Effect of transtibial prosthetic alignment change related to asymmetry gait pattern and fundamental motion measurement

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INTRODUCTION
To date there are no studies having assessed the relative outcomes of the final dynamic prosthetic alignment and the recommended static prosthetic alignment, and how these are related. Does the recommended static alignment influence and confirm more symmetrical gait during dynamic analysis in terms of kinematic and kinetic measurement? This project aimed to evaluate the clinical results of the final total static weight line of transtibial amputees using a 3D motion analysis system by measuring the differences between the final total static weight line and the recommended static alignment, and then comparing the effect of total static weight line changed with asymmetrical individual gait pattern in terms of kinematic and kinetic analysis.

METHOD
Subjects: Ten unilateral transtibial amputees with at least one year experience of endoskeletal transtibial prosthesis user participated in this study. All participants routinely used the same prosthetic type endoskeletal prosthesis with patellar tendon bearing socket and multi-axial prosthetic foot.

Procedures: The Vicon® motion capture System was used to collect the static and dynamic data, and the differences in gait parameters values between two groups of participants’ total static weight line were analysed collectively.

Data Analysis: Six participants were included in anterior weight line group which their total static weight line were represented by GRF passing anteriorly through the knee joint while four remaining participants were defined in posterior weight line group that their total static weight line were signified GRF passing posteriorly. Symmetrical kinematic/kinetic data within subject between both limbs was compared by a general linear model for repeated measures, then those values were combined and analysed to provide mean results of all ten participants and compared the significant difference among participants in each group.

RESULTS
The sound side exerted greater effort during the gait cycle as observed from most of the kinematic and kinetic curves that represented high magnitude values when compared to the prosthetic side. The kinematic and kinetic variables showed that the joint relative angles, joint forces, and joint powers were of more symmetrical in the posterior weight line groups. However, the anterior weight line group presented more symmetrical in terms of time and distance parameters. The kinematic and kinetic data represented asymmetrical gait frequently in mid-stance and terminal stance phases.

DISCUSSION
Firstly, the sound side exerts more effort during the gait cycle so asymmetrical gait may be the means by which the sound side tries to protect the residual limb. Secondly, the joint relative angles, joint forces, and joint powers are of more symmetrical parameters in the posterior weight line group. However, the anterior weight line group presents more symmetrical in term of time and distance. Lastly, the joint angles and the joint forces represent asymmetrical gait frequently in mid-stance and terminal stance phases as a consequence of the less stability of the prosthetic side during the single limb support phase.

CONCLUSION
Asymmetrical gait pattern in terms of kinematic and kinetic parameters were not influenced by how severely the final prosthetic alignment differed from the recommended static alignment in this present study results.

CLINICAL APPLICATIONS
The process of evaluating and learning 3D measurement systems could help researchers and clinicians to develop acknowledgement of the prosthetic alignment system and transtibial amputee gait clinical analysis.

REFERENCES
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