Abstract Title: Effects of an Adaptive Prosthesis on Level and Sloped Walking for Transtibial Prosthesis Users

Research Objectives: To evaluate the effects of an adaptive, microprocessor-controlled prosthetic ankle (MPA, Ossur premarket device) on individuals with unilateral transtibial amputation during level and sloped walking, compared to their prescribed prostheses.

Design: Crossover trial

Setting: Vanderbilt University motion analysis lab

Participants: Eight unilateral transtibial prosthesis users (7 male, 1 female, height 1. 75 ± 0. 07 m, weight 88 ± 13 kg, age 45 ± 16 years). At least 6 months post amputation. K3/K4 level ambulators. All subjects were consented.

Interventions: Participants were fitted with an MPA by a prosthetist, then wore it at home for at least two weeks to acclimate before testing. The MPA was designed to provide toe-clearance during leg swing and adjust ankle angle on slopes.

Main Outcome Measure(s): Lower-limb joint kinematics and kinetics

Results: The MPA adapted its ankle angle by the programmed amount on slopes (6.0 ± 1.5° dorsiflexion for 7.5° incline, 2 ± 0.4° plantarflexion for 7.5° decline). The MPA provided more toe-clearance than the prescribed prostheses during level (1.6 ± 1.2 cm, $p=0.007$) and incline walking (2.2 ± 1.5 cm, $p=0.004$). Statistical significance evaluated via paired t-test, $\alpha=0.05$. During incline walking, four users switched from a toe-landing strategy on their prescribed prosthesis to a heel-to-toe gait pattern with the MPA, which was more consistent with able-bodied gait. The MPA stored/returned less elastic energy for 6 of 8 users compared to their prescribed prosthesis.

Conclusions: The MPA may provide benefits by reducing trip risk due to increased toe-clearance, and promoting a more typical heel-to-toe gait for incline walking; however, elastic energy return was generally reduced relative to prescribed prostheses.

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