

Effects of BOSU Ball Exercises Versus Wobble Board Exercises on Pain and Balance in Individuals with Pes Planus

Prathibha D¹, Kamalakannan M², Anitha A³, Ramana K⁴

¹Undergraduate, ²Associate Professor, ³Associate Professor, ⁴Assistant Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

How to cite this article: Prathibha D, Kamalakannan M, Anitha A et al. Effects of BOSU Ball Exercises Versus Wobble Board Exercises on Pain and Balance in Individuals with Pes Planus. Indian Journal of Physiotherapy and Occupational Therapy / Volume 18, Year 2024.

Abstract

Background: Pes planus, usually called flat foot is a deformity that causes the medial longitudinal arch to collapse and makes the foot flat to the floor level. Flat feet may be caused by aging, pregnancy, heredity, physiological condition or an injury to the foot ligaments. Weight-bearing exercises are performed on an unstable surface such as wobble board and BOSU ball as part of the balance board training technique.

Purpose: To find out the effect of BOSU ball exercises versus wobble board exercises among individuals with pes planus.

Materials and Methods: A sample of 30 was taken using a navicular drop test on the arch of the foot, NPRS on pain, and Berg balance scale on balance. According to the selection criteria for the study which was divided into two groups, a BOSU ball with ultrasound (n=15) and wobble board with ultrasound (n=15) were given. Interventions were given as 6 sessions a week for 2 weeks. The entire process was performed from November 2022 to April 2023.

Result: The mean value of BOSU ball exercises at the post-test was found to be higher than the mean value of wobble board exercises with a p-value of <0.0001.

Conclusion: The study concludes that the BOSU ball with ultrasound therapy has a higher positive outcome in managing pes planus.

Keywords: Pes planus, BOSU ball, wobble board, FFI, NPRS, Berg balance scale

Introduction

Flatfoot is a condition where the arch present in the midfoot collapses while walking. It is also called "Pes planus". Pronated feet are also related to flat feet.¹ The foot comprises three sections: Hind, mid, and forefoot. The Transverse Arch, Medial Longitudinal, and Lateral Longitudinal are formed.² Muscles such as the tibialis anterior and extensor digitorum longus

helps in the stability of the foot and give support to the medial arch. Flatfoot can be identified in clinical practice using a variety of methods, including clinical diagnosis, footprint analysis, and radiographic study.³⁻⁵

The flat foot has been linked to family history, infant footwear, obesity, living in a city, age, gender, and foot length.⁶⁻⁸ At the knee and throughout the

Corresponding Author: Kamalakannan M, Associate Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India.

E-Mail: kamalakannan.scpt@saveetha.com

lower extremities, the foot is critical in bearing the stress of floor contact and shaping the technique of alignment of posture and joint movement.⁸ When the Medial Longitudinal Arch becomes too loose to support the arch, the foot pronates excessively, causing the heel to evert and the body weight to transfer medially, compressing the Medial Longitudinal Arch. It's also included as a health modifier.⁹ Symptoms of the flat foot include swelling around the ankle, muscle cramping, muscle pain in the foot or leg, arch, ankle, heel, or outside of the foot pain, Changes in the pattern of gait or pain while walking, and drifting toes. A study from India found that early footwear use, combined with a gain in overall weight and ligamentous laxity, increases the occurrence of flat feet.¹⁰ In a healthy adolescent age group, males had a higher prevalence of flat feet than females. Flat feet were linked to higher BMI and shorter body height across all severity levels.¹¹ A wobble board is a multidirectional balance board consisting of a round, disk-like platform resting on a partially or partially attached ball attached to the center and bottom of the platform, allowing for many planar movements. Wobble board exercises are widely used for maintaining balance.¹²

On the other hand, the name "Bosu" is derived from David Weck's invention, Both Sides Up, a piece of equipment with a hemispheric shape that allows users to use each part with varying degrees of instability. Bosu ball which is made of plastic and contains industrial fibers that have unique adhesion, semi-elastic properties, and great pressure resistance. The BOSU ball, which has two sides and a circular, flat component, is primarily used to improve posture, balance, and the tone of the body's muscles.¹³⁻¹⁷

Aim

To find out the effect of BOSU ball exercises and wobble board among individuals with pes planus using a navicular drop test on the arch of the foot, NPRS on pain, and Berg balance scale on balance.

