Flatfoot in Indian population

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ABSTRACT

**Purpose.** To compare outcomes of different conservative treatments for flatfoot using the foot print index and valgus index.

**Methods.** 150 symptomatic flatfoot patients and 50 controls (without any flatfoot or lower limb deformity) aged older than 8 years were evaluated. The diagnosis was based on pain during walking a distance, the great toe extension test, the valgus index, the foot print index (FPI), as well as eversion/ inversion and dorsiflexion at the ankle. The patients were unequally randomised into 4 treatment groups: (1) foot exercises (n=60), (2) use of the Thomas crooked and elongated heel with or without arch support (n=45), (3) use of the Rose Schwartz insoles (n=18), and (4) foot exercises combined with both footwear modifications (n=27).

**Results.** Of the 150 symptomatic flatfoot patients, 96 had severe flatfoot (FPI, >75) and 54 had incipient flatfoot (FPI, 45–74). The great toe extension test was positive in all 50 controls and 144 patients, and negative in 6 patients (p=0.1734, one-tailed test), which yielded a sensitivity of 96% and a positive predictive value of 74%. Symptoms correlated with the FPI (Chi squared=9.7, p=0.0213). Combining foot exercises and foot wear modifications achieved best outcome in terms of pain relief, gait improvement, and decrease in the FPI and valgus index.

**Conclusion.** The great toe extension test was the best screening tool. The FPI was a good tool for diagnosing and grading of flatfoot and evaluating treatment progress. Combining foot exercises and foot wear modifications achieved the best outcome.

**Key words:** flatfoot; foot orthoses

INTRODUCTION

Flatfoot (pes planus) involves various anatomic and pathological conditions.1 Feet enable ambulation with a bipedal gait,2 and provide a stable platform that is supple during the early part of the stance phase and then converts to a rigid lever to push off during the latter part of the stance phase.1,3 This
is due to the elastic arches or springs in the foot known as longitudinal arches. These arches are segmented to best sustain stress and thrusts. During the walking cycle, a normal foot changes from a supple to rigid position while the concavity of the sole is maintained. A flatfoot remains in a supple position and does not convert to a rigid position for push off, and the concavity of the sole is lost during the stance phase. The degree of non-conversion to a rigid position depends on the degree of flatfoot. In children, the foot appears flat as the infantile pad of fat obliterates the medial arch. Flatfoot entails a loss of the medial longitudinal arch, and the entire sole is in contact with the ground. The heel adopts a valgus position and the foot pronates at subtalar-midtarsal complex. Dorsiflexion is limited owing to a contracted or tight Achilles tendon. Flatfoot is usually asymptomatic, but may cause chronic pain or a stress fracture. It is usually flexible or mobile so that the normal appearance of the arch disappears on weight bearing. If an acceptable medial longitudinal arch does not appear during non-weight bearing, the flatfoot is fixed or rigid.

Flatfoot can be evaluated based on the patellar position in relation to both the sagittal plane and the toes, the great toe extension test, alignment of the great toe nail, tightness of the calcaneal tendon, the valgus index, foot prints, and photography. Conservative treatment includes foot wear modifications and foot exercises to strengthen invertors and plantar flexors of the sole. Only the Thomas crooked and elongated heel and the Rose Schwartz insoles are commonly used. Nonetheless, the role of conservative treatment is still debatable. We thus compared outcomes of different conservative treatments for flatfoot using the foot print index and valgus index.

MATERIALS AND METHODS

Between 2005 and 2006, 150 symptomatic flatfoot patients and 50 controls (without any flatfoot or lower limb deformity) aged older than 8 years presenting to our hospital were evaluated. Diagnosis of flatfoot was based on pain during walking a distance, the great toe extension test, the valgus index, foot prints index (FPI), as well as eversion/inversion and dorsiflexion at the ankle.

In the great toe extension test, the great toe was fully dorsiflexed, and result was deemed positive when the medial longitudinal arch was restored and the tibia was pronated laterally. The test was deemed negative when the arch was not restored (Fig. 1).

The valgus index recorded any medial or lateral shift (in percentage) of the malleoli (and therefore the ankle) in relation to the centre of the heel imprint. It measured the relation of the centre of the intermalleolar line and a line from the centre of the heel print to the centre of the third toe print. A positive/negative index indicated a shift of the ankle medially/laterally. The valgus index tends to decrease with age, especially from 12 to 16 years of age.

Static and dynamic foot prints were taken on graph papers. The FPI was calculated as: the broadest part of midfoot over the broadest part of forefoot (in mm) x100, and classified as high arch foot (<20), normal foot (20–44), incipient flatfoot (45–74), and flatfoot (≥75). In a normal foot, the forefoot and heel are connected by a wide band on the outside. The foot lands on the outside of the heel, then rolls inward (pronates) slightly to absorb the shock. Flatfoot lands on the outside of the heel and rolls inward excessively. A high-arched foot usually pronates insufficiently and thus is not good at absorbing shock.

Patients were unequally randomised into 4 treatment groups: (1) foot exercises (n=60), (2) use of the Thomas crooked and elongated heel with or without arch support (n=45, Fig. 2), (3) use of the Rose Schwartz insole (n=18, Fig. 2), and (4) foot exercises combined with both footwear modifications (n=27). Treatment outcome was evaluated by reviewers.
blinded to the study. Fisher’s exact test or Pearson Chi squared test was used to evaluate association between discrete variables. A p value of <0.05 was considered statistically significant.

