



EFFECT OF MODIFIED TOWEL CURL EXERCISE ON DYNAMIC BALANCE IN INDIVIDUALS WITH FLEXIBLE FLAT FOOT : AN EXPERIMENTAL STUDY.

Yashashri Shashikant Salve¹ Dr. Ashwini Kalsait² Dr. Kalyani Nagulkar³

Intern¹ Associate Professor² Associate Professor³

Department Of Physiotherapy ,

Dr . Ulhas Patil College Of Physiotherapy , Jalgaon , India.

ABSTRACT:

Aim -To study the effect of modified towel curl exercise on dynamic balance in individuals with flexible flat foot. **Methodology and analysis** – An experimental study was conducted among 25 male and female with flexible flat feet aged 17-26 years using convenient sampling . Individuals with Any Musculoskeletal disorder or deformity , Neurological or Cardiovascular Condition , having Limb length discrepancy , having Any other congenital abnormalities or suffering from psychological problems were excluded. Individuals with flexible flat feet were diagnosed using Sit to Stand Navicular Drop Test (SSND) . Pre and post analysis for dynamic balance of individuals with flexible flat feet was done with the help of Star Excursion Balance Test (SEBT).Modified towel curl exercise was given to subjects for 4 weeks , 5 days/week. **Result** - Paired t test was used for analysis of pre and post treatment variables the obtained p value for outcome SEBT readings in all directions for both limbs is <0.0001, which showing significant improvement. **Conclusion** -The present study concluded that 4 weeks of Modified Towel Curl Exercise program was effective in improving the dynamic balance among flexible flat feet individuals.

Keywords – dynamic balance, flexible flat foot , modified towel curl exercise, SSND, SEBT

INTRODUCTION

Flat feet also called pesplanus or fallen arches is a postural deformity in which the arches of the foot collapse, with the entire sole of the foot coming into complete or near complete contact with ground^[1].Prevalence of flexible flat foot

among 18 -25 years old in an Indian adults was 13.6%.Prevalence of flexible flat feet is more female (14.4%) than male(12.8%).^[2]

A flexible flat feet is caused by tibialis posterior dysfunction, foot bone malformation, ligament loosening, Achilles tendon shortening, and foot muscle weakness^[3].In flexible flat foot medial

longitudinal arch appear to be normal in non-weight bearing position and becomes flat in weight-bearing position^[3] These deformations lead to excessive pronation of the foot during weight bearing^[4] Flat feet have excessive subtalar joint pronation, which damage to the lower extremity cause hypermobility and passive instability.^[5]

In flexible flat foot, excessively pronated foot postures can affect somatosensory input via changes in joint mobility or surface contact area or, change in muscular strategies to maintain a stable base of support. Excessive pronation may place greater demands on the neuromuscular system to stabilize the foot and maintain an upright stance. So, measurement of balance is an important tool in the assessment of foot dysfunction.^[6,7,8]

Flexible flat foot can be assessed by navicular drop test, Navicular Drop (ND) of ≥ 10 mm was regarded as flexible flat foot.^[2] Navicular drop is defined as the change in height of the navicular bone when the foot moves from subtalar neutral non-weight bearing to a relaxed weight bearing stance. Navicular height measurement is commonly used to measure medial arch height.^[9]

Flat foot individuals have difficulty to do daily living tasks such as walking on uneven ground, walking fast, running, and maintaining balance, so they predisposed to fall.^[14] This study will help in generating the data among this population. Also it will help to decrease the incidence of fall and consequent accidents among the flat foot individuals.

The balance of the body is observed in conditions relating to low back and thigh musculature whereas dynamic balance specifically related to flat foot and normal individual is having less database so to explore this query such study should be warranted.^[15] Also, Dynamic balance and fall risk was observed in condition related to geriatric and neurodynamic abnormalities not related to conditions like flat foot. so, this study will help to observe dynamic balance and fall risk in flat feet Individuals.^[16,17,18]

There are many exercise protocols for flexible flat foot but in this study we are trying to emphasize on modified towel curl exercise.

NEED FOR STUDY

Dynamic balance was observed in condition related to geriatric and neurodynamic abnormalities but not related to conditions like flat foot.

