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Effect of Foot Orthoses on GRF in Running Gait

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A thesis submitted in partial fulfillment of the requirements for
the Degree of
Masters of Philosophy

Massey University
New Zealand

31st June 2004

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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Acknowledgments

There are a couple of people I would like to acknowledge for their help and support.

Firstly I would like to thank my supervisor, Dr Alan Walmsley for supporting me in developing the methodology for this project. Dr Walmsley provided constant support through the writing of this thesis.

I would also like to thank my wife for her efforts in typing my research project. This work could not have been done without her help and support.

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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.

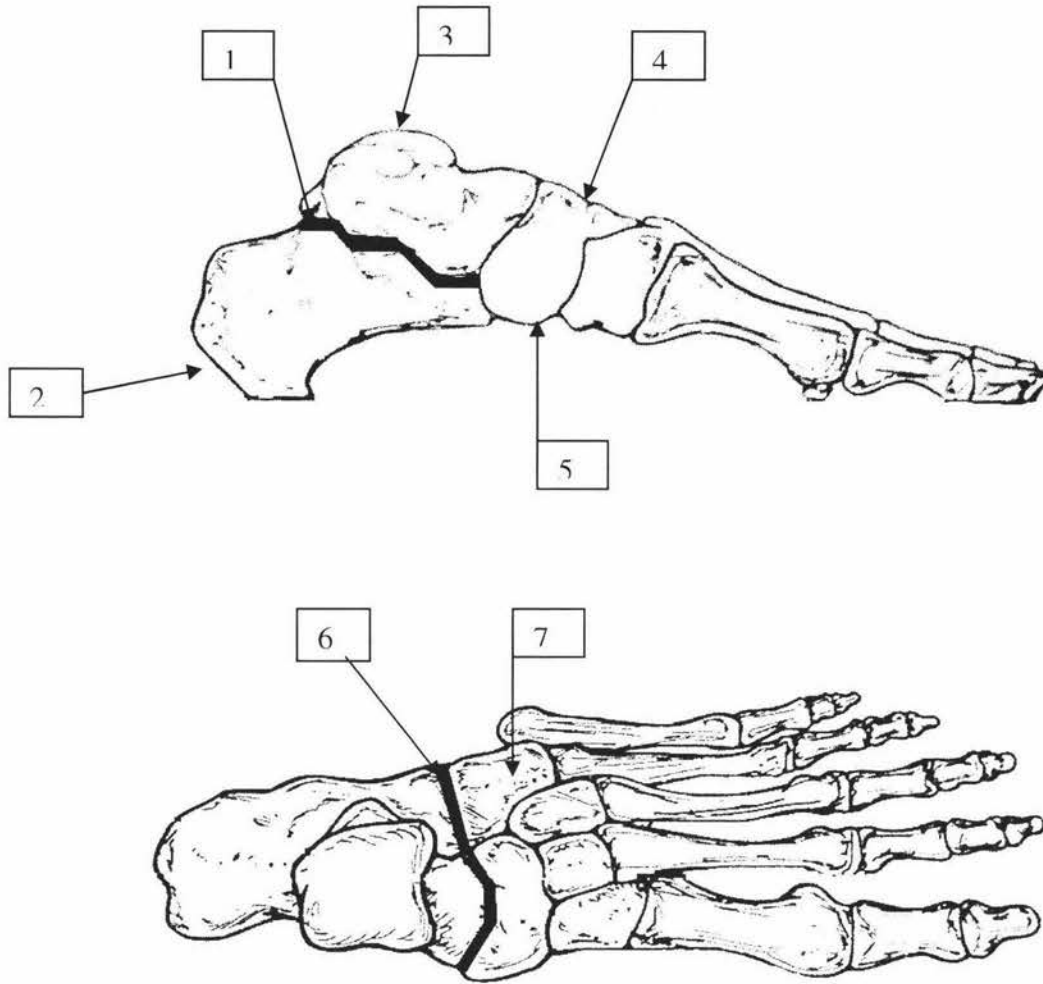


Figure 1 Selected Joints and Bones of the Foot

Key

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