

LOAD-MODIFYING FOOTWEAR INTERVENTION DOES LOWER KNEE ADDUCTION MOMENT IN SUBJECTS WITH SYMPTOMS OF MEDIAL COMPARTMENT KNEE OSTEOARTHRITIS

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INTRODUCTION

A high maximum adduction moment at the knee during walking has been associated with the treatment outcome (Andriacchi 1994) and rate of progression (Miyazaki et al. 2002) of medial compartment knee osteoarthritis (OA). Consequently, many interventions for knee OA are aimed at reducing the maximum knee adduction moment. While footwear modifications, using wedged insoles or shoes (Crenshaw 2000 and Fisher 2002) have been shown to reduce the knee adduction moment, subjects often find such interventions uncomfortable to wear. Fisher *et al.* 2004 reported that a variable stiffness shoe reduced the knee adduction moment in healthy individuals. However, it has not been shown that a variable stiffness shoe can reduce the adduction moment in subjects with medial compartment knee OA, or if there are certain patients that are not responsive to a variable stiffness shoe. The purpose of this study was to test the following hypothesis: the variable stiffness shoes will lower the knee adduction moment in the affected leg of individuals with symptoms of medial compartment knee OA, compared to the subjects' personal shoes and control shoes.

METHODS

26 subjects (17 male, 9 female; age: 58.2 ± 10.4 yrs; height: 1.72 ± 0.09 m; mass: 80.6 ± 15.8 kg) with symptoms of medial compartment knee OA participated in this

study after giving written consent in accordance with the Institutional Review Board. Inclusion criteria included the presence of medial compartment knee pain, and exclusions included serious back, hip, ankle, or foot problems; the use of shoe inserts, rigid knee braces, walking aids, or narcotic medications; age less than 18 or greater than 80 years; body mass index greater than 35 kg/m^2 ; total knee replacement; and gout. Each subject performed 3 walking trials at self-selected slow, normal, and fast speeds in each of 3 shoes: their personal walking shoe, a control shoe (constant-stiffness sole), and an intervention shoe (variable-stiffness sole). In the intervention shoe the lateral sole stiffness was greater than the medial sole stiffness.

Kinematic and kinetic data were collected using an 8-camera optoelectronic system and reflective markers (Andriacchi 1998). External inter-segmental forces and moments were calculated for the lower limb using previously described methods (Andriacchi 2004). The first peak knee adduction moment was calculated for each trial. Average values for each shoe, speed, and subject were determined for each subject's more affected leg (determined by self-reported pain). Paired one-tailed Student's T-tests were used to compare the different shoes ($\alpha = 0.05$).

RESULTS AND DISCUSSION

The knee adduction moment of the subjects' more affected leg was significantly reduced at all walking speeds for both the intervention vs. personal and intervention vs. control shoe cases (Figure 1).

The amount of reduction in the adduction moment varied from more than a 20% reduction to a 7% increase with the intervention shoe relative to the control, with 4 of the 26 subjects having an increase in the adduction moment with the intervention shoe (Figure 2).

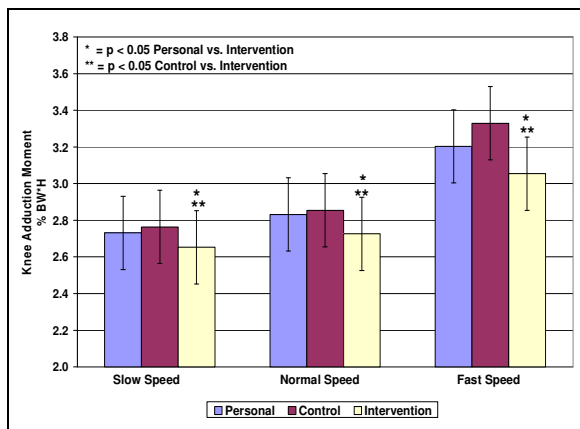


Figure 1: Average knee adduction moments (\pm SEM) for all subjects' affected legs.

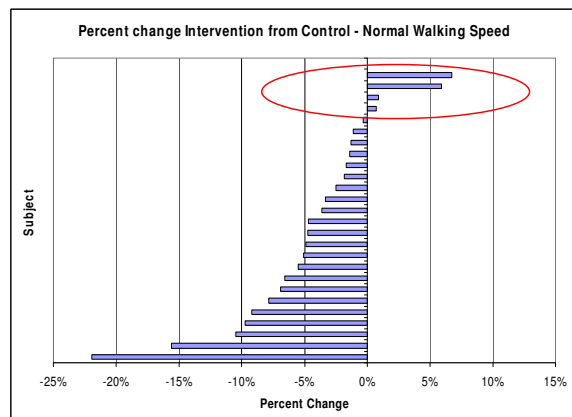


Figure 2: Patient responses to the intervention shoe had substantial variation. Red circle indicates non-responders.

SUMMARY/CONCLUSIONS

The intervention shoes successfully reduced the knee adduction moment in nearly all subjects with symptoms of medial compartment knee OA.

However, as shown in Figure 2, the amount of reduction varied substantially among the population, with a small percentage of the population having an increase in loading with the intervention shoe.

Future work identifying factors to explain the non-responders' increase in knee adduction moment will be important to implement the intervention shoes clinically. By identifying responders vs. non-responders, physicians will be able to accurately prescribe a footwear intervention to slow the progression of medial compartment knee osteoarthritis.

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