Effectiveness of Plyometric Exercises Versus Flatfoot Corrective Exercises in Subjects with Flexible Flat Foot

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Abstract-
Background and aim: Flatfoot frequently causes tissue tension, pain, overuse injuries, poor functioning, and incapacity in the lower limbs, all of which have a negative influence. Eccentric and concentric contractions move quickly and strongly together during Plyometric exercise. The goal of the Plyometric exercise is to increase the athlete's capacity to produce force from a fast muscle contraction rapidly and effectively. Plyometric exercise is a simple and effective training programme for a variety of stability and balance and is a better option for corrective exercise.
Methods: The experimental study was conducted at SIMATS. A total of 30 students were selected as per the inclusion criteria and exclusion criteria. Selected individuals were randomly allocated into two groups. Group A (control group n-15) and Group B (experimental group n-15) were assessed with the Navicular drop test (NDT) and foot function index (FFI). Group A was given flatfoot corrective exercises, and Group B was given Plyometric exercises. Both treatment programmes were given for 8 weeks. The pre-test and post-test values of the Navicular drop test (NDT) and foot function index (FFI) have been noted.
Results: Statistical analysis was done for all the collected data using a paired t-test. The test showed significant effects ($p<0.0001$) in both groups. The test showed that the subjects who received Plyometric exercises had improved foot arches among flexible flat feet.
Conclusion: The results and the data obtained from this research were statistically classified, and it has been concluded that there was a definite and positive effect of Plyometric exercises for flexible flat feet.

***Keywords*: Exercises, pes planus, foot functional index**

INTRODUCTION:

Talus medial rotation and plantar flexion, calcaneus eversion, collapsing medial arch, and forefoot abduction are characteristics of the flat foot. [1] Flat feet can be diagnosed in clinical practice using a variety of methods, including clinical diagnosis. [2] Flatfoot frequently causes tissue tension, pain, overuse injuries, poor functioning, and incapacity in the lower limbs, all of which have a negative influence. [3] Flexible flatfoot deformity is caused by the posterior tibial tendon (PTT), the spring ligament, the deltoid ligament complex, and the articular connection of the talonavicular and subtalar joints. [4] Plyometric exercise is characterised by a rapid and powerful interaction movement between eccentric and concentric contractions. [5] According to certain research, performing a 15-minute Plyometric exercise improves postural stability. [6] Foot workouts have been shown to promote intrinsic foot muscular activation. The complex ankle-foot structures offer active (muscles) and passive (bony structures) support systems in addition to the neurological subsystem, which includes sensory receptors within the fascia, capsules, various supporting ligaments, muscles, and tendons. Reduce navicular drop+, rectify arch deformation, and induce MLA collapse by inverse foot pronation. The active support system for the foot arch includes the extrinsic (principal movers) and intrinsic muscles of the foot, which maintain the MLA and control arch deformation. These muscles effectively regulate stiffness in the feet in static as well as dynamic circumstances, allowing for forefoot rigidity in terminal stance. The MLA collapses when weight-bearing due to a lack of or diminished arch, abduction of the forefoot, and a lot of heel eversion. [7] Eccentric and concentric contractions move quickly and strongly together during Plyometric exercise. For improving balance, leaping ability, response speed, endurance, power and strength, energy generation, motor performance, and coordination, this sort of training is safe and effective in both adults and children. After performing a 15-minute Plyometric exercise, several studies found that postural stability had improved to some extent. Obese children with flexible flatfeet's balance, foot posture, and functional mobility after Plyometric workouts with flatfoot-corrective activities [8] One of the changes that may result in postural control disorder, foot pressure disorder, various lower extremity injuries, and changes in the foot and ankle joint mobility when in contact with the ground is the flat foot. [9] A case of an aberrant foot structure is the flexible flatfoot with an uncompensated forefoot varus. The foot posture when not carrying any weight comprises forefoot varus and first metatarsal dorsiflexion. In order for the foot's medial border to touch the ground while bearing weight, the forefoot adopts a valgus stance. The goal of the plyometric exercise is to increase an athlete's capacity to swiftly and effectively generate force through a fast muscle contraction. [10] Plyometric exercises are incorporated into the training regimens of sports that rely on speed and power. The goal of the Plyometric exercise is to increase the athlete's capacity for producing force from a fast muscle contraction rapidly and effectively. [11] Brody also stated that a drop in Navicular height of at least 15 mm was abnormal, with a drop of no more than 10 mm being considered normal. [12] The Foot Function

