

Effectiveness of Jumping Rope Exercise Verses Short Foot Exercise on Pain and Quality of Life for Subjects with Flat Foot

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Abstract

Background: Pes planus, commonly known as flat foot, is a deformity that leads to the collapse of the medial longitudinal arch and flattening of the foot against the ground. This study aims to compare the effectiveness of jumping rope exercise and short foot exercise on pain reduction and improvement in quality of life for patients with flatfoot.

Purpose: To find out the effect of Jumping rope exercise versus short foot exercise among individuals with flatfoot.

Method: A sample of 30 participants who met the inclusion and exclusion criteria were selected for the study. They were divided into two groups: the jumping rope exercise group with ultrasound (n=15) and the short foot exercise group with ultrasound (n=15). The interventions were administered five times a week for three weeks. The entire process was performed from November 2022 to April 2023.

Outcome measure: The navicular drop test (NDT) was used to measure the degree of foot pronation, the Numeric Pain Rating Scale (NPRS) was employed to assess pain levels, and the Foot Health Status Questionnaire (FHSQ) was utilized to evaluate participants' quality of life.

Results: The mean value of the jumping rope exercise group at the post-test was significantly higher than that of the short foot exercise group, with a p-value of <0.0001

Conclusion: Based on the findings, it can be concluded that jumping rope exercise with ultrasound therapy yields superior outcomes in managing Pes Planus compared to short foot exercise.

Keywords: Flatfoot exercise, Jumping rope, Pes Planus, Foot Health Status Questionnaire

Introduction

The human foot has an extraordinarily complex architecture that allows it to execute a wide range of activities. It provides a stable basis for standing. The foot must be secure during push off and foot strike during gait. These bones and the Ligaments

that surround them and create the medial, lateral and longitudinal arch. The structure and dynamics of the foot arch are critical for the foot to execute functions such as shock absorption, transmission of body weight, and acting as a lever to drive the body forward during locomotion.¹

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Classification: Flatfoot can be classified in to pathological and physiological pathological: Children with underlying disorders are more prone to develop pathological flatfoot, which is characterized by foot stiffness, tends to persist, and commonly leads in disability.²

Flat foot biomechanics include calcaneal drift, posterior tibial tendon, forefoot displacement, mid foot laxity. When functioning properly, the foot is an outstanding, adaptable, and effective aid in movement, whether walking, running, leaping, traveling uphill or downhill, or overcoming slippery surfaces.³ Foot dysfunction is frequently manifested by the lack of normal foot function. As a result of the structural support, the form of the object changes. The loss of the medial longitudinal arch may be caused by a mismatch between the forces that operate to sustain and flatten the arch.⁴

The prevalence of flatfoot is relatively high (ranging from 21% to 57%) in the adult population, but decreases to around 5% to 14% when considering prevalence among adults and most prevalent cause of acquired flat feet is a combination of excessive strain on the arch and insufficient arch support.⁵ The biomechanics of a normal arch when responding with a therapy that strengthens the arch's supporting structures or reduces the influences that flatten the arch. The arch-supporting muscles, particularly the posterior tibial tendon, play a decreased role in maintaining the arch after surgeries or after hindfoot fusions.⁶ Re balancing the forces pressing on the arch can improve performance while minimizing the chance of deformity development in the future.⁷⁻⁹

The jump ropes or skipping ropes are the one which are easily available, affordable and which tend to improve the overall cardiorespiratory health and agility Improved strength can be tested to better the arch in patients with flat foot which in turn reduces the pain at the knee joint.¹⁰⁻¹²

Aim

The aim of this study is to determine whether jumping rope exercise or short foot exercise have an effect on pain and quality of life in subjects with flatfoot.

Methods

It was a comparative study conducted on 30 subjects with Flatfoot, age between 18-25 years. Convenient sampling with random allocation method was used in the study.

Inclusion criteria:

1. Both Genders
2. Age 18 To 25yrs
3. Subjects with Navicular Drop Test Positive
4. Jack's Test Positive

Exclusion criteria:

1. Recent Fracture In Lower Extremities
2. Neurological Disorder

Outcome measures

The navicular drop test (NDT) was used to measure the degree of foot pronation.