The balance of the body is observed in conditions relating to low back and thigh musculature whereas dynamic balance specifically related to flat foot is having less database so to explore this query such study should be warranted.

Flat foot individuals have difficulty to do daily living tasks such as walking on uneven ground, walking fast, running, and maintaining balance, so they predisposed to fall.

This study will help in generating the data among this population. Also it will help to decrease the incidence of fall and consequent accidents among the flexible flat foot individuals by improving the dynamic balance.

Many studies have been conducted for improving dynamic balance in flexible flat feet individuals but no study has been conducted on effect of Modified towel curl exercise for improving dynamic balance in flexible flat foot individuals.

There is a paucity of research related to the effect of Modified towel curl exercise on reducing risk of fall flexible flat feet individuals.

AIM

To study the effect of medial arch lift exercises on dynamic balance in flexible foot individuals.

OBJECTIVE

To see the effect of modified towel curl exercise on Dynamic Balance in individuals with flexible flat foot.

MATERIALS AND METHODOLOGY

MATERIALS

- Pen
- Paper
- Cardboard sheet
- Scale
- Marker

- Measuring tape.
- Black cello tape
- Small Turkish towel

To conduct the following study permission was taken from the institutional ethical committee of Dr. Ulhas Patil College of Physiotherapy. Subjects were taken according to the inclusion and exclusion criteria and written consent was taken from the subjects. The procedure was well explained. The Pre-intervention Assessment was done for dynamic balance with Star Excursion Balance Test .Then Modified Towel Curl Exercise – Given for 10 repetitions with 5sec rest interval – 3sets - 5days/week - for 4weeks. After the 4 weeks of intervention, the Post-intervention Assessment was taken for dynamic balance. Data was collected and Statistically analysed.

METHODOLOGY

- Study design: Pre and post experimental study
- Study population: 17-26 years of age group.
- Sampling method :Convenient sampling
- Place of study: Jalgaon
- Study duration :6 Months
- Sample size: 25

Selection criteria

Inclusion criteria-

1. Individual having both sided flexible flat foets.
2. Individuals of age group 17- 26 years

Exclusion criteria-

1. Any Musculoskeletal disorder/ deformity
2. Any Neurological /Cardiovascular Condition
3. Limb length discrepancy
4. Any other congenital abnormalities
5. Individual is suffering from psychological problems.

Screening Test-

- 1) Sit to Stand Navicular Drop Test (SSND) for diagnosis of flat feet

Outcome measure-

- 1) Star Excursion Balance Test (SEBT) for assessing dynamic balance.

PROCEDURE

NAVICULAR DROP TEST

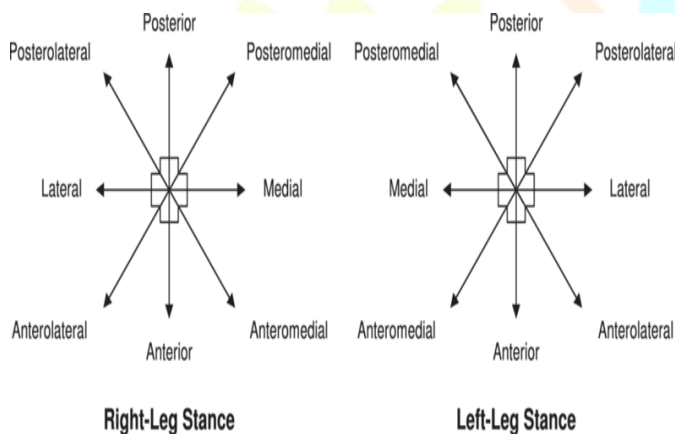
Navicular drop test is a valid predictor of navicular height in non-weight bearing and weight bearing position to characterise the arches of foot.

- Individual subject was placed in a sitting position with their feet flat on a firm surface with the hip and knees flexed to 90 degree and ankle joints in neutral position.
- Subtalar neutral position is achieved when talar depressions are equal on medial and lateral side of the ankle.
- The examiner takes measurement by Kneeling in front of the subject
- While the subject was still on a sitting position, a dot was marked on the navicular tuberosity.
- An index card was placed and was marked at the level of navicular tuberosity.
- Then the subject was asked to bear an equal weight on both the foot and was asked to stand.
- The new position of navicular tuberosity was marked in index card.
- The difference between the marks in index card was measured with scale in millimeter.

