Effectiveness of Short Foot Exercises Versus Towel Curl Exercises to Improve Balance and Foot Posture in Individuals with Flexible Flat Foot

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Abstract

Background: Flexible flat foot is a condition of foot in which the medial longitudinal arch is lowered which is visible in weight bearing foot. This condition may be asymptomatic and needs to be treated to prevent further overuse injuries. Many of the literature suggest that individuals with flexible flat foot shows imbalances in the strength of IFM like abductor hallucis, flexor hallucis brevis, flexor digitorum brevis and interosseous muscles which plays major role in maintaining stability. The dynamic balance is found to be more affected in flexible flat foot which needs to be treated by strengthening the IFM. Strengthening IFM with greater efficacy can improve the dynamic balance and also have impact on foot posture of individuals with flexible flat foot.

Objective: to find the effect of 2 different types of IFM strengthening on dynamic balance

Material and Method: In this pre-post intervention study 40 individuals with flexible flat foot were included. They were randomly divided into 2 groups with 20 individuals in each group. Group A was instructed to perform short foot exercises and Group B was instructed to perform towel curl exercise for four weeks. After pre-post assessment, data was analysed with help of appropriate statistical methods.

Results: According to result the in Group A and Group B there is significant increase in both right and left anterior, posteromedial and posterolateral directions with p value < 0.0001.

Conclusion: Both short foot exercise and towel curl exercise are found to be equally effective in improving the dynamic balance in individuals with flexible flat foot. The impact of these exercises on foot posture needs to be taken into consideration.

Keywords: *Flexible flat foot, intrinsic foot muscles (IFM), short foot exercises, towel curl exercise, Y balance test, foot posture index.*

Introduction

Flat foot (pes planus) is a condition of foot in which the medial longitudinal arch (MLA) is lowered such that it is close or in contact with the ground. [2] There are two types of flat foot, rigid (congenital) flat foot and flexible (acquired) flat foot. [12] The characteristic feature of rigid flat foot is lower medial longitudinal arch in both weight bearing and non-weight bearing foot. [12] Flat foot is normal in infants and young children that is up to 2-3 years of age as there is presence of fat pad in the longitudinal arch of foot. As the child starts walking and bearing weight on the foot the fat pad is reduced and gradually the flat foot is diminished. In children congenital flat foot is most common. The characteristic feature of flexible flat foot is presence of normal medial longitudinal arch in non- weight bearing position and lower medial longitudinal arch in weight bearing position. [4] Flexible flat foot may be present due to number of factors such

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as poor postural habits, malalignment of body weight on foot in standing, improper foot wear. Flexible flat foot may be asymptomatic but may lead to lower limb pain, fatigue, overuse injuries and also postural instability. [10]

There is a relationship between medial longitudinal arch and balance. The foot structure and the functions of the foot arches like shock absorption, even distribution of body weight on foot are related to each other and has its effect on posture and stability while walking or propulsion of body.[4] Many literature suggest that there is postural instability or balance issues in individuals with flat foot. Foot complex is the major component on which the whole body weight is equally distributed and balanced. Foot complex plays a measure role in gait, posture and balance and any imbalance is this component may alter the functions. The bony structures, muscles and ligaments play a measure role to maintain the stability. [6] Literature suggest that there are imbalances in the intrinsic foot muscle (IFM) strength in individuals with flat foot as IFM supports the medial longitudinal arch. It is believed that IFM plays a major role in providing stability. [4] The intrinsic foot muscles that is abductor hallucis, flexor hallucis brevis, flexor digitorum brevis and interosseous muscles become weak in flat foot due to which there are balance issues in individuals with flat foot. [11]

The intrinsic foot muscles need to be strengthened in individuals with flexible flat foot in order to improve the balance and to prevent further complications in these individuals. [5] As this condition is sometimes asymptomatic in many individuals, it remains undiagnosed and hence untreated. Many of the literature suggest that asymptomatic flexible flat foot needs seldom treated or should be treated only if symptoms such as pain or associated injuries are evident.[10] But in fact flexible flat foot if remains untreated may lead to overuse injuries or severe postural deformities due uneven forces acting on the foot. There is presence of pronated foot in individuals with flat foot which increases the risk of overuse injuries. [2] Hence Intrinsic Foot musculature training exercises must be incorporated in the management of flexible flat foot. [4]

