

**Comparison of plantar fascia thickness in symptomatic & asymptomatic individuals using ultrasonography**

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**Abstract**

**Introduction:** Plantar fasciitis is one of the most common causes of heel pain. It is due to the inflammation of the insertion of plantar fascia on the medial process of the calcaneal tuberosity. Ultrasonography is very sensitive and specific in the diagnosis of plantar fasciitis. So the purpose of this study is to compare the plantar fascia thickness in symptomatic & asymptomatic individuals using ultrasonography and to analyze the sociodemographic factors associated with plantar fasciitis.

**Materials & method:** This is an observational, analytical study conducted in the Dept of PMR, Govt Medical college, Trivandrum. First group comprised of patients clinically diagnosed with plantar fasciitis & the second group consisted of volunteers with no history of heel pain (30 in each group). After getting consent, structured proforma was used to collect data & ultrasound examination of plantar fascia was carried out to assess the thickness & other changes. Analysis of data

done with SPSS 25. Quantitative variable expressed as mean with standard deviation & qualitative variable as proportion. Student t test & Chi square test were used.

**Result:** Plantar fascia thickness was significantly increased in symptomatic group (2.5 – 7.6mm, mean -5 .5mm) compared with heel of patients in asymptomatic group (2.5 –5 mm, mean – 3.76mm). The mean age of symptomatic subjects was between 40 to 60 years and was more common in females. The risk of developing plantar fasciitis is more in those doing standing heavy jobs and those with BMI more than 25. Diabetic individuals are also prone for developing plantar fasciitis. Heel spurs were not found to be associated with development of plantar fasciitis.

**Conclusion:** It has been found that plantar fascia thickness is increased in patients with plantar fasciitis when compared to asymptomatic individuals measured using ultrasonography. Plantar fasciitis is more common in middle aged to older population with a female predilection. The incidence of plantar fasciitis is more in

individuals engaged in standing heavy jobs, those with increased BMI and those who have comorbidities like Diabetes mellitus.

**Keywords:** Plantar fasciitis Plantar fascia thickness Ultrasonography.

### **Introduction**

Plantar fasciitis is the most common cause of inferior heel pain. The pain and discomfort associated with this condition can have a dramatic impact on physical mobility. Planter fasciitis affects approximately 10% of the population, with approximately 1 million people being treated annually. Females are more commonly affected compared to males. The etiology of plantar fasciitis is multifactorial. Age, obesity, excessive foot pronation and limited ankle dorsiflexion are intrinsic factors whereas occupational prolonged weight bearing, inappropriate shoe wear and rapid increase in activity level are the extrinsic factors. All these factors lead to a pathologic overload on plantar fascia leading to microtears, perifascial oedema and increasing heel pad thickness. Various seronegative spondyloarthropathies have plantar fasciitis as an association. The patient gives a history of heel pain and tightness after standing up from bed in the morning or after being seated for a prolonged time. Walking barefooted on hard surfaces aggravates the pain. The pain also develops after prolonged standing, walking or running. Clinical examination shows tenderness over medial calcaneal region on palpation. Imaging is of immense help in arriving at an appropriate diagnosis, providing adequate treatment and in assessing response to treatment. It has been observed that in PF the thickness of the plantar fascia is increased compared to individuals without PF. The modalities used are plain radiograph, ultrasound, or magnetic resonance imaging (MRI). MRI is expensive, time consuming, and is unsuitable for claustrophobic patients. Hence,

ultrasonography is now being increasingly used to assess plantar fascia in the diagnosis of plantar fasciitis. It is non-invasive, cost effective, easily accessible, good with spatial resolution for the superficial structures and evaluation of the tissues with real-time dynamics. It is also useful in guiding treatment.[1] So the aim of this study is to compare the thickness of plantar fascia using ultrasonography in symptomatic and asymptomatic individuals. Some of the sociodemographic factors associated with this condition are also studied. This will help in more accurate diagnosis of plantar fasciitis in future.

### **Primary objective**

To compare the thickness of plantar fascia using Ultrasonography in subjects clinically diagnosed with plantar fasciitis with that of asymptomatic individuals.

### **Secondary objective**

To analyze the sociodemographic variables associated with plantar fasciitis.

### **Materials & methods**

#### **Study design**

Observational, Analytical study.

