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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

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is due to the elastic arches or springs in the foot known as longitudinal arches.[4] These arches are segmented to best sustain stress and thrusts.[4] During the walking cycle, a normal foot changes from a supple to rigid position while the concavity of the sole is maintained.[5] 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.[5] The degree of non-conversion to a rigid position depends on the degree of flatfoot.[5,6] In children, the foot appears flat as the infantile pad of fat obliterates the medial arch.[3] Flatfoot entails a loss of the medial longitudinal arch, and the entire sole is in contact with the ground.[7] The heel adopts a valgus position and the foot pronates at subtalar-midtarsal complex.[5] Dorsiflexion is limited owing to a contracted or tight Achilles tendon.[5] Flatfoot is usually asymptomatic, but may cause chronic pain or a stress fracture.[1,8] It is usually flexible or mobile so that the normal appearance of the arch disappears on weight bearing.[3,5] If an acceptable medial longitudinal arch does not appear during non–weight bearing, the flatfoot is fixed or rigid.[7]

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.[9,10] Conservative treatment includes foot wear modifications and foot exercises to strengthen invertors and plantar flexors of the sole.[11–13] Only the Thomas crooked and elongated heel and the Rose Schwartz insoles are commonly used.[12,14] Nonetheless, the role of conservative treatment is still debatable.[12,14,15] 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,[16] the valgus index,[17] the foot print 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).

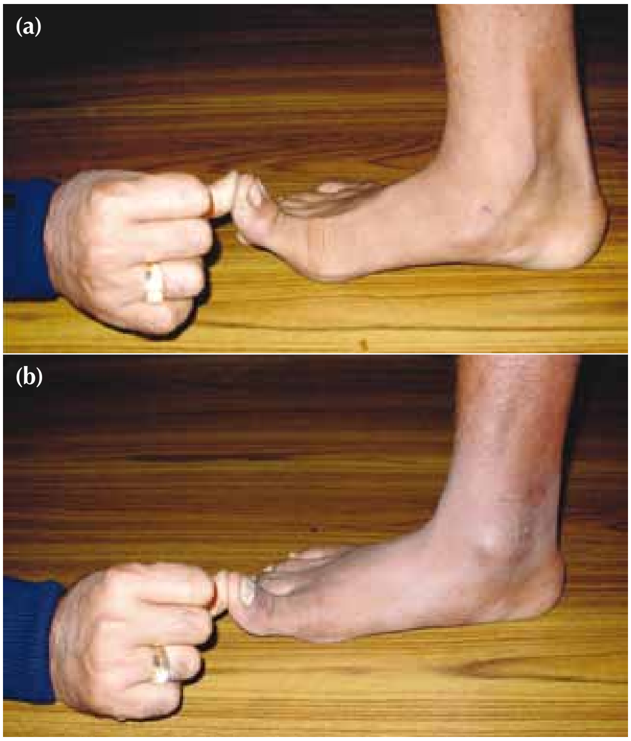

Figure 1 **(a)** Positive and **(b)** negative great toe extension test.

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 inter-malleolar 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.[18,19]

Static and dynamic foot prints[10,20,21] 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

Figure 2 **(a)** Thomas crooked and elongated heel, **(b)** Rose Schwartz insole.

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
Correlation of symptoms and foot print index*

Foot print index	No. of patients			
	Forefoot pain	Midfoot pain	Hindfoot pain	Heel deformity
45–74 (incipient flat foot)	8	24	12	18
≥75 (flat foot)	11	56	29	96

* Chi squared=9.7, p=0.0213

Table 2
Distribution of feet according to the valgus index and foot print index

Foot print index	No. of patients	Valgus index			
		Before treatment		After treatment	
		Right foot	Left foot	Right foot	Left foot
45–74 (incipient flat foot)	54	0–16 (79 feet)	0–14 (75 feet)	0–4 (79 feet)	0–4 (75 feet)
≥75 (flat foot)	90	8–22 (45 feet)	8–25 (45 feet)	0–8 (45 feet)	0–8 (45 feet)
≥75 (flat foot) and negative great toe extension test	6	≥25 (4 feet)	24–25 (2 feet)	20–25 (4 feet)	18–22 (2 feet)

Table 3
Change in foot print index, pain relief, and gait improvement after conservative treatments

Treatment	No. of patients									
	Foot print index		Change in foot print index				Pain relief		Gait improvement	
	45–74 (incipient flat foot)	≥75 (flat foot)	0–5	6–10	11–15	16–20	Yes	No	Yes	No
Foot exercises (n=60)	42	18	60	0	0	0	18	42	16	44
Rose Schwartz insole (n=18)	12	6	6	9	3	0	18	0	18	0
Thomas crooked and elongated heel (n=45)	10	35	18	18	9	0	39	6	36	9
Foot exercises and foot wear modifications (n=27)	20	7	10	12	5	0	27	0	27	0

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.[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.[14,22] Foot wear is not associated with the foot arch,[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-cunieform joint.[11] The best screening tool is the great toe extension test.[18,19] In 237 school children, none had negative test results, and 20 feet showed only an arch rise.[18,19] In 100 normal adults, only 2 feet had negative test results, whereas in 170 flatfoot patients, 71 feet had negative test results.[18,19] In 2294 children, 4 had negative great toe extension test results and these flatfeet were rigid.[3,15] After excluding patients with abnormal great toe or tight calcaneal tendon, a negative great toe extension test result indicates an abnormal foot that cannot function correctly,[18,19] and/or the presence of severe deformity and disabling symptoms.[17,20] Foot wear habits had no effect on the test result.[14,15,22]

With regard to phasic activity of intrinsic muscles of the foot, normal and flatfoot subjects show no essential difference in electrical activity during stair climbing, walking on slope, or standing on toes.[23] The arch of the loaded foot is not necessary to maintain when it is at rest.[10] Muscles play little, if any, role in maintaining the longitudinal arches of the foot and thus foot exercises are not emphasised.[10]

Foot wear modifications in the form of the Rose Schwartz insole and the Thomas crooked and elongated heel yield good results in terms of pain relief and gait improvement. The former has an advantage over the latter, as it can be inserted into a variety of shoes and does not need repair. However, the Rose Schwartz insole cannot be used in sandals and slippers, which are common forms of foot wear in this region. Although the Thomas crooked and elongated heel can be used in slippers and sandals, it elongates the heel to inner side of forefoot and inverses the forefoot. This is responsible for relapse of the flatfoot, regardless of the wearing duration.[14,15,21] Repeat repairing of shoes is necessary, as the foot tends to slip down the slope toward the outer side of the shoe and causes deformation of the outer wall of the heel sheet.[14,15,21]

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.

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