Materials and Method

A sample size of 30 subjects aged between 18-25 years, clinically diagnosed as pes planus were taken into consideration. The entire process was performed from November 2022 to April 2023.

Inclusion criteria

- People aged between 18-25 years
- Subjects with navicular drop test positive.
- Subjects with foot pain

Exclusion criteria

- Recent foot injuries
- Neurological disorders

Outcome Measures

1. Navicular drop test (NDT) used to measure the arch of the foot.
2. Numeric pain rating scale (NPRS) to assess pain.
3. Berg balance scale (BBS) to assess balance.

Procedure

In this current study, the subjects were randomly allocated into two groups: Group A, which received BOSU ball exercises with ultrasound therapy, and Group B, which received wobble board exercises with ultrasound therapy. The study followed a single-blind design, where the subjects were unaware of the group they were assigned to.

Group A: BOSU ball exercises

Positioning the BOSU ball: The BOSU ball was placed on a flat surface with the flat side down and the dome side up.

Procedure: In this study, 15 subjects performed BOSU ball exercises consisting of 15 repetitions and 3 sets, in addition to receiving ultrasound therapy.

Single limb stance

The participants were instructed to lift one foot off the ground and place the sole of the foot in the center of the BOSU ball's dome. They were then asked to balance by engaging their core muscles and stabilizing their standing leg. The participants were instructed to hold the single limb stance for a specific duration, such as 30 seconds as a starting point. They were then asked to switch to the other leg and repeat the exercise.

Double limb stance

The participants were instructed to Stand at the center of the Bosu ball, with both feet positioned

on the dome. The feet should be shoulder-width apart, toes pointing forward. Ask them to engage the core, keep their shoulders relaxed, and maintain good posture. The participants were then asked to balance and stabilize the body on the Bosu ball. The participants were asked to hold the double limb stance for a specific duration, such as 30 seconds to begin with. Progressively, the duration was increased and movements like squats were added. After completing the desired duration, the participants were asked to step off the Bosu ball safely and rest.

Group B: Wobble board exercises

Positioning the wobble board: the board is placed on a rounded base to create an unstable surface.

Procedure: In this study, 15 subjects were given wobble board exercises (15 repetitions; 3 sets) with ultrasound therapy. The participants were instructed to stand at the Centre of the wobble board with their feet shoulder-width apart. The knees were kept in a slight bend position and the core was engaged.

Forward Movement

The participants were asked to weigh forward, allowing the board to tilt towards the front. As the board tilts, patients were asked to maintain balance and control the movement using their core and leg muscles. Patients were asked to try to maintain a controlled and slow movement without jerking or sudden shifts.

Backward Movement

Once the participants have mastered the forward movement, they can progress to the backward movement. The participants were asked to shift their weight backward, causing the wobble board to tilt towards the back. Again, patients were asked to focus on maintaining control and balance throughout the movement.

Ultrasound therapy

Frequency-3MHz,

Duration-15 minutes,

Mode-continuous mode; 6 sessions per week

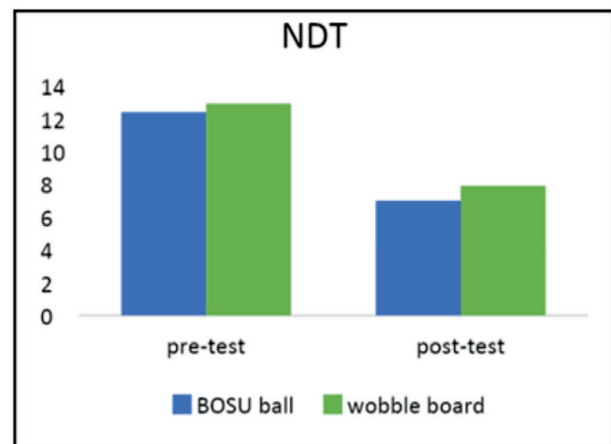
Procedure

This program was prescribed for all the subjects. During the application, a gel was used for

