
EFFECT OF SELECTED REMEDIAL EXERCISE PROGRAMS ON FLAT FOOT

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Abstract

The purpose of this study was to find out the effect of selected remedial exercise programs on flat foot. To facilitate the study, the investigator selected randomly sixty children with flexible flat foot by observation and their age ranged between 8 and 10 years as subjects from various schools in Chidambaram. These selected subjects for the study were further divided into three groups at random consisting of twenty subjects in each group. Group-I practiced remedial bare foot walking with power exercises, Group-II practiced remedial foot gymnastics exercises and Group-III was treated as a control group and they were not involved in any specialized foot exercises programs and lead normal routine life. The training period were fixed five days per week (except Saturday and Sundays) for 12 weeks, Taking into consideration the feasibility criteria, availability of instruments and the relevance of the variables to the present study, the dependent variables selected were right foot plantar arch and left foot plantar arch, Foot arches were determined through Staheli's Plantar Arch Index. The pre-tests were conducted for all the subjects on foot arch for both legs. The experimental groups participated in their respective remedial exercises programs for twelve weeks. The post-tests were conducted on dependent variables after a period of twelve weeks of remedial exercises programs. The differences between the initial and final scores on selected variables were subjected to statistical treatment using Analysis of Covariance (ANCOVA) to find out whether the adjusted post-test means were significant or not. Whenever F ratio was found to be significant Scheffé's test was applied for adjusted paired mean differences to find out significant differences if any. In all the cases 0.05 level of confidence was fixed. The results of the study shows that that the twelve weeks of bare foot walking with power exercise and foot gymnastics exercises altered the right foot plantar arch and left foot plantar arch measured through Staheli's Plantar Arch Index significantly when compared to the control group but there was no significant difference between the two exercise groups in altering right foot plantar arch and left foot plantar arch after the experimental treatment.

Introduction

An ideal man should be strong, healthy, broad mind and active. Participation in daily physical activities results in proper growth and the maintenance of good health. It is a biological principle that function builds structure and structure decides the function. For human locomotion, foot plays a vital role. The base of the support for the body in an upright position is the foot. They are solely responsible for propelling the body in movement as a locomotive organ.

Flat feet (also called pesplanus or fallen arches) is a formal reference to a medical condition in which the arch of the foot collapses, with the entire sole of the foot coming into complete or near-complete contact with the ground. In some individuals (an estimated 20–30% of the general population) the arch simply never develops in one foot (unilaterally) or both feet (bilaterally). The appearance of flat feet is normal and common in infants, partly due to "baby fat" which masks the developing arch and partly because the arch has not yet fully developed. The human arch develops in infancy and early childhood as part of normal muscle, tendon, ligament and bone growth. Training of the feet, especially by foot gymnastics and going barefoot on varying terrain, can facilitate the formation of arches during childhood, with a developed arch occurring for most by the age of four to six years. Flat arches in children usually become proper arches and high arches while the child progresses through adolescence and into adulthood. (<http://en.wikipedia.org>)

One method for determining plantar arch is to use Staheli's plantar arch index. The plantar arch index is measured with a footprint. To calculate the arch index, a line is drawn along the inside of the footprint (medial edge) from the forefoot to the heel. The middle of the line is used as the mean point and a line is drawn perpendicular to this line, extending to the other side of the foot (lateral edge). This is line A. The same is done at the heel, with a perpendicular line drawn across the area of the heel. This is line B. To calculate the plantar arch index, line A is divided by line B. (<http://www.northcoastfootcareblog.com>)

Thus physical activities are always considered as most important aspect of curing and rehabilitation of individuals apart from forming up proper postural development.

Foot gymnastics refers to basically any kind of exercise designed to strengthen the muscles of the feet and legs. This exercise usually lengthens the muscles in the foot and can therefore reduce the problem of flat feet. It's often recommended by doctors to children who have flat feet. Since this exercise designed with kids in mind, its exercise that is fun. Many of the tasks that the person do when doing foot gymnastics are actually just little games that they play with their feet. (<http://kathrynvercillo.hubpages.com>)

When one goes barefoot, the person rolling back the clock and waking with their body back up to its natural state of health. It's incredibly rejuvenating, which comes from the grounding or earthing effect and from the feedback we get from the ground. It's as if the ground gives us a message to flip the on-switch or reboot. By connecting with the earth our circulation improves, our balance improves, muscles grow stronger, our joints feel better, our posture improves, and even our immune system gets a boost. At the same time it

helps reduce blood pressure and inflammation throughout the body. As person go barefoot, we're focused on the ground beneath our feet. This helps him to get away from let go of distractions and focus on each individual step.