RESULTS

Of the 150 symptomatic flatfoot patients, 96 had severe flatfoot (FPI, >75) and 54 had incipient flatfoot (FPI, 45–74). The great toe extension test was positive in all 50 controls and 144 patients, and negative in 6 patients (p=0.1734, one-tailed test), which yielded a sensitivity of 96% and a positive predictive value of 74%.

The most common complaints were midfoot pain, followed by heel pain and calf pain during strenuous activities, in addition to heel deformity and abnormal walking (walking with heel in a valgus position and placing most weight on the medial rather than lateral part of the foot). Symptoms correlated with the FPI (Chi squared=9.7, p=0.0213, Table 1). Thus, the FPI was a good tool for diagnosing and grading of flatfoot and evaluating treatment progress.

Foot wear also correlated with flatfoot. Those wearing soft rubber slippers or hard sole slippers were more likely to have flatfoot, compared with those wearing shoe.

The valgus index (normal range, 8) was not associated with the FPI. Most patients had a valgus index ranging from 0 to 20 regardless of their FPI (Table 2).

**Table 1**

<table>
<thead>
<tr>
<th>Foot print index</th>
<th>Forefoot pain</th>
<th>Midfoot pain</th>
<th>Hindfoot pain</th>
<th>Heel deformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>45–74 (incipient flat foot)</td>
<td>8</td>
<td>24</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>≥75 (flat foot)</td>
<td>11</td>
<td>56</td>
<td>29</td>
<td>96</td>
</tr>
</tbody>
</table>

* Chi squared=9.7, p=0.0213

**Table 2**

<table>
<thead>
<tr>
<th>Foot print index</th>
<th>No. of patients</th>
<th>Valgus index Before treatment</th>
<th>Valgus index After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>45–74 (incipient flat foot)</td>
<td>54</td>
<td>0–16 (79 feet)</td>
<td>0–4 (79 feet)</td>
</tr>
<tr>
<td>≥75 (flat foot)</td>
<td>90</td>
<td>8–22 (45 feet)</td>
<td>0–8 (45 feet)</td>
</tr>
<tr>
<td>≥75 (flat foot) and negative great toe extension test</td>
<td>6</td>
<td>24–25 (2 feet)</td>
<td>18–22 (2 feet)</td>
</tr>
</tbody>
</table>

Figure 2  (a) Thomas crooked and elongated heel, (b) Rose Schwartz insole.
Table 3
Change in foot print index, pain relief, and gait improvement after conservative treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of patients</th>
<th>Foot print index</th>
<th>Change in foot print index</th>
<th>Pain relief</th>
<th>Gait improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>45–74 (incipient flat foot)</td>
<td>≥75 (flat foot)</td>
<td>0–5</td>
<td>6–10</td>
</tr>
<tr>
<td>Foot exercises (n=60)</td>
<td>42</td>
<td>18</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rose Schwartz insole (n=18)</td>
<td>12</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Thomas crooked and elongated heel (n=45)</td>
<td>10</td>
<td>35</td>
<td>18</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Foot exercises and foot wear modifications (n=27)</td>
<td>20</td>
<td>7</td>
<td>10</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

Of 60 patients treated with foot exercises, 18 reported pain relief and 42 had persistent symptoms. All had minimal reduction (≤5) in their FPI (Table 3). Foot exercises had no effect on the longitudinal arches of the foot. Of 18 patients treated with the Rose Schwartz insole, all reported pain relief and gait improvement (in terms of less wear on the medial than lateral part of their shoes). Reduction in the FPI was ≤5 in 6, 6 to 10 in 9, and 11 to 15 in 3 (Table 3). The mean reduction in FPI was 7.83±4.04. Of 45 patients treated with the Thomas crooked and elongated heel, 39 reported pain relief and 36 had gait improvement. Reduction in the FPI was ≤5 in 18, 6 to 10 in 18, and 11 to 15 in 9 (Table 3). The mean reduction in FPI was 7.04±4.14. Of 27 patients treated with foot exercises combined with both foot wear modifications, they all reported pain relief and gait improvement. Reduction in the FPI was ≤5 in 10, 6 to 10 in 12, and 11 to 15 in 5 (Table 3). The mean reduction in FPI was 6.81±3.67.

**DISCUSSION**

Foot wear has no effect on the width of the midfoot and hindfoot in shod and unshod populations, but has an effect on the width of forefoot.4,14,22 The mean width of the broadest part of forefoot is widest in unshod and slipper wearing populations, less wide in those who wear shoes with soft soles, and least in those who wear shoes with hard soles.4,14,22 Foot wear is not associated with the foot arch,4,14,22 which is in contrast to findings of this study.

A toe raising test has been used to detect the joint at which the fault lies; fusion is advised if radiographs reveal sagging at the naviculo-cuneiform joint.11 The best screening tool is the great toe extension test,18,19 which is in contrast to findings of this study.

Thus, to correct pronated flatfoot, the skeletal structure of the foot must be altered. The Rose Schwartz insole is effective in maintaining correction. The horseshoe shape prevents lateral sliding of the
heel and thus relapses. It is comfortable to wear and does not produce pressure points, unlike the Helfet insole.

**DISCLOSURE**

No conflicts of interest were declared by the authors.

**REFERENCES**