Index (FFI) is a collection of 23 measures separated into three subscales that assess the impact of foot disease on pain, disability, and activity limitation. [13] The Foot Function Index is a three-part questionnaire used in patients suffering from foot and ankle problems to produce clinical scores for the categories of activity limitation, function, and impairment. [14] Thus, an attempt is made in a research study to compare the efficacy of Plyometric effects with corrective exercises to improve the functional performance of subjects with flexible flat feet.

METHODS:

The study design is an experimental study, and the samples were selected from Saveetha College of Physiotherapy students. A convenient sampling technique was used, and 30 members were included in the study. The study duration was 8 weeks. The samples were included according to the age group of 18 to 25 years of both genders—people who were tested positive for Jack's test. Obese people, acute injuries, and recent fractures were excluded.

PROCEDURE:

A Google Form questionnaire has been circulated to 100 students at Saveetha College of Physiotherapy. Among them, 70 students have enrolled. Out of which, 30 students were confirmed to have flexible, flat feet and tested positive for the Navicular drop test with more than 10 mm and the jack test. They were recruited based on the inclusion and exclusion criteria, and informed consent was obtained from the subjects. The subjects were explained about the safety and simplicity of the study. The subjects were randomly allocated into 2 groups: Group A (n = 15) received flatfoot corrective exercises, which included stretching of the calf and peroneus brevis, single leg weight-bearing exercises, toe and heel walking, and abductor hallucis strengthening exercises, while Group B (n = 15) subjects received Plyometric exercises, which included jump jacks, skipping, side-to-side jumping, jumping vertically, and forward and backwards jumps. The Navicular drop test was measured for the subjects by placing them in a sitting position, ensuring that the subtalar joint maintained neutral posture on both hips and 90° bent knees. The Navicular drop was then measured using a ruler after palpating and marking the Navicular tuberosity. (ND-1). The Navicular tuberosity's distance from the ground was measured in millimetres. After that, the individual was instructed to stand with their feet relaxed. The Navicular tuberosity was then palpated and marked once again to remove any potential skin movement errors, and the height of the mark was measured from the floor (ND-2). The ND (ND1 - ND2=ND in mm) represented the difference in Navicular tuberosity height between the two markers. Jack's test is done while standing and bearing weight. The subject was made to stand normally and relax, then passively flex the first metatarsal joint. In a flexible pes planus, the arch of the foot elevates and the leg rotates laterally. ND and Jack's tests were measured as pre-tests prior to the intervention, and the same was measured post-intervention after 8 weeks of intervention as post-tests.

RESULTS:

The gathered information was tallied and examined. For each parameter, the mean and standard deviation (SD) were utilised. The statistically significant differences between pre-test and post-test measures were examined using the paired t-test. The difference between the post-test results for the experimental treatment group and the control group was determined using an unpaired "t" test. Statistical analysis was done for all the collected data using a paired t-test. The test shows significant effects ($p<0.0001$) in both groups. The test shows that the subjects who received Plyometric exercises have improved foot arches among flexible flat feet.

