Elevated vacuum socket suspension improves balance and gait performance in elderly dysvascular transtibial amputees

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INTRODUCTION
Lower-limb amputation leads to physical and functional deficits, most frequently with impairments in balance, gait and transfers (1). Poor socket suspension is an issue that frequently compromises the ability of the patient to develop confidence and walk safely with the prosthesis, especially in elderly TT amputees. Therefore, the purpose of this study was to investigate whether a vacuum assisted socket suspension system (VASS) improves the control of the prosthetic limb, stability, balance, and walking capabilities in elderly TT amputees.

METHOD
A convenience sample of 16 transtibial amputees meeting the following inclusion criteria was enrolled to this study: age 50 years or older, unilateral dysvascular TT amputation, informed consent to participate. Patients underwent the four square step test (FSST), Berg balance scale (BBS), the timed up and go test (TUG), the 6 minute walk test (6MWT) and answered the Locomotor Capabilities Index (LCI-5) and Houghton scales at baseline as well as after four weeks of use of the VASS Harmony system (Otto Bock HealthCare, Duderstadt/Germany). Statistical analysis was conducted using the Wilcoxon signed rank test with a power of 80%.

RESULTS
16 dysvascular TT amputees (14 males, 2 females) with an average age of 65.1 ± 10.1 years, 6 patients MFCL-2, 10 patients MFCL-3, completed this study. Patients highly significantly improved their balance on the BBS from 45.7 ± 6.9 to 49.1 ± 5.6 (p=.01) and in the FSST from 18.2 ± 3.8 sec to 15.0 ± 3.9 sec (p=.01) when using the VASS Harmony. Average TUG times highly significantly improved from 14.3 ± 3.3 sec to 11.6 ± 2.5 sec (p=.01). The distance walked in the 6MWT improved significantly from 288.5±59.6 m to 321.4 ± 72.8 m (p=.01). In the MFCL-3 subgroup, use of the Harmony VASS resulted in significant improvements in the Berg Balance Scale (p=.03), FSST (p=.01), TUG (p=.01), 6MWT (p=.01), and LCI-5 (p=.04). In the MFCL-2 subgroup, use of the Harmony VSS lead to significant improvements in the FSST (p=.04) and the Houghton scale (p=.04).

DISCUSSION
The results of this study suggest that the Harmony VASS supports the control of the prosthesis which in turn results in improved balance and walking performance of elderly dysvascular transtibial amputees. Subjects with MFCL-3 mobility demonstrated significant improvements in almost all outcome measures related to the risk of falling and walking capacity. Individuals with MFCL-2 mobility showed similar trends, but due to the limit sample size the differences attained significance only in the TUG indicative of the risk of falling and in the Houghton scale representing prosthesis use. The reason for these improvements is likely the improved linkage between the residual limb and the prosthetic socket that minimizes relative movements and pistoning between the residual limb and the prosthetic socket (4, 5), thus improving "proprioception" and motor control of the prosthesis.

CONCLUSION
This study has demonstrated that elevated vacuum suspension using Harmony VASS may improve safety, balance and walking performance in dysvascular TT amputees as compared to regular prosthetic sockets.

REFERENCES

DISCLOSURE
Andreas Kannenberg is a full-time employee of Otto Bock HealthCare LP, Austin, TX, the manufacturer of the Harmony VASS. Luis...
Guirao Cano and his team received a research grant from Ottobock to conduct this study.