#### **Study period**

12 months after obtaining IEC clearance

#### **Study setting**

Hospital based, conducted in the Department of Physical Medicine and Rehabilitation, Govt. Medical College, Thiruvananthapuram.

#### **Study participants**

The first group comprised of patients clinically diagnosed with plantar fasciitis coming to the OPD, Dept of Physical Medicine and Rehabilitation, Govt. Medical College, Thiruvananthapuram. The second group consisted of volunteers with no history of heel pain. All subjects were above 18 years of age.

### Sample size

(Etienne Cardinal, Rethy K Chhem, Germain Beauregard, Benoit Aubin, Michel Pelletier; Plantar Fasciitis: Sonographic Evaluation, Radiology 1996;201:257-259) [3]

Sample size is calculated using the formula

$$n = \frac{(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})^2 + (\sigma_1^2 + \sigma_2^2)}{(\mu_1 - \mu_2)^2}$$

N-sample size;  $Z_{1-\alpha/2}=1.96$ ;  $Z_{1-\beta}=0.84$ ;

$\Sigma 1$ -Standard deviation of plantar fascia thickness in first group

$\Sigma 2$ -Standard deviation of plantar fascia thickness in second group

$\mu 1$ -Mean plantar fascia thickness in first group

$\mu 2$ -Mean plantar fascia thickness in second group;

Substituting the values

Sample size is 30. (30 in each group)

### Inclusion criteria

The inclusion criteria were patients coming to OPD, Dept of Physical Medicine and Rehabilitation, Govt. Medical College, Thiruvananthapuram. Diagnosis was based on clinical history and physical examination.

Group 1: Patients coming with history of heel pain.

Group 2: Patients coming with complaints other than heel pain.

Age group: More than 18 years

### Exclusion criteria

The exclusion criteria were:

1. Patients with history of previous foot surgery.
2. Patients with recent abrupt trauma.
3. Patients with congenital defects of the lower extremity.
4. Patients with history of systemic inflammatory

diseased with manifestation similar to plantar fasciitis (seronegative spondyloarthropathies)

5. Patients with corticosteroid injection in the heel in the previous 3 months

6. Patients with Acral hyperplasia. Eg: Acromegaly.

### Sampling method

Participants who meet the inclusion criteria will be consecutively recruited to the study till the required sample size is met.

### Study variables

Sociodemographic variables like

1. Age
2. Gender
3. Occupation
4. BMI
5. Comorbidities
6. X ray findings
7. Plantar fascia thickness using Ultrasonography.

Data collection tools

1. Semi structured proforma
2. Clinical examination & Laboratory investigations.
3. Ultrasonographic evaluation of plantar fascia

### Data collection procedure

After obtaining consent from the study participant, a pretested semi-structured proforma will be used to record relevant information like patient data, history, clinical findings and investigation reports by interviewing the patient.

USG machine is present in the department of PMR. It can be done free of cost and is non-invasive. Data can be collected as per patients coming to the OPD, PMR, Govt. Medical College, Thiruvananthapuram.

The Ultrasound examination was carried out with a two-dimensional, B mode, Real time ultrasound system (Esaote, SL1543, mylabgamma). A high resolution, 3-13 mhz, Linear transducer was used.

The subjects were in supine position. The acoustic coupling gel was applied to the patient's foot and the transducer. The foot scanning was done in such a way as to visualise the plantar fascia from its insertion into the calcaneus to approximately 4cm distally [2]. The thickness of PF was measured within 1cm of its calcaneal attachment. [1] The plantar fascia was also assessed for its echogenic appearance, thickness changes and any fluid collections.

### **Data management and analysis**

Data will be entered into EXCEL sheet.

Quantitative variables will be expressed as mean with standard deviation.

Qualitative variables will be expressed as proportion. Student t test to calculate mean  $\pm$  SD and 95% confidence intervals.

Analysis of data will be done with statistical software SPSS 25

### **Ethical considerations**

Privacy and confidentiality of the data collected from the participants shall be strictly maintained throughout the study. No cost shall be incurred from the participants. Participants have the right to withdraw from the study at any point of time.

### **Results**

The plantar fascia is a fibrous aponeurosis, which inserts along the plantar aspect of calcaneus. It supports the longitudinal arch of foot. The normal fascia is reported to be 2 to 4 mm thick and has a slightly echogenic fibrillar pattern at ultrasound. On ultrasound, the commonly used criteria of plantar fasciitis are increased thickness (greater than 4mm) and hypo echogenicity.