OUTCOME MEASURE - STAR EXCURSION BALANCE TEST:

Star excursion balance test (SEBT) is one of the reliable and feasible method used to assess the dynamic balance as it challenges a person's ability to maintain a stable BOS simultaneously performing reach movements.

- The star excursion test layout consists of 4 lines applied to the floor with athletic tape; two forming vertical and horizontal lines and two positioned perpendicular to each other and at 45° with respect to the vertical and horizontal lines.
- A rectangle representing the starting position of the feet is placed at the center point.
- This box is large enough to fit the subjects feet.
- The subject is asked to reach along the lines marked, with one leg while standing on the other leg.
- The distance reached in each direction is recorded separately by measuring through tape from the centre point to the point the subject has reached using the distal part of foot.



Individual Perform the Star Excursion Balance Test for Left limb in Anteromedial direction



**INTERVENTION PROTOCOL
MODIFIED TOWEL CURL EXERCISE-**

Individual sit in a chair have to keep his/her feet on turkish towel (2mm thickness).
First has to curl the toes and lift the towel and then do inversion hold for 8-10 sec.
Lastly spread the toes apart then come to the starting position.
Do 10 repetitions with 5sec rest interval – 3sets - 5days/week - for 4weeks.

STATISTICAL ANALYSIS

- The present study included 25 subjects with flexible flat foot within 17-26 years of age group who met the inclusion criteria.
- The data was collected, analysed and entered in excel sheet and statistical analysis was done using Instat version 3.05 software.
- Statistical significance was set as $p \leq 0.05$.

RESULT

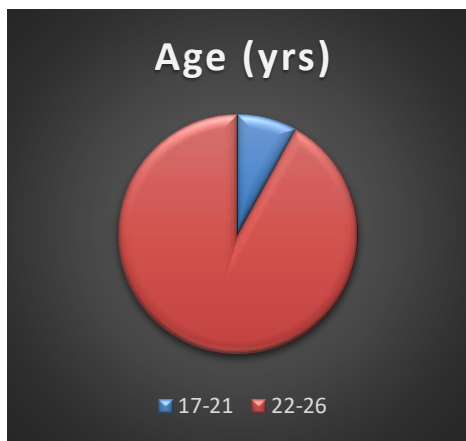
The present study included 25 subjects with flexible flat feet with 17-26 years of age group who met the inclusion criteria. The subjects were given intervention (Modified towel curl exercise) for a period of 4 weeks. The outcome measures were assessed pre and post intervention.

TABLE 1: Baseline characteristics of participants in terms of Age and Gender

| Sr. No. | Variable | Groups | Frequancy | Percentage |
|---------|----------|--------|-----------|------------|
| 1 | Age | 17-21 | 2 | 8% |
| | | 22-26 | 23 | 92% |
| 2 | Gender | Male | 4 | 16% |
| | | Female | 21 | 84% |

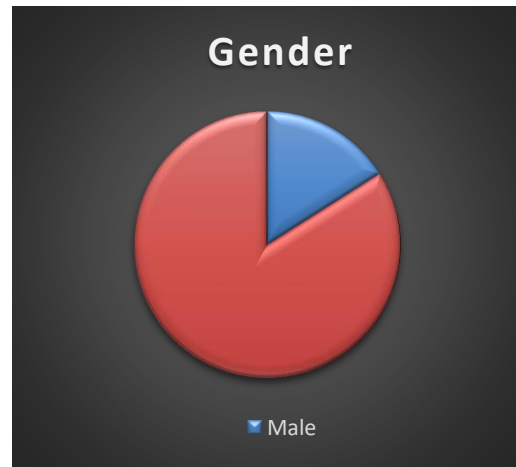
Inference: Table 1 shows the distribution of study population in terms of age and gender.

GRAPH 1: Age group Distribution



Inference: Graph 1 shows that study population between 17-21 years of age was 8% and between 22-26 years of age was 92%.