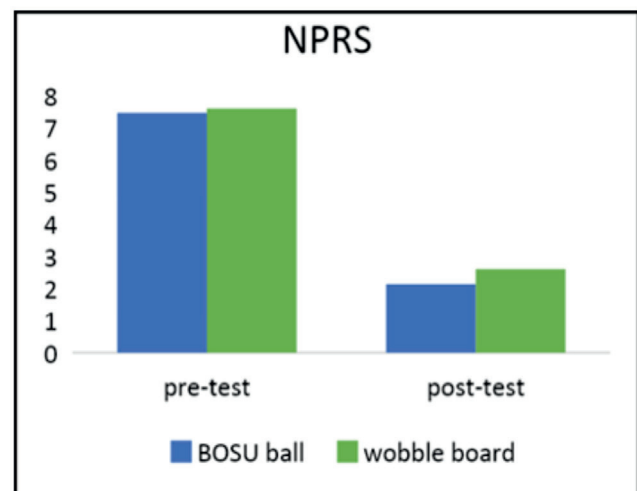
the transmission of ultrasonic waves between the transducer and the subject's skin. The treatment was provided in longitudinal strokes using the direct contact method throughout the arch.

Data Analysis

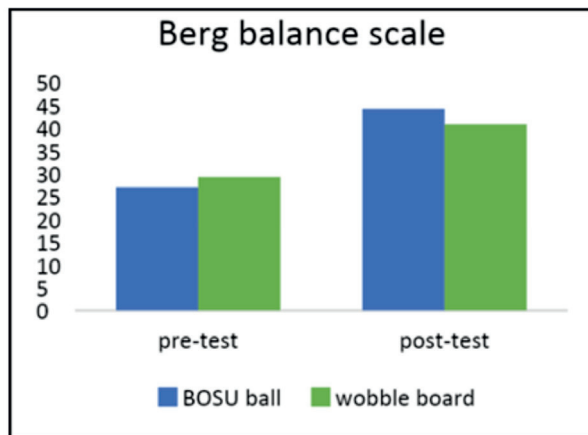
Using descriptive and inferential statistics, the data collected were tabulated and analyzed. The mean and standard deviation (SD) were applied to all parameters. The significant differences between the BOSU ball exercise group and the wobble board exercise group were analysed using an unpaired t-test. A p-value of <0.0001 was known to be statistically significant.



Graph - 1 Comparison of pre-test and post-test values of Group A and Group B using NDT



Graph - 2 Comparison of pre-test and post-test values of Group A and Group B using NPRS



Graph - 3 Comparison of pre-test and post-test values of Group A and Group B using the Berg balance scale

Result

Comparing the two intervention groups, Group A (BOSU ball) exhibited a greater reduction in pain intensity, a pronounced improvement in arch of the foot and balance compared to Group B (Wobble board exercise).

These findings suggest that BOSU ball may be a more effective approach in alleviating pain, and enhancing balance and arch of the foot for individuals with pes planus.

Overall, the study highlights the positive impact of both interventions on pain, balance and arch of the foot in individuals with pes planus, with BOSU ball demonstrating superior results.

Discussion

The foot becomes overpronated, causing the heel to evert and the weight of the body to transfer sideways, compressing the medial longitudinal arch, which is too loosened to the point where it can no longer support the arch. Due to the synchronization in their biomechanics, the decrease in height of the arch affects the ability of the foot, which leads to inflammation or tenderness in the foot. A study from India found that early footwear use, combined with a gain in overall weight and ligamentous laxity, increases the occurrence of flat feet.¹⁸

