

Effect of low dye taping and faradic foot bath in subjects with flat foot: A randomised clinical trial

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Abstract

Flatfoot may occur in up to 20% of adults, many of whom are flexible and have no resulting difficulties. But as the condition progresses, it leads to various biomechanical alterations in posture which further deteriorates the quality of life of an individual. The objective of the study was to evaluate and compare the effects of low dye taping and faradic foot bath using navicular drop test and arch index in subjects with flat foot. 34 subjects with functional flat feet with mean age of 22.11 ± 2.74 years were included. The subjects were randomly allocated, with 17 subjects in each group and were assigned to 2 groups: Low dye taping (Group A) and Faradic foot bath (Group B). Demographic data was collected and navicular drop height and arch index was measured pre and post the 3 weeks intervention. The results showed that the percentage change in the navicular drop height post the intervention in Group A was 35.92% and in Group B was 39.66%. A mean change in the arch index was 0.0005 ± 0.002 in Group A and 0.0005 ± 0.002 in Group B. Whereas, there was no statistically significant difference found between the groups. It was concluded that low dye taping and faradic foot bath was equally effective in reducing the navicular drop height and the arch index in subjects with flat foot.

Keywords: flat foot, low dye taping, faradic foot bath, exercises

1. Introduction

Flat feet also known as pes plans, is a foot deformity in which there is a reduction in the medial longitudinal arch of the foot. Pes plans may be congenital or it may result from trauma, muscle weakness, ligament laxity, dropping of the talar head, paralysis or pronated foot. It may occur in up to 20% of adults, out of which many include flexible flat feet and have no resulting difficulties. A study was done on normal healthy volunteers between the age group of 25 to 40 years and it was observed that the prevalence of flat foot was 24.59% in males and 22.04% in females of Indian population ^[1].

Flat foot can be flexible or rigid. In flexible flat foot, the subject's arch is maintained when not weight-bearing, but on weight-bearing, the foot pronates excessively and the arch structure collapses. In rigid flat foot, the subject's arch is flattened irrespective of the weight bearing position of the foot.

The role of the arch is said to be influenced by the shape of the foot, bony structure, ligamentous stability and muscular fatigue while factors such as race, footwear, age and gender are also found to effect the formation of medial longitudinal arch ^[2]. The integrity of the arches is governed primarily by the ligamentous support with assistance from bony alignment and the additional support received from the extrinsic muscles of the foot. The plantar fascia, long and short plantar ligaments, the spring ligament, the collateral ligaments of the ankle and the interosseous ligament of the subtalar joint; all contribute important soft tissue support to the arches of the foot ^[3].

Adult acquired flatfoot and arch deformities result from disruption of the supporting ligaments as well as from muscle weakness or tightness leading to direct impairments in the

arch. It can also develop due to injury, unusual or prolonged stress to the foot, faulty biomechanics or as part of the normal aging process. Over pronation disrupts the alignment of the leg and may result in injuries due to over-stressing of the knee and leg.

The managements available for flat foot include strengthening of the intrinsic and extrinsic muscles of foot, stretching of the Achilles tendon, taping and orthosis or use of wedge to correct the foot posture, mobilizing the bones of the midfoot and faradic stimulation. The classical treatment involves prescription of arch support orthosis or orthotics. These postural control insoles naturally reduce the excessive pronation of the foot by recruiting the appropriate intrinsic muscles.

The purpose of this study was to find the comparative effect of low dye taping and faradic foot bath in subjects with functional flat foot. A study has shown that low dye taping for the foot has immediate effects on navicular bone and it has reported to increase the arch height by 8-16% ^[4]. There is a dearth of literature on faradic stimulation for the intrinsic muscles of the foot. So, a comparative effect of these treatments on the navicular height and arch index in subjects with flat foot was done to find out which one is superior to the other.

2. Materials and methods

2.1 Participants

An approval for the study was obtained from the Institutional Ethical Committee. The study was conducted at a Tertiary health care centre, Belagavi, Karnataka during the period of March 2016 to February 2017. 34 subjects aged between 18 to 30 years, both males and females, with unilateral or bilateral

involvement, having functional flat feet with navicular drop test positive [5] and arch index more than 0.26 [6] were included. Exclusion consisted of history of fractures in the lower limb, skin infections and wounds on the foot, tape allergies, any neurological deficit and peripheral vascular diseases. Prior to the involvement in the study, a written informed consent was obtained from the subjects. The subjects were randomly allocated, with 17 subjects in each group and were assigned to 2 groups: Low dye taping (Group A) and Faradic foot bath (Group B).