Table1: Pre and Post test values for NDI and FFI for control group and Experimental group

Parameters	Control Group		Experimental Group		t value	p value
	Pre-Test	Post Test	Pre-Test	Post Test		
NDI	15.6 ± 1.35	14.4±1.30	16.0±1.64	11.5±1.3	6.34	<0.001
FFI	8.1±1.4	10.3±1.2	9.0±2.1	12.2±1.9	12.10	<0.001

Table 2: Post test value for NDI and FFI for Control group and Experimental group

Parameters	Control Group		Experimental Group		t value	P value
	Post Test Value		Post Test Value			
	MEAN	SD	MEAN	SD		
NDI	14.4	1.30	11.5	1.3	6.34	<0.001
FFI	10.3	1.2	12.2	1.9	12.10	<0.001

DISCUSSION:

The purpose of the study is to investigate the impact of Plyometric training on flat-footed individuals' functional mobility, balance, and foot posture. The current study found that remedial exercises are useful in improving balance and foot posture. [8] Pes planus is a rather prevalent ailmmaturity and is characterised by partial or total loss (collapse) of the MLA. Foot ent in the adult population. Adult flat foot is a foot ailment that occurs at skeletal modifications may result in changes in the plantar contact area,

which is required in footprints. Based on this information, various researchers have estimated arch height using footprints, and several metrics have been proposed to identify arch groups. [18] According to the current study's findings regarding the impact of Plyometric activities on balance, the experimental group's (Plyometric exercise) balance improved significantly after intervention. who stated that 8 weeks of aquatic and land Plyometric training increased the muscular strength and balance of young athletes. This is consistent with Arazi and Asadi. [19] Myer et al. stated that using the Plyometric training programme increased balance performance. [20] Chaouachi et al. When they indicated that Plyometric exercise enhanced balance, leaping abilities, and squat strength measurements, they were consistent with our findings. [21] Ankle plantar flexion in the land training group represented the sole increase in muscular strength (torque) required to produce vertical-jump force in the current experiment. [22] The improvement in balance abilities following Plyometric exercises might be attributed to the quick stretch-shortening cycle, which combines centre of gravity movements in both vertical and horizontal directions, potentially improving postural control and equilibrium. [23]

In contrast to these two varieties of flexible flatfoot, Harris and Beath classified stiff flatfoot as being characterised by a limitation of subtalar joint mobility. The arch stays flat when the individual's foot is dangling in the air while seated, as well as during toe-standing and the toe-raising test. This sort of flatfoot can cause discomfort and incapacity on occasion. [24,25] The improved proprioception and neuromuscular control as a result of Plyometric exercise helped with balance development. [26] In our study, given that the Plyometric programme did not expressly target the inverted leg press, it was remarkable that the Plyometric group increased overall thigh strength by the same absolute amount as the weight training group. Plyometric exercise dramatically enhances strength, as indicated by the leg press. Most likely, adaptations to the Plyometric activities performed in this study, notably activation of the stretch reflex and the series of elastic components of the implicated muscle, are what led to the improved leg press strength. [27] The Plyometric exercises group improved the most, followed by the Plyometric and balance exercises groups. Plyometric exercises are entertaining and secure. Additionally, it can increase quickness, agility, and functional balance. The impact of combining balance and Plyometric training on young college players' postural stability as compared to Plyometric or balance exercises used independently the Plyometric exercises group improved the most, followed by the group that performed both Plyometric and balancing exercises. [28] During weight-bearing, the foot's medial longitudinal arch collapses to varying degrees in flexible flatfoot. However, by standing on tiptoe (the tiptoe test), the foot arch develops again. This arch may be seen when weight-bearing stresses on the feet are eased. If the foot is not bearing any weight and the medial longitudinal arch is not visible, the condition is known as stiff (fixed) flatfoot. Jack's test makes it simple to distinguish between these two circumstances. [29] The present study is limited to one setting and has few participants.

CONCLUSION

The results of the study concluded that Plyometric exercises can be effective in improving foot posture and functional performance in terms of balance in subjects with flexible, flat feet. Hence, this Plyometric training can be used as an adjunct treatment protocol for the rehabilitation of flat feet.

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