The aim of this study was to compare the thickness of plantar fascia in symptomatic patients with plantar fasciitis and asymptomatic individuals measured using

ultrasonography and to study some sociodemographic variables like age, gender, occupational categories, BMI, comorbidities, X ray findings in patients with plantar fasciitis.

Twenty-six patients (17 women, 9 men; aged 26 to 62 yrs. With mean age of 48.5 yrs.) With a clinical diagnosis of plantar fasciitis were prospectively evaluated using ultrasonography for thickness of plantar fascia.

Heel pain was unilateral in 22 patients and bilateral in 4 patients. (30 symptomatic heels)

The height, weight, BMI, nature of occupation (standing heavy / sedentary), comorbidities, X ray findings were also recorded.

These were compared with findings from 30 asymptomatic heels Increase in thickness of plantar fascia is a finding associated with plantar fasciitis.

In this study, the plantar fascia thickness of symptomatic group ranges from 2.5 mm to 7.6mm with mean thickness of 5.62 $\pm$ 1.3mm whereas in asymptomatic group, the thickness ranges from 2.5mm to 5mm with mean thickness of 3.76 $\pm$ 0.58mm.

The results of this study indicate that the mean PF thickness of people with plantar fasciitis is greater than the mean PF thickness of people without heel pain.

These findings are in accordance with Wall et al [2] where mean plantar fascia thickness was 5.68 $\pm$ 1.55mm in the study group and 3.58 $\pm$ 0.63mm in the control group.

The mean age in symptomatic group was 48.5 years and 41.17 years in asymptomatic group. Most of the people who presented with plantar fasciitis to our OPD was in the range of 40-60 years. Hence these findings are similar to the findings reported by Purnima [1] et al. Where Plantar fasciitis was observed in the age group of 40-58 years.

In the symptomatic group, 10 of them were males (33.3%) and 20 were females (66.6%). In this study, the majority of patients were females, which is in concordance with the results published by Purnima [1] et al., where plantar fasciitis was more common in females as compared to males (42/44).

In symptomatic group, 90% were in standing heavy jobs and 10% in sedentary jobs. The results showed there is more risk of developing plantar fasciitis in people involved in standing heavy jobs when compared to sedentary jobs. This is secondary to stress due to repetitive trauma from excessive job related standing and walking. This is in accordance with Riddle et al [4] which says the study group have an Odds ratio of 3.6 when compared to reference. So, the number of working hours standing will contribute to the development of plantar fasciitis.

In symptomatic group, 63.3% fall in 25 to 30 BMI, 23.3% in less than 25 and 13.3% above 30. Studies like Riddle et al [4], Sabir et al [5] and Ozdemir [6] et al quotes BMI as a risk factor for the development of plantar fasciitis. As per Riddle et al, the group with BMI more than 30 have an odds ratio of 5.6 compared to reference group whereas Sabir et al gives a mean BMI of 34.2 +/- 6.6 in the study group. Ozdemir et al gives 77% incidence of plantar fasciitis in >25 BMI group and 51% in > 28 BMI group. In this study, the incidence of plantar fasciitis is increased in > 25 BMI group which is similar to the above findings.

In symptomatic group, 36.7% had comorbidities (Diabetes). D'Ambrogi [7] et al suggests an increased incidence of plantar fasciitis in those having Diabetes mellitus. Therefore, in this study, it has been found that there is an increased incidence of plantar fasciitis with comorbidities like Diabetes. Out of the 30 symptomatic heels, only 1 X ray showed presence of heel spur. This is

converse to what has been observed by De Maio [8] et al where heel spurs are implicated as a risk factor for plantar fasciitis.

