# EFFECT OF ALIGNMENT CHANGES ON SOCKET REACTION MOMENTS IN TRANSFEMORAL PROSTHSES: A CASE STUDY

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## BACKGROUND

Alignment of transfemoral prostheses is important for amputee gait. It is tuned through bench, static and dynamic alignment procedures. Effect of alignment changes on socket reaction moments has been investigated in transtibial prostheses (Boone et al., 2012; Kobayashi et al., 2012). Socket reaction moments are moments acting about the geometric center of the socket and transferred through the prosthesis at the distal end of the socket while walking (Kobayashi et al., 2012). It was demonstrated that alignment changes could have systematic in-plane effects on socket reaction moments in the sagittal and coronal planes in transtibial prostheses (Boone et al., 2012a). However, little is known about the effect of alignment changes on transfemoral prostheses. The aim of this case study was to investigate the effect of alignment changes on socket reaction moments in transfemoral prostheses.

## METHOD

A male adult amputee (Mass: 77 Kg; Height: 1.73 m) using a transfemoral prosthesis for 12 years participated in this study. This study was approved by the institutional review board governing the institution, and a consent form was obtained from each subject. A Smart Pyramid TM (Orthocare Innovations, Oklahoma City, OK) was used to measure socket reaction moments. It was mounted at the base of the subject's prosthetic socket. Alignment of the prosthesis was adjusted to the satisfaction of the prosthetist and the subject. From this nominally aligned condition, socket angle changes of 6° (flexion, extension, abduction and adduction) and socket translation changes of 15 mm (anterior, posterior, lateral, and medial) were induced in a random order. Angulation alignment changes were recoded using biaxial MEMS tilt sensors, translation alignment changes were recorded using mm scales on a translation adjuster. Nine alignment conditions were tested in this study. The subject was instructed to walk along a hallway at self-selected walking speed. The subject chose a self-selected walking speed according to the current practice of alignment tuning process in the clinical setting. The socket reaction moments were interpolated with a cubic spline function to 1% increments of a whole gait cycle and the data of the 3 gait cycles were averaged and plotted. Gait initiation and termination steps from each trial were excluded from the analysis. External extension moments in the sagittal plane and external valgus moments in the coronal plane were defined as positive. Cadence was also measured under each alignment condition.

## RESULTS

Both angle and translation alignment changes in the sagittal plane revealed consistent changes in the sagittal socket reaction moments. Cadence raged from 50 to 53 steps / min. Both angle and translation alignment changes in the coronal plane also revealed consistent changes in the coronal socket reaction moments. A varus moment at early stance was followed by a valgus moment throughout the stance under the nominally aligned condition. A valgus moment was dominant during stance. Cadence ranged from 50 to 55 steps / min.

## DISCUSSION

This case study demonstrated that alignment changes could have systematic effects on socket reaction moments in the transfemoral prostheses. Therefore, socket reaction moments could potentially serve as useful biomechanical parameters to assess alignment in transfemoral prostheses. A larger scale study should be conducted to investigate the effect of alignment changes on socket reaction moments in transfemoral prostheses.

## ACKNOWLEDGEMENT

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## REFERENCES

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