TEST-RETEST RELIABILITY OF IN-SHOE LATERAL HEEL PRESSURE MEASUREMENTS DURING GAIT

Kristyn M. Leitch, Trevor B. Birmingham, J. Robert Giffin, Ian C. Jones and Thomas R. Jenkyn
Wolf Orthopaedic Biomechanics Laboratory, University of Western Ontario: London, Ontario, Canada
email: kleitch@uwo.ca

INTRODUCTION

Lateral heel wedges (LHW) provide a potential non-invasive and low cost means of decreasing knee joint loads and pain in individuals with medial compartment knee osteoarthritis (OA). Although there is some evidence to suggest that LHWs decrease the external knee adduction moment (EKAM) during gait and improve symptoms, previous studies have produced inconsistent results [1, 2]. Further investigation into the mechanisms of LHW is warranted. It has been suggested that wedging causes a change in foot pressures that directly affect the knee adduction moment [3, 4]. However, the measurement of foot pressures during walking is a relatively new aspect of quantitative gait analysis that has not yet undergone rigorous reliability testing, particularly under the conditions used to test the effects of LHWs. The purpose of this present study was to examine the test re-test reliability of the lateral heel pressure (LHP) during gait with a LHW intervention.

METHODS

Twenty-eight participants (9 male, 17 females, mean age 44 ± 8 yrs.) completed two separate test occasions, at least 24 hours apart and within one week. After giving written consent in accordance with the Institutional Review Board, each participant underwent three-dimensional gait analysis, using 8 high speed high resolution digital cameras and a floor mounted force plate, while instrumented with the Novel Pedar-X in-shoe plantar pressure measurement system (Novelelectronics Inc., St.Paul, MN, USA). During testing, participants were exposed to three LHW conditions in random order: standardized footwear (SF) (no wedge condition), or SF with 4°, and 8° wedge, placed underneath the insole on the lateral side of the participants dominate leg.

Kinematic and kinetic data were combined to calculate the first peak EKAM normalized to body size (%BW x Height). The foot was divided into four quadrants and the lateral heel quadrant was used to determine LHP at the moment first peak EKAM occurred. The same area of pressure cells was analyzed for visit 1 and visit 2 for each participant. Statistical analysis was confined to the limb receiving the LHW intervention. To graphically assess agreement between measures, Bland and Altman plots were constructed. Intra class correlation coefficients (ICCs) (type 2, 1) and standard error of measurement (SEM) were then calculated to evaluate reliability of the measurements [5, 6, 7]. The ICC provided an indication of how well the measures distinguished among patients (relative reliability), while the SEM provided an expression of the measurement error in original units (absolute reliability).

RESULTS AND DISCUSSION

Bland and Altman plots for day 1 and day 2 show a strong agreement and a systematic bias between days 1 and 2 (Figure 1). This bias indicates a possible learning effect. The ICCs with 95% CIs and the SEMs are reported in Table 1. The ICCs for LHP were consistently high (0.79 - 0.83). The SEM allows us to interpret the lateral heel pressure measurements within a certain amount of measurement error. For example, if a participant reported a lateral heel pressure measurement of 120kPA we could be 95% confident that the participant’s true value range from 97.38 kPa to 142.62 kPa.

CONCLUSIONS

The present reliability estimates are only generalizable to participants with characteristics similar to those in this study, as well as to similar
It is encouraged that further investigation into the effect of lateral heel wedges on similar gait parameters be conducted.

REFERENCES


**Figure 1:** Bland and Altman Plots for day 1 and day 2 LHP during SF, 4 and 8 wedge condition

**Table 1:** Test Re-Test Reliability Statistics For Lateral Heel Pressure

<table>
<thead>
<tr>
<th></th>
<th>ICC*</th>
<th>95% CI*</th>
<th>SEM*</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Min, max</td>
<td></td>
</tr>
<tr>
<td>Lateral Heel Pressure kPa</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Standardized Footwear</td>
<td>0.83</td>
<td>0.65, 0.92</td>
<td>10.33</td>
</tr>
<tr>
<td>4° Wedge</td>
<td>0.81</td>
<td>0.58, 0.91</td>
<td>11.39</td>
</tr>
<tr>
<td>8° Wedge</td>
<td>0.79</td>
<td>0.58, 0.90</td>
<td>11.54</td>
</tr>
</tbody>
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*ICC= Intraclass Correlation Coefficients, SEM = Standard Error of Measurement, CI = Confidence Interval*