

EVALUATION OF ROCKER SOLE SHAPES FOR RIGID ANKLE FOOT ORTHOSES

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INTRODUCTION

Rocker soles (RS) are frequently used to improve the biomechanical function of walking when the ankle has been immobilised. Varying pathologies can require ankle fixation including short-term conditions such as traumatic injuries as well as long-term chronic conditions including ankle arthrodesis. The aim of a RS is to allow smooth progression of the leg in the absence of the normal rocker action of the ankle (Perry, 1992).

There is little consensus as to which rocker sole design would optimize walking function. Various RS designs are available commercially and clinicians can also fabricate subjective designs. Theoretical models have also been developed in an attempt to optimise design for each individual. Investigation in this area is important, as rocker soles are prescribed frequently to treat a number of pathologies. However, research in this area is limited.

RS designs were fabricated using a theoretical model proposed by Gard and Childress (2001) that defines a radius of curvature proportional to the individual's leg length. This design was compared to RS with greater and lesser curvatures, a prefabricated RS (Donjoy Nextep Contour Walker TM) and a no orthosis condition. The control and experimental sides were also compared. Variables selected for comparison of function were smoothness of progression, knee

stability and trunk work. It was hypothesised that the RS using the theoretical model would provide optimal biomechanical results and that there would be no difference between the two sides.

METHOD

Ethics approval was obtained at the associated facilities. Five asymptomatic subjects were recruited. Using the geometric model a radius of curvature (0.41 of leg length) was determined for each individual (Gard and Childress, 2001). This radius was increased and decreased by 20% to examine closely related radii of curvature. RS were fabricated using a jig, placing the apex at the proximal third length of the boot.

The Peak Motus system and A.M.T.I. force plates were used to gather motion and force data during walking. The subject was allowed a three-minute acclimatisation period for each condition before walking five trials down a 10m walkway at a self selected walking speed. Order of presentation of conditions was randomised.

Statistical analysis consisted of one-way and two-way ANOVAs for repeated measures. Alpha level was set at 0.05.

RESULTS

The results suggested that the prefabricated RS significantly improved smoothness of progression, compared to the RS shape determined by the model. This is seen in Figure 1,

which illustrates the absolute difference between the experimental and control sides.

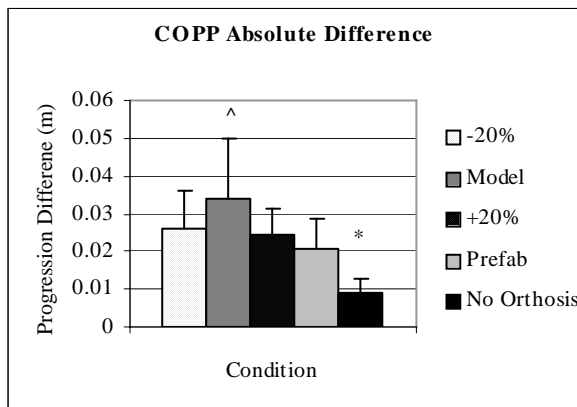


Figure 1. Illustrates the absolute COPP difference for each condition. An asterisk (*) indicates significant differences between the no orthosis and all other conditions, a hat (^) indicates significant differences between the model and -20% condition.

The prefabricated condition also significantly decreased trunk work compared to the RS shapes based on the theoretical model. Results can be seen in Figure 2. The trunk work takes into consideration both kinetic and potential energy and is a useful indicator of the biomechanical performance of each RS.

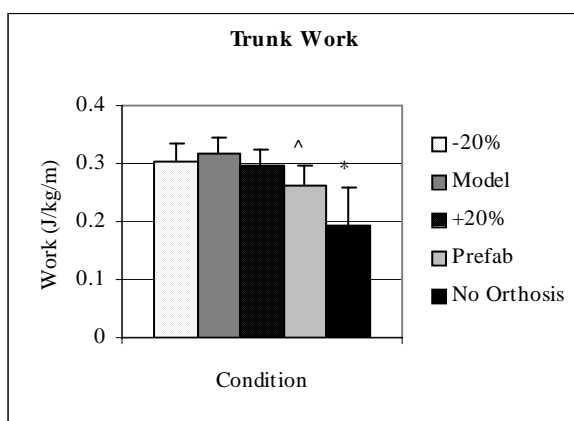


Figure 2. Illustrates trunk work for each condition. Analysis found statistical difference between the no orthosis and the fabricated rockers (*). The hat (^) indicates statistical difference found between the prefab and other conditions.

When comparing the experimental and control sides, significant differences were found in peak knee flexor moments and centre of mass vertical displacement.

DISCUSSION

The theoretical model RS did not provide optimal biomechanical function. The prefab condition provided the best biomechanical function of the RS shapes tested.

Differences were found when comparing between sides, therefore the hypothesis was not supported.

Previous investigations provide little opportunity for comparison (Hullin & Robb, 1991; Pollo *et al*, 1999). Research in this area is limited and does not focus on the specific kinematic and kinetic variables measured in this study.

Clinical implications of this research are important as this orthosis can be used long term and should ensure limited compensations.

The thickness of the RS shapes based on the geometric model may contribute to the increase in trunk work found. Future research should consider metabolic energy in order to confirm this increase in work.

As this was a preliminary study in this area, the scope of development for this research topic is substantial. Future research should test this geometrical model considering other individual characteristics, as well as apex placement. Kinematic and kinetic research warrant further investigation.

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