International Journal of Yoga, Physiotherapy and Physical Education
ISSN: 2456-5067; Impact Factor: RJIF 5.24
Received: 09-09-2019; Accepted: 11-10-2019
www.sportsjournal.in
Volume 4; Issue 6; November 2019; Page No. 32-34

The effect of corrective foot exercise program among badminton players with flat feet

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Abstract
Background: Professional badminton players usually their 60% of the gaming is done by the foot and when there is any abnormality in supporting structure of medial longitudinal arch years of wear and tear can weaken the tendon and mostly affects the performance level and also results in fallen arches, which is a postural deformity in which the arches of foot collapse and results in flatfoot.
Objective: The objective of the study was to find the effect of corrective foot exercise program among badminton players with flat feet.
Study Design: Quasi- Experimental design, pre and post type.
Intervention: The foot was assessed using navicular drop test and foot prints**.**
Outcome Measures: Padegraph foot print test and Navicular drop test.
Results: The study shows a significant result for increase in Medial Longitudinal arch and decreased angle of arch and navicular drop value
Conclusion: The study concluded that the Badminton players with Flatfeet showed decrease in Angle of Arch of Foot and Navicular drop test between the Experimental and Control Group. Medial Longitudinal Arch in Experimental group showed increase in Medial Longitudinal Arch than Control group. Control group who were not given any intervention showed decrease in the Medial Longitudinal Arch.

Keywords: flat foot, foot prints, navicular drop test, badminton players

Introduction
The Badminton is a highly competitive racquet sports which is played using the racquets to hit a shuttlecock or ball across a net. In this game the 60% of the work is done by "foot" hence the foot alignment factor plays a major role to avoid injury and improve their performance level. The flatfoot occurs when the Medial Longitudinal Arch is decreased because of the arch is increased or it is been relaxed more and excessively pronated, so the eversion of the heel takes place so that the weight load is fall over and it compress the Medial Longitudinal Arch. When the medial longitudinal arch is completely lost it leads to structural or functional deformity. The ability of arch is to absorb the impacts such as shock and sense is decreased. Probably the balance lost and decreases in stability during walking, running and hence endurance is decreased and the players prone to injury and their sports performance may reduce. The Structural deformation of the feet leads to lesions in the ankle joint, feet and lower limb and it leads to early fatigue and pain due to excessive actions of the intrinsic and extrinsic muscles, and it ends in the decrease in the balance and stability.
Flatfoot is classified as congenital or acquired. It occurs, when there is any abnormality in supporting structure of medial longitudinal arch. Years of wear and tear can weaken the tendon and mostly affects the performance level. It is also known as fallen arches and a postural deformity in which the arches of foot collapse. The arches provide the elastic, springy connection between the forefoot and hind foot. It is usually a painless condition. Flexible flat foot in which the arch is visible during sitting or standing in tip toe but disappears during standing17. Height of the navicular bone is important for maintain the integrity of the entire medial longitudinal arch, as it is situated at medial side of the tarsus between talus and cuneiform.
Navicular drop is defined as the change in navicular bone when the foot moves from subtalar neutral non weight bearing to relaxed weight bearing stance is valid and reliable

Methodology
Study Design: Quasi-Experimental Study.
Study Type: Pre and post type
Sampling Method: Convenient Sampling.
Sample Size: 30Subjects.
Study Duration: 6Weeks
Study Setting: SRM College of Sports - Kattankulathur
Dev Sports Academy–Chengalpattu

Inclusion Criteria
Age group: 18-28 years
Gender: Both Men and Women are included Professional badminton players of experience > 2 years off season players
Navicular drop test

Exclusion Criteria
Participation in another study History of disc pathology congenital foot deformities
Any other congenital deformities of knee & ankle
Strain and Sprains
Soft tissue injuries of lower limb within 3 months
History of spinal surgery in past two years

History of any fractures in past two years

Procedure

The Participants are selected based on the inclusion and exclusion criteria. Informed consent is obtained from the participants. The age of the participants and the years of experience are also recorded. The participants were given exercise regimen and administered to perform for

45 mins per day for 5 days in a week for 4 weeks. The arch of the foot is measured by using two methods Footprint and Navicular drop test.

30 subjects were conveniently selected based on Inclusion and Exclusion Criteria and randomly divided in to two groups. Group - A and Group - B. Each group consists of

15samples The Group a participants were given exercise protocol for duration of 6 weeks of period. The Exercise Protocol includes. Calf rise, Step stretch, Toe curl, Short foot exercise with and without weight-bearing, Toe pick up, Intrinsic muscle strengthening, Single leg hops, Double leg hops. Angle of Arch and Medial Longitudinal Arch were measured by using FOOT PRINT test and Navicular Drop Test was measured using Navicular Drop Test was taken before intervention. Subjects have to follow a set of exercise protocol for 6 weeks

Group – A

After pre -test assessment the Exercise Protocol were taught to Group-A subjects with respective rest period for 6weeks.