The Numeric Pain Rating Scale (NPRS) was employed to assess pain levels.

The Foot Health Status Questionnaire (FHSQ) was utilized to evaluate participants' quality of life.

Procedure

The finalized Subjects Were Randomly Allocated Into 2 Group; Group A (N=15) And Group B (N=15). The Experimental Group were Given Jumping Rope Exercises, While The Control Group were Given with Short Foot Exercises. Both Group are combined with Conventional Therapy such as stretches and ultrasound given to improve arch formation to reduce Pain and to Improve Quality of life. This study contain outcome measure such as Navicular Drop Test that can be used to access the arch, NPRS can be used to assess the pain and to quantify reduction in pain after treatment and finally Foot health status questionnaire (FHSQ) that can be used to assess and find out how quality of life was improved to the patient

Group A: Jumping Rope Exercises

Participants in Group A were assigned to jump rope; the leap was conducted barefoot and the individuals were instructed to jump on their toes. Session - 3 sessions each repetitions: 12 per day, rest

time: 5 seconds, hold time: 10 seconds, frequency: 5 days per week, duration: 3 weeks combined with conventional therapy and pain management of ankle discomfort with ultrasound 3mhz for 10 minutes 5 days per week

Group B: Short Foot Exercises

Participants were allocated to undertake a short foot workout with exercise. Session – two sessions each day, repetitions – 12 repeats per day Rest time is 5 seconds, hold time is 10 seconds, and the frequency is 5 days per week. Combined with pain treatment for ankle discomfort with ultrasound at 3 mhz for 10 minutes five days a week and conventional therapy.

Both group A and group B are combined with conservative management for pain

Gastrocnemius stretch: The individuals are advised to stand three feet away from a wall and place their right foot behind them, toes pointing front. Then they lean forward with their right knee straight and their heel on the ground.

Soleus stretch: Individuals should take a step back from a wall, place their foot behind it, and make sure their toes face front. Then they lean forward at the ankle, bending the right knee and keep the heel on the ground.

Heel Lifting: The individuals were told to lift their heels while maintaining their toes and forefoot on the ground.

Toe Lifting: To develop the lower leg muscles, the patients were advised to lift their toes and forefoot off the floor while maintaining their heels on the ground

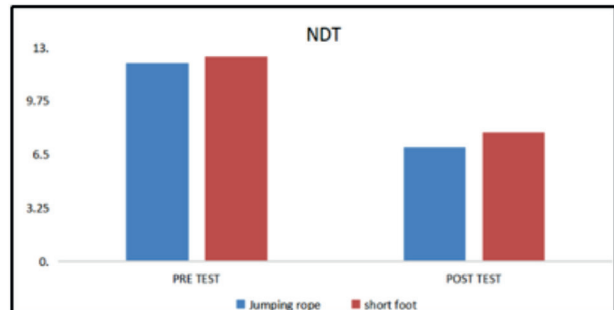
Parameters for ultrasound therapy-

Frequency – 3MHz, Duration – 10 minutes, Intensity – 1W/Cm², Mode – continuous

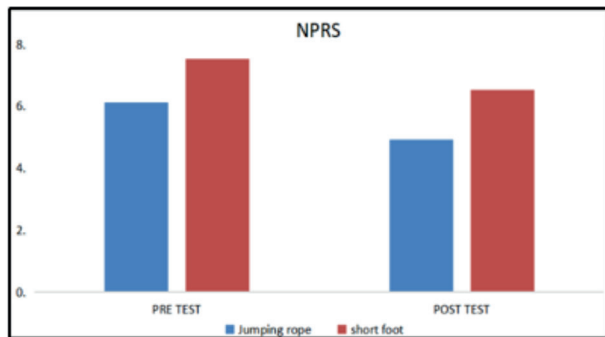
Procedure: This curriculum was mandated for all courses. A gel was utilized during the application to transmit ultrasonic waves between the transducer and the subject's skin. The therapy was given in longitudinal strokes along the arch using the direct touch approach (10 minutes; continuous mode; 5 sessions per week for 3 weeks)

