The Effect of Lateral Wedged Shoes on Medial Compartment Load of the Knee Joint

INTRODUCTION:
Osteoarthritis of the knee joint most often starts at the medial compartment, presumably due to its higher loading [1]. Several conservative methods exist to unload the medial compartment, such as the use of valgus braces, canes and laterally wedged shoes. Several studies have shown that the external adduction moment, which is associated with medial compartment load, is reduced by 4-12% when walking with laterally wedged shoes [2]. However, no direct measurements have been performed so far to confirm the load reducing properties of wedged shoes. The aim of this study was therefore to measure the loading of the knee joint in vivo with an instrumented implant and to examine the effect of laterally wedged shoes.

METHODS:
An instrumented tibial tray with telemetric data transmission was developed to measure six load components (3 forces and 3 moments) in vivo [3]. The measured moment $M_i$ in the frontal plane is assumed to be caused solely by the axial force $F_z$, acting onto the tibial tray with an offset $s$, in medio-lateral direction $(M_i = -F_z \cdot s_1)$ [4]. The force $F_{\text{med}}$ on the medial compartment was calculated for $F_z >1000N$, assuming a constant distance between both condyles.

RESULTS:
During the stance phase of gait two force peaks occurred at contralateral toe off (CTO) and contralateral heel strike (CHS) (Fig.1). In all subjects 64-84% of the axial force was transferred by the medial compartment at these instants.

DISCUSSION:
This study is limited by the small number of subjects. Furthermore all subjects underwent total knee replacement and were free of pain at the time of measurement. However, in the small cohort it was shown that laterally wedged shoes do not reduce medial contact forces in the knee joint substantially. Maximum load reductions of only 5% were observed when walking with a laterally wedged sole of 10mm. Load reductions within this range may also be achieved by weight loss, changed gait patterns or the use of canes. Greater unloading effects can be expected when walking with (more inconvenient) valgus braces [5]. The effect of lateral wedged soles might partly be compensated by movement of the ankle. Studies have shown that this movement can be restricted by ankle-stabilizing orthoses [6]. Further in vivo measurements are needed to examine if laterally wedged shoes in combination with ankle-stabilizing orthoses are a more effective treatment of medial knee osteoarthritis.

REFERENCES:

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Table 1: Subject data
<table>
<thead>
<tr>
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<th>K3R</th>
<th>K5R</th>
</tr>
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<td>Body mass [kg]</td>
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<td>Time post-op [months]</td>
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<td>18</td>
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</table>

Fig 1: Average medial and total axial forces during walking with different footwear (subject K2L)

In general the effects of laterally wedged shoes were small. At CTO (Fig.2) $F_{\text{med}}$ was significantly reduced in 3 subjects with the 5mm insole (-5%) and 10mm wedge (-4%). This reduction was not predominantly caused by a load shift to the lateral side, but by a reduction of $F_z$ (-5% with the 5mm insole and -4% with the 10mm wedge).