The research question raised in this investigation was how far remedial exercises are influences the flat feet arches. The remedial exercises were classified into two broad categories, namely barefoot walking with power exercises and foot gymnastics. In the present study the investigator examined, which of the remedial exercise would produce better effect on flat foot and to what extent.

Methodology

Purpose

The purpose of this study was to find out the effect of remedial exercises on flat foot. By doing so, the remedial foot exercises classified into two broad categories namely barefoot walking exercises and foot gymnastic exercises. Thus investigated the effect of these two exercises on flat foot.

Subjects and Variables

The subjects were selected randomly from various schools in Chidambaram town. For this present study, the selected children were clinically evaluated by the physicians to determine whether the children are having flexible flat foot. Foot prints of the children with flexible flat feet were obtained and Staheli's Plantar Arch Index, advocated by *Hernandez et al (2007)* was calculated. Children with plantar arch index greater than 1.15 in right leg and 1.14 in left leg were selected for this study as flat footed children. Finally, the sixty children with flexible flat foot were selected as subjects for this study and their age ranged between 8 and 10 years. The selected sixty subjects were randomly divided into three equal groups of twenty subjects each, out of which group - I (n = 20) underwent barefoot exercise, group - II (n = 20) underwent foot gymnastics exercise and group - III (n = 20) remained as control. The selected flat footed children's parents were gave their voluntary consent to admit their children to undergo the interventions program

One of the most commonly discussed topics in orthopedics, particularly in the pediatric realm, are the static-postural changes of the feet. Reviewing the concepts about human foot evolution, we notice that the lower limb, and particularly the foot, is amongst the most distinctive characteristics of human anatomy. The overwhelming development of human brain cortex, vocal apparatus, and lower limb and foot structure make a triad

distinguishing men from other mammals. Footprints of hominoids already demonstrated the existence of a plantar arch 3.7 million years ago, and, during human evolution, feet - and not hands - experienced extraordinary changes. Hence, the right foot plantar arch and left foot plantar arch were selected as criterion variables for this study. Thus, the present study was undertaken to assess the effect of barefoot walking and foot gymnastics exercise on right foot plantar arch and left foot plantar arch. Test were used to assess the criterion variables of the study and it was presented in Table -1.

Table – 1
Tests Selection

Sl. No.	Criterion Variables	Test Items	Unit
1.	Right Foot Plantar Arch	Staheli's Plantar Arch Index	Index numbers
2.	Left foot Plantar Arch	Staheli's Plantar Arch Index	Index numbers

Training Protocol

The control group was not exposed to any specific training programme. The experimental group I and II were subjected to twelve weeks of barefoot walking with power exercise and foot gymnastics exercise programme respectively. The training was given for five days per week (except Saturday and Sunday). Before starting exercises the experimental group I and group II were gathered in one place and given warm up exercises, walking briskly and stretching the legs for 10 minutes. Then the Group-I underwent barefoot walking with power exercise includes Proper Walking, Alternate Walking, Toe Flexibility Exercises, Toe Power Exercises and Gathering Small Objects. Group-II underwent foot gymnastics exercise programme includes sticks with tricks, bring the rings, cup setup, tie the knot and drawing the towel. Five minutes of duration were given for all the exercises of both the experimental groups. After the exercises both the experimental groups were given warm down exercises for 5 minutes by doing slow walking. Care was taken to exercise with both feet in turn. Subjects were asked to avoid overstrain, as long as the subjects was not acquainted to challenging exercise. If the subject felt discomfort or even pain, they were asked to return to the easier exercises of the above sections.

