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Stability boots for the treatment of Achilles tendon injuries: how do they affect ankle biomechanics while walking?

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with lace during toe turns. There were no consistent differences in peak instantaneous rate of force development/decay during toe turns or any differences in the five variables during heel turns.

Discussion and conclusion

We characterised carving snowboard turns with five metrics: peak force, time to peak force, peak rate of force development, peak rate of force decay, and standard deviation of force around the peak. Both goofy (right foot forward) riders had greater forces on their rear foot during toe turns while the regular rider (left foot forward) had symmetrical peak forces across turns. The standard deviation of force around peak force may be inappropriate to quantify turn smoothness.

Riders exhibited increased peak force and faster times from force onset to peak in BOA configurations during toe turns while we saw no differences during heel turns.

Toe turns may challenge boot fit more than heel turns as imparting force under the toes with a stiff-soled boot could create a lever onto the heel like the 'teeter-totter' effect (Nigg, 2021) in running shoes.

Dual-dial BOA configurations that target heel hold improved peak force and time to peak force during carving in snowboarding.

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Stability boots for the treatment of Achilles tendon injuries: how do they affect ankle biomechanics while walking?

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KEYWORDS Walking; biomechanics; boots; Achilles tendon; musculoskeletal injury

Introduction

Achilles tendon injuries (ATI), such as a partial or complete rupture, are common in the adult population. Such injuries can be treated either by immobilization via cast or with functional rehabilitation, including weight bearing with the ankle kept in a plantarflexed position (Frankewycz et al., 2017). The functional treatment improves patient satisfaction and shortens the time until returning to activities of daily life, without increasing the risk of complications (Ecker et al., 2016; McCormack & Bovard, 2015). To achieve this, orthopaedic boots with the aim to reduce Achilles tendon (AT) loading are used. However, only limited research has been done assessing their influence on walking biomechanics with human participants.

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Purpose of the study

The aim of this study is to investigate the influence of different orthopaedic boots on lower extremity biomechanics during walking.

Methods

Three types of orthopaedic boots commonly used for the treatment of acute ATI were tested by healthy subjects (HE) and ATI patients (PAT): Vacoped (OPED AG), Ortho Rehab Absolut (ORA, Kuenzli SwissSchuh AG) and Vario Stabil (Orthotech GmbH), all in the maximal plantarflexion setting.

The 10 HE and 4 PAT underwent a gait analysis: HE walked with each product; PAT walked with their prescribed product only.

Gait data were captured by a marker-based, optoelectronic motion capturing system (Vicon Nexus, 240 Hz), as well as two force plates (AMTI, 1200 Hz). All subjects walked at 1.2 m/s. Sagittal ankle range of motion (sA_ROM) was used as a measure of boot stability, while the peak ankle plantarflexion moment (pA_PFM) led to an estimate of AT loading. Additionally, the centre of pressure (COP) was recorded.

For the HE, differences between boots were analyzed by a repeated-measures ANOVA while PAT were analyzed descriptively.

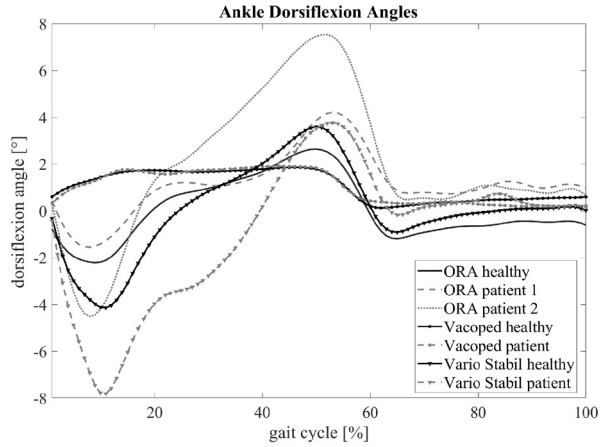

Figure 1. Ankle dorsiflexion for healthy subjects and patients while walking at 1.2 m/s.