2.2 Measurements and outcome measures

Demographic data was collected and navicular drop test and arch index was measured pre and post the 3 weeks intervention.

Navicular drop test was done in which the subject was asked to sit and the talus was maintained in neutral position by the therapist, the distance of the navicular tuberosity from the floor was measured. Then with the subject in standing, again with neutral position of the talus; the navicular distance from floor was measured. The differences between both the readings were recorded and a measurement more than 10mm was considered abnormal [5].

The arch index was calculated with the subject in standing position. After that they were made to immerse their foot in a tray filled with ink and then they were asked to place their foot on the graph paper. For calculating the arch index, the linear distance of the centre of the heel and the tip of the second toe was measured on the foot print. Next perpendicular line was drawn tangential to most anterior point of the main body of the foot print and their point of intersection was marked. The

vertical line was divided in three equal parts (A, B and C). A is the area of the forefoot, B is the area of the midfoot and C is the area of the hind foot. Arch Index = $B \div [A+B+C]$ [6].

2.3 Intervention

Subjects in Group A received low dye taping for the foot following which they had to perform the conventional exercises. Tape was applied with the subject in prone with the ankle in neutral position and the foot was maintained at 90°. Longitudinal anchor strips was applied along the lateral aspect of the 5th metatarsal going to the hind foot, around the calcaneum and then progressed to the medial aspect of the foot along the 1st metatarsal on the plantar aspect of the foot. The transverse arch support strips were applied by pulling from lateral border to the medial border of the foot along the plantar surface and the area from the anterior surface of the calcaneum to the metatarsal heads was covered. The transverse strips were locked in the same method as the longitudinal anchor strips. Tape was changed every 3 days [4]. (Figure 2)

Subjects in Group B were given faradic foot bath and conventional exercises. The placement of the electrodes was, one at the heel and the other at the metatarsal heads to stimulate the intrinsic muscles of the foot [7]. During the stimulation, the subjects had to actively perform toe curls and 30 contractions of 3 sets were given. (Figure 3) Conventional exercises included toe curls, foot inversion – eversion, toe and heel raises. 10 repetitions of each exercise were performed. Treatment was given for 5 days a week for 3 weeks.