Table 1: Age distribution

AGE DISTRIBUTION				
Age category	Symptomatic (n=30)	Asymptomatic (n=30)	Total	P value
18-39 yrs.	1 (3.3%)	13 (43.3%)	14 (23.3%)	<0.001*
40-60 yrs.	28 (93.3%)	16 (53.3%)	44 (73.3%)	
>60 yrs.	1 (3.3%)	1 (3.3%)	2 (3.3%)	

Graph 1: Age distribution

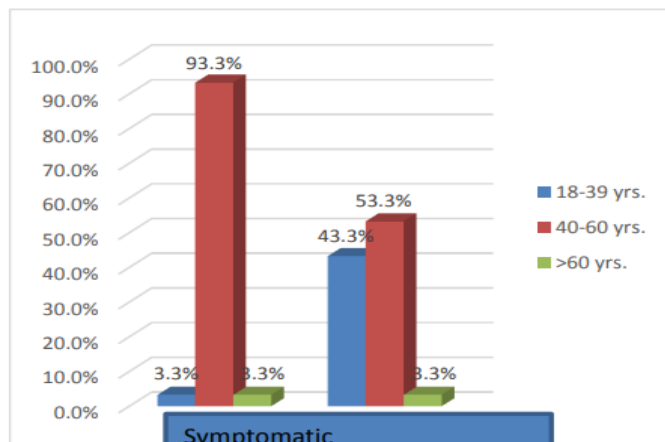


Table 2: Gender distribution

Gender	Symptomatic (n=30)	Asymptomatic (n=30)	Total	P value
Male	10 (33.3%)	7 (23.3%)	17 (28.3%)	0.39
Female	20 (66.7%)	23 (76.7%)	43 (71.7%)	

Graph 2: Gender distribution

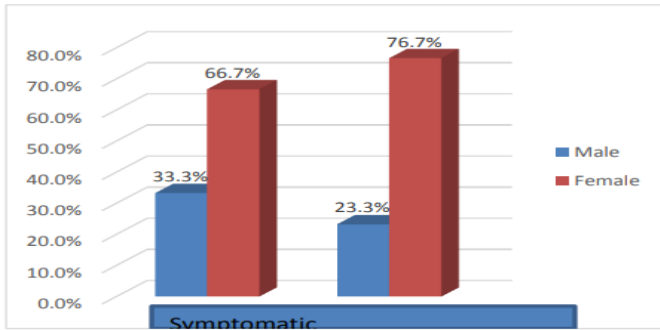


Table 3: Comparison of plantar fascia thickness between symptomatic and asymptomatic groups

Comparison of Plantar fascia thickness between Symptomatic and asymptomatic

Parameter	Symptomatic (n=30)		Asymptomatic (n=30)		Mean Difference	Std. Error Difference	95% C.I of the Difference		p value
	Mean	Std. Deviation	Mean	Std. Deviation			Lower	Upper	
Thickness (mm)	5.62	1.30	3.76	0.58	1.86	0.26	1.34	2.38	<0.001*

\*Significant

Graph 3: Comparison of thickness of plantar fascia between symptomatic and asymptomatic groups

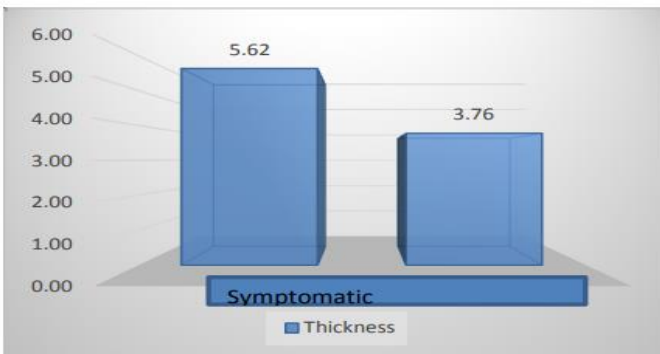


Table 4: Comparison of occupational categories between symptomatic and asymptomatic groups

Occupational categories	Symptomatic (n=30)	Asymptomatic (n=30)	Total	p value
Standing heavy jobs	27 (90%)	15 (50%)	42 (70%)	0.001*
Sedentary jobs	3 (10%)	15 (50%)	18 (30%)	

Graph 4: Comparison of occupational categories between symptomatic and asymptomatic groups

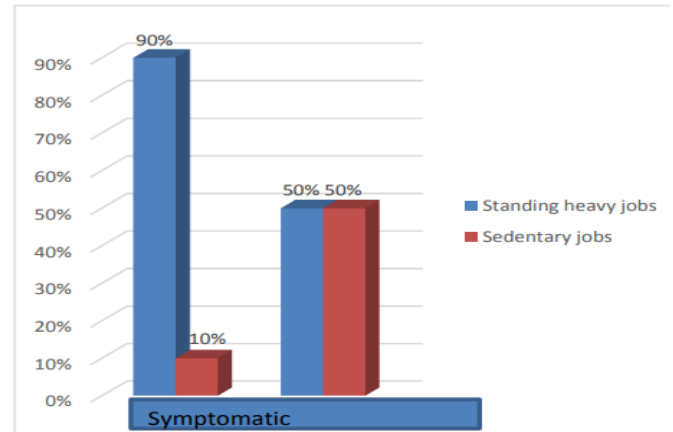


Table 5: Comparison of presence of co morbidities between symptomatic and asymptomatic groups (diabetes)