There are mainly two forms of intrinsic foot musculature training according to the recent studies, short foot exercises and towel curl exercises. Both forms of exercise focus on the intrinsic foot muscle strength. These exercises have their own effects on foot and is believed that both are helpful in increasing strength of IFM. [4]

There are several methods to assess dynamic balance test; Y balance test, modified star excursion balance test (SEBT). [5]

In this study dynamic balanced was assessed by using Y balance test. It is a simple yet reliable test. The reliability of this test is 95%, Interrater test reliability for maximal reach is 0.80-0.85 and interrater test reliability for average reach of 3 trials 0.85-0.93 which indicates good reliability.

This test is very simple to perform and requires minimal equipment and can be performed in multiple settings and safer environment. So in this study Y balance test was used to assess dynamic balance. [5]

In this study foot posture was also assessed to find the presence of flexible flat feet. There are several methods to assess the presence of flexible flat feet such as foot posture index 6, foot posture index 8 and navicular drop test. [1]

In this study foot posture index 6 was used as it indicates good reliability with inter-tester reliability ranging from 0.81-0.91. This test is simple to perform, can be conveniently performed in multiple setting and requires minimal equipment and hence this test is used to assess the presence of flexible flat feet in this study. [1]

Materials and Methodology

- **Type of study:** Experimental study
- **Study design:** Pre and post study
- **Sampling method:** Simple random sampling
- **Sample size:** 40

Formula:

$$N = \frac{(SD_1^2 + SD_2^2) * (Z1_{-a/2} + Z_{1-b})\,2}{D} = 40$$

$SD_1 = 6.2$ SD2 = 7.1

D =16.81

N = Size of sample

$Z_{1-a/2}$ = Value of standard variable at given confidence level i.e. at 85 % CI.

Z_{1-b} = Value of standard variate at given power

D = Difference between two means that practically meaningful.

SD = Standard deviation

- **Study duration:** 4 months.
- **Place of study:** Karad
- Inclusion criteria:

1. Younger individuals between the age group of 18 to 25 years
2. Individuals with presence of flexible flat foot.
3. Individuals willing to participate.
4. Individuals with dynamic balance impairment.

- **Exclusion criteria:**

1. Individuals with history of recent lower limb surgeries.
2. Individuals with history of recent lower limb injuries.
3. Individuals with any structural deformities of foot.
4. Individuals with recent low back injuries.
5. Individuals with neurological deficits which will hinder the balance.

- **Material :**

Ø Tape

Ø FPI-6 data collection sheet

Ø Inch tape

Ø Consent form.

- **Outcome measures:**

Ø Y balance test

Ø Foot posture index.

PROCEDURE

All the subjects were selected for the study according to the selection criteria. Demographic data and consent from was taken from them. Included participants will be divided in 2 groups by simple random sampling method. Pre and post assessment will be taken after 4 weeks of the treatment respectively with the help of outcome measures.

Group A received Short foot exercise. Participant were instructed to raise the medial longitudinal arch of the foot by drawing in the metatarsal heads towards the calcaneus without flexing the toes and holding an isometric contraction for 5 seconds during each repetition. Participant were instructed to perform 100 repetitions of the prescribed exercise on a daily basis for 4 weeks.

Group B received Towel curl exercise. Participants were instructed to place a towel on a slick surface (tile or hardwood floor) and place their toes on the edge of the towel. They were then instructed to drag the towel under their foot by flexing their toes, generating a strong grip on the fabric and hold for 5 seconds per repetition. Participant were instructed to perform 100 repetitions of the prescribed exercise on a daily basis for 4 weeks.

The effect of the treatment given to each group was noted immediately using the outcome measures. The experimental results was statistically analysed. The significant difference between the two groups was investigated with the un-paired t test and within the group with paired t test.

Findings

Pre and post data was analysed, according to the result the within the Group A the anterior, posteromedial and posterolateral direction of both right and left are considered extremely significant with p value <0.0001.

