Relationship between Hamstring Tightness and Planter Fasciitis

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ABSTRACT

Introduction: Plantar fasciitis is a pathological condition whose etiology is multifactorial. It constitutes a major bulk of patients attending our outpatient department. Some of the risk factors involved are sport or physical exercise, being overweight, age, gender, prolonged standing, increased subtalar pronation accompanying pes cavus or flat feet, and limited ankle dorsiflexion. There have been few studies about the relationship between tightness of the posterior lower limb muscles such as hamstring tightness and plantar fasciitis, and most of them can be interpreted in terms of some contracture of the hamstring muscles of thigh being present in cases of plantar fasciitis. So, we hypothesized there is relation between hamstring tightness and plantar fasciitis.

Material and Methods: A total of 68 subjects, 34 with plantar fasciitis and 34 matching controls were recruited. Hamstring was evaluated through the straight leg elevation test, popliteal angle test, and ankle dorsiflexion (with knee extended and knee flexed). At least three measurements were taken and a mean value was calculated. All variables were compared between the 2 groups. Along with hamstring tightness other characteristics such as age, gender, and BMI were also compared. Univariate analysis was done with chi-square test and t-test.

Results: Difference between the 2 groups for the tests used to assess hamstring tightness were highly significant i.e., $p<0.001$ in comparing the values of Popliteal angle (PA) and $p=0$ of Ankle dorsiflexion with knee flexed (ADFKF), moderately significant i.e. $p = 0.032$ in comparing the values of Ankle dorsiflexion with knee extended (ADFKE). However, there was no significant difference $p=0.588$ in comparing the values of Straight leg elevation test (SLET). Since there were significant relation in three parameters PA, ADFKF and ADFKE we can conclude there is hamstring tightness in patients with plantar fasciitis. In comparing the values regarding Body Mass Index between the 2 groups, there was highly significant statistical difference ($p<0.001$).

Conclusion: There is significant association between hamstring tightness in patients with plantar fasciitis. These results of the study suggest that therapists who are going to employ a stretching protocol for treatment of plantar fasciitis should look for hamstring tightness.

Key words: Plantar Fasciitis, Hamstring Tightness, Straight Leg Elevation Test, Popliteal Angle

INTRODUCTION

Plantar fasciitis is an inflammation of plantar fascia. It is composed of dense collagen fibers arranged mainly longitudinally, arises posteriorly from the medial process of the calcaneus and fans out over the sole and divides into five bands, one for each toe.[1] It is a painful heel condition that can affect both sedentary and active individuals and is most often seen in the adult population.

The most common symptom associated with plantar fasciitis is heel pain and PF is the most common cause of chronic pain beneath the heel in adults. The patient complains of pain in the medial side of the heel, most noticeable with initial steps after a period of inactivity and usually lessens with increasing level of activity during the day, but will tend to worsen towards the end of the day. Symptoms may become worse following prolonged weight bearing and often precipitated by increase in weight bearing activity.[2]

Although several factors have been proposed as causes of plantar fasciitis, biomechanical abnormalities are considered to play a major role in this condition. However, the exact changes to the biomechanics that cause this ailment are controversial and inconclusive. The effect of tight posterior leg muscles causing decreased ankle dorsiflexion has been studied and has been determined to be detrimental to the stress applied to the plantar fascia. Harty at el suggested tight hamstrings increase knee flexion, which in turn induces prolonged forefoot loading and engages the windlass mechanism. Other biomechanics include tightness of the Achilles tendon and plantar fascia, reductions in strength in foot and ankle muscles, and abnormal foot alignment. With repetitive use of the foot and ankle, the plantar fascia is loaded and can develop chronic degenerative changes with marked thickening and fibrosis within the fascia.[3]

In Plantar fasciitis, there is inflammation and healing with fibrosis because of the repeated microtears. This results in contracture of the plantar fascia which decreases its elasticity and makes it more vulnerable to further microtear as loss of elasticity decreases the threshold of breakage point in the stretch strain curve of the fascia. There is vicious cycle of microtears caused by stress of normal walking during day and healing by fibrosis during rest at night. So, this vicious cycle of microtear and fibrosis should be interrupted in order to restore the normal threshold of breakage point of plantar fascia, which can be done by stretching the plantar fascia

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within its elastic limits.

