Can Foot Exercises Alter Foot Posture, Strength, and Walking Plantar Pressure Patterns in People with Severe Flat Foot?

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The authors have no potential conflicts of interest to disclose.

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Background

Muscle training for barefoot running (i.e. doming seated and standing) and post foot and ankle injury (i.e. seated plantar flexion and inversion) are common. (McKeon PO, et al. Br J Sports Med 2015)

Although studies demonstrated improvement in foot posture (validated foot posture index [FPI]) immediately following a 4-week exercise program this was not assessed in people with flatfoot.

More rigorous assessment of foot function in response to exercise is lacking (i.e. foot posture, strength, and plantar pressure during walking) and may assist individuals with flat foot.

If specific exercises have a strong influence on foot function in patients with non-painful flat foot these exercises may be beneficial for patients with various pain syndromes (e.g. plantar fasciitis) and after trauma (i.e. Foot and ankle fractures).
The purpose of this pilot study was to assess the immediate effect of a 4-week exercise program on a comprehensive assessment of foot function to evaluate the potential for a more rigorous clinical trial.

Study Design- Case Series (Pre/Post Exercise Test)
Methods - Sample

- Eighteen individuals
  - 8 with a severe flatfoot, measured by foot posture index (FPI) (> 6/12, average=8.4±0.7 [max score possible = 10]), age=27.8±6.9, 7 females and 1 male
  - Pre/Post Exercise Testing

- 9 age/gender matched controls with a normal foot (FPI=0-5, average=2.2±2.0) participated.
  - Tested once (did NOT perform exercise)
Methods - Exercise

The Exercise group completed 3 foot exercises

- Doming (seated)
- Doming (standing)
- Seated plantar flexion and inversion

Frequency was - 5 days/week twice daily.
Methods – Pre/Post Exercise Measures

- **Gait Analysis**
  - Plantar pressure during a controlled walking cadence (110 bpm) (average of 5 steps over 40 feet). Masks were applied (medial/lateral toes and forefoot, heel, midfoot) and specific variables calculated (peak pressure, percent mean pressure) during stance phase.

- **Clinical tests**
  - Heel rise repetitions – standardized published methods
  - Navicular drop - calipers
  - Paper pull test (peak force) - Evaluated with 3D embedded force plate

- **Analysis**
  - T-tests were used to assess the effects of pre to post in the SFF group and between the SFF group and AMC pre and post exercise.
Lateral forefoot mask - percent total mean pressure was lower in the Flat Foot group pre exercise versus controls (right $p=0.02$, left $p=0.07$). Lateral forefoot mask - pre to post exercise peak plantar pressure increased (left $p=0.014$, right $p=0.02$) and percent of total mean pressure also increased (right $p=0.04$, left $p = 0.07$).
Results - Clinical Tests

- **Heel Rise Endurance** – significantly increased from pre to post exercise in the flat foot participants

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<th>Pre-Exercise</th>
<th>Post-Exercise</th>
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<tr>
<td>Right</td>
<td>25.6</td>
<td>31.8</td>
</tr>
<tr>
<td>Left</td>
<td>25.8</td>
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- **Navicular Drop**
  - Indicated less arch lowering on the right (p=0.4) and left (p=0.06)

- **Paper Pull Test (peak force)**
  - No pre/post test differences

Graph 3: * indicates p-value < .05
Conclusions

- The findings of this study support the hypothesis that a 4-week foot muscle training program can affect foot posture, foot pressure data and foot muscle strength in people with asymptomatic flat feet.

- The increases in heel rise endurance and plantar pressure data are significant and suggest an important clinical benefit may arise from strengthening of the foot in patients with flat foot.

- However, this preliminary findings requires study in a larger data set.
References