The mean pre intervention of Group A for Right anterior is 61.27 (SD=3.6), for posteromedial direction mean is 62.20 (SD=5.2) and for posterolateral mean is 62.19 (SD=5.5), changed to post intervention mean for anterior direction 66.49 (SD=3.4), for posteromedial direction mean is 66.9 (SD=5.1) and for posterolateral direction mean is 66.8 (SD=5.13). (Fig.1)

The mean post intervention of Group A for Left anterior is 61.47 (SD=5.2), for posteromedial direction mean is 60.62 (SD=5.0) and for posterolateral mean is 61.1 (SD=5.2), changed to post intervention mean for anterior direction 65.64 (SD=5.0), for posteromedial direction mean is 65.08 (SD=5.0) and for posterolateral direction mean is 65.1 (SD=5.08). (Fig.2)

According to the pre and post data analysis within the Group B the anterior, posteromedial and posterolateral direction of both right and left are considered extremely significant with p value <0.0001.

The mean pre intervention of Group B for Right anterior is 64.08 (SD=2.4), for posteromedial direction mean is 64.26 (SD=3.0) and for posterolateral mean is 64.08 (SD=2.2), changed to post intervention mean for anterior direction 66.8 (SD=2.2), for posteromedial direction mean is 66.7 (SD=2.5) and for posterolateral direction mean is 66.58 (SD=1.9). (Fig.3)

The mean post intervention of Group B for Left anterior is 63.4 (SD=2.4), for posteromedial direction mean is 63.8 (SD=2.2) and for posterolateral mean is 63.60 (SD=2.3), changed to post intervention mean for anterior direction 65.25 (SD=2.1), for posteromedial direction mean is 65.32 (SD=2.1) and for posterolateral direction mean is 65.20 (SD=2.2). (Fig.4)

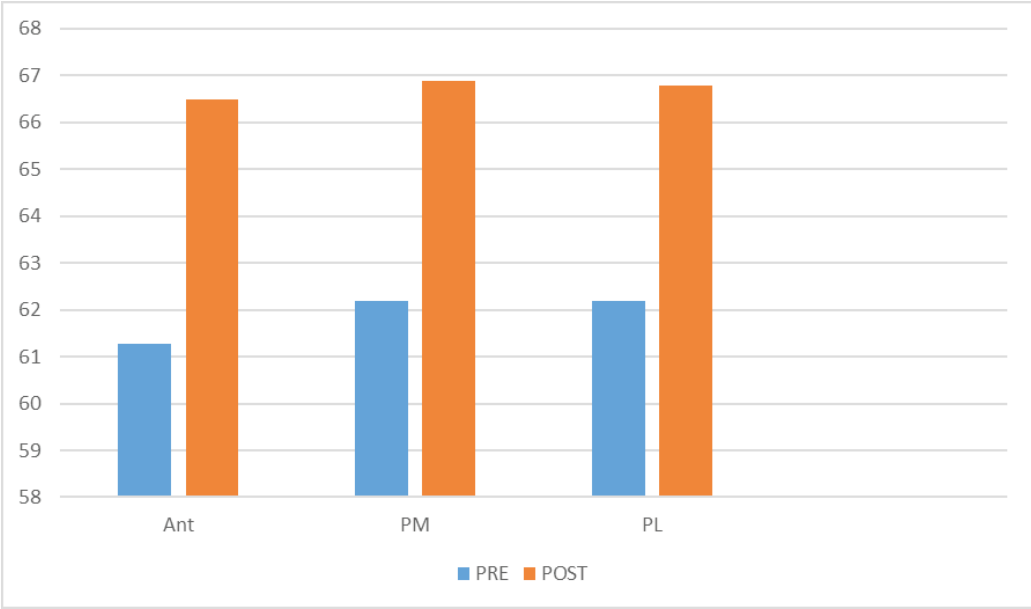

Fig.1: Group A (RIGHT LEG)