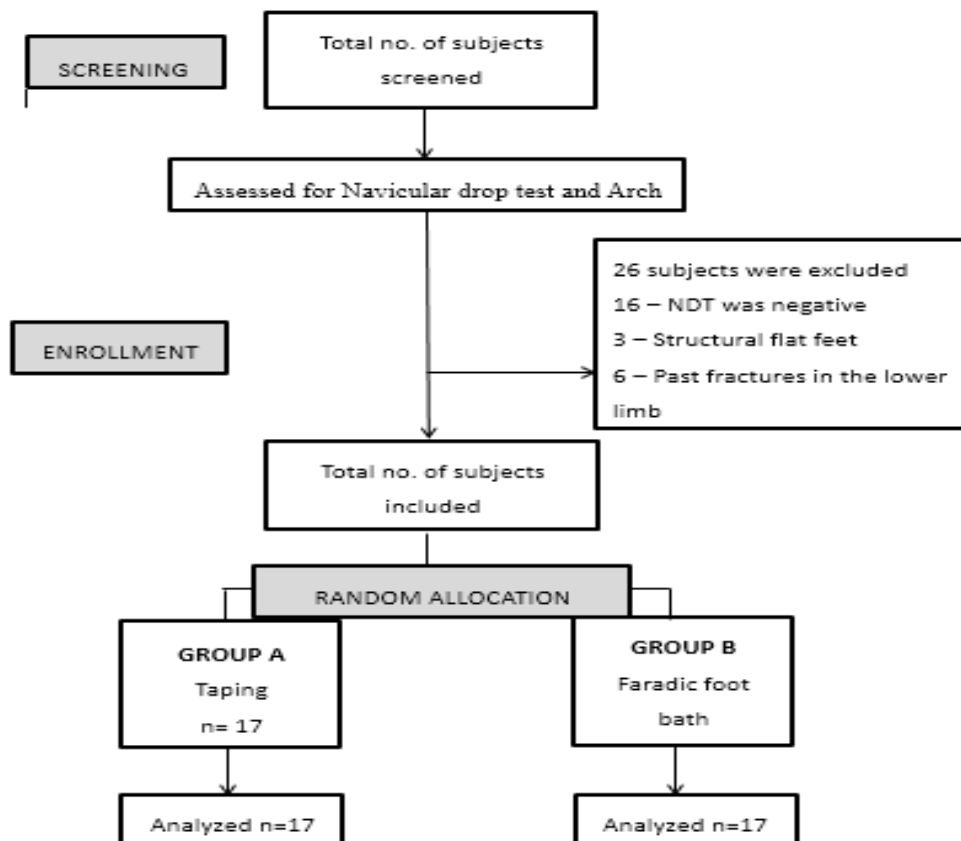


Fig 1



Fig 2



Fig 3

3. Results

As seen in Table 1, the demographic data of all the subjects at the baseline. A mean change in the navicular drop height of $4.29 \pm 0.63\text{mm}$ and $4.76 \pm 1.18\text{mm}$ was seen in the groups A and B as seen in Tables 2 and 3. On comparing the mean

scores for the navicular drop height, linear distance of the foot and arch index between the groups by un-paired ‘t’ test, it showed that the p value was not significant (Table 4). It can be further concluded that both the groups were equally effective.

Table 1: Demographic data

Parameter	GROUP A (Low dye taping) n=17	Group B (Faradic Foot Bath) n=17
Age (yrs)	22.47 ± 3.16	21.76 ± 2.33
Weight (kgs)	61.2 ± 15.7	58.8 ± 14.3
Height (cm)	163.2 ± 11.99	164.2 ± 13.15
BMI (Kg/m ²)	23.7 ± 5.41	23.38 ± 4.87

Table 2: Group A – Comparison of Low dye taping group using Paired t test

Parameter	Mean \pm SD		t value	p value
	Pre	Post		
Navicular drop height (mm)	11.94 ± 1.08	7.64 ± 2.37	7.84	0.0000003*
Linear distance of the foot (mm)	63.21 ± 4.34	62.57 ± 4.30	1.57	0.13
Arch index	0.33 ± 0	0.329 ± 0.002	1	0.3321

* p value ≤ 0.05

Table 3: Group B – Comparison of Faradic foot bath group using Paired t test

Parameter	Mean \pm SD		T Value	P Value
	Pre	Post		
Navicular Drop Height (Mm)	12 ± 1.36	7.24 ± 2.56	8.14	0.0000002*
Linear Distance Of The Foot (Mm)	64.48 ± 5.06	63.3 ± 4.88	2.1615	0.02308*
Arch Index	0.33 ± 0	0.329 ± 0.002	1	0.332

Table 4: Comparison between the groups in navicular drop height, linear distance of the foot and arch index using un-paired t test

Parameter	Group A		Group B		P value
	MEAN \pm SD		MEAN \pm SD		
	PRE	POST	PRE	POST	
Navicular drop height (mm)	11.94 ± 1.08	7.64 ± 2.37	12 ± 1.36	7.24 ± 2.56	0.56
Linear distance of the foot (mm)	63.21 ± 4.34	62.57 ± 4.30	64.48 ± 5.06	63.3 ± 4.88	0.42
Arch index	0.33 ± 0	0.329 ± 0.002	0.33 ± 0	0.329 ± 0.002	1

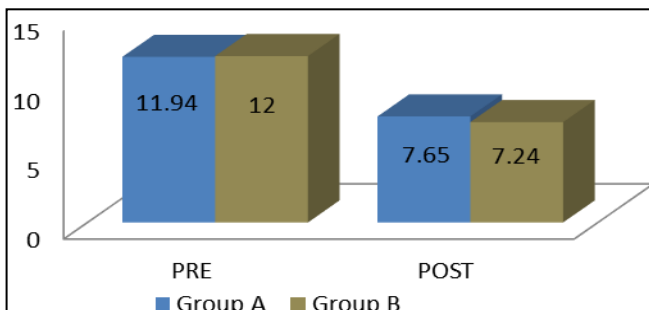


Fig. 4: Differences between the groups in the Navicular drop height in mm.

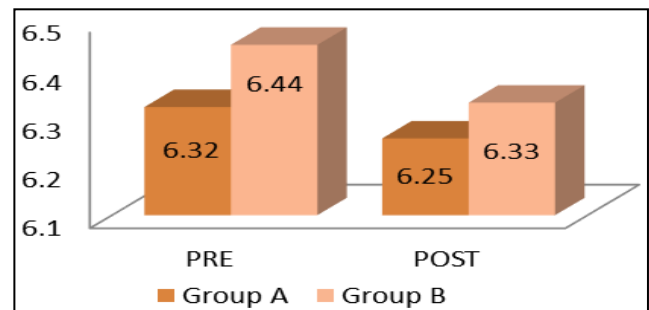


Fig 5: Differences between the groups in the Linear distance of the foot in mm.

