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Effect of Foot Orthoses on GRF in Running Gait

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Abstract

For many years foot orthoses have been used to treat injuries of the feet, lower limb and back. Much of the evidence for their use has been anecdotal and measurement of kinematic or kinetic effects has been inconclusive. A single subject was selected for this case study to test the effect of orthoses on ground reaction forces during running.

The subject was a competitive multi-sports athlete, and a heel strike runner (characterized as a runner who’s heel is the first part of the foot to contact the ground).

The experiment was conducted in a hall on a 40m curved running track with a force plate on one side. Timing lights were placed 5m from each end of the plate to measure speed and a video camera recorded the foot strike on the plate. The subject was asked to run at constant speed while wearing shoes and shoes with foot orthoses, at two self-selected speeds. Data from left and right foot was combined for analysis.

The results showed a significant decrease in the magnitude of the vertical impact peak and the maximum vertical peak while the time to vertical impact peak was increased when wearing foot orthoses. Significant reductions were also seen in the peak posterior shear with both the time to peak and magnitude of the peak being changed by wearing foot orthoses.

The mediolateral force was characterized by a medial impact followed by larger lateral impulse. It is the lateral force in the absorption phase of stance that is responsible for pronation, however no changes were seen in the mediolateral ground reaction force with the use of foot orthoses. This indicates that there is no acute effect in the shear forces that act at approximately right angles to the subtalar joint axis. If orthoses have an acute effect on the lower limb it is likely to be complex and highly patient specific.
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# Table of Contents

Abstract ............................................................................................................................... ii
Acknowledgments .............................................................................................................. iii
Table of Contents ............................................................................................................... iv
List of Tables ....................................................................................................................... vi
List of Figures ..................................................................................................................... vii
Introduction ......................................................................................................................... 3
  Clinical purpose of foot orthoses ..................................................................................... 3
  Anatomy and motion of the ankle joint .............................................................................. 6
  Lower Limb motion during running .................................................................................. 10
  Previous Clinical Research ............................................................................................... 12
  Previous Experimental Research ..................................................................................... 15
  Purpose of Study ................................................................................................................ 19
Methodology ......................................................................................................................... 21
  Orthoses ........................................................................................................................... 21
  Subject .............................................................................................................................. 23
  Set Up .............................................................................................................................. 24
  Preparation ....................................................................................................................... 28
  Protocol ............................................................................................................................ 28
  Procedure ........................................................................................................................ 29
Results ................................................................................................................................... 37
  Analysis of Vertical Ground Reaction Force .................................................................. 38
  Effect of Orthoses ............................................................................................................ 41
  Effect of Speed ................................................................................................................. 43
  Interaction between Condition and Speed ...................................................................... 44
List of Tables

Table 1 Descriptive Statistics for Vertical Ground Reaction Force .................. 40
Table 2 Difference between Shod and Orthotic Condition .......................... 41
Table 3 Difference between Fast and Slow Running Speed ......................... 41
Table 4 Interaction between Condition and Speed ........................................ 44
Table 5 Descriptive Statistics for Anteroposterior Ground Reaction Force .... 47
Table 6 Differences between Shod and Orthotic Condition ......................... 47
Table 7 Differences between Fast and Slow Running Speed ....................... 48
Table 8 Interaction between Condition and Speed ........................................ 49
Table 9 Descriptive Statistics for Mediolateral Ground Reaction Force ......... 53
Table 10 Differences between Shod and Orthotic Condition ....................... 54
Table 11 Differences between Fast and Slow Running Speed ..................... 54
Table 12 Interaction between Condition and Speed ..................................... 55
Table 13: Average Running Speed Recorded in Blocks of 8 Trials ............... 56
List of Figures

Figure 1 Selected Joints and Bones of the Foot ......................................................... 2
Figure 2 Variation in the Sub Talar Joint Axis of Motion ............................................. 5
Figure 3 Subtalar Joint Axes of Motion ........................................................................ 7
Figure 4 Midtarsal Joint Axes of Motion ..................................................................... 8
Figure 5 Medial view of foot positioned on orthosis ................................................... 9
Figure 6 Rotation of sub-talar joint .............................................................................. 11
Figure 7 Schematic diagram of rearfoot and forefoot posting .................................... 22
Figure 8 Foot orthoses used for study .......................................................................... 22
Figure 9 Foot positioned on orthoses .......................................................................... 23
Figure 10 Schematic diagram of experiment set up ...................................................... 25
Figure 11 Data Collection Set Up showing 40m circuit ............................................... 26
Figure 12 Data Collection Set Up showing the ramp and force plate ............................. 26
Figure 13 Vertical Ground Reaction Force .................................................................. 30
Figure 14 Anteroposterior Ground Reaction Force ..................................................... 31
Figure 15 Mediolateral Ground Reaction Force .......................................................... 32
Figure 16 Foot position at heel strike ........................................................................... 33
Figure 17 Approximate foot position at T1 for Vertical and Mediolateral Ground Reaction Forces ................................................................. 34
Figure 18 Approximate foot position at T1 Anteroposterior Ground Reaction Force ... 35
Figure 19 Approximate foot position at T0 for Anteroposterior and PAP0 for Vertical and Mediolateral Ground Reaction Forces .................................................. 36
Figure 20 Mean Vertical Ground Reaction Force .......................................................... 39
Figure 21 Mean Anteroposterior Ground Reaction Force ......................................... 46
Figure 22 Mean Mediolateral Ground Reaction Force for Right Foot ..........................52
Figure 23 Mean Mediolateral Ground Reaction Force for Left Foot..........................52
Glossary

Abduction – A frontal plane motion where the segment rotates away from the mid line.

Adduction – A frontal plane motion where the segment rotates towards the mid line.

Ankle - The articulation of the tibia and talus (Talocrural joint).

Dorsiflexion – Flexion of the talocrural joint.

Eversion – Motion occurring in the frontal plane where the plantar aspect of the foot is tilted away from the mid line of the body, about axes in the sagittal and transverse planes.

Inversion – Motion occurring in the frontal plane where the plantar aspect of the foot is tilted towards the mid line of the body, about axes in the sagittal and transverse planes.

Foot orthoses – Orthopedic appliances used to correct deformity or inadequacy of the foot and lower limb. Also referred to as Orthotics.

Plantarflexion – Extension of the talocrural joint.

Pronation – A complex motion of the rear foot that requires movement in all three anatomical planes.

Midtarsal joint – Articulation between the calcaneus and cuboid and the talus and navicular.

Rear foot valgus – An everted structural position of the rear foot.

Rear foot varus – An inverted structural position of the rear foot.

Subtalar joint – Articulation between the talus and the calcaneus.

Valgus – The distal segment is angled away from the mid line of the body.

Varus – The distal segment is angled towards the mid line of the body.
Figure 1 Selected Joints and Bones of the Foot

Key

1. Subtalar Joint
2. Calcaneus
3. Talus
4. Navicular
5. Navicular tuberosity
6. Midtarsal Joint
7. Cuboid