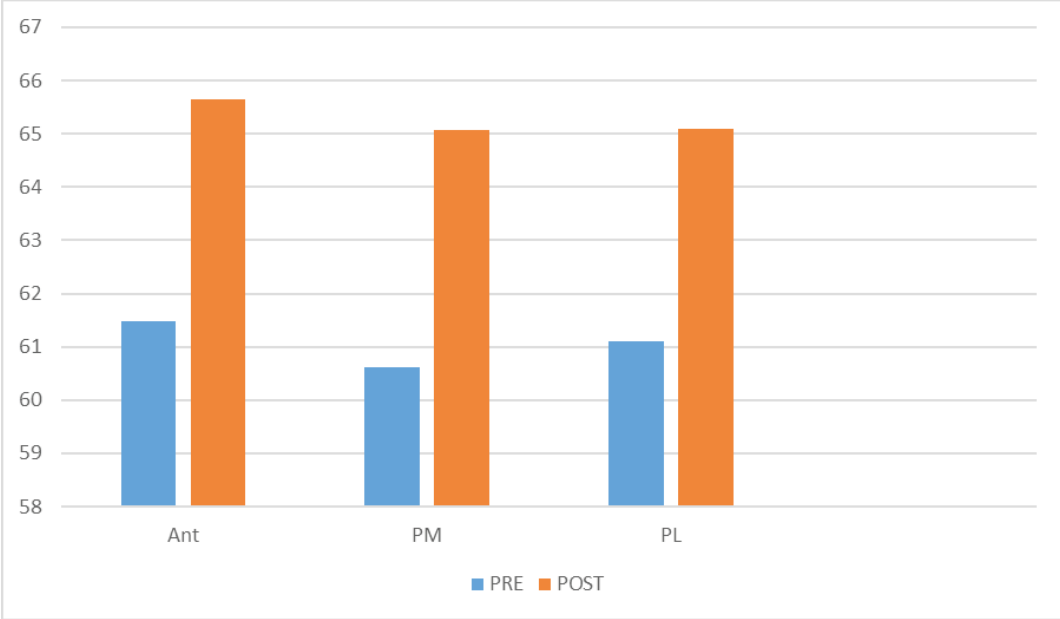

Fig. 2 : Group A (LEFT LEG)

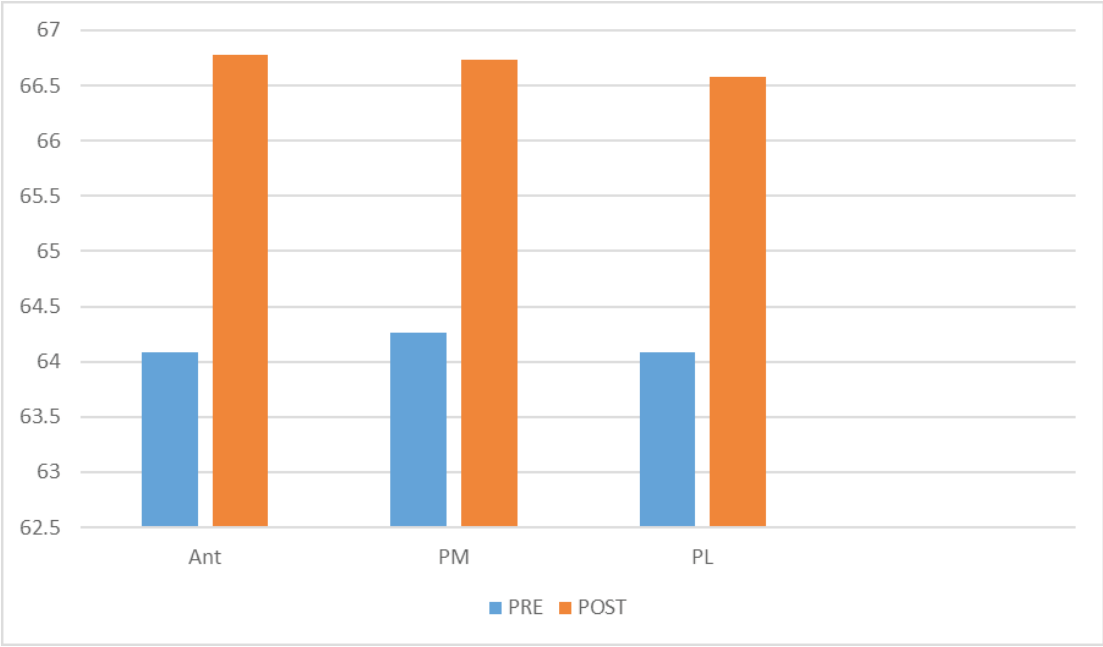

Fig. 3: Group B (RIGHT LEG)