Risk factors identified for plantar fasciitis are obesity, sedentary lifestyle, wearing inappropriate shoes, frequent running and long standing.[4]

Differential diagnosis includes plantar fascia rupture, enthesopathies, fat pad atrophy, heel bruise, bursitis, stress fracture of calaneum, pagets disease, primary and secondary tumor, infection, tarsal tunnel syndrome, trapped abductor digiti quinti nerve and sciatica.[5]

Most patients have spontaneous resolution of symptoms but about 10% tent to chronic symptoms. Though both surgical and non-surgical approaches are available for management, non-surgical approaches are generally considered as first line. Use of night splint to keep foot in dorsiflexion, ultrasound massage, custom designed shoes, prefabricated soft insoles, Achilles tendon stretching exercise and plantar fascia stretching exercise are some of the available options.[6]

Local steroid is often painful with risks of plantar fascial rupture, fat pad atrophy, lateral plantar nerve injury and calcaneal osteomyelitis.[4] Orthotics gives poor patient compliance of bulky night splints and is expensive. Surgery caries the risk of residual pain (approximately 25% of patients will still experience heel pain), flat foot deformity due to over-release of the plantar fascia, medial calcaneal nerve injury, plantar tendon scar and infection.[7]

MATERIAL AND METHODS

A comparative cross-sectional study was designed. A total of 68 subjects, 34 with plantar fasciitis and 34 matching controls were recruited from March, 2018 to May, 2019 at Bharatpur Hospital. Hamstring was evaluated through the straight leg elevation test, popliteal angle test, and ankle dorsiflexion (with knee extended and knee flexed). At least three measurements were taken and a mean value was calculated. All variables were compared between the 2 groups. Individuals with plantar fasciitis were included in the study group and individuals without plantar fasciitis in control group i.e., apparently healthy individuals. Along with hamstring tightness other characteristics such as age, gender, and BMI were also compared. Univariate analysis was done with chi-square test and t-test.

History taking and thorough physical examination was done. After confirmation of clinical diagnosis of plantar fasciitis, patients who met the inclusion criteria were allocated to the study group.

Patients who served as the control group were matched in age, sex and lower limb side.

Study Group: Individuals with plantar fasciitis.

Control Group: Individuals without plantar fasciitis after pair matching.

Verbal and written instructions regarding the examination and a university-approved consent form, signed prior to participation were given to the individuals. The patients were asked questions in order to complete a questionnaire that provided information and a history profile of the heel pain. The background information included age, gender, height, weight, duration of symptom, history of recent trauma or surgery on the lower limb and co-morbid conditions. Radiographs were evaluated for the presence of an infracalcaneal spur.

The straight leg elevation test (SLET), Popliteal angle (PA), Ankle dorsiflexion with the knee extended (ADFKE) and Ankle dorsiflexion with the knee flexed (ADFKF) were measured.

The final value of each variable to be measured with the goniometer was obtained by the mean of 3 repeated measurements.

In cases where plantar fasciitis was unilateral, the affected limb was the one to be measured. In cases where plantar fasciitis is bilateral, only the more affected limb was included, or if both were affected equally, a coin toss was done to select the limb to measure at random. Measurements were always made by the same researcher.

RESULTS

Frequency distributions of different variables in study and control group were observed.

As the inclusion criteria included age above 18 years there were 47.06% of patients in the age group 18-40 years, 44.12% in 41-65 years and 8.82% in 65 years and above age group both in the study and control group.