Data analysis

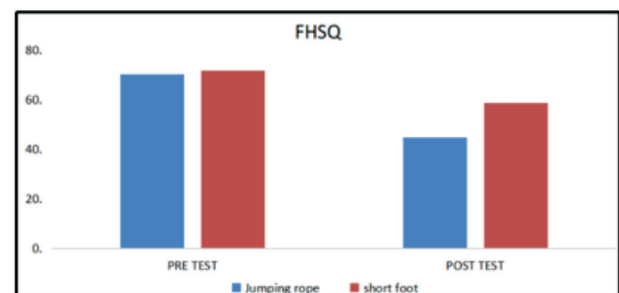
Pre-test and post-test values of Navicular Drop Test, Numerical Pain Rating Scale and Foot Health Status Questionnaire are analyzed were analysed for flatfoot.



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 Foot Health Status Questionnaire

Results

All 30 subjects completed the study successfully pre-test and post-test values of NDT, NPRS, FHSQ were presented in the following graphs 1,2,3.

Statistical analysis shows there is a significant improvement from pre intervention to the post.

Discussion

Pes planus is a rather common adult illness. Adult flat foot is a foot condition that arises at skeletal maturity and is distinguished by partial or entire loss (collapse) of the medial longitudinal arch. Foot alterations may result in variations to the needed plantar contact area in footprints.

Using this data, many researchers assessed arch height using footprints, and numerous criteria for identifying arch groups were presented.¹³ In terms of the effect of jumping rope exercises on balance, the current study indicated that the Experimental group's (jumping rope exercise) improved arch and balance greatly after intervention. They said that 8 weeks of jumping rope and brief foot exercise training increased arch development, muscular strength of calf muscles, and it is the most essential muscle to maintain the arch and balance.¹⁴

Myer et al. stated That Jumping rope improved balance skills, and employed jumping rope activities, which are a sort of plyometric exercise.¹⁵ Findings of Chaouachi et al were congruent with our findings when they said that Jumping rope training improved balance, jumping ability, and squat strength metrics.¹⁶

In the current experiment, ankle plantar flexion was the only gain in muscle strength (torque) necessary to create vertical-jump force in the land training group. The improvement in balance abilities following jumping rope exercise might be attributed to the quick stretch-shortening cycle, which combines center of gravity movements in both vertical and horizontal directions, potentially improving postural control and equilibrium.¹⁷

As per Dong-chul moon et al, apart from improving postural stability and muscular activation, brief foot training improved dynamic balance in flexible flatfoot individuals with excessively pronated feet.¹⁸ Eunsang lee et al, Short foot exercises used for balance training function to increase ankle proprioception and develop intrinsic foot muscles support and improve dynamic standing balance.¹⁹ In contrast to these two varieties of flexible flatfoot, Harris and Beath classified stiff flatfoot - stiff flatfoot

is defined by a restriction in subtalar joint movement. When the individual's foot is dangling in the air while seated, as well as during toe-standing and the toe-raising test, the arch remains flat. On occasion, this type of flatfoot can cause discomfort and immobility. The improved proprioception and neuromuscular control as a result of jumping rope exercise helped with balance development.²⁰

In flexible flatfoot, the medial longitudinal arch of the foot collapses to variable degrees during weight bearing. However, by standing on tiptoe (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.²¹

Conclusion

In conclusion, this study provides empirical evidence supporting the efficacy of jumping rope exercise as a viable management strategy for individuals with flatfoot. The findings indicate significant improvements in pain levels and quality of life following the intervention. Jumping rope exercise demonstrates positive effects on arch formation, muscle tightness, range of motion, in the management of flatfoot.

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Conflict of interest: Nil

Reference

1. Henry JK, Shakked R, Ellis SJ. Adult-acquired flatfoot deformity. *Foot & ankle orthopaedics*. 2019 Jan 14;4(1):2473011418820847.
2. Flores DV, Mejía Gómez C, Fernández Hernando M, Davis MA, Pathria MN. Adult Acquired Flatfoot Deformity: Anatomy, Biomechanics, Staging, and Imaging Findings. *Radiographics: a review publication of the Radiological Society of North America, Inc*. 2019 Sep 1;39(5):1437-60.
3. Aenumulapalli A, Kulkarni MM, Gandotra AR. Prevalence of flexible flat foot in adults: a cross-

