Comparative Effectiveness of Microprocessor and Energy-Storing Prosthetic Ankles: Patient Reported Outcome Measures

Kaluf B

Ability Prosthetics and Orthotics, Inc.

INTRODUCTION

Advancements in microprocessor prosthetic ankle-feet (MPA) allow additional functionality for lower-limb amputees. Evidence on MPA includes 3D kinematic and kinetic data (Struchkov, 2016), gait symmetry (Agrawal, 2013), energy expenditure (Darter, 2013), and socket pressure (Wolf, 2009). Further comparative effectiveness research is needed in larger samples. This study compares differences in patient-reported balance, mobility, and socket comfort functional socket comfort while walking and standing on a ramp with an energy storing and returning (ESAR) and MPA.

METHOD

Subjects: Twenty-three unilateral transtibial amputees enrolled in an IRB-approved, randomized crossover protocol with ankle-foot configurations consisting of the participant's current ankle, ESAR (Paccifica LP), and a MPA (Kinnex, Freedom Innovations).

Research Tools: Activities Specific Balance Confidence (ABC), Prosthesis Evaluation Questionnaire-Mobility Subscale (PEQ-MS), Prosthetic Limb User Survey of Mobility (PLUS-M), Socket Comfort Score (SCS).

Procedures: Ankle-feet were assembled and aligned to participants' current socket by a certified prosthetist. Testing was performed after a four-week accommodation period. Participants stood and walked on a 15° sloped ramp while responding to the SCS.

RESULTS

Average scores for ABC, PLUS-M T-Score, PEQ-MS, and SCS for all ramp conditions are summarized in Table 1 and depicted in Figure 1 and 2.

Table 1. Average ABC, PLUS-M, PEQ-MS scores, and SCS for walking ramp ascent/descent and standing facing ramp ascent/descent for Kinnex and Pacifica LP.

	ABC Average	PLUS-M Average	PEQ-MS Average	
Kinnex	87.38%	58.03	3.47	
Pacifica	85.13%	55.73	3.23	
	SCS Walking Ascent	**SCS Walking Descent**	**SCS Standing Ascent**	**SCS Standing Descent**
Kinnex	9.43	9.36	9.00	9.43
Pacifica	7.85	7.71	7.21	6.86

DISCUSSION

Improvements were seen in self-reported balance (ABC) and mobility in the community (PLUS-M and PEQ-MS) when patients used the MPA compared to the ESAR. A fixed 90° ankle can cause loss of balance and limited mobility on uneven terrain, and the 30° range of motion (ROM) in the MPA and can allow greater ground contact and reduced socket reaction force couples when ambulating on typical environmental barriers (e.g., uneven terrain, ramps and stairs). Additionally, SCS was consistently higher with the MPA compared to ESAR when patients stood still and walked on a 15° ascending and descending slope. The ankle ROM of the MPA allowed patients to stand and walk on the ramp with reduced socket reaction forces, and this was reflected in the SCS results.

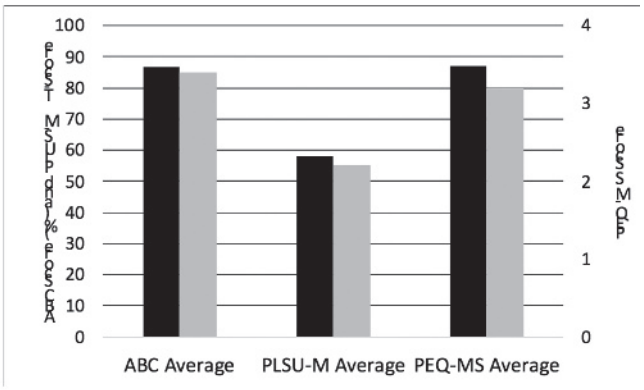

Figure 1. ABC, PLUS-M T-Score, and PEQ-MS average scores for Kinnex (black) and Pacifica LP (grey).

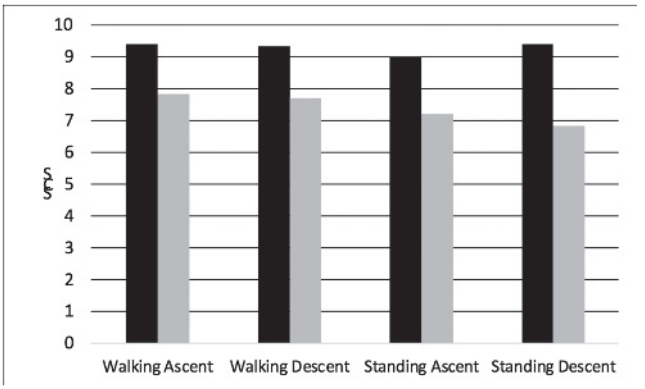

Figure 2. SCS average scores while walking/standing slope ascent/descent for Kinnex (black) and Pacifica LP (grey).

CONCLUSION

The MPA demonstrated higher patient-reported outcome measure results. These results highlight important benefits of this advanced technology, and the findings need to be interrogated by a statistician in order to inform treatment decisions.

CLINICAL APPLICATIONS

This study represents the largest known investigation of MPA and includes the type of outcome measures that clinicians, physicians, patients, and payer sources care about.

REFERENCES

Struchkov V, Buckley JG *Clin Biomech* 2016;32:164–70.
Agrawal V, et al. *J Rehabil Res Dev* 2013;50(7):941–50.
Darter BJ, Wilken JM. *Prosthet Orthot Int* 2014;38(1):5–11.
Wolf SI, et al. *Clin Biomech* 2009;24(10):860–65.