Experimental Study

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To Determine the Effectiveness of Tibialis Posterior Strengthening along with Conventional Therapy on Ankle Dorsiflexion Range of Motion, Functional Status and Navicular Position in Patients with Plantar Fasciitis

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Abstract

Background: Plantar fasciitis is most common cause of heel pain. Plantar fasciitis is common inflammatory condition of the plantar fascia and surrounding perifascial structure. Strengthening of tibialis posterior along with conventional therapy helps to improve functional status, ankle dorsiflexion range of motion and navicular position.

Method: 40 subjects with plantar fasciitis participated in the experiment study underwent treatment duration for four weeks after giving their informed consent. They were evaluated and randomize into experimental group receiving tibialis posterior strengthening along with conventional therapy and control group receiving only conventional therapy. The pre and post values of ankle dorsiflexion range of motion, Navicular drop and Foot Function were recorded at start of the treatment and consequently after the end of treatment.

Conclusion: Tibialis posterior strengthening along with conventional therapy were found to be more effective in improving functional disability, ankle dorsiflexion ROM and Navicular drop values. Tibialis posterior strengthening shows better result in improving over pronation of foot, hence decreasing risk of plantar fasciitis.

Keywords: Plantar Fasciitis (PF), Tibialis Posterior Strengthening, Conventional therapy, Navicular drop test (NDT), Foot Function Index (FFI), Iontophoresis, Windlass Mechanism.

Introduction

The plantar fasciitis also known as Heel pain, Plantar fasciopathy, Jogger's heel, Painful heel syndrome, Heel spur syndrome, Runner's heel, Sub calcaneal pain, Calcaneodynia and Calcaneal periositis.[1,2,3] The word "fasciitis" assumes inflammation is an inherent component of this condition.[4] Plantar fasciitis is defined as an inflammation of the origin of the plantar fascia and surrounding perifascial structure.[5] In general population 40 – 60 years of age group is in higher risk of plantar fasciitis. Women are more prone than men and have reported higher incidence of persisting symptoms. [6,7]

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The etiology of PF is various faulty biomechanics such as pes planus (excessive pronation), claw toes, pes cavus (high arch) and prominent metatarsal heads.[3] Overpronation contributes excessive foot mobility, which can increase the 2 level of stress applied to the musculofascial and soft tissue structures through plantar fascial elongation and increase tissue stress. reduction in the strength of hip abductors and lateral rotators can lead to adduction and medial rotation of the hip and dynamic knee valgus, which is related to pronation of the foot.[8]

Predisposing factors of plantar fasciitis are obesity (common in middle aged female) or sudden weight gain/High body mass index >30kg/m2, degenerative changes with increased age, functional alteration in gait cycle, abnormal foot biomechanics, anatomy of foot deformity such as pes planus and pes cavus, standing on hard surface, leg length discrepancy, traumas, decrease ankle dorsiflexion range of motion, tightness in calf and hamstring muscle.[1,3,6,7,8,9,10,11,12,13,14]

Some risk factors are occupational activity require prolong standing and walking involving teachers, construction workers, cooks, nurses, military personnel, athletes, dancers.[14]

The plantar fascia originates from the medial originates from the medial calcaneal tuberosity, dividing into 3 bands, medial, central, and lateral band that connect to the superior surface of the abductor hallucis, flexor digitorum brevis, and abductor digiti minimi musculature, respectively.[13,14] The central portion is thick, with thinner medial and lateral bands that help maintain the longitudinal arch. It is triangular and divided into five bands at the mid metatarsal level which is further subdivided into a deep tract and a superficial tract.[16] The foot has a visible medial longitudinal arch (MLA), resembles rods. These rods are connected at their base by the plantar fascia. When force is applied to the apex of the MLA, the arch depresses, the two rods separate, and tension is distributed throughout the plantar fascia. The main ligaments are the long and short plantar ligaments and calcaneonavicular ligament (spring ligament) which support MLA.[14] Tibialis posterior is deeply situated in the posterior compartment of the lower leg, between the flexor digitorum longus and flexor hallucis longus. It is a main muscle to supporting the medial arch of the foot. Tibialis posterior dysfunction can lead to flat feet and weak arch control in adult. Abductor hallucis, flexor digitorum brevis, flexor hallucis longus also help to stabilize and re supinate the foot.[14]