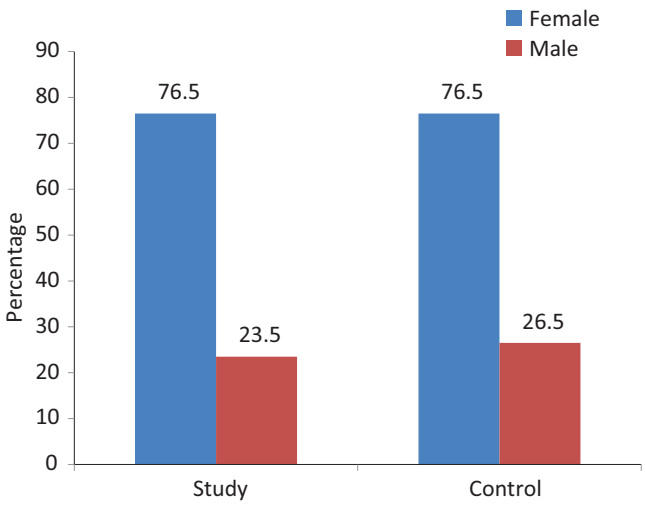

Figure-1: Sex Distribution

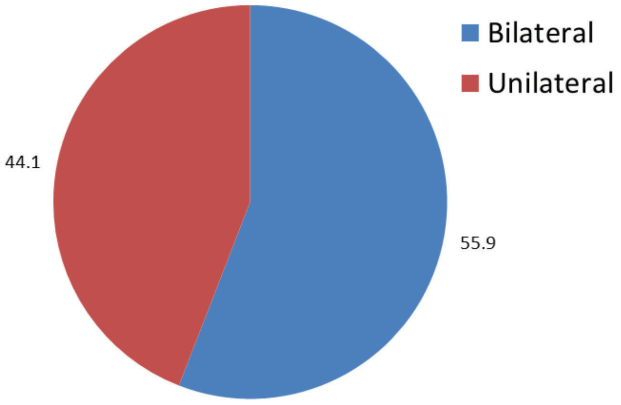

Figure-2: History of plantar fasciitis in the study group

Majority of the patients were female, accounting for 76.5% of the total patients in each group.

About 55.9% of the patients had a history of bilateral heel pain and 44.1% had a history of unilateral heel pain.

The mean duration of pain in patients in the study group was about 8.94 months with standard deviation of 11.73.

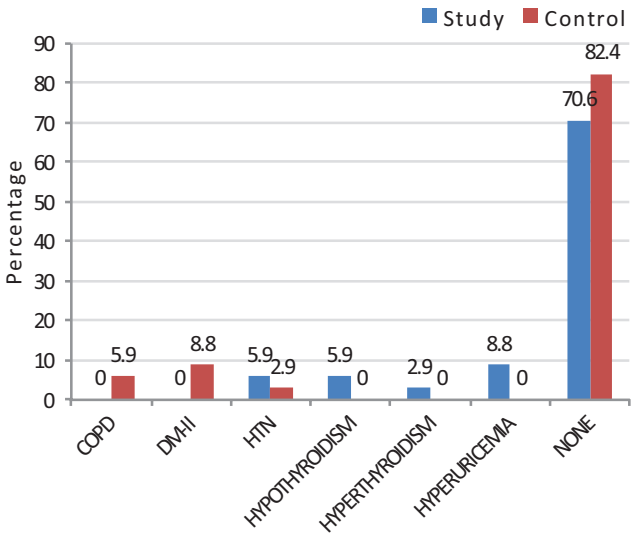

Figure-3: Co-Morbidities in patients in study and control group

Only 2 patients i.e., 5.9% in the study group with plantar fasciitis had radiographic presence of calcaneal spur in the study group.

About 14.7% had Hypertension, 5.9% had Hypothyroidism, 2.9% had Hyperthyroidism and 8.8% had Hyperuricemia in the study group. About 5.9% had COPD, 8.8% had DM-type II and 2.9% had Hypertension in the control group.

The mean weight in the study group was 65.79 kg and in the control group was 56.43 kg. The mean height was 1.57 m in study group and 1.59 m in control group. The mean BMI was 26.74 in the study group and 22.44 in control group.

The comparison of the values of weight and BMI between the two groups showed statistically significant differences in all cases as shown in the table 8 with p value <0.001.

