

Effect of Intrinsic Muscle Training on Balance in Bharatanatyam Dancers: Randomized Control Trial

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ABSTRACT

Background: Bharatanatyam is an ancient classical dance form originated from Tamil Nadu.

Bharatanatyam dancers are more prone for ankle and foot problems. Due to repetitive tapping of the foot, changes are seen in the medial longitudinal arch causing flat foot in Bharatanatyam dancers which affects their balance while dancing.

Materials and methodology: Randomized control trial implemented in which 60 participants were selected randomly according to inclusion and exclusion criteria. 30 participants were divided into experimental (Group A) and control group (Group B). Informed consent was taken. Short foot exercises were implemented for 4 weeks with 100 repetitions on experimental group. Pre and Post outcomes were noted.

Results: Short foot exercises shown significant improvement on balance ($p < 0.001$) and foot posture ($p < 0.001$) with mean \pm S.D. of 50 ± 2.26 for pre-treatment, 56 for post treatment. Pre-treatment mean \pm S.D. for foot posture index is 2.33 ± 3.37 and post treatment 1 ± 1.90 . In control group, pre-treatment mean \pm S.D. is 2.29 ± 3.32 and 50 ± 2.6 ; post-treatment 2.23 ± 3.37 and 50 ± 2.6 for Berg balance scale and foot posture index respectively.

Conclusion: Intrinsic muscle training for foot musculature improves balance in Bharatanatyam dancers.

Key words: Bharatanatyam dancers, Balance, Intrinsic muscles training, Foot posture.

INTRODUCTION

Bharatanatyam is an Indian classical dance form that originated in Tamil Nadu. [1-3] Traditionally this has been a solo dance that was performed by women in Temples [4,5] and it also expressed South Indian religious themes, spirituals ideas, particularly of Shaivism, but also of Vaishnavism and Shaktism. [1,6,7]

The intrinsic foot muscles comprise four layers of small muscles, who's insertion attachments within the foot. They include abductors hallucis, flexor digitorum brevis, abductor digiti minimi, and quadratus plantae. Most of the muscles are located on the inferior part of the foot and primarily stabilize the arch. (8)

The present study focuses on the intrinsic foot flexors muscles and the effect of strength training method on;

(1) Static and dynamic balance

(2) Foot arch formation

The foot's intrinsic muscles-once overlooked by most practitioners have begun to attract attention. Recent studies show that strong intrinsic foot muscles help to maintain the foot health and intrinsic muscle weakness may also contribute to painful foot conditions.

Bharatanatyam dancers are more prone to foot problems which lead to pain in ankle and changes in the arches of the foot causing repetitive injury lead to flattening of arch. It has shown that flattening of arch

causes postural instability and balance problems in healthy population.

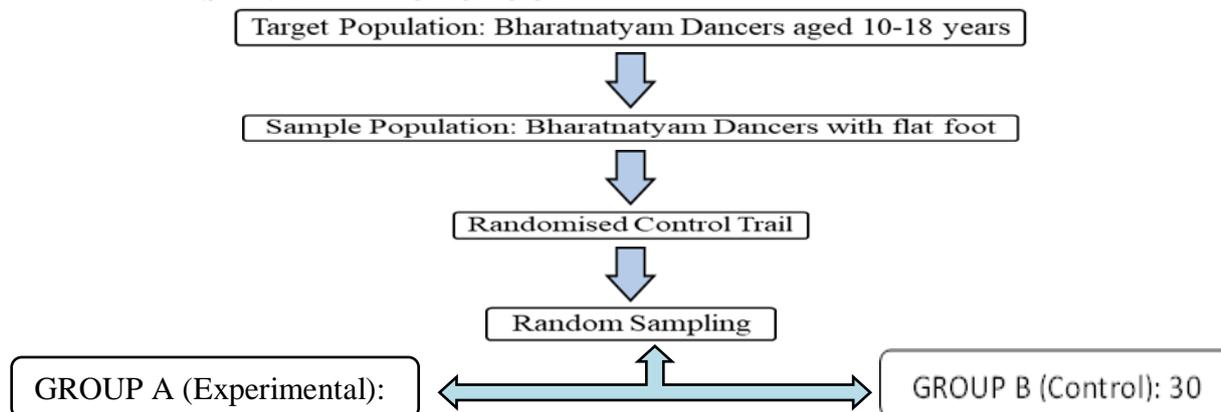
The biomechanical interactions of the anatomical structures and functions of the foot are said to have a complex structure. Efficient functioning of the foot depends heavily on the integrity of the medial longitudinal arch (MLA), as it plays a vital role in the transfer of forces through the foot. The important point is that improper functioning of the MLA has been shown to be a significant factor in lower extremity, and numerous investigators have established a relationship between over Flat foot pronation, Recent injuries and Various types of injuries.⁽⁹⁾

Intrinsic muscles of the foot play an important role in maintaining arch of the foot. Though this arch helps in weight distribution on foot during any weight bearing activity. As repetitive injury may

cause weakness in foot musculature followed by flattening of the arch which reduces overall performance in dancers. Hence the need to find out the effect of intrinsic muscle training on balance and their performance during Bharatnatyam dance.