Co-morbidities	Symptomatic (n=30)	Asymptomatic (n=30)	Total	p value
Yes	11 (36.7%)	3 (10%)	14 (23.3%)	0.015*
No	19 (63.3%)	27 (90%)	46 (76.7%)	

Graph 5: Comparison of presence of co morbidities between symptomatic and asymptomatic groups (diabetes)

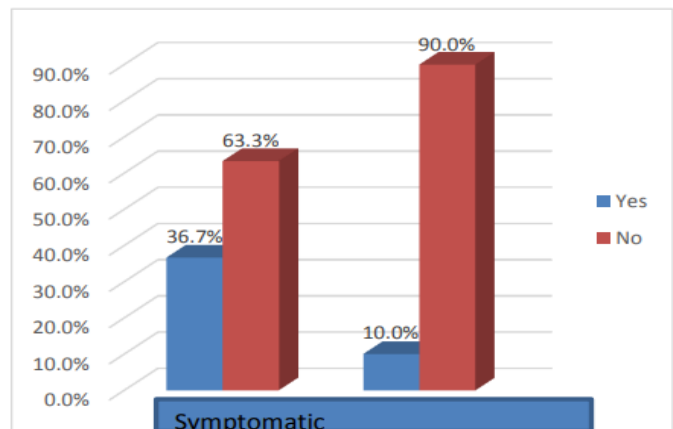




Table 6: Comparison of BMI categories between symptomatic and asymptomatic groups

BMI category	Symptomatic (n=30)	Asymptomatic (n=30)	Total	p value
<25	7 (23.3%)	14 (46.7%)	21 (35%)	0.172
25 - 30	19 (63.3%)	14 (46.7%)	33 (55%)	
>30	4 (13.3%)	2 (6.7%)	6 (10%)	

Graph 6: Comparison of BMI categories between symptomatic and asymptomatic groups

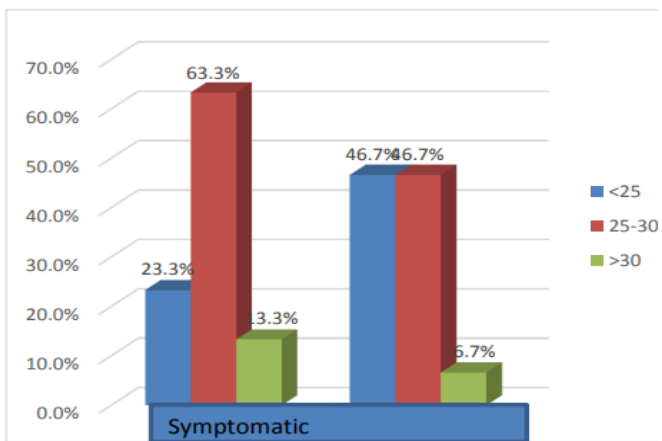


Table 7: Comparison of x-ray findings between symptomatic and asymptomatic groups

X-ray	Symptomatic (n=30)	Asymptomatic (n=30)	Total	p value
Yes	1 (3.3%)	0 (0%)	1 (1.7%)	1.000
No	29 (96.7%)	30 (100%)	59 (98.3%)	

### Conclusion

The results of this study indicate that the mean plantar fascia thickness of people with plantar fasciitis is greater than the mean plantar fascia thickness in asymptomatic subjects. The incidence of plantar fasciitis is more in the age group of 40-60 years with a female preponderance. It is also concluded that standing heavy jobs, increased BMI and comorbidities like diabetes are risk factors in the development of plantar fasciitis. The finding of heel spur in Xray was not found as a risk factor for plantar fasciitis.

### List of abbreviations

US - Ultrasonography

MRI – Magnetic Resonance Imaging

PF - Plantar Fasciitis

BMI – Body Mass Index

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