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Foot Muscle Activation in Resting, Barefoot, and Shod Walking Conditions - A Pilot Study

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Foot Muscle Activation in Resting, Barefoot, and Shod Walking Conditions - A Pilot Study

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### Methods

- **Five subjects** (3 women and 2 men, ages 22-33) participated in this pilot study.
- Participants had no foot injuries in the last 6 months and do not regularly use minimalist footwear.
- Each subject visited the MRI facility three times. Subjects were asked to rest for 30 minutes with feet elevated prior to the first MRI scan.
- 2 MRI scans were taken - before and after one of the following conditions:
  - Condition 1: subject walked on a treadmill with their normal, supportive footwear.
  - Condition 2: subject rested.
  - Condition 3: subject walked barefoot on a treadmill.
    - Walking speed was self-selected at a pace that the subject considered to be brisk. The same speed was used for both walking conditions.
- Scans were performed on a Siemens TIM-Trio 3.0T MRI scanner.

### Measurements – Muscle Segmentation

<table>
<thead>
<tr>
<th>Subject ID</th>
<th>Rest</th>
<th>Barefoot Walking</th>
<th>Shod Walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>66.67%</td>
<td>77.46%</td>
<td>-41.87%</td>
</tr>
<tr>
<td>2</td>
<td>-3.73%</td>
<td>99.36%</td>
<td>6.31%</td>
</tr>
<tr>
<td>3</td>
<td>-0.56%</td>
<td>0.47%</td>
<td>8.20%</td>
</tr>
<tr>
<td>4</td>
<td>5.20%</td>
<td>14.17%</td>
<td>12.54%</td>
</tr>
<tr>
<td>5</td>
<td>-11.60%</td>
<td>5.90%</td>
<td>13.61%</td>
</tr>
</tbody>
</table>

**Positive** numbers represent an increase in muscle activation from pre to post. **Negative** numbers represent a decrease in muscle activation from pre to post.

**Analysis:** All MRI images were processed in Horos Medical Image Viewer.
- Four selected muscles were manually segmented by a blinded researcher.
- T2 maps were used to measure changes in activation.
- Muscle activation for individual muscles were added to create a composite score to represent IFM activation.
- The percent change in activation from the pre to post scan was then calculated.

### Discussion

- Each subject saw more activation in the barefoot condition compared to the resting condition.
  - The amount of change was highly variable between subjects.
- Activation levels were highly variable in shod and barefoot conditions.
- Some subjects had greater muscle activation in shod walking, while others had greater activation in barefoot walking.

Contrary to our hypothesis:
- Subjects 1 and 4 showed increases in muscle activation after a 20 minute rest.
- Subject 4 showed a large decrease in activation after walking shod.

Further research should be done to explain why these inconsistencies appeared.

**Limitations:**
- Subjects used their own supportive shoes, which may have presented variability due to age and/or shoe construction.
- In this pilot study, we used resting as the third condition rather than minimalist shoes, which will be used in the full study. This was chosen to test the T2 mapping technique for muscle activation by having a control condition in which no muscle activation was expected.

### Conclusions

- **Results** were highly variable between subjects.
- Therefore, it is unclear if there is a difference in foot muscle activation between conditions.
- More subjects should be recruited and minimalist footwear included.

### References


Presented at BYU 2020