The windlass mechanism expresses the manner by which the plantar fascia supports the foot during weightbearing activities and provides information regarding the biomechanical stresses placed on the plantar fascia. Truss arch formed by the calcaneus, midtarsal joint, and metatarsals (the medial longitudinal arch) and tie rod which is run from the calcaneus to the phalanges is formed by the plantar fascia. Ground reaction forces travel upward though calcaneus and the 6 metatarsal heads, which can further attenuate the flattening effect because these forces fall both posterior and anterior to the tibia. The heel-cord tightness is seen in patients with plantar fasciitis and it restricts dorsiflexion range during gait. A person with a flexible foot type can compensate for this limit of ankle dorsiflexion by unlocking the midtarsal joint because dorsiflexion and abduction are movements permit at the midtarsal joint's oblique axis and this increased motion results in excessive pronation that can stress the plantar fascia. Increased internal rotation of lower leg, which accompanies over pronation of the subtalar joint. More transverse rotation must be absorbed in the knee joint with subsequent disturbance of the normal tibio-femoral rotation relational relationship and disturb in normal patellofemoral mechanics. A now-rigid first ray promotes further locking of the tarsus by tightening the plantar fascia.[8]

Symptoms related with plantar fasciitis is pain with first few steps in the morning and discomfort in the inferior heel region, which is provoke on weight bearing after a period of non-weight bearing. Symptoms settle, only after period of rest and/or later in the day.[9,17]

The diagnosis of plantar fasciitis is usually based on clinical features, specifically pain localized on medial tubercle of calcaneus. A positive windlass test, navicular drop test and assessment of ankle range of motion are useful.[15,18,19]

A wide variety of management strategies have been developed to treat plantar fasciitis. Medical treatment involves non-steroidal anti-inflammatory drugs (NSAIDS), oral steroids, local corticosteroid injections, platelet rich plasma therapy, prolotherapy. Surgical management involves either open or endoscopic partial plantar fasciotomy.[20,21,22,23,24]

Physiotherapy application includes rest, activity modifications, shoe modifications, ice, contrast bath, stretching of calf and plantar fascia, strengthening exercises for intrinsic foot muscles, ultrasound, phonophoresis, iontophoresis, extra corporeal shock wave therapy, manual treatment include joint mobilization, taping, night splints, walking casts, arch support and orthotics.[3,5,25,26,27,28]

Material and Method

Subjects were recruited from MYH department of physiotherapy after obtaining informed consent and patient general examination. A total of 47 patients are selected in this study by means of convenience sampling technique at sampling stage one. All the subjects both male and female were included and also included 25 – 60 years of age with Pain in first few steps in the morning, NPRS – 5 to 10, Plantar heel pain for more than 3 months, Pain on palpation along the proximal plantar fascia, Positive Windlass test, Reduced dorsiflexion of ankle joint, Navicular drop > 1 cm. Age group > 60 & < 25years, Undergoes prior physiotherapy treatment, High BMI, Pregnant ladies, Peripheral vascular diseases, Neurological conditions, Calcaneal stress fractures, Any foot or heel surgeries are excluded from this study.

All the subjects both male and female were included according to the set inclusion criteria, afterwards 7 were excluded, as they were not interested and having bilateral heel pain. At sampling stage two, random allocation of 20 subjects each to group A and B, i.e., Control group and experimental group were done respectively and specific physiotherapy protocol were given to the subjects. Assessment values of ankle dorsiflexion range, foot function status, navicular position was taken before the intervention and then the group A, (Control group) receives the conventional therapy while the group B, (experimental group) receives the Tibialis posterior strengthening along with conventional therapy protocol. Ethical Clearance was the study was obtained from the ethical committee of the Mahatma Gandhi Memorial Allied health science institute Indore.

Procedure: All subjects had undergone two measurements, one on entry to the study (pre-test) and one after the 4 weeks of intervention period (post-test).

Group A – Control group (Receiving conventional therapy)

Iontophoresis with 0.4% Dexamethasone drug for 10 mins, 3 sessions per week for four weeks. 2. Stretching of calf and plantar 3. Self-release of plantar fascia with tennis Ball 4. Intrinsic foot muscle strengthening Exercises - Short foot exercises - Heel raise - Toe curls (no hold, repeat 10 times, 2 sets). FITT – 10 Repetitions / 10 secs hold/ 2 sets/ twice a day for 4 weeks.

Group B – Experimental group (Tibialis posterior strengthening along with conventional therapy)

1. Ankle inversion using elastic band emphasizing eccentric control
2. Side lying ankle inversion using ankle weight, emphasizing eccentric phase control
3. Single leg stance balance Activities with neutral foot positions. FITT – 15 Repetitions / 10 secs hold/ 2 sets/ twice a day for 4 weeks.

Statistical Analysis

Descriptive and inferential statistics were implemented as statistical tools to analyse the gathered data statistically. Baseline demographic and clinical characteristics was analysed using Mean ± Standard Deviation (Min-Max). The study differences between pre and post test score of NDT, FFI and ankle dorsiflexion ROM were analysed using parametric test and paired parametric test. Independent sample t-test was used to observe the significance of mean difference of score of NDT, FFI and ankle dorsiflexion ROM of Plantar fasciitis patients of group A and group B.

