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Original Research Article

Immediate Effect of Neural Tissue Mobilization on Tibial Nerve Mobility in Individuals with Flatfeet

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ABSTRACT

Introduction: Tarsal tunnel syndrome is compression of the posterior tibial nerve as it travels through the tarsal tunnel. Individuals with flatfeet are prone to develop tarsal tunnel syndrome as there is outward tilting of heel which flattens the medial arch. Neural tissue mobilization is a manipulative technique by which neural tissues are moved and stretched either by movement relative to their surroundings or tension development. The aim of the study was to see the effect of neural tissue mobilization on tibial nerve mobility in subjects with flat feet.
Methodology: An experimental study was conducted on twenty four participants,18-30 years of age, with bilateral flatfeet by positive navicular test with no symptoms. Individuals with symptoms, severe hamstring tightness, and recent ankle sprain were excluded. Straight leg raise (SLR) was performed by therapist on one leg, till a stretching sensation distal to knee in the area of tibial nerve was observed. Once symptoms appeared double ended sliders targeting knee and ankle were given, 3 repetitions on any side. The other limb was used as a control limb. Results were noted in the form of range of motion (ROM) of SLR and compared using independent sample t test.
Result: Difference in mean SLR between both groups (19 ± 1.3, $t=6.25$, $p<0.001$, CI=12.28 to 23.96) was statistically significant.
Conclusion: Neural tissue mobilization can be given as an intervention to improve SLR range of motion in individuals with flat feet. Further studies can be done to see prevention of compression of tibial nerve in individuals with flat feet with neural mobilization.

Keywords: Flatfoot, neural tissue mobilization, tibial nerve

INTRODUCTION

The human foot has 26 bones, ten major extrinsic tendons and their respective muscles, numerous intrinsic musculotendinous units, and more than 30 joints. These musculoskeletal structures work together with the neurovascular elements, fat pads, and skin to provide a mobile, adaptive foundation during standing and to provide a means of balance and locomotion during gait.[1] The tarsal tunnel is a narrow fibro-osseous space that runs behind and inferior to the medial malleolus. It is bound by the medial malleolus anterosuperiorly, by the posterior talus and calcaneus laterally, and is held against the bone by the flexor retinaculum which extends from the medial malleolus to the medial calcaneus and prevents medial displacement of its contents. It contains the tendons of the posterior tibialis, flexor digitorum longus (FDL), and flexor hallucis longus (FHL) muscles the posterior tibial artery and vein, as well as posterior tibial nerve (L4-S3).[2]

Flat feet also known as pes planus or fallen arches, is a condition in which the medial longitudinal arch of the feet, which runs lengthwise along the sole of the foot is lowered or flattened out. Causes for functional flat feet are intrinsic muscle fatigue, plantar muscle weakness, ligament hypermobility, obesity, and inappropriate footwear. There are biomechanical changes occurring with flat feet like eversion of calcaneus in relation to talus and medial rotation of navicular bone.[3] One foot or both feet may be affected. The weight and pressure from flat feet can compress the tibial nerve. Individuals with flatfoot (both males & female) are prone to develop tarsal tunnel syndrome as there is outward tilting of heel which flattens the medial arch.[4] Valgus heel is an identifiable cause of Tarsal tunnel syndrome (TTS). A tarsal tunnel syndrome can develop by increasing the tibial nerve pressure in valgus heel with associated flat foot.[5]The posterior tibial nerve passes into the foot running posterior to the medial malleolus in the tarsal tunnel.[6] Tarsal tunnel syndrome is caused by compression of the posterior tibial nerve as it travels through the tarsal tunnel. Compression of the posterior tibial nerve can cause pain, tingling or numbness in the foot.[7] It has been established that adults with flexible flat feet have a significantly increased likelihood of reporting back or lower limb pain, foot pain, hallux abducto-valgus, callus, hammertoes and degenerative joint disease.[8] The navicular drop test (NDT) has been widely used as a clinical method to assess foot mobility.[9]

Neurodynamic assessment and treatment methods focus on nerve mobility- both intraneural (between neural connective tissue sheaths) and extraneural (between nerve and its surrounding structures).[10] Neural tissue mobilization is a manipulative technique by which neural tissues are moved and stretched either by movement relative to their surroundings or tension development.[11] Sliders and tensioners are two techniques which form an integral part of comprehensive neurodynamic assessment and treatment in manual therapy which addresses symptoms originating from peripheral nerves. Biomechanically, the slider technique stretches the nerve at one end while relaxing at another; the tensioner technique stretches the nerve at both the ends.[12]

Thus it can be seen that tibial nerve compression may occur as a long term effect of flat feet. Studies about neural mobilization in tarsal tunnel syndrome are few. So this study aims to see the effect of neural tissue mobilization on tibial nerve mobility in subjects with flat feet with no symptoms.

