Influence of Gait Training And Prosthetic Foot Category on Functional Outcomes of Vascular Transtibial Amputees – Implications for Foot Prescription

VR Agrawal, PhD[1,2], RS Gailey, PhD[1,2], IA Gaunaurd MS[1,2], CO O'Toole MS[2], AA Finnieston CP[2], R Tolchin DO[2]

[1]University of Miami Miller School of Medicine, Department of Physical Therapy, Miami, FL. [2]Miami VA Medical Center, Miami, FL.

INTRODUCTION

Prosthetic foot prescription guidelines for unilateral transtibial amputees (TTAs) typically associate a category of prosthetic foot (K1, K2 or K3) with the four mobility level of an amputee, defined by the Medicare Functional Classification Level as K-Level-1 through K-Level-4. These guidelines not only lack scientific evidence but also overlook the functional contribution of a prosthetic foot towards an amputee's mobility and health of the contralateral limb. The objective of this randomized cross-over trial was to determine the efficacy of prosthetic foot prescription guidelines for K-Level-2 (dysvascular) TTAs.

METHOD

A convenience sample of 5 unilateral TTA (mean age 60.60 ±2.30 years, mean weight 105.53 ± 6.42 kg), subjects completed the study. All subjects were classified as K-Level-2 amputees based on a baseline Amputee Mobility Predictor (AMP) score of 37 ± 2 points. Subjects underwent 6 testing sessions over a 10-12 week period. At session 1, subjects were tested in their existing socket and foot. They then received 2 weeks of specialized gait training by a physical therapist to minimize gait deviations and were tested again in their existing prosthesis. In sessions 3-6 subjects were tested using a study socket and one of four randomized test feet i.e. SACH, SAFE, Talux - classified as categories K1, K2, K3 respectively - and a microprocessor controlled foot (PROPRIO FOOT). There was a 10-14 day accommodation period with each foot. The study protocol was designed to minimize gait deviations resulting from confounding variables, such as socket fit and training. At each testing session, subjects completed 2 self-report measures, i.e. Locomotor Capabilities Index (LCI), Prosthesis Evaluation Questionnaire – Mobility scale (PEQ-13) and were evaluated using 2 performance-based measures i.e. AMP and six-minute walk test (6MWT). Kinetic gait symmetry between the intact and amputated limbs was assessed using the Symmetry in External Work (SEW) measure. Ground reaction forces were collected using F-scan sensors and force plates.SEW values were calculated based on the method described by Agrawal et al. (2009). A repeated measures ANOVA was used to determine differences, with a significance level of $p<0.05$.

RESULTS

K3 foot had the greatest negative work symmetry, significantly higher than K2 foot ($P<=0.01$). Following gait training, there was a significant improvement in AMP score and positive work symmetry (Table 1).

	BASE-LINE	TRAI-NING	SAFE	TALUX
SEW Negative work	81.26 ± 25.4	80.6 ± 15.0	82.98 ± 20.0	**100.5 ±15.7** [b]
SEW Positive work	64.01 ± 34.0	**82.1 ± 39.7**[a]	83.0 ± 25.8	91.94 ± 34.3
AMP (points)	37 ± 2	**40.4 ± 3.2**[a]	40.6 ± 3.6	42.2 ± 2.6
6MWT (meters)	410.5 ± 66.3	432.6 ± 42.8	439.9 ± 38.9	456.4 ± 44.9
LCI (score)	53.6 ±4.8	54.6 ± 1.9	52.6 ± 5.5	54.6 ± 1.5
PEQ-13 (score)	111.02 ± 17.4	111.8 ± 14.8	92.94 ± 34.7	115.14 ± 10.8

Table1: Mean ± SD values of selected outcome measures. [a] significantly different from Baseline, [b] significantly different from SAFE foot ($p<0.05$)

DISCUSSION

The improvement in function and positive work symmetry, following training, can be attributed to the increased use of residual limb musculature by the subjects during gait. The "J" shaped ankle design and a heel-to-toe footplate of the Talux foot, facilitated single-limb stance balance and permitted a longer step with the intact limb. The negative work symmetry of Talux was therefore significantly greater than the SAFE foot having a solid ankle and flexible keel.

CONCLUSION

Dysvascular, K-Level-2 amputees who are trained to take advantage of K3 prosthetic foot properties may exhibit greater work symmetry and improved function. There exists a need for an objective determinant for categorizing and prescribing prosthetic feet.

REFERENCES

Gailey, R. Arch Phys Med Rehabil, 83, 613-627, 2002.
Agrawal, V.R. Prosthot Orthot Int, . 33, 148-156, 2009.

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