- sectional study. *Journal of clinical and diagnostic research: JCDR*. 2017 Jun;11(6):AC17.
4. Atik A, Ozyurek S. Flexible flatfoot. *Northern clinics of Istanbul*. 2014;1(1):57.
 5. Aenumulapalli A, Kulkarni MM, Gandotra AR. Prevalence of flexible flat foot in adults: A cross-sectional study. *Journal of clinical and diagnostic research: JCDR*. 2017 Jun;11(6):AC17.
 6. Xu L, Gu H, Zhang Y, Sun T, Yu J. Risk Factors of Flatfoot in Children: A Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health*. 2022 Jul 6;19(14):8247.
 7. Yu HB, Tai WH, Li J, Zhang R, Hao WY, Lin JZ. Effects of Shoe Midsole Hardness on Lower Extremity Biomechanics during Jump Rope in Healthy Males. *InHealthcare* 2021 Oct 18 (Vol. 9, No. 10, p. 1394). MDPI.
 8. Karpińska A, Wrzesiński B, Łopatka P, Piechocka E. Exercises of the short-foot as a method of pes planus treatment. *Journal of Education, Health and Sport*. 2018 Jul 16;8(8):359-68.
 9. Yu HB, Li J, Zhang R, Hao WY, Lin JZ, Tai WH. Effects of Jump-Rope-Specific Footwear Selection on Lower Extremity Biomechanics. *Bioengineering*. 2022 Mar 24;9(4):135.
 10. Mashhadi M. Foot arch index during Jana's Short-Foot maneuver in subjects with excessively pronated feet. *Medicina Sportiva: Journal of Romanian Sports Medicine Society*. 2017 Apr 1;13(2):2935-9.
 11. Allam HH, Muhsen A, Al-Walah MA, Alotaibi AN, Alotaibi SS, Elsayyad LK. Effects of plyometric exercises versus flatfoot corrective exercises on postural control and foot posture in obese children with a flexible flatfoot. *Applied Bionics and Biomechanics*. 2021 Oct 31;2021.
 12. Riccio I, Gimigliano F, Gimigliano R, Porpora G, Iolascon G. Rehabilitative treatment in flexible flatfoot: a perspective cohort study. *Musculoskeletal Surgery*. 2009 Dec;93(3):101-7.
 13. Volpon JB. Footprint analysis during the growth period. *Journal of pediatric orthopedics*. 1994 Jan 1;14(1):83-5
 14. Arazi H, Asadi A. The effect of aquatic and land plyometric training on strength, sprint, and balance in young basketball players. *Journal of Human Sport and Exercise*. 2011;6(1):101-11
 15. Myer GD, Ford KR, PALUMBO OP, Hewett TE. Neuromuscular training improves performance and lower-extremity biomechanics in female athletes. *The Journal of Strength & Conditioning Research*. 2005 Feb 1;19(1):51-60
 16. Chaouachi A, Othman AB, Hammami R, Drinkwater EJ, Behm DG. The combination of plyometric and balance training improves sprint and shuttle run performances more often than plyometric-only training with children. *The Journal of Strength & Conditioning Research*. 2014 Feb 1;28(2):401-12.
 17. Miller MG, Berry DC, Bullard S, Gilders R. Comparisons of land-based and aquatic-based plyometric programs during an 8-week training period. *Journal of Sport Rehabilitation*. 2002 Nov 1;11(4):268-83
 18. Moon DC, Kim K, Lee SK. Immediate effect of short-foot exercise on dynamic balance of subjects with excessively
 19. Matsumoto T, Chang SH, Takeda R, Tanaka S, Juji T. Bilateral stress fractures of the talus associated with adult-acquired flatfoot deformities. *Case Reports in Orthopedics*. 2018 Sep 9;2018.
 20. Alghadir AH, Gabr SA, Rizk AA. Plasmatic adipocyte biomarkers and foot pain associated with flatfoot in schoolchildren with obesity. *Revista da Associação Médica Brasileira*. 2019 Sep 12;65:1061-6.
 21. Sulistyowati AA, Rosida L. Effect Short Foot Exercise On The Medial Longitudinal Arch In Flat Foot Patients: Narrative Review. *InProsiding University Research Colloquium* 2021 Dec 8 (pp. 549-562).