Sex differences in pedobarographic findings and relationship between radiograph and pedobarograph measurements in young healthy adults

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Disclosure

The authors have no disclosures.
Purpose

- To examine the pedobarographic characteristics of young healthy adults with regard to sex-related differences and correlations among measurement indices
# Patients demography

- 20 Patients (10 male, 10 female)
- 20 Limbs (right feet)

<table>
<thead>
<tr>
<th></th>
<th>Man</th>
<th></th>
<th>Woman</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>22.0</td>
<td>1.4</td>
<td>22.8</td>
<td>0.9</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>172.4</td>
<td>3.7</td>
<td>161.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>70.9</td>
<td>5.4</td>
<td>52.2</td>
<td>5.0</td>
</tr>
<tr>
<td>BMI (kg/cm²)</td>
<td>23.9</td>
<td>1.8</td>
<td>20.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Radiographic measurements

- **AP**
  - Talo-1\textsuperscript{st} metatarsal angle
- **Lateral**
  - Naviculocuboid overlap
  - Talo-1\textsuperscript{st} metatarsal angle
- **Selection of indices based on a previous study**
Radiographic measurements

- Plantar soft tissue thickness
  - 1st metatarsal head
  - calcaneal tuberosity
Max Ankle DF during gait

- Computerized motion capture system using Vicon MX T-10 system (Vicon Motion Systems, Oxford, UK)
- 4 reflective skin markers (heel, 2nd metatarsal head, lateral malleolus, tibia)
- Sampling rate 100 Hz
Measurement of Dynamic foot pressure

- 5 plantar segments
  1. Medial forefoot (MFF)
  2. Lateral forefoot (LFF)
  3. Medial midfoot (MMF)
  4. Lateral midfoot (LMF)
  5. Heel
Measurement of Dynamic foot pressure

- Peak pressure, pressure-time integral
- Peak pressure & pressure-time integral varus/valgus index:
  \[ \frac{(MFF + MMF) - (LFF + LMF)}{(MFF + MMF + LFF + LMF)} \]
- Peak pressure forefoot/heel index:
  \[ \frac{(MFF - Heel)}{(MFF + Heel)} \]
- Pressure-time integral forefoot/heel index:
  \[ \frac{(MFF + LFF - Heel)}{(MFF + LFF + Heel)} \]
# Results

## Radiographic Measurements

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP talo-1st MT (°)</td>
<td>5.8 (SD 6.7)</td>
<td>14.0 (SD 7.3)</td>
<td>0.018</td>
</tr>
<tr>
<td>NC overlap (%)</td>
<td>55.4 (SD 21.0)</td>
<td>64.1 (SD 17.2)</td>
<td>0.323</td>
</tr>
<tr>
<td>Lat talo-1st MT (°)</td>
<td>1.8 (SD 5.4)</td>
<td>6.9 (SD 7.3)</td>
<td>0.091</td>
</tr>
<tr>
<td>MT soft tissue thickness (mm)</td>
<td>9.1 (SD 1.8)</td>
<td>7.0 (SD 2.4)</td>
<td>0.040</td>
</tr>
<tr>
<td>Heel soft tissue thickness (mm)</td>
<td>13.2 (SD 1.5)</td>
<td>10.1 (SD 1.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

## Kinematic data and peak pressure

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum ankle DF (°)</td>
<td>14.9 (SD 3.5)</td>
<td>22.1 (SD 9.2)</td>
<td>0.041</td>
</tr>
<tr>
<td>Dynamic pedobarograph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak pressure (N/cm²)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MFF</td>
<td>34.3 (SD 6.3)</td>
<td>25.9 (SD 5.5)</td>
<td>0.005</td>
</tr>
<tr>
<td>LFF</td>
<td>26.1 (SD 6.9)</td>
<td>17.2 (SD 5.3)</td>
<td>0.004</td>
</tr>
<tr>
<td>MMF</td>
<td>17.9 (SD 8.4)</td>
<td>23.1 (SD 6.1)</td>
<td>0.130</td>
</tr>
<tr>
<td>LMF</td>
<td>18.2 (SD 5.6)</td>
<td>17.0 (SD 4.0)</td>
<td>0.587</td>
</tr>
<tr>
<td>Heel</td>
<td>28.1 (SD 4.4)</td>
<td>25.6 (SD 3.3)</td>
<td>0.161</td>
</tr>
<tr>
<td>Varus/Valgus index</td>
<td>0.08 (SD 0.1)</td>
<td>0.18 (SD 0.1)</td>
<td>0.088</td>
</tr>
<tr>
<td>Forefoot/Heel index</td>
<td>0.09 (SD 0.2)</td>
<td>0.00 (SD 0.1)</td>
<td>0.144</td>
</tr>
</tbody>
</table>
Results (Correlation)

- **BMI**: significantly correlated with
  - Soft tissue thickness (p=0.018, 0.007)
  - Peak pressure on the MFF (p=0.005), LFF (p=0.029)
  - Pressure-time integral on the heel (p=0.012)
  - Total pressure-time integral

- Maximum dorsiflexion **negative** correlation with
  - Pressure-time integral on the MFF (p=0.007)
  - Total pressure-time integral

- **Pressure-time integral varus/valgus index**: significantly correlated with
  - Pressure-time integral forefoot/heel index (p=0.036)
  - Pressure-time integral on the MFF (p=0.001), MMF (p=0.004)

- Peak pressure varus/valgus index (p=0.001) Increase AP talo-1MT angle decreased pressure-time integral of heel (p=0.031).

- Increase Lat talo-1MT angle decreased peak pressure of LFF (p=0.017), varus/valgus index of peak pressure (p=0.048) and pressure-time integral (p=0.048).
Discussion

- Sex-related differences in pedobarographic exam were observed.
- The results supports the clinical consensus that limited dorsiflexion due to tight Achilles tendon tend to have foot discomfort or pain caused by plantar pressure.
- Radiographic parameter was correlated with plantar pressure.
- Correlation between varus/valgus index and forefoot/heel index of pressure-time integral might be function of subtalar joint.
  - further investigation is required regarding the role of subtalar joint in distributing foot pressure