

# Diagnostic Accuracy of High-Resolution Ultrasound in Clinically Suspected Pakistani Patients with Plantar Fasciitis

Esha Habib Butt<sup>1</sup>, Sehrish Zafar<sup>2</sup>, Amna Mehar<sup>3</sup>, Soman Rasool<sup>4</sup>, Ajwa Binte Abbas<sup>5</sup>, Faryal Gohar<sup>6</sup>

- 1 Assistant Professor, Department of Radiology, Fatima Jinnah Medical University / SGRH, Lahore Pakistan  
*Manuscript writing, data collection*
- 2 Assistant Professor, Department of Radiology, SIMS / Services Hospital, Lahore Pakistan  
*Literature review*
- 3 Women Medical Officer, Services Hospital, Lahore Pakistan  
*Data analysis*
- 4 House Officer, Lahore General Hospital, Lahore Pakistan  
*Data interpretation*
- 5 Medical Student, Muhammad Medical & Dental College, Mirpur Khas Sindh Pakistan  
*Data analysis*
- 6 House Officer, Lahore General Hospital, Lahore Pakistan  
*Data interpretation*

## CORRESPONDING AUTHOR

Dr. Esha Habib Butt  
Assistant Professor, Department of Radiology,  
Fatima Jinnah Medical College / SGRH, Lahore  
Pakistan  
Email: esharkn@gmail.com

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## ABSTRACT

**Background:** Plantar fasciitis is the term used for inflammation of plantar fascia which is serious and common problem in young individuals, which leads to impaired mobility and hampered quality of life. There is a lack of availability of local research data therefore current study aims to establish the accuracy of high-resolution sonography in diagnosing patients with plantar fasciitis. The importance of ultrasound as the first line of investigation lies in its cost effectiveness as most of our population belongs to lower socioeconomic status. **Objective:** The objective of this study was to assess the diagnostic accuracy of high-resolution ultrasound in clinically suspected patients of plantar fasciitis. **Study Design:** Comparative analytical study. **Settings:** Department of Radiology, FJMU/Sir Ganga Ram Hospital, Lahore Pakistan. **Duration:** April 2022 to September 2022. **Methods:** This was conducted in the, from. Total 50 patients who were suspected cases of plantar fasciitis clinically, were assessed with high resolution ultrasound by using 7 MHz linear array transducer on Toshiba Applio 300. All patients with chronic heel pain of more than 3 months duration, with or without heel pad tenderness on clinical examination were included in this study. While patients with long standing neuromuscular diseases, systemic inflammatory arthritis and diabetes mellitus were those who were excluded from our study. **Results:** In patients of plantar fasciitis, plantar fascia thickness was significantly increased (in 84% patients) on ultrasound (maximum measuring 6.1mm and mean 5.3 mm). Near calcaneal insertion of plantar fascia, at its proximal end, fascia was diffusely hypo-echoic in symptomatic (81%) patients. In a few patients, evidence of calcification, fluid collection (63%) and fascia rupture (47%) was noted. The sensitivity of high-resolution ultrasound to detect plantar fasciitis was 97 %, specificity was calculated as 100 % and diagnostic accuracy was 86%. **Conclusion:** We recommend ultrasound as an accurate, low cost and non-invasive imaging modality for verification of clinical diagnosis of plantar fasciitis because of the fact that common sonographic findings of plantar fasciitis are increased thickness (> 4mm) with decreased echogenicity of plantar fascia.

**Keywords:** Plantar fasciitis, linear array transducer, prone position.

## INTRODUCTION

Heel pain is a well-known problem in the adult population. Plantar fasciitis is a common cause of heel pain, responsible for 15 % of all patients having foot complaints in outpatient department of orthopaedics. Plantar fascia is not a true fascial layer. Plantar fascia is a fibrous aponeurosis for intrinsic plantar foot muscles that serves to separate, support and attach muscles. Plantar

fascia runs from the calcaneum to the phalanges. The plantar fascia has three parts, which include: medial, lateral and central bands. The thickest and strongest part of the plantar fascia is the central band and most commonly involved in plantar fasciitis. Plantar Fasciitis is a condition that can seriously affect mobility of an individual and quality of life. The Plantar Fascia is thick connective tissue supporting the medial arch of the foot on the plantar aspect.

There are