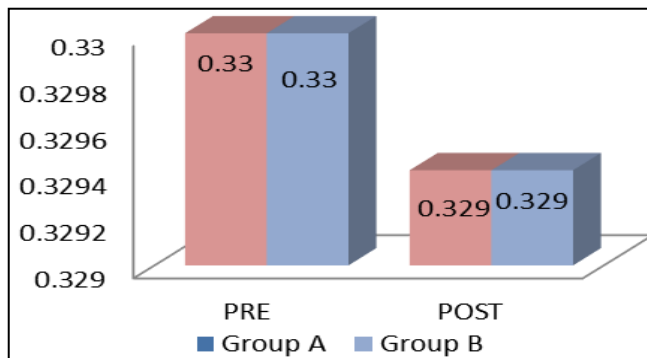


Fig 6: Differences between the groups in the Arch Index.

4. Discussion

The present study was conducted to evaluate the effects of low dye taping and faradic foot bath in individuals with asymptomatic flat feet. Conventional exercises of toe curls, heel and toe raises, inversion and eversion of the foot was integrated in both the groups in order to exclusively find out the additional effects. A study conducted, revealed that there is approximately 8% to 22.5% of increase in the plantar muscle activity during exercises involving extension of the toes [8]. Foot exercises acts by increasing the navicular height as exercises strengthen the elevator muscles in the foot. These exercises also help in improving the strength of the intrinsic as well as extrinsic muscles of foot. This is supported by a study on the effect of an 8 weeks corrective exercise program on the navicular height in teens aged between 12 to 16 years. It was noticed that there was an increase in the navicular height after the intervention and the corrective exercise program could be effective in the treatment of flat feet [9].

Low dye taping acts by controlling pronation of the foot by pulling the calcaneus anteriorly and medially, thereby limiting hind foot eversion and restricting the associated talar adduction and plantar flexion. When the subtalar motion is limited, the arch is elevated subsequently reducing the stretch on the plantar aponeurosis. Likewise, the medial arch height is raised as the tape pulls the lateral aspect of the foot medially [10].

Electrical stimulation of frequencies above 60 Hz helps in improving the muscular strength [11, 12]. The present findings demonstrated the results defined by Lainey CG, Malmsey RP and Andrew GM about the effectiveness of exercise plus electrical stimulation compared to that of exercise alone, for increasing the strength of the quadriceps muscle in 6 males and 2 female patients following knee surgery. It was a double cross-over design which was done for 6 weeks. No significant differences in strength gains were found and the results suggested that electrical stimulation may be a valuable adjunct to exercise in the development of muscle strength in individuals who have undergone knee surgery, particularly after the initial postoperative period [13].

It has been also been observed that fatigue of the intrinsic muscles of the foot increases foot pronation [14]. Thus, the pronation of the foot may be controlled by improving the strength of the muscles by faradic stimulation. Since the medial arch height of the foot improved, it may have caused a decrease in the linear distance of the foot leading to noteworthy differences post intervention.

The arch index almost had a negligible change post the intervention in both the groups. This may be due to the

minimal change in the linear distance of the foot. It may have affected the arch index ratio of the foot which was calculated. This is supported by a study done on 7 male and 16 female persons with pes planus with a mean age of 30 ± 7.1 years and mean weight of 80 ± 17.0 kgs. The subjects performed a strength training program of the intrinsic and extrinsic muscles of the foot four times per week for a period of 6 weeks. It was noted that there was an absence of changes in the foot indices after treatment while there was a change in the plantar pressure pattern of the foot during walking [15].

Based on the results gained in the present study, it revealed that faradic foot bath was more effective than low dye taping but statistically there was no difference found between the groups. The limitations of the study were that long term effects of the interventions were not evaluated and individuals with age above 30 years were not included. The future scope of the study could be compared between symptomatic and asymptomatic individuals with flat foot, the long term effects could be studied and a comparison between individuals with structural and functional flat foot could also be carried out.

5. Conclusion

The percentage change in the navicular drop height post the intervention in Group A was 35.92% and in Group B was 39.66%. A mean change in the arch index was 0.0005 ± 0.002 in Group A and B. Low dye taping and faradic foot bath were equally effective in reducing the navicular drop height in subjects with flat foot.

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