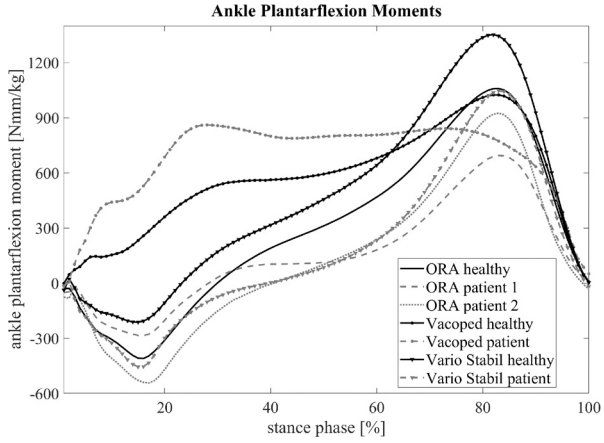

Figure 2. Ankle plantarflexion moment for healthy subjects and patients while walking at 1.2 m/s.

Results

For the HE, all products differed significantly in the sA_ROM, with Vacoped showing 1.8 (0.3)°, ORA 5.0 (1.3)° and Vario Stabil 7.9 (1.7)°. The PAT with Vacoped showed a similar sA_ROM as the HE, while PAT with Vario Stabil and ORA showed increased sA_ROM (Figure 1).

The largest pA_PFM was observed in Vario Stabil, which differed significantly from the other two products (for HE). All PAT showed a smaller pA_PFM than the corresponding HE (Figure 2).

In the HE, the COP of ORA and Vario Stabil stayed close to the ankle joint centre for a longer period than for Vacoped, resulting in a smaller initial moment. A longer proximity of the COP to the joint was also recorded for PAT with ORA and Vario Stabil.

Discussion and conclusion

All boots influenced gait variables to a different extent. Based on sA_ROM, Vacoped showed the highest stability. For ORA and Vario Stabil, the PAT showed larger sA_ROM compared to HE. The HE had their boots tightened by the investigator while PAT did this themselves. This could have resulted in a looser fitting of the shoes for PAT. Also, the longer wearing time of the prescribed boots could have led to material changes.

For PAT, the smallest pA_PFM was obtained with ORA. The rounded shoe sole construction led to the COP being closer to the ankle joint and, therefore, reducing the maximal joint moment and potentially the AT loading. Conclusions about loading of the AT is limited by the chosen approach using surface markers mounted on the boot.

Overall, all boots were successful at reducing loading of the Achilles tendon or range of motion of the ankle. Future research is needed to determine the desired range of those variables to select the most appropriate boot.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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The long-term effect of flexible shoes on children's foot strength and functional performance

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KEYWORDS Children's footwear; balance; ultrasound; toe flexor strength; standing long jump; flexible shoes

Introduction

Barefoot childhood results in better foot strength and performance outcomes than shod childhood (Hollander et al., 2017; Zech et al., 2018). Laboratory studies have established standard school shoes restrict foot motion and alter foot kinematics (Wegener et al., 2015).

No long-term studies into the effect of different children's shoe design on foot and low limb strength development exist to date. The aim of this prospective, longitudinal, randomised controlled trial was to establish whether a child's foot strength and low limb functional performance improves with flexible shoe use.

Methods

Seventy 9–12-year-old healthy children were recruited from a Sydney School and randomly assigned control or experimental shoes. Exclusion criteria were: <3-month-old foot/ankle injury, orthotic use, general ligament laxity, >4 hours/week of gymnastics/dance, BMI >95th percentile.

The control group wore standard school shoes. The experimental group wore shoes previously established in pilot laboratory studies to have minimal foot motion restriction. The shoes were worn for non-sports days, during school hours (±18hrs/wk) for 9 months. Pre- and post-intervention measures were taken.

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