Araimandi is the basic of Bharatnatyam dance; this dancing posture has a closed chain knee flexion with hip abduction and external rotation. To maintain the balance (stability), dancers need adequate flexibility in their lower extremity muscles. Ankle bells (ghungaroots) further adds to the stress experienced by the foot. Daily use of these ankle bells may overload the connective tissues of legs and can lead to overextension, tendon strain and other connective tissue injuries during the performance.

MATERIALS AND METHODOLOGY



Inclusion criteria: -

- 1) Bharatnatyam dancers who have been practicing more than 6 months.
- 2) Age group consider is 10-18 years.

Exclusion criteria:

Recent Foot Injuries
Subjects who not willing to participate

Outcome measures:

- 1) Berg balance scale
- 2) Foot posture index

Materials:

Towel
Chair
Foot stepper
Consent form

Data collection sheet
Pencil

PROCEDURE:

Permission was taken from the institutional ethical committee. Participant will be selected on the basis of inclusion and exclusion criteria. The aim and method of the study will be explained and their consent on the consent form will be taken. Foot posture index and berg balance scale will be taken during the assessment.

The various materials which were used during the study were Foot stepper, towel, chair. Postural deviations were

observed using foot posture index scale. In this scale talar head, supra and infra navicular angle, calcaneal curve, medial longitudinal arch, abduction /adduction of the rear foot.

For determining the foot posture index ask the subjects to stand still to observe the deviations in the angles of the foot. After taking each score on the foot posture index scale of 6 components, (0) is given for neutral, (+2) is given for pronated, (-2) is supinated. The final score was a whole number between -12 to +12. Control group of 30 female individuals and Experimental group of 30 female individuals are considered. In foot posture index, pre-treatment and post is taken, all the components as mentioned above are taken. Total score of foot posture index is calculated and scoring is given accordingly. In Berg balance scale, components (1) Sitting to standing (2) Standing unsupported (3) Sitting with back unsupported but feet supported on floor or on a stool (4) Standing to Sitting (5) Transfers (6) Standing unsupported with eyes closed (7) Standing unsupported with feet together (8) Reaching forward with outstretched arm while standing (9) Pick the object from the floor from the standing position (10) Pick up the object from the floor from the standing position (11) Turning to look behind over left and right shoulders while standing (12) Turn 360 degrees (13) Place Alternate Foot on step or stool (14) Standing unsupported foot in front (15) Standing on one leg. Ask the patient to perform these components and give the scoring accordingly (Total score out of 56). Calculate pre and post treatment.

After assessment intrinsic foot muscle exercises were implemented to experimental group (Group A) and control group (Group B) asked to do their regular warm up activities. Intrinsic foot muscle exercises given as follows;

Protocol (2times/day for 4 weeks)

Short foot exercises:

1) Sit with good posture in a sturdy chair with both foot on the floor, your toes facing

straight forward and your knees bent to 90 degrees.

2) Ask the patient to inhale and contract the muscles on the bottom of your right foot and lower legs to raise the arch of your foot without curling your toes. This is position is called short foot position. Hold this for 6 seconds and then relax. Continue this exercise for 100 repetitions.

Towel curl exercises:

1) Place the towel under the foot, flat. Move the towel towards yourself in front of your foot.

2) Sit with your heels under your knees.

3) See to it that both the feet are parallel to each other with the toes pointing forward.

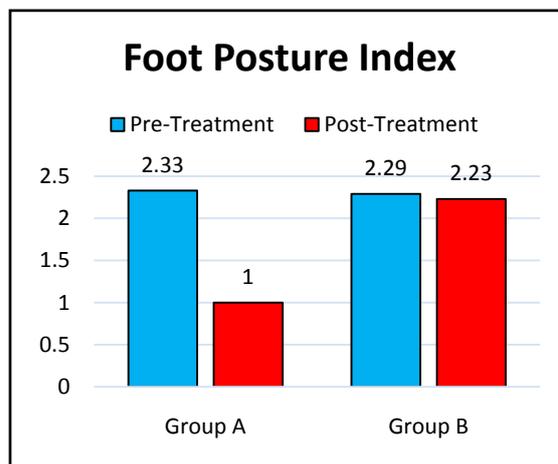
4) Your heel stays in place on the towel as you reach out evenly along both sides.

5) Pull the towel towards your heel, repeat the move for 100 repetitions.