Experimental Design and Statistical Procedure

The experimental design used for the study was similar to random group design involving sixty subjects. The data collected from the three groups prior to experimental treatment and after twelve weeks of training right foot plantar arch and left foot plantar

arch were statistically examined for significant difference, by applying the analysis of covariance (ANCOVA). No attempt was made to equate the groups in any manner. Hence to make adjustments for difference in the initial means, the adjusted post-test means for significant differences, the analysis of covariance was used. Whenever the 'F' ratio for adjusted post-test means was found to be significant, Scheffe' S test was followed, as a post-hoc test to determine which of the paired mean differ significantly. In all the cases 0.05 level of confidence was fixed

Results

The pre and post test data collected from barefoot walking with power exercise group, foot gymnastic exercise group and control group on right and left foot plantar arch were statistically analysed by ANCOVA and the obtained results are presented in table-2.

Table-2

Analysis of Covariance for Data on Right and Left Foot Plantar Arch of Bare Foot Walking With Power Exercise Group, Foot Gymnastic Exercise Group and Control Group

Adjusted Post-Test									
	Walking with Power Exercise	Gymnastic Exercise Group	Control group	SoV	Sum of squares	df	Mean square	F ratio	
Right Foot Plantar Arch									
Mean	1.186	1.197	1.251	B:	0.044	2	0.022	17.00*	
				W:	0.073	56	0.0013		
Left Foot Plantar Arch									
Mean	1.200	1.195	1.242	B:	0.0304	2	0.0152	21.11*	
				W:	0.0403	56	0.00072		

* Significant at 0.05 level of confidence.

df-degrees of freedom; SD-Standard Deviation; S.O.V.-Source of Variance. B-Between; W-Within

The table value required for significance at 0.05 level with df 2&56 is 3.16.

Table-2 shows that, the adjusted post-test means values of bare foot walking with power exercise group, foot gymnastic exercise group and control group were 1.186, 1.197 and 1.251. The obtained 'F' ratio value of 17.00 for adjusted post-test means was higher than the required table value of 3.16 required for significance at 0.05 level. It is inferred from the result of the study that the experimental treatment had significantly altered the right foot plantar arch among the experimental and control groups.

Further, the table-2 shows that the adjusted post-test mean on left foot plantar arch of the bare foot walking with power exercise group was 1.200, foot gymnastic exercise group was 1.195 and control group was 1.242. The obtained F ratio of 21.11 was higher than the required table value of 3.16 required for significance at 0.05 level of confidence. It is inferred that the experimental treatment had significantly altered the left plantar arch among the experimental and control groups.

The above statistical analysis indicates that there was a significant alteration in the right and left foot plantar arch index of the bare foot walking with power exercise group, foot gymnastic exercise group and control group. Further, to determine which of the paired means had a significant difference, the Scheffé S was applied as a post hoc test. The result of the follow up test is presented in table-3.

Table-3

Scheffé's Test for the Difference between the Adjusted Post-Test Mean of Right and Left Foot Plantar Arch

