The Effects of Work Footwear on Lower Extremity Kinematics

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Background

Literature has shown that different types of footwear affect the lower extremity ROM and joint alignment achieved during a typical gait cycle.[1–3] It was predicted that every day of wearing the same type of footwear for work could have long term impacts.[4,5] Therefore, the purpose of this study was to determine how an individual's choice of footwear may relate to joint alignment and as a result, function, throughout the workday. Based on the results, the hope is that physical therapists will be able to educate patients on the importance of proper footwear choice. Varying types of footwear will impact the joint alignment and ROM achieved at joints of the LE during the gait cycle. It was predicted that if significantly different values were found between the conditions, it could lead to impacted function at work; as certain types of footwear change the initial conditions of gait, thereby changing the movement throughout the entirety of the gait cycle. The hypothesis was that sneakers would keep the values most similar to reported norms, followed by work boots and then high heels.

Methods

Vicon Motion Systems (Yarnton, Oxford) was used to collect data from reflective markers placed on several key landmarks on participants lower extremities, including: ASIS, PSIS, mid-thigh, knee joint line, mid-calf, lateral malleolus, head of 2nd metatarsal, heel. The two subjects walked at a comfortable, self-selected walking speed for three trials, wearing one pair of sneakers, high-heels (12cm heel), and work boots over a level surface. Each participant completed the walking task in each condition; all 3 trials of each condition were completed consecutively. A Plug-In Gait Model™ was used to compute joint angles for the hip, knee, and ankle, from these the peak angular displacement were averaged at each joint and then compared to control parameters established using the Ranchos Los Amigos[6] normal gait cycle ranges.

Results

When comparing the sneaker values to the control values the largest differences were found with peak hip flexion increased ~9˚ and peak plantarflexion increased ~11˚ in the sneaker condition (Figures 1) and peak hip flexion decreased ~20˚ in the heel condition. The boot condition was overall relatively similar to control values, with a small difference in peak hip flexion increased ~10˚ (Figure 2). The largest difference was noted when comparing heel footwear values to the control with a decrease in peak knee flexion noted in the heel value.

Discussion and Clinical Conclusion

The data indicated that work boots resulted in the most similar hip, knee, and ankle kinematics to that of Ranchos Los Amigos normative values,[6] followed by sneakers and then heels. From this, it is possible that sneakers and boots are both better options than heels for workday footwear. However, it is important that a limitation to our data interpretation is that although we compared the peak values recorded to the normative peak values of each motion, these peaks were not necessarily occurring at the same times. Therefore, the different footwear conditions could be having a greater impact than we realize as they may be greatly increasing or decreasing the motion, but it was not noted because the range is expected in a different portion of the gait cycle. Therefore, sneakers and boots may be a better choice compared to heels for daily wear.[4,5] As clinicians, we should advise patients against wearing heels to decrease abnormal lower extremity kinematic stress occurring as a result of extreme angles. Even though boots demonstrated the best lower extremity kinematics in the data, sneakers were a close second showing similar kinematics as well. In conclusion, sneakers and boots mimic a more neutral position resulting in better kinematics. Therefore, they may decrease the risk for injury and numbers of days out of work due to injury and should be advised as appropriate work footwear depending on job duties.

