulation and body care and movement categories (see table 1). In the mobility category, group 3 differed statistically from group 2 at *P* equal to .024, but there was no statistical difference between group 2 and group 1 ($P>.05$).

DISCUSSION

Various physical performance measures are recommended in the literature, yet there is little consensus on a standard measure for physical mobility.[9] As hypothesized, patients with both impaired speed and gait deviation had statistically higher disability scores than patients with either impaired speed or gait deviation.

Three distinct groups were found for the ambulation and body care and movement categories. Unexpectedly, only 2 distinct groups were identified in the mobility category. Subjects with either decreased walking speed or gait deviation were found to be statistically similar to the group without impaired speed and deviation. A combination of measures appears to provide a better representation of impaired mobility among this patient population. This finding may be due to the underlying measurement of the mobility scale, which considers gait speed and symmetry essential for general movement around one's environment.

These preliminary findings suggest that a simple combination of timed walking speed and observational gait deviation may be a valid measure of disability and impaired mobility after lower-limb salvage. Further investigation is needed to support the routine use of this combined outcome measure. Recommendations for future research include the validation of gait speed and deviation with a comprehensive set of strength, balance, gait, and coordination tasks and also with additional self-reported measures of disability.[2,3,10]

CONCLUSIONS

Although the separate measures of walking speed and gait deviation provide clinicians with valuable information regarding physical functioning, a combination of these measures appears to provide a valid measure of physical disability for patients with lower-limb salvage.

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