There has been extensive research on the treatment of flatfoot. In their investigation of the

impact of footwear on the flatfoot, Rao and Joseph claimed that wearing suitable footwear could aid in arch normalization.¹⁹ Bosu ball research demonstrates that exercises for the lower extremities performed with dynamic cushions on an unstable surface may result in greater activity than similar exercises for the upper limbs performed in the same posture on a stable or unstable surface.²⁰ When exercising on an unstable surface as opposed to one that is stable, proprioceptive muscles must contract more forcefully in response to the strength of the visual input.^{21,22} Also, the two most difficult balance aids the BOSU Ball and the wobble board show a kinematic perturbation that is almost eight to ten times greater than that of simply standing on the floor.²³

Studies on the mechanism of action of balancing training have revealed that it decreases antagonist muscle co-activation, despite having no effect on the agonist muscle's level of muscle activation.²⁴ Another study showed that the wobble board balance, practiced for eight weeks, significantly improved dynamic balance.²⁵ Training on unstable surfaces violates the principle of training specificity, creates unique demands, and may therefore improve dynamic balance.²⁶

According to Unver B, Erdem EU, and Akbas E, 6 weeks of short foot exercises provide a decrease in navicular drop, pain in the foot, and disability of the medial midfoot in pes planus.²⁷ The objective of a training regimen in the BOSU ball should not focus on increasing strength but rather focus on increasing stability, balance, and proprioceptive capabilities stated by Behm et al.

Conclusion

In conclusion, this study provides evidence supporting the effectiveness of BOSU ball training as a management strategy for pes planus. The findings demonstrate significant improvements in foot function, pain levels, and balance following the intervention. These positive outcomes align with recent research emphasizing the benefits of balance training on foot stability and function. BOSU ball exercises show potential for strengthening intrinsic foot muscles, restoring the medial longitudinal arch, and enhancing postural stability. Further research and long-term follow-up studies are necessary to

validate these results and assess the long-lasting effects of BOSU ball training in the management of pes planus.

Ethical clearance: Taken from the institutional ethical committee. ISRB number-03/ 060/ 2022/ ISRB/ SR/ SCPT.

Funding: Self.