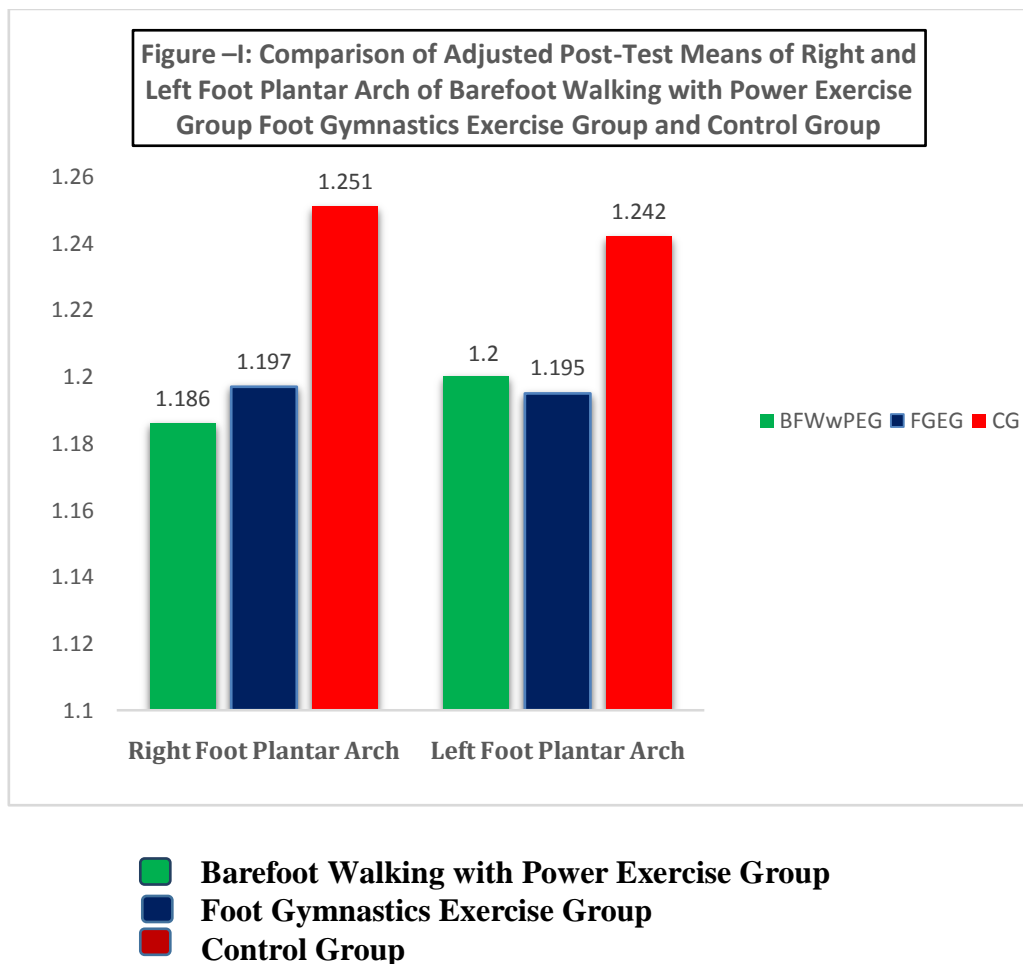
Adjusted Post-Test Means			Means Differences	Confidence Interval at 0.05 level
Bare Foot Walking with Power Exercise Group	Foot Gymnastic Exercise Group	Control group		
Right Foot Plantar Arch				
1.186		1.251	0.065*	0.028
	1.197	1.251	0.054*	0.028
1.186	1.197		0.011	0.028
Left Foot Plantar Arch				
1.200		1.242	0.042*	0.0067
	1.195	1.242	0.047*	0.0067
1.200	1.195		0.005	0.0067

* Significant at 0.05 level.

Table-3 shows that the adjusted post-test mean difference in right foot plantar arch between bare foot walking with power exercise group and control group was 0.065 and the mean differences between foot gymnastic exercise group and control group was 0.0547, which were significant at 0.05 level of confidence. The result also indicated that there was no significant difference between bare foot walking with power exercise group and gymnastic exercise group as the obtained mean difference of 0.011 which was insignificant at 0.05 level of confidence.

Further, table-3 shows that adjusted post-test mean differences between bare foot walking with power exercise group and control group was 0.042 and the mean differences between foot gymnastic exercise group and control group was 0.047 and both of these mean difference were significant at .05 level of confidence. The result also indicated that there was no significant difference between bare foot walking with power exercise group and foot gymnastic exercise group with a mean difference of 0.005 which was insignificant at 0.05 level of confidence.

The paired mean difference on right and left foot plantar arch among bare foot walking with power exercise group, foot gymnastic exercise group and control group are graphically presented in figure-1.



Discussion

The result of the study shows that there was a significant reduction in right and left foot plantar arch after the barefoot walking power exercise and foot gymnastic exercise when compared with the control group. *Nolan and Kennedy, (2009)* also found that there was a significant reduced lateral forefoot peak plantar pressure immediately after the low

dye pressure and it was last longer up to ten minutes. The result of the study also shows that there was no significant difference was found between the exercise groups. There was a significant reduction in right and left foot pronation after the barefoot walking with power exercise and foot gymnastic exercise. The result of the study also shows that there was no significant difference was found between the exercise groups. The following authors were proved that the remedial exercise programs are altered the flat foot *Goo et al,(2016)*, *Samaila et al,(2016)*, . *Park and Seo (2015)*, *LópezLópez (2014)* and *Sammarco, (2004)* are supported this study favourably.

Conclusion

It was concluded from the findings of the study that twelve weeks of bare foot walking with power exercise and foot gymnastics exercises altered the right foot plantar arch and left foot plantar arch measured through Staheli's Plantar Arch Index. The findings of the study also shown that there was no significant difference between these two exercise groups in the altered right foot plantar arch and left foot plantar arch after the experimental treatment.

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