# VARIATIONS IN GROUND REACTION FORCES OF TRANSTIBIAL AMPUTEES DURING PROLONGED STRENUOUS ACTIVITIES

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## INTRODUCTION

Modern pylon load cells hold the promise for continuous and accurate assessment of amputee gait outside the lab environment, minimizing the influence on the patient's locomotion. In the current study we introduce a new method for the creation of Pedotti diagrams based on pylon load measurements, taking a step towards a more informative depiction of this type of data (Papaioannou, 2010). Finally we utilize this technique for the comparison of the walking patterns of seven transtibial amputees when using two different socket technologies.

## METHOD

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. The patients were asked to perform at their self-selected speed the Amputee Strenuous Activity Protocol (Papaioannou, 2011), which covers the most important tasks a person encounters in everyday life, while a wireless load cell (CPI, 2013) was used to measure the forces and moments applied on each prosthetic pylon (Figure 1a). All patients were also fitted with two socket technologies, namely Total Surface Bearing (TSB) and Elevated Vacuum (EV).

After the detection and separation of the walking steps (3004 in total), all measurements were normalized for easier comparison. Following the preprocessing, the position of the Center of Pressure (COP) on the patient's sole was calculated using the definition of moment together with the axial distance from the load cell. Based on these coordinates, Pedotti diagrams where constructed for the average step of all patients.

The statistical comparison of EV and TSB technologies was based on thirteen parameters which were defined using the local extrema of the measured waveforms and based on previous bibliography (Racic, 2009)

## RESULTS

The following diagrams (Figure 1b-i) represent the walking patterns of all patients with the last couple corresponding to the bilateral amputee. The statistical analysis revealed statistical significant differences between the two socket technologies for 72% of the measured parameters (75/13*8).

## DISCUSSION-CONCLUSION

In this study we propose a new method of prosthesis evaluation based mainly on the assessment of the deviation of amputee gait from healthy kinetics. The preliminary data of this case study demonstrate the great disruption of the patient's kinetics and balance and if combined with the subjective evaluations of the patients indicate improvement in comfort when EV is used.

## CLINICAL APPLICATIONS

The method of gait characterization proposed in this study can serve as a useful tool for the prosthetist to inform the design and manufacture of prosthesis and also to improve the alignment and fitting process.

## REFERENCES

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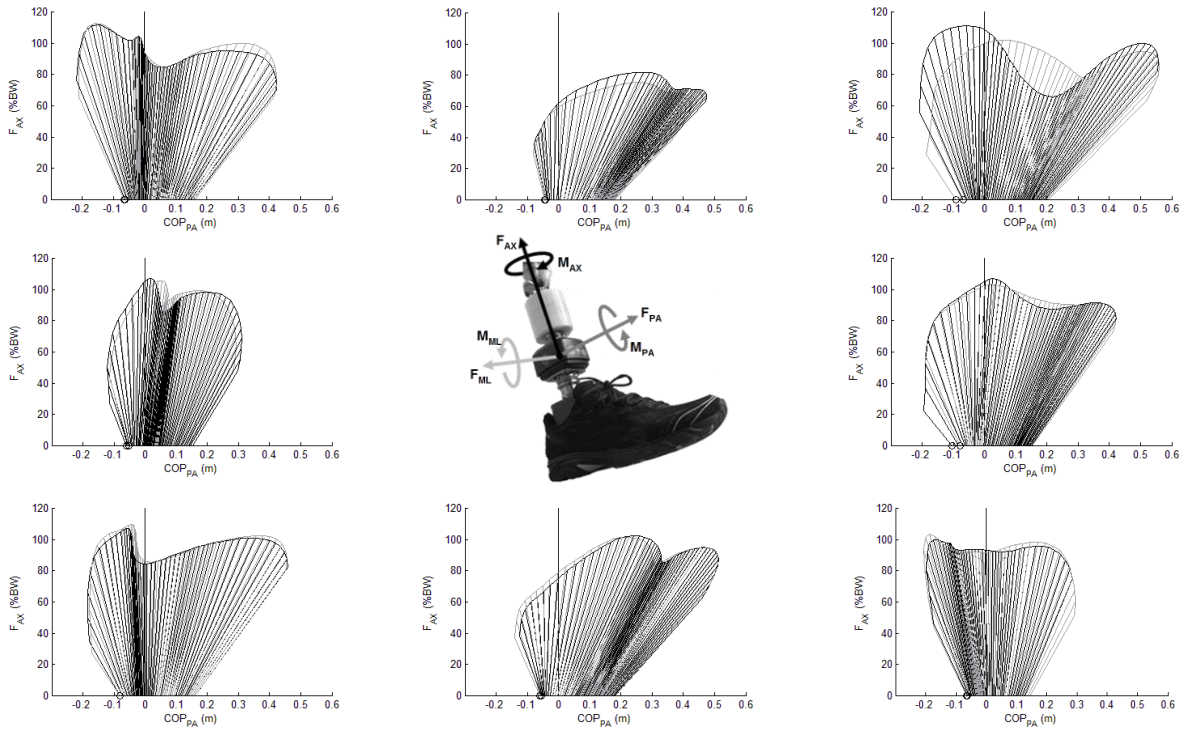


Figure 1. Measurement apparatus (a) and generated pedotti diagrams for all patients (b-i) (EV:black, TSB:gray).

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