Conflict of interest: Nil

Reference

- Patel M, Shah P, Ravaliya S, Patel M. Relationship of anterior knee pain and flat foot: A cross-sectional study. *International Journal of Health Sciences and Research*. 2021;11(3):86-92.
- McKeon PO, Hertel J, Bramble D, Davis I. The foot core system: a new paradigm for understanding intrinsic foot muscle function. *British journal of sports medicine*. 2018 Mar 1;49(5):290-.
- Menz HB, Fotoohabadi MR, Wee E, Spink MJ. Visual categorisation of the arch index: a simplified measure of foot posture in older people. *Journal of foot and ankle research*. 2012 Dec;5(1):1-7.
- Murley GS, Menz HB, Landorf KB. A protocol for classifying normal-and flat-arched foot posture for research studies using clinical and radiographic measurements. *Journal of foot and ankle research*. 2019 Dec;2(1):1-3.
- Queen RM, Mall NA, Hardaker WM, Nunley JA. Describing the medial longitudinal arch using footprint indices and a clinical grading system. *Foot & ankle international*. 2017 Apr;28(4):456-62.
- Abdel Fattah MM, Hassanin MM, Felembane FA, Nassaane MT. Flat foot among Saudi Arabian army recruits: prevalence and risk factors. *EMHJ-Eastern Mediterranean Health Journal*, 12 (1-2), 211-217, 2019.
- Abolarin TO, Aiyegbusi AI, Tella BA, Akinbo SR. Relationship between selected anthropometric variables and prevalence of flatfoot among urban and rural school children in south west Nigeria. *Nigerian quarterly journal of hospital medicine*. Apr 1;21(2):135-40.
- Echarri JJ, Forriol F. The development in footprint morphology in 1851 Congolese children from urban and rural areas, and the relationship between this and wearing shoes. *Journal of pediatric orthopaedics B*. Mar 1;12(2):141-6.
- Shibuya N, Jupiter DC, Ciliberti LJ, VanBuren V, La Fontaine J. Characteristics of adult flatfoot in the United States. *The Journal of foot and ankle surgery*. 2020 Jul 1;49(4):363-8.
- Sachithanandam V, Joseph B. The influence of footwear on the prevalence of flat feet. A survey of 1846 skeletally mature persons. *The Journal of bone and joint surgery. British volume*. 2019 Mar;77(2):254-7.
- Haller T, Galvin M, Meroka P, Alca J, Alvarez A. Who gains from community conservation? Intended and unintended costs and benefits of participative approaches in Peru and Tanzania. *The Journal of Environment & Development*. 2018 Jun;17(2):118-44.
- Kalra S, Pal S, Pawaria S, Yadav J. Comparative Study of Wobble Board and Bosu Ball along with Strength Training on Lower Limb Strength, Dynamic Balance, Agility and Functional Performance of Runners with Lateral Ankle Instability. *Journal of Clinical & Diagnostic Research*. 2021 May 1;15(5).
- Lippincott williams & wilkins. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription; 2013 Mar 4.
- Elfateh AI. Effects of ten weeks of instability resistance training (BOSU ball) on muscular balance and the learning level of fencing basics. *Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health*. 2018 Jul 2;16.
- Dusa FS, Badau A, Badau D, Trambitas C, Brinzaniuc K. Investigating the deformation parameters of PVC fitness balls in relation to the height and body mass index of the users. *Mater. Plast*. 1;54(4):606-9.
- Franché C, inventor; Therrex Innovations LLC, assignee. Balance board for exercise and physical therapy. United States patent US 9,700,756. 2017 Jul 11.
- Romero-Franco N, Martínez-López EJ, Lomas-Vega R, Hita-Contreras F, Osuna-Pérez MC, Martínez-Amat A. Short-term effects of proprioceptive training with unstable platform on athletes' stabilometry. *The Journal of Strength & Conditioning Research*. 2018 Aug 1;27(8):2189-97.
- Sachithanandam V, Joseph B. The influence of footwear on the prevalence of flat foot. A survey of 1846 skeletally mature persons. *The Journal of bone and joint surgery. British volume*. 2018 Mar;77(2):254-7.
- Rao UB, Joseph B. The influence of footwear on the prevalence of flat foot. A survey of 2300 children. *The Journal of bone and joint surgery. British volume*. 2020 Jul;74(4):525-7.

20. Badau A, Badau D, Enoiu RS. Evaluation of stable balance capacity by using bosu ball surfaces on different pressure levels. *Mater. Plast.* 2019 Mar 30;56:216-9.
21. Cosio-Lima LM, Reynolds KL, Winter C, Paolone V, Jones MT. Effects of physio ball and conventional floor exercises on early phase adaptations in back and abdominal core stability and balance in women. *The Journal of Strength & Conditioning Research.* 2003 Nov 1;17(4):721-5.
22. Norwood JT, Anderson GS, Gaetz MB, Twist PW. Electromyographic activity of the trunk stabilizers during stable and unstable bench press. *The Journal of Strength & Conditioning Research.* 2007 May 1;21(2):343-7.
23. Strøm M, Thorborg K, Bandholm T, Tang L, Zebis M, Nielsen K, Bencke J. Ankle joint control during single-legged balance using common balance training devices—implications for rehabilitation strategies. *International journal of sports physical therapy.* 2016 Jun;11(3):388.
24. Acar H, Eler N. The Effect of Balance Exercises on Speed and Agility in Physical Education Lessons. *Universal Journal of Educational Research.* 2019;7(1):74-9.
25. Sonapat H. Effect of wobble board balance training program on static balance, dynamic balance & triple hop distance in male collegiate basketball athlete. *International journal of physiotherapy and research.* 2014;2(4):657-62.
26. Cressey EM, West CA, Tiberio DP, Kraemer WJ, Maresh CM. The effects of ten weeks of lower-body unstable surface training on markers of athletic performance. *The Journal of Strength & Conditioning Research.* 2007 May 1;21(2):561-7.
27. Unver B, Erdem EU, Akbas E. Effects of short-foot exercises on foot posture, pain, disability, and plantar pressure in pes planus. *Journal of sport rehabilitation.* 2019 Oct 18;29(4):436-40.