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5. Zhang X, Paquette M, Zhang S. A comparison of gait biomechanics of flip-flops, sandals, barefoot and shoes. *J Foot Ankle Res*. 2013;6(1):45.
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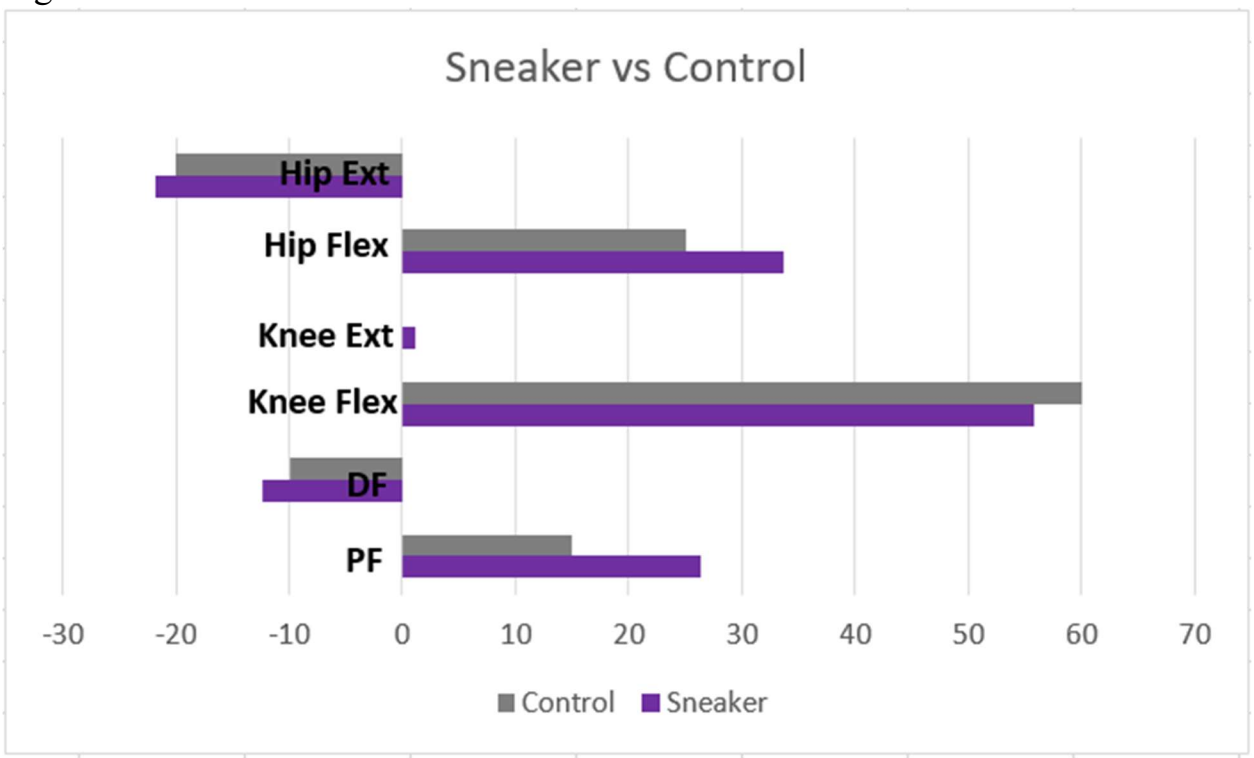
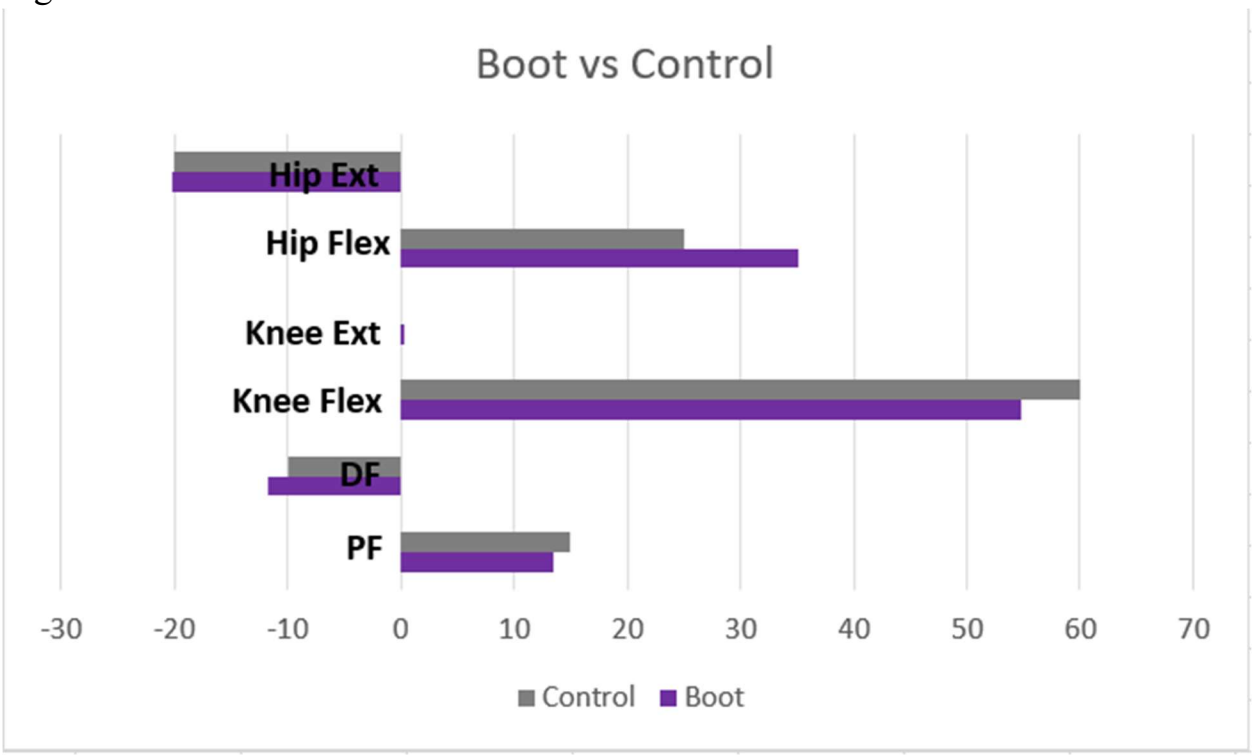
Figure 1