GRAPH 2 : Gender group Distribution

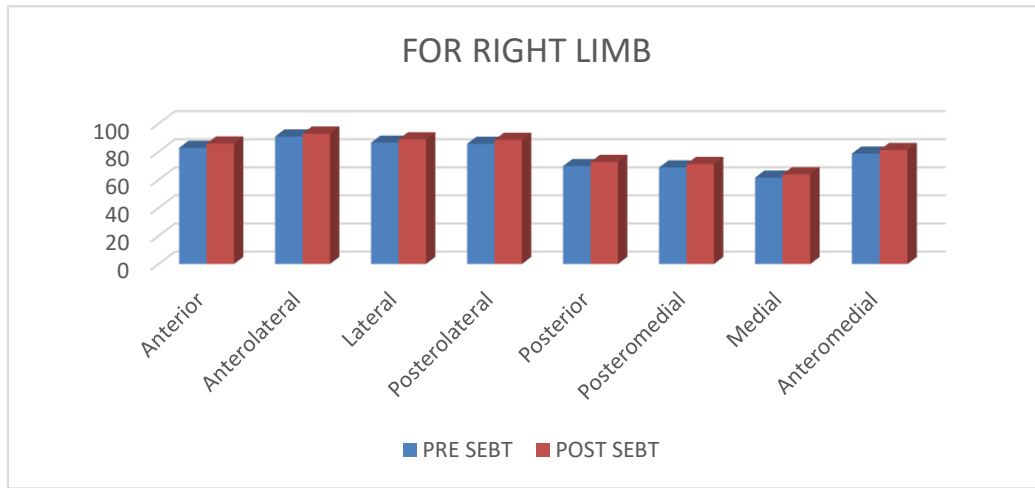


Inference: Graph 2 shows the distribution of males and females i.e. male population was 16% and female population was 84%.

INTRA GROUP COMPARISON OF PRE-POST STAR EXCURSION BALANCE TEST TO ASSESS DYNAMIC BALANCE OF RIGHT LIMB IN ALL 8 DIRECTIONS

| Sr.No | Direction | Right mean | | T value | P value |
|-------|----------------|---------------|---------------|---------|---------|
| | | PRE ± SD | POST ± SD | | |
| 1 | Anterior | 82.78 ± 11.19 | 85.8 ± 10.92 | 12.249 | <0.0001 |
| 2 | Anterolateral | 90.88 ± 13.37 | 92.96 ± 13.46 | 16.242 | <0.0001 |
| 3 | Lateral | 86.48 ± 14.74 | 88.8 ± 14.70 | 20.834 | <0.0001 |
| 4 | Posterolateral | 85.68 ± 17.66 | 88.48 ± 18.21 | 15.336 | <0.0001 |
| 5 | Posterior | 69.8 ± 12.34 | 72.72 ± 12.24 | 22.801 | <0.0001 |
| 6 | Posteromedial | 68.80 ± 9.38 | 71.28 ± 9.38 | 17.363 | <0.0001 |
| 7 | Medial | 61.56 ± 10.07 | 63.96 ± 9.96 | 16.971 | <0.0001 |
| 8 | Anteromedial | 78.68 ± 9.89 | 81.20 ± 9.60 | 14.453 | <0.0001 |

Table : depicts pre and post intra group intervention of mean ± SD in 8 directions , It also includes t and P values with respective directions which is extremely significant. Table describes comparison between pre and post intervention for right limb in 8 directions as specified in the table. Intra group comparison between pre and post of right limb in 8 directions was calculated by using paired t test.



GRAPH: Graph shows the difference between pre and post star excursion balance test in each direction, there was significant improvement in balance of right limb at each direction after towel curl exercises.

