THE EFFECT OF SHOE DESIGN AND LATERAL WEDGING ON KNEE LOADING

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INTRODUCTION
The mechanical environment of the knee during walking can influence both the health and breakdown of the knee cartilage. With walking being the most common activity of daily living as well as producing a cyclically reproducible pattern of loading a close link to the maintenance of healthy knee cartilage is indicated. (1) Normally 60–80% of the total intrinsic compressive load transmitted across the knee is on the medial compartment (7). Alignment of the knee influences the load distribution. In a varus knee (bow legged), the load-bearing axis is shifted so that the medial compartment experiences greater stress. In a valgus knee (knock-knee), stress is increased in the lateral compartment. The medial compartment is usually first affected by knee osteoarthritis (4).

Foot wedges have shown promising results with potential pain reduction and knee load. There is a lack of high quality evidence to substantiate the effect of lateral wedges(2-4). Thus the aim of the present study is to evaluate the interaction between design of foot wear and the effect of lateral wedges and to investigate if their effectiveness correlates to a subject’s peak adduction moment prior to intervention.

METHODS
Thirteen healthy individuals with no current knee pain or history of trauma or knee surgery were selected. The subjects performed four walking conditions at self-selected walking speeds. Three different shoes and barefoot walking were tested. A common running shoe (Nike Air Pegasus), a normal leather shoe (Klaveness) and a leather shoe with a rocker (Klaveness new rehab) were tested. Walking velocity was maintained within 5%. Participants underwent 3D gait analysis. Data of movement were collected at 120Hz using an 8-camera system (Qualisys Proreflex, Gotenburg, Sweden) and ground reaction force were recorded at 1200 Hz from 2 Amti force platforms (Amti OR6-5). Surface EMG was recorded during all walking trials.

EMG signals were recorded from six lower extremity muscles of the right leg. Bipolar surface electrodes (Ambu Blue sensor Ag–AgCl) were placed on the vastus lateralis and medialis, Biceps femoris (long head), Semi tendinosus, Gastronemius laerals and medialis muscles. Cocontraction index was calculated as described earlier. (6)

RESULTS AND DISCUSSION
Thirteen subjects were included. Nine men and four women with an average age of: 31 years. (Height: 1.75m; mass: 74.2kg) A significant reduction in knee adduction moment was observed with all three shoe designs (table 1). None of the shoes modified the effect of the lateral foot wedge, but the Nike shoe showed a lower knee adduction moment both with and without wedges. The difference between walking barefoot and walking with maximal external foot rotation were significantly less compared to the effect of the lateral wedges in all three shoes. No differences in initial knee flexion and knee flex from heel strike to early peak knee adduction moment were observed between shoes. The degree of co-contraction was not significantly different between the four conditions.

CONCLUSIONS
The results of this study showed that shoe design affects loading at the knee, but does not interact with the effect of lateral wedges. A significant reduction in peak knee adduction moment are observed with a 10 degree lateral wedge in all three shoes. On average the peak knee adduction moment effects are greater in subjects with greater peak knee adduction moments prior to wedging.

ACKNOWLEDGEMENTS
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REFERENCES
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<th>Nike Pegasus</th>
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Table 1: Differences in early Peak Knee adduction moment with and without lateral foot wedges and differences between neutral barefoot walking and increased foot progression angle.