Nearly 27% smoke among study group as compared to 29.4% in control group. The difference in percent of smokers is not significantly different for case and control.

About 17.6 % among case take alcohol among the study group in comparison to 8.8 % in control group. The difference in percent of individuals who take alcohol is no significant for both the study and the control group.

Mean SLET was 76.26 in study group as compared to 77.5 in control group, the mean difference was not significant (p=0.588). The mean PA was 29.35 in study group as

Age (years)	Study Group (n=34)		Control Group (n=34)	
	Frequency	Percent	Frequency	Percent
18-40	16	47.06	16	47.06
41-65	15	44.12	15	44.12
66 and above	3	8.82	3	8.82
Total	34	100	34	100

Table-1: Age distribution

	Mean	Standard Deviation
Duration of pain	8.94	11.73

Table-2: Duration of pain in the study group

Calcaneal SPUR	Frequency	Percent
Absent	32	94.1
Present	2	5.9
Total	34	100.0

Table-3: Radiographic presence of calcaneal spurs in study group.

Measurement	Study Group (n=34)	Control Group (n=34)
Age	45.59 (29-75)	45.59 (29-75)
Gender M/F	8/26	8/26
Weight (Kg)	65.79 (45-90)	56.43 (42-76)
Height (m)	1.57 (1.42-1.65)	1.59 (1.5-1.7)
Body mass index (BMI)	26.74 (19.5-36.6)	22.44 (17.8-28.9)
Duration of Pain (months)	8.94 (1-48)	-
Calcaneal spur	Absent= 32 Present= 2	-
Smoking (No/Yes)	25/9	24/10
Alcohol (No/Yes)	28/6	31/3

Table-4: Summary of baseline measures of the study and control group

	Group	Mean	SD	t	p
Age	Study	45.59	13.46	0	1
	Control	45.59	13.46		
Weight	Study	65.79	10.77	4.043	<0.001
	Control	56.43	8.15		
Height	Study	1.57	0.06	-1.026	0.309
	Control	1.59	0.06		
BMI	Study	26.74	4.32	4.907	<0.001
	Control	22.44	2.75		

Table-5: Comparison of variables Age, Weight, Height and BMI between the 2 groups.

Smoking	Study group	%	Control group	%	Chi Square	p
No	25	73.5	24	70.6	0.073	0.787
Yes	9	26.5	10	29.4		
Total	34	100.0	34	100.0		

Table-6: Comparison of Smoking between two groups

Alcohol	Study group	%	Control group	%	Chi square	p
No	28	82.4	31	91.2	0.512	0.474
Yes	6	17.6	3	8.8		
Total	34	100.0	34	100.0		

Table-7: comparison of Alcohol intake between two groups

	Group	Mean	SD	t	p
SLET	Study	76.26	9.10	-0.544	0.588
	Control	77.50	9.61		
PA	Study	29.35	10.41	4.785	<0.001
	Control	18.76	7.63		
ADFKE	Study	17.71	4.03	-2.196	0.032
	Control	19.91	4.25		
ADFKF	Study	17.44	6.80	-4.64	0
	Control	24.47	5.64		

Table-8: Comparison of Variables SLET, PA, ADFKE and ADFKF between the 2 groups.

compared to 18.76 in control group, the mean difference was significant (p<0.001). The mean ADFKE was 17.71 in study group as compared to 19.91 in control group, the mean difference was significant (p=0.032). The mean ADFKF was 17.44 in study group as compared to 24.47, the mean difference was significant (p=0). The comparison of the values of PA, ADFKE and ADFKF between the two groups showed statistically significant in all cases. However, the value of SLET was not significant. Even though the value of SLET did not come out to be significant, the three values of PA, ADFKE and ADFKF that measure the elasticity of the hamstring muscles and triceps surae muscular bellies in the soleus region showed significant differences.

DISCUSSION

Plantar fasciitis comprises a significant bulk of patients attending in General OPD and Orthopedics OPD. These patients undergo various treatment modalities ranging from NSAIDS, physiotherapy, Orthotics and even surgery. Over the past years various studies has been carried out and it is now established that the outcome of the disease is typically favorable.

