THE INFULENCE OF THE ROCKER SHOE DESIGN ON SHEAR IMPULSES DURING WALKING IN PATIENTS WITH DIABETIC NEUROPATHY

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INTRODUCTION

Rocker outsole shoe is commonly prescribed to diabetic patients to reduce the risk of plantar ulceration. It is well stablished that the primary biomechanical role of the rocker outsole is to offload the plantar aspect of the forefoot [1]. Shear stresses have been previously affiliated to the etiology of diabetic foot ulcers [2]. However, there is a paucity of research on the effect of the rocker outsole design on the shear components in diabetic patients. While shear impulses can be measured during walking [3], the majority of studies concentrated on the vertical component of the Ground Reaction Force (GRF).

Anterior-posterior (AP) shear impulses which are termed positive and negative impulses respectively [4], change the momentum of the body in forward direction. However, Medial-lateral (ML) shear impulses act to push the body away (negative) and towards (positive) the contralateral side [4]. It is envisaged that the rocker outsole design can alter these impulses by changing the contact angles and forces during the shoe-ground interaction. Therefore, the purpose of this study was to investigate the effect of different rocker outsole designs on AP or ML shear impulses.

METHODS

Ten female participants with diabetes aged 55.6±5.25 years, with no history of previous ulceration were recruited to the study after ethical approval was granted by the local university. Three different (A, B and C) designs of toe-only rocker outsoles (with the rocker angle, apex angle and heel height of A:10°, 80°, 2 cm; B: 15°, 95°, 3.5 cm; C: 20°, 95°, 4 cm, respectively) were used. These designs were previously shown to be most effective in plantar pressure reduction in diabetic patients [5]. GRFs were collected while subjects walked with each of the three rocker outsole shoes in a random order with a controlled self-selected speed over a 10-meter walkway. A Kistler force plate was used to record the GRFs of right and left feet at 100 Hz from a total of six trials. AP and ML GRFs of each trial were time-normalized and then integrated to find the shear impulses, and further averaged over left and right trials, separately. Main outcome measures were: the negative, positive and total AP and ML impulses as well as the AP and ML positive/negative impulse ratios. A repeated measures ANOVA followed by an adjusted post hoc with Fisher's Least Significant Difference (LSD) analysis was performed with a confidence interval of 95% using SPSS software.

RESULTS AND DISCUSSION

The positive and total ML impulses of the left foot were both significantly (P<0.05) lower in A compared to B and C while there was no significant difference between B and C (Figure 1). This can be mainly due to the different apex angle of the rocker A (80°) compared to the apex angles in the other two rockers (95°).

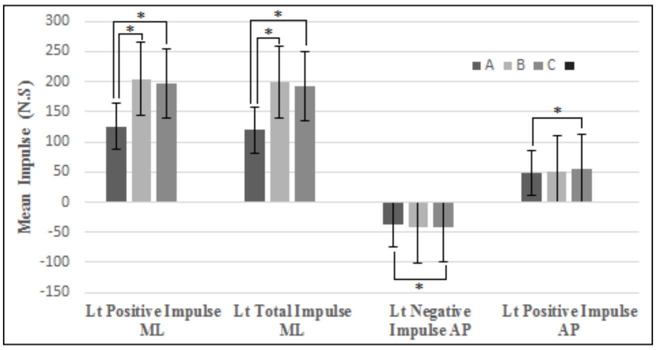

Figure 1: Significant results for three rocker outsoles A, B and C. * indicates statistical significance at p<0.05.

The negative AP impulse for the left foot was also significantly (P<0.05) lower in A compared to B and C, with no significant difference between B and C. This can be related to much bigger differences in height between A and B/C compared to the height difference between B and C with rocker A having the least height. The positive AP impulse for the left foot was significantly (P<0.05) lower in A compared to C, with no significant difference between A and B or between B and C. This finding can be the consequence of a more considerable increase in the rocker angle from 10° in A to 20° in C. No significant difference between different rocker outsoles were found for the right foot.

CONCLUSIONS

The results of this study showed that the outsole design of the rocker can influence the shear impulses. Although it has been frequently demonstrated that the offloading capability of the rocker outsoles increases while increasing the rocker angle, it might have negative effect on the shear impulses. This can influence the effectiveness of rocker by increasing the risk of mechanical trauma/ulceration to the foot during walking.

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