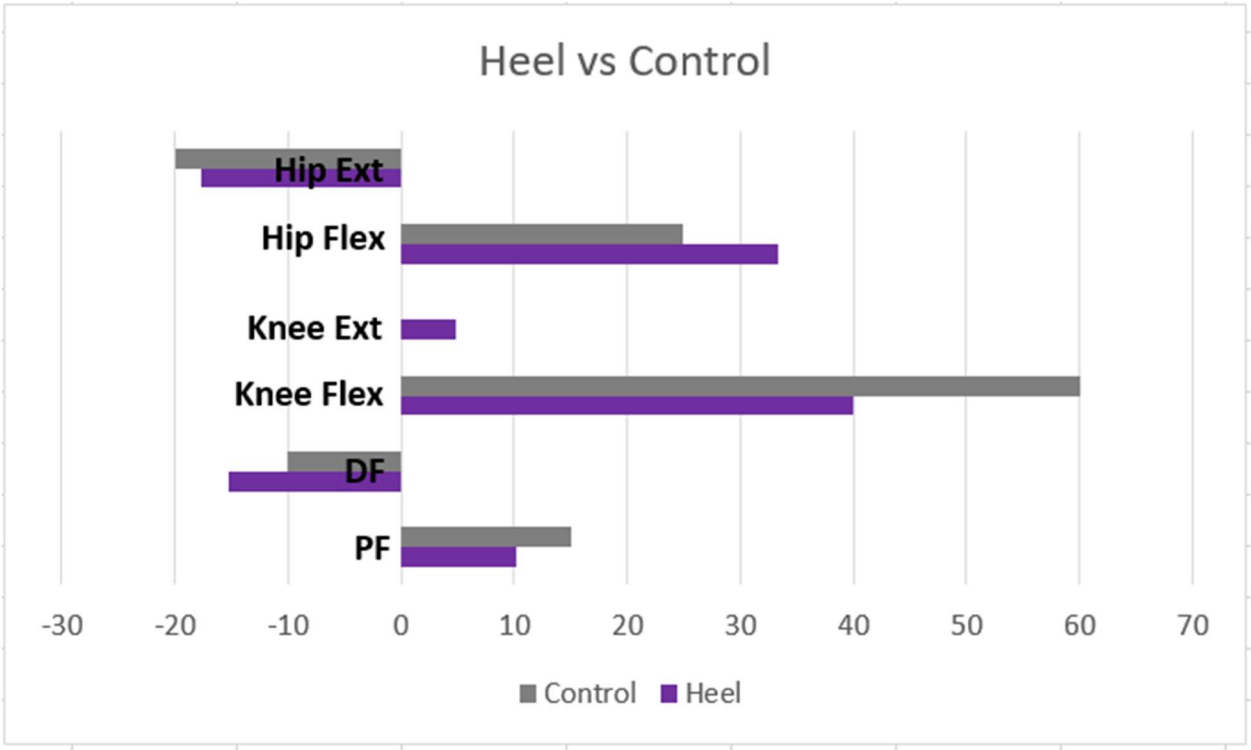
DF= dorsiflexion; PF= plantarflexion

Figure 2



DF= dorsiflexion; PF= plantarflexion

Figure 3



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