INTRA GROUP COMPARISON OF PRE-POST STAR EXCURSION BALANCE TEST TO ASSESS DYNAMIC BALANCE OF LEFT LIMB IN ALL 8 DIRECTIONS

| | | PRE ± SD | POST ± SD | T value | P value |
|---|----------------|---------------|---------------|---------|---------|
| 1 | Anterior | 85.88 ± 11.24 | 88.92 ± 11.61 | 14.905 | <0.0001 |
| 2 | Anterolateral | 88.76 ± 10.71 | 90.92 ± 10.96 | 12.699 | <0.0001 |
| 3 | Lateral | 83.00 ± 11.71 | 84.96 ± 11.57 | 13.336 | <0.0001 |
| 4 | Posterolateral | 79.6 ± 14.67 | 82.36 ± 14.82 | 15.693 | <0.0001 |
| 5 | Posterior | 67.24 ± 8.47 | 70.28 ± 8.27 | 24.877 | <0.0001 |
| 6 | Posteromedial | 72.08 ± 10.75 | 74.52 ± 10.61 | 18.751 | <0.0001 |
| 7 | Medial | 62.08 ± 12.74 | 64.72 ± 12.75 | 6.288 | <0.0001 |
| 8 | Anteromedial | 80.32 ± 11.19 | 82.76 ± 10.96 | 14.025 | <0.0001 |

Table : depicts pre and post intra group intervention of mean ± SD in 8 directions , It also includes t and P values with respective directions which is extremely significant. Table describes comparison between pre and post intervention for left limb in 8 directions as specified in the table. Intra group comparison between pre and post of left limb in 8 directions was calculated by using paired t test.



GRAPH: Graph shows the difference between pre and post star excursion balance test in each direction, there was significant improvement in balance of left limb at each direction after towel curl exercises.

DISCUSSION

This study was conducted to find the effect of Modified Towel Curl Exercise for improving the dynamic balance in flexible flat feet individuals.

Study resulted that 4 weeks of Modified Towel Curl Exercise program was effective in improving the dynamic balance among flexible flat feet individuals.

Statistical analysis proves that Modified Towel Curl Exercise significantly effective in improving dynamic balance in flexible flat feet individuals with p value <0.0001 for Star Excursion Balance Test in all direction for both limbs.

The foot is a direct interface between the body and ground so it contributes to postural stability in most static and dynamic activities. The intrinsic foot muscles such as abductor hallucis, flexor digitorum brevis and interosseus contribute to stabilize the foot arch during propulsion. And also extrinsic foot muscles like tibialis posterior contribute to maintaining medial longitudinal arch during dynamic balance.

Modified Towel Curl Exercise activates the intrinsic foot muscles and also tibialis posterior muscle. The abductor hallucis is largest foot intrinsic muscle and it acts during flexion of first MTP joint and tibialis posterior is extrinsic muscle

that inverts foot at subtalar joint and supports medial longitudinal arch of foot.

Da-bee Lee et al(2016) done study group performed foot intrinsic muscle strengthening exercise along with exercise to strengthen the tibialis posterior muscle. The strengthening tibialis posterior muscle during sensory receptor activities and neuromuscular functions improves dynamic balance due to dynamic support of the medial arch and static support of the intrinsic foot muscle. These strengthening exercises are capable of solving balance problems in flexible pes planus patient.

Hyong et al (2009) reported that when extrinsic foot muscle strengthening exercises were implemented with subtalar joint treatment, dynamic balance significantly increased.

Panichawit et al (2015) implemented the intrinsic and extrinsic muscle strengthening exercises for flexible pes planus patients and reported that foot functions improved.

So the above mechanisms supports that Modified Towel Curl Exercise program can effectively improves the dynamic balance by strengthening the intrinsic foot muscles and extrinsic foot

muscle and increasing foot proprioception leading good quality of life in flexible flat feet individuals

Modified Towel Curl Exercise program can effectively improve the dynamic balance among flexible flat feet individuals.

CONCLUSION

The present study concluded that 4 weeks of Modified Towel Curl Exercise program was effective in improving the dynamic balance among flexible flat feet individuals.

LIMITATION OF THE STUDY

- Study includes relatively limited population
- Study was done for a short duration i.e. 4 weeks
- The assessment was directly taken prior to the exercise protocol and directly after 4 weeks of protocol. In between no assessment was taken.

CLINICAL IMPLICATION

- Modified Towel Curl Exercise can be used as adjunct to other forms of exercises which are used to treat flexible flat foot.
- It is easy to understand and can be carried out easily anywhere, anytime and it is cost efficient.

FUTURE SCOPE

- The study can be done for a longer period of time.
- The study can be done with a large, wide spread population.
- The study can be use vernier calliper for measuring navicular drop.

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