MATERIALS & METHODS

An experimental study was conducted at SBB College of physiotherapy with twenty four participants. Institutional Ethics committee approval was not taken. Estimated sample size was 24 which were based on a pilot study. Twenty four participants having flat feet were included. All participants met the following inclusion criteria: male or female, age between 18-30 years having bilateral flat feet diagnosed by the navicular drop test with no symptoms in the feet or elsewhere. Participants with history of congenital deformity in the foot; previous history of foot fractures, history of pain in either foot, individuals with symptoms related to flatfeet, severe hamstring tightness were excluded. Informed consent to participate was obtained. Random allocation of any foot was done to one of two group -group 1 (Experimental group) and group 2 (Control group) using the lottery method. Procedure is shown in figure 1.

Participants were first screened for flat feet using Navicular drop test (NDT).[13] 65 participants were screened, of which 24 had bilateral flat feet. NDT to assess presence of flat feet was performed with the participant in high sitting on a firm surface with the navicular bone marked bilaterally. The participant's subtalar joint was first placed in neutral position using palpation and the height of the navicular bone from the floor was marked on an index card placed on the medial aspect of the foot. The participant was then asked to relax their feet in standing and the resulting lower position of the navicular bone was also marked on the card. The difference between the two marks is navicular drop and indicates the amount of foot pronation or flattening of the medial longitudinal arch during standing. Any measurement greater than 10mm is considered as a flatfoot[14].

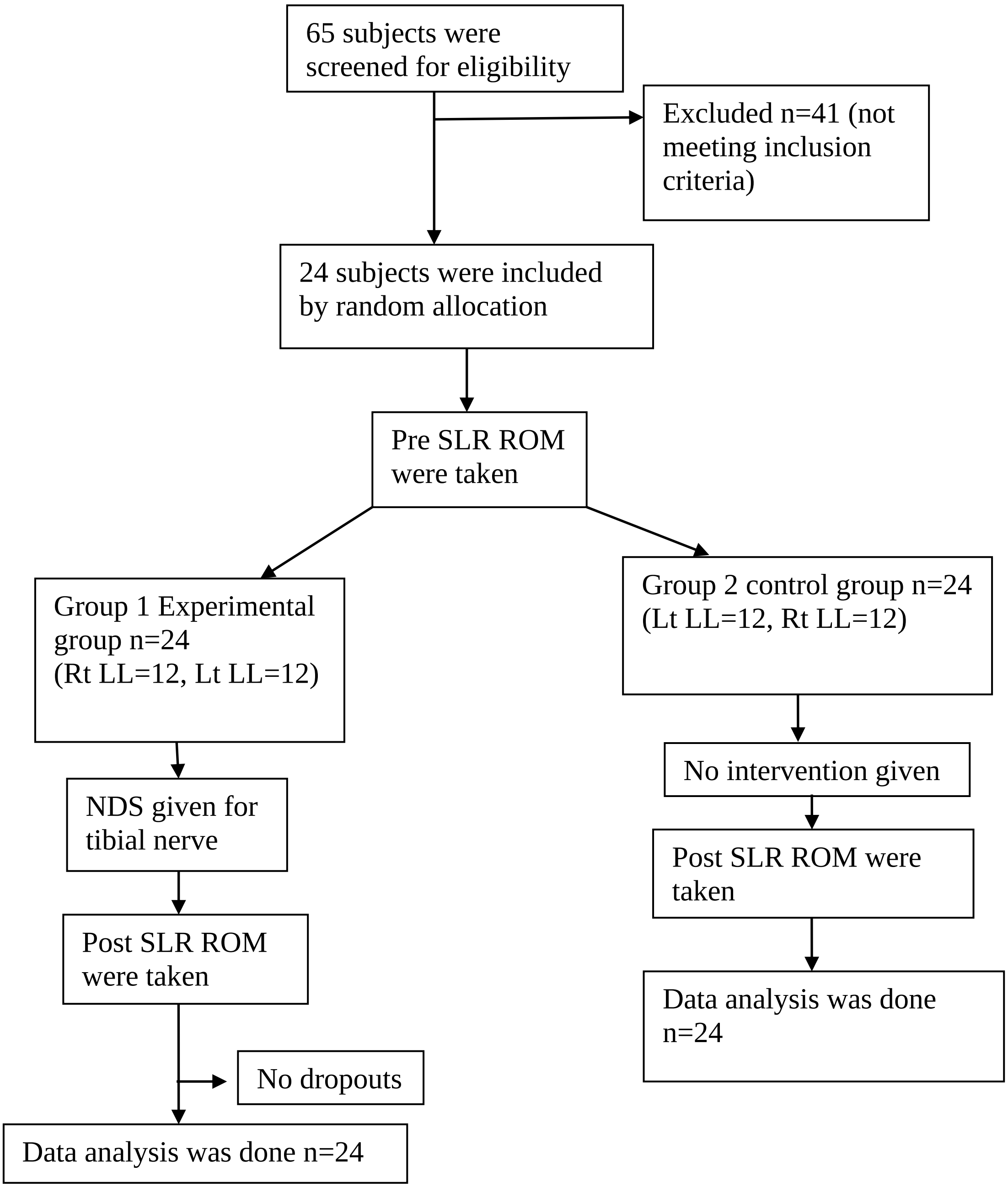

Figure 1: Flow chart showing study selection processes

At the beginning of the procedure, the straight leg range of motion was measured for both lower limbs. One leg was randomly allocated to experimental group and one leg to the control group. For the intervention with neurodynamics (NDS) the participant was taken into the supine position. With ankle in dorsiflexion and eversion, straight leg raise was performed by the therapist till a stretching sensation distal to knee in the area of tibial nerve was observed. Once symptoms appeared double ended sliders targeting the knee and ankle were given. The participants were asked to maintain normal curvature of the head and spine. The participant’s foot was held using the hand of the therapist. Subsequently, knee flexion, dorsiflexion, and eversion of the foot were performed on the subject in order to conduct the neurodynamic technique of the distal tibial nerve. To perform the neurodynamic technique of the proximal tibial nerve, knee extension, plantar flexion, and inversion of the foot were done simultaneously and 3 repetitions were given. The SLR range was measured at the end of the intervention for both limbs.

STATISTICAL ANALYSIS

Statistical analysis was done using SPSS version 20. Level of significance was kept at 5%. The data was found to be normally distributed so independent t test was used to compare the mean SLR ROM at the end of the intervention.

RESULT

Twenty four participants (mean age 22.10±1.88 years) completed the study. Graph 1 shows the SLR ROM before and after intervention in both groups. Mean difference in SLR between experimental and control group (19±1.3 degrees, t=6.25, p<0.001,CI=12.28 to 23.96) was found to be statistically significant as shown in table 1.

Table 1: Results of the two groups

Group	Mean±SD SLR ROM (degrees)	t value	P value
Control	51.87±10.71	6.25	< 0.001
Experimental	70±9.31		

DISCUSSION

Present study shows tibial nerve mobilization has an effect on Straight leg raise Range of motion and improves tibial nerve mobility among individuals with flat feet with no symptoms. Not many studies have been done in a similar population. However, P. Senthil Kumar et al found that tibial nerve neurodynamic mobilization can be considered as an effective treatment of neuropathic pain symptoms in type II diabetes mellitus patients. They also added that the slider techniques improve gliding without compromising the nerve circulation or increasing nerve tension.[15] Mobilization of the nervous system is an approach founded on affecting pain physiology by mechanical manipulation of nervous tissues and non-neural structures in an area of the nervous system. Techniques for the mobilization of nervous tissue consist of passive or active movements focused on recovering the nervous system's ability to tolerate normal pressure, frictional and tensile force, typical for everyday and sports activities, i.e. to reduce mechanosensitivity of the nervous system and recover its usual movement abilities. Neural mobilization has a positive effect on symptoms due to improvement of intraneural circulation, axoplasmatic flow, viscoelasticity of neural connective tissue and reduction of sensitivity of AIGS – abnormal impulse generating sites.[16] Passive straight leg raise sciatic nerve mobilization done among patients with neurogenic low back pain was found to improve pain, hip flexion ROM, decreasing symptom distribution and reducing disability.[17] Jennifer M. Medina McKeon et al showed that neural gliding exercise may aid in the reduction of neural symptoms and improvement in function in patients with CTS.[18]

The nervous system possesses a natural ability to move and withstand mechanical forces that are generated by daily movements, helps in the prevention of injury and malfunction. Nervous system must successfully execute three primary mechanical functions: withstand tension, slide in its container, and be compressible, to move normally. The first of the primary mechanical events in the nervous system is the generation of tension. Since the nerves are attached to each end of their container are lengthened by elongation of the container, So it can improve ROM. The second primary mechanical event in the nervous system is the movement of the neural structures relative to their adjacent tissues. This is also called excursion, or sliding, and occurs in the nerves longitudinally and transversely. Excursion is an essential aspect of neural function because it serves to dissipate tension in the nervous system.[19]

Limitation of this study is that long term effect of neurodynamic solutions on flat feet without symptoms was not seen. Further studies can be designed on subjects having flat feet with symptomatic tarsal tunnel syndrome. Further studies can also be done to see prevention of compression of tibial nerve in individuals with flat feet with neural mobilization.

CONCLUSION

Neural tissue mobilization can be given as an intervention to improve tibial nerve mobility in individuals with flat foot.

Declaration by Authors

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