Calf-Rise

The subjects were asked to stand on the ground and knee should be straight ahead and the heels should drift towards the floor.

Toe-Curl

The subjects were asked to sit and then the towel should be placed under the feet curl the towel by using their toes and should bunch the towel and release.

Toe-Pickup

The subjects should place their feet on the floor and should place their toes flat on the ground and pick up the objects or they could raise their toes.

Step-Stretch

The subjects were asked to stand on their feet at first and then they are asked to take a big step forward using their left foot and place it over the step or step stool so that the subjects are in a staggered stance.

Double Leg Hops

The subjects were asked to stand in both their feet at the same time and arms should be placed straight and in front they are asked to jump upward and forward.

Single Leg Hops

The subjects were asked to stand on their feet on floor and then one leg in extension of knee and arms straight out in front and jump upward and forward.

Intrinsic Muscle Strengthening

Toe Lift

The subjects are asked to stand and then they should lift their big toe upward and other toes and heel should be on the ground for few seconds and then they should lift their other four toes whereas their big toe and heel on the ground.

Big Toe Stretch

The subjects were asked to sit with legs straight out, and should pull back the big toe and hold.

One Foot Balance

The subjects were asked to stand with feet flat on the ground, pull the toes towards the heel, and then they should lift one leg while the opposite foot in ground and balance.

Short Foot Exercise with Weight Bearing

The subjects are asked sit and then to lower the toes not the arch, and should hold this raised arch for a minute, and this position is Short foot position and knee should point the center of foot.

Short Foot Exercise without Weight Bearing

The subjects are asked stand and then to lower the toes not the arch, and should hold this raised arch for a minute.

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

Exercise Protocol

Table 1

Weeks	Exercise	Dosage
1st Week	calf rise, step stretch, toe curl, short foot exercise without weight bearing toe pick up, intrinsic muscle strengthening, single leg hops, double leg hops.	5 sets for 10 reps 30 sec rest interval between exercise 1.30 min for 3 sets 30 sec rest intervals between exercise
2nd Week	calf rise, step stretch, toe curl, short foot exercise without weight bearing toe pickup, intrinsic muscle strengthening, single leg hops, double leg hops.	5 sets for 15 reps 30 sec rest interval between exercise 2 min for 3 sets 30 sec rest interval between exercise
3rd Week	calf rise, step stretch, toe curl, short foot exercise without weight bearing toe pickup, intrinsic muscle strengthening, single leg hops, double leg hops.	8 sets for 10reps 30 sec rest interval between exercise 2 mins for 3 sets 30 sec rest interval between exercise
4th Week	Calf rise, step stretch, toe curl. Short foot exercise with weight bearing toe pick up, intrinsic muscle strengthening, single leg hops, double leg hops.	8 sets for 15 reps 30 sec rest interval between exercise 3mins for 3 sets 30 sec rest interval between exercise
5th Week	calf rise, step stretch, toe curl, short foot strengthening with weight bearing toe pickup, intrinsic muscle strengthening, single leg hops, double leg hops.	10 sets for 15 reps 30 sec rest interval between exercise 3mins for 3 sets30 sec rest interval between exercise
6th Week	calf rise, step stretch, toe curl, short foot strengthening with weight bearing toe pickup, intrinsic muscle strengthening, single leg hops, double leg hops.	10 sets for 20reps 30 sec rest interval between exercise 5mins for 3sets 30 sec rest interval between exercise

The above exercise protocol has been performed after the pre-test and then the post-test values are calculated

Outcome Measures

Arch Assesment

Foot Print Test: The participants were said to wash their both legs. The participants are made to place their foot in the footprint stamp and asked to place it in an A2 sheet. The impression of the foot can be seen in the sheet.

Navicular Drop Test

The participants with presence of flat foot were assessed with Navicular Drop Test. The participants were made to sit in a chair with knees flexed at 90◦and ankle joint in neutral position. The most prominent position in the navicular tubercle was marked using a pen. When the subtalar neutral position is maintained the index card is placed from floor in a vertical position passing the navicular bone level of most prominent point of tubercle is marked on card. Then the participants were asked to stand in standing position, by transferring equal weight both limbs. The prominent position of navicular tubercle is again marked. Finally, the differences between original height of navicular tubercle in sitting position and in weight bearing position are measured.

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