The relationship between plantar fasciitis and contracture of the posterior muscles of lower extremity such as hamstring group of muscles has previously been studied. Rome et al [18] found no statistically significant differences (p=0.39) between a control group and a group with PF with respect to limited ankle dorsiflexion. Taunton et al [19] retrospectively reviewed 267 cases of PF, of which 43 (16%) had excessive contracture of the gastrocnemius-soleus complex. Irving et al [20] reported a case-control study that included ankle dorsiflexion as a variable. The results showed the PF group to present greater values of this angle than the control group. On the other hand, most current evidence suggests that tight hamstring and gastrocnemius is an etiologic factor for PF. Harty et al[20] observed a significant contracture of the hamstrings muscles in a group of subjects PF compared with a control group. Domiguez et al [21] observed a limited ankle dorsiflexion and knee extension in most of the PF subjects, which would confirm contracture of triceps surae and hamstrings. Labovitz et al[17] found that patients with hamstring tightness were about 8.7 times as likely to experience PF in the corresponding foot compared with patients without hamstring tightness. The results of the

above mentioned studies support the functional deficit of the plantar fascia caused by hamstring shortening. That is, tight hamstrings could increase knee flexion, which in turn would induce prolonged forefoot loading and would engage the windlass mechanism. Also, when tight posterior leg muscle group exists, ankle range of motion is limited, and it may be compensated by excessive pronation of the subtalar joint, causing tension on the plantar fascia. Additionally, the significance of this deficit is demonstrated since clinical symptoms are more likely to develop because of the mechanical changes to the limb

In this study the PA that measured the elasticity of the hamstring muscle, the mean value was 29.35 in study group showed moderate hamstring contracture as value of 16 to 34 degrees corresponded to moderate contracture, which suggested hamstring tightness in the individuals with PF as shown in table 11. However, the SLET that determined the stiffness of the elastic component of the knee flexed, the mean values of 76.26 in study group and 77.50 in the control group was not significant. And the other test such as ADFKE and ADFKF that also measured elasticity of hamstring muscles and triceps surae muscular bellies in the soleus region were significant. As there were significant differences statistically in three parameters except on SLET measurement, these results could serve as a basis for future investigations.

This study also showed that with respect to BMI, the patients with higher BMI range (>25) had a proportionately higher prevalence of plantar fasciitis ($p<0.001$).

The practical application of the present results could be for the therapist to include examination of the posterior muscles of the lower extremity that is the hamstrings and triceps surae in the examination protocol of PF patients. Plantar fasciitis is a problem of repetitive microtrauma that can be managed with aggressive nonoperative therapy focused on the specific etiology, such as discussing weight loss in the obese patient with plantar fasciitis. The typical treatment for plantar fasciitis involves decreasing the abnormal mechanics causing the overload of the plantar fascia. Previously equinus was the mechanical deforming force that was treated. However, the study shows that the hamstring tightness is associated with the plantar fasciitis and should also be addressed in the treatment. Also, stretching exercises could be recommended for the treatment of PF, focusing on stretching the hamstrings along with other measures such as rest or use of physiological footwear and foot orthoses.

Yet, study limitations do exist. So, the limitations could be

1. Small sample size.
2. Shorter duration of study.
3. Study had convenient sampling, so it may have selection bias.

CONCLUSION

Plantar fasciitis is a very common condition with multiple etiologies, including neurological, vascular, soft tissue and structural. This study demonstrates that hamstring tightness plays an important role in the etiology of this condition. However, further studies are necessary to determine the role and the efficacy of treatments that are directed toward the tight hamstrings in plantar fasciitis patients.

This study supports the tight hamstrings can lead to plantar fasciitis so stretching, aggressive physical therapy and other treatments will likely address tight hamstrings since these modalities have successfully targeted gastrocnemius-soleus complex. Treatment and rehabilitation of plantar fasciitis can also be focused on the epidemiologic at-risk groups to target a more effective outcome for the individual patient.

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