RESULTS

Table 1: Graphical Representation of Pre-Post Interventional values of Foot Posture Index

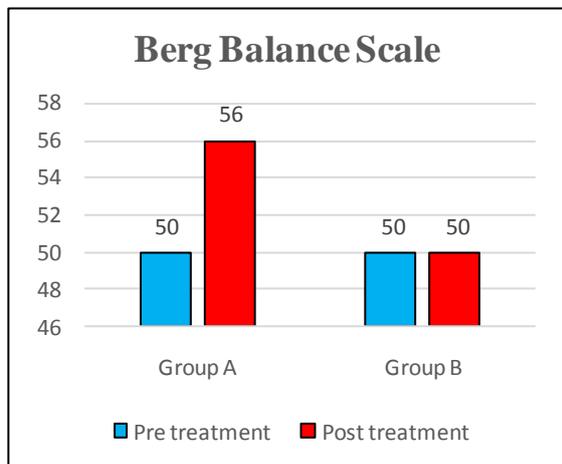
	Group A (Experimental Group)		Group B (Control Group)	
	Pre	Post	Pre	Post
Mean ± S.D.	2.33±3.37	1±1.90	2.29±3.32	2.23±3.37
p-Value	<0.0001		0.0017	



Interpretation-In Group the pre-treatment for foot posture index is 2.33 and post treatment is 1 (p-value <0.0001). In group B the pre-treatment for foot posture index is 2.29 and post treatment is 2.29 (p-value 0.0017).

Table 2: Graphical Representation of Pre-Post Interventional values of Borg Balance Scale

	Group A (Experimental Group)		Group B (Control Group)	
	Pre	Post	Pre	Post
Mean ± S.D.	50±2.6	56	50±2.6	50±2.6
p-Value	<0.0001		0.0047	



Interpretation-In Group the pre-treatment for Berg Balance scale is 50 and post treatment is 56 (p-value <0.0001). In group B the pre-treatment for foot posture index is 50 and post treatment is 50 (p-value 0.0047).

DISCUSSION

The Author named Da-bee, Jongduk Choi study effect of foot intrinsic muscle and tibialis posterior strengthening exercise on plantar pressure and dynamic balance in adult's flexible pes planus in which the objectives are to investigate the effect of foot intrinsic muscle and tibialis posterior muscle strengthening exercise for plantar pressure and dynamic balance in adults with flexible pes planus. Results are the experimental group had significantly lower plantar pressure of medial heel area than the control group in stand (p<05). The experimental group had significantly higher dynamic balance ability than control group (p<05).

Another study of author V. Anbarasi, David V Rajan, K. Adalarasu, Analysis of Lower extremity muscle flexibility among Indian classical Bharatanatyam Dancers. In which the objective is to identify lower extremity

muscle flexibility parameters prevailing among Bharatanatyam dancers and analyse if there is any significant difference exist between normal and injured dancers in flexibility parameters. Conclusion is that injured dancers have high hamstring tightness that lead to pain and MSD. Though the result did not show much variation among the muscle group, good flexibility is a part of dancers' well-being. There is a large group of dancers who complaints of pain, though the pain level was not severe enough to stop their dancing career. Lack of stretches and muscle tightness may lead to overuse injury or even produce early wear and tear changes in the weight bearing joints.

Scott K. Lynn, Ricardo A. Padilla, and Kavin K.W. Tsang studied about the Differences in static and Dynamic-Balance Task Performance after 4 weeks of intrinsic foot muscle training: The Short Foot Exercise Versus the Towel Curl Exercise. Objective is to investigate the effects of 2 different types of IFM training on the height of the MLA and static and dynamic balance task performance. Results-There were no differences in the navicular height or static balance tests. Conclusion-The SPE appeared to train the IFM more effectively than the TCE; however, there were differing results between the dominant and nondominant legs. These imbalances need to be taken into consideration by clinicians. ⁽⁹⁾

From the observations the study concludes that the feet of the Bharatanatyam dancers are constantly exposed to the forces that can lead to the instability and postural deviations thus the Bharatanatyam dancers are more susceptible to develop many types of foot problems and injuries. Therefore, the study recommends that the dancers should be well trained about the foot problems and their prevention. Bharatanatyam dancers should be formulated a treatment based programme according to their lifestyle and profession. ⁽¹⁰⁾

Mean value for pre-treatment of foot posture index is 2.33 and Post treatment mean is 1. Mean value for Pre-treatment of

berg balance scale is 50 and for post is 56. P-value is <0.001 which is extremely significant. By giving intrinsic muscle training to the foot musculature the medial longitudinal, base of support, strength of the hallucis longus muscle and flexor digitorum has helped to improve balance.

CONCLUSION

Intrinsic muscle training for foot musculature improves balance in Bharatnatyam dancers.

Limitation and Future scope of study:

Other dance styles can also be considered.

Conflict of interest: None

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