**Transtibial Amputee Prolonged-Gait Characteristics Assessed Using an Intelligent Prosthetic Endoskeletal Component System-iPecs™**

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**INTRODUCTION:** Although the population of amputees is difficult to determine worldwide, it can be estimated that they are in the order of tens of millions, a number which is proven to increase with time. Among all cases transtibial and transfemoral are the most frequent levels of amputation representing 47% and 31% of amputees respectively [1]. The combination of the above groups indicates the importance of gait characterization as a tool for the evaluation of prosthetic devices and enhancement of patient comfort. In this study a new method of prosthesis evaluation is presented based on step durations and stance phase percentage of prolonged transtibial amputee gait measured with a prosthetic wireless gait assessment device-iPecs™. Using this method Total Surface Bearing (TSB) and Elevated Vacuum (EV) socket technologies are compared and the effects of these different socket interventions on prosthetic kinetics are evaluated.

**METHODS:** One bilateral and six unilateral transtibial amputees (Age: 65±16 years, body mass: 86±20 kg, body height: 176±7 cm, stump length: 15±4 cm) participated in this study approved by the Institutional Review Board. All patients were asked to perform at their self-selected speed the Amputee Strenuous Activity (ASA) protocol which covers the walk during Prolonged Strenuous Activities of Daily Living”.

**RESULTS:** The step duration and stance phase percentage measurements were based on the Antero-Posterior Force (FAP) which has the greater consistency between steps and its form allows the algorithmic detection of heel-strike and toe-off events. Analytically, the FAP measurements were put through a digital low-pass Butterworth filter of first order and the step durations and stance phase percentages were calculated for every step. Afterwards, walking was separated from the rest of the ASA protocol tasks based on the similarity to the steps of a predefined period. This study focuses on these steps and all its results refer to walking only. Lastly linear least squares method was used for the regression of all measurements.

**DISCUSSION:** In this study we attempted to define a new method of prosthesis evaluation based on the characterization of amputee gait. The results indicate that the kinematics behavior of patients differs for the cases of TSB and EV prosthesis. Based on patient comments for the two sockets and our preliminary results it can be stated the EV enhances amputee gait by reducing its variability and by enhancing bilateral symmetry. Furthermore the tendency of patients to walk faster with time when using the TSB can possibly be a reflex to cope with the accumulated discomfort. All these results can be further examined to minimize the possibility that fatigue (ASA lasts 2 hours) has an influence on the results. Our future work should include the implementation of a device that measures some characteristics of the healthy limb of the patient so as to be able to further examine the symmetry of gait.

**SIGNIFICANCE:** The method for prosthesis evaluation that is proposed in this study can be the start for the accurate characterization of amputee gait and an important tool for overall socket performance evaluation. Its application can extend to any walking task where there is the possibility to measure step durations.

**ACKNOWLEDGEMENTS:** NIH SBIR grant #1R44HD068150-01 and EC 7th Marie Curie student/scientist exchange grant # 251649.