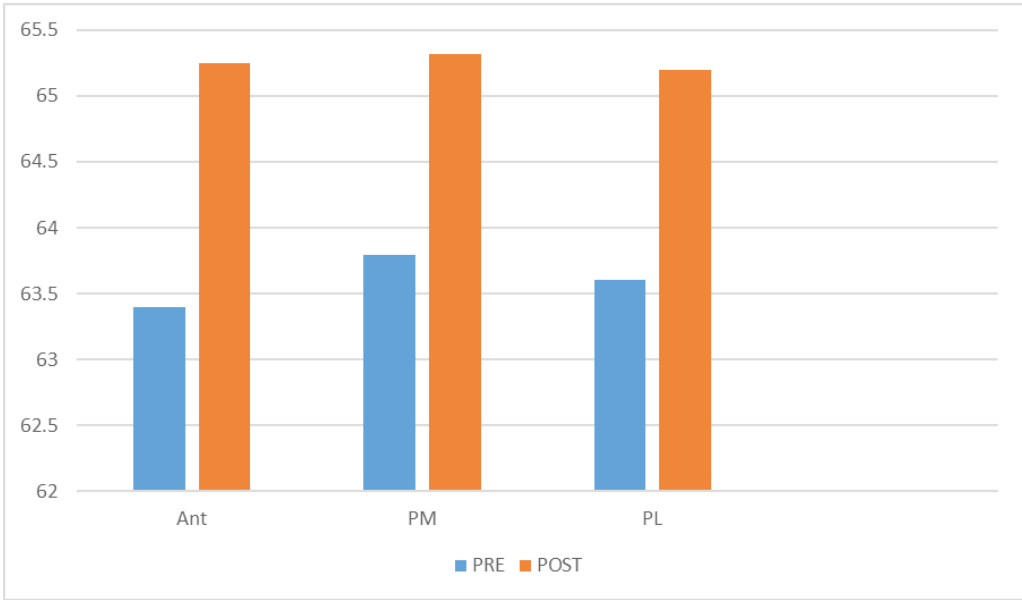

Fig.4: Group B (LEFT LEG)

Conclusion

On the basis of the result of the study it is concluded that the short foot exercises and towel curl exercises appears to be equally effective in improving the dynamic balance in individuals with flexible flat foot. The impact of these exercises on the foot posture needs to be taken into consideration.

Discussion

The aim of this study was to study the effect of short foot exercise versus towel curl exercise to improve dynamic balance and foot posture in individuals with flexible flat foot with an objective of finding the benefits of each exercise and comparing its effects to fulfil the aim of the study.

The individuals included in this study had flexible flat foot which was assessed using foot posture index

(FPI-6) measure and individuals were scored according to the outcome measure were included in the study.

There were 40 participants which were selected according to the criteria and they were randomly divided into 2 groups (group A and group B) with each containing 20 participants. Group A was asked to perform short foot exercises according to given procedure and group B was asked to perform towel curl exercises. This study was carried out for 4 weeks on daily basis and pre and post assessment was taken using Y balance test after 4 weeks. After the pre and post assessment the data was statistically analysed.

According to this both the exercise groups appeared to be equally effective in improving the dynamic balance in the participants and were considered extremely significant with p value <0.0001 for both right and left leg.

According to a literature variety of exercises must have been used in improving balance. Some literature suggest that the short foot exercises were helpful in improving the muscle activity of intrinsic foot muscles and balance in flexible flat feet. [11] The short foot exercise must have appeared to be more effective than towel curl exercise in improving the static and dynamic balance in some literature but this study was done in individuals without any lower limb pathology or in participants with normal posture .[4]

Conflict of Interest: There were no conflicts of interest in my study.

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Ethical Clearance: The Institutional Ethics committee has hereby given permission to initiate the research project titled, " Effect of short foot exercises versus towel curl exercises to improve balance and foot posture in individuals with flexible flat foot"

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