Results

Table 1: Demographic data (Gender) of the subjects with plantar fasciitis

Sex	Experimental Group	Control Group	Total
Female	17	15	32
Male	3	5	8
total	20	20	40

Table 2: Mean and standard deviation of demographic data (age) of the subjects with plantar fasciitis

Group	N	Mean age	S.D	p- value
Experimental	20	43.5000	11.17563	0.14 (non-significant)
Control	20	39.2500	9.25587	

Table 3: Effect of conventional therapy on Foot Function Index (FFI) of control group having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
FFI	Pre	20	55.65	9.96	12.45	<0.05
	Post	20	18.30	8.98		

Table 4: Effect of Tibialis posterior strengthening along with conventional exercises on Foot Function Index (FFI) of experimental group having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
FFI	Pre	20	52.00	17.11	9.09	<0.05
	Post	20	10.75	10.91		

Table 5: Effect of conventional therapy on Ankle dorsiflexion ROM of control group having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
Ankle Dorsiflexion ROM	Pre	20	10	3.97	3.56	<0.05
	Post	20	14	3.08		

Table 6: Effect of Tibialis posterior strengthening along with conventional therapy on Ankle dorsiflexion ROM of experimental group having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
Ankle Dorsiflexion ROM	Pre	20	9.50	4.89	5.81	<0.05
	Post	20	17.50	4.44		

Table 7: Effect of conventional exercises on Navicular drop test (NDT) of control group having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
Navicular drop test	Pre	20	1.93	0.42	1.60	>0.05
	Post	20	1.73	0.39		

Table 8: Effect of Tibialis posterior strengthening along with conventional exercises on Navicular drop test (NDT) of experimental group having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
Navicular drop test	Pre	20	1.85	0.41	3.82	<0.05
	Post	20	1.38	0.38		

Table 9: Comparison between effect of conventional therapy and Tibialis posterior strengthening along with conventional therapy on Foot Function Index (FFI) of patient having plantar fasciitis

Variable	Condition	N	Mean	S.D	t-value	p-value
FFI	Control (Pre)	20	18.30	8.98	2.39	<0.05
	Experimental (Post)	20	10.75	10.91		

Table 10: Comparison between effect of conventional exercises and Tibialis posterior strengthening along with conventional exercises on Ankle dorsiflexion ROM of patient having plantar fasciitis.

Variable	Condition	N	Mean	S.D	t-value	p-value
Ankle dorsiflexion ROM	Control (Pre)	20	14	3.08	2.90	<0.05
	Experimental (Post)	20	17.5	4.44		

Table 11: Comparison between effect of conventional exercises and Tibialis posterior strengthening along with conventional exercises on Navicular drop of patient having plantar fasciitis.

Variable	Condition	N	Mean	S.D	t-value	p-value
Navicular drop	Control (Pre)	20	1.73	0.39	2.88	<0.05
	Experimental (Post)	20	1.38	0.38		

Discussion

The purpose of the present study was to find out the effectiveness of tibialis posterior strengthening along with conventional therapy on ankle ROM, functional status and navicular position in patients having plantar fasciitis.

Total 40 patients between age group 25-60 years have fulfilled the inclusion and exclusion criteria. Patients were randomly divided into two groups in which 20 patients in each group.

Group A (20) control group, received conventional therapy and group B (20), received tibialis posterior strengthening along with conventional therapy. The patients were treated for 5 sessions per week for four weeks and changes in ankle ROM, functional status and navicular position were recorded before and after the interventions. The demographic data of our study shows the more prevalence in female subject in plantar fasciitis because of the various factors like different footwear use, pain severity, health status, physical activity schedule or social characteristics between both sexes.

In this study, the Tibialis posterior strengthening along with the conventional therapy were proved to be statistically significant effect in pain and functional status of foot, Ankle Dorsiflexion ROM and Navicular drop values in the management of Plantar fasciitis. Tibialis posterior strengthening helps to reduce overpronation of the foot and navicular pronation, ultimately improving biomechanics of foot. It has a significant effect on decreasing the stress over the plantar fascia, which ultimately leads to normal alignment of navicular bone and appropriate biomechanics of foot.

Todd J. May et al state that between 81% - 86% of individual with Plantar fasciitis having Excessive foot pronation can lead to tibialis posterior in a lengthen positioned and are easily fatigued in an attempt to control excess motion. This causes plantar fascia and tibialis posterior become weak to restore the MLA and re-supinate the STJ before toe-off.

Hence, there will be significant effect of conventional therapy on FFI and ankle dorsiflexion ROM but the results show more significant effect of tibialis posterior strengthening along with the conventional therapy on FFI, ankle dorsiflexion ROM as well as Navicular drop position in experimental group.

Conclusion

This study concluded that there was significant effect of tibialis posterior strengthening along with conventional therapy on foot functional status, ankle dorsiflexion ROM and navicular position in

patient with plantar fasciitis. The statistical analysis suggested that the measurement values of foot function index, ankle dorsiflexion range of motion and navicular drop value were significantly improved when the tibialis posterior strengthening along with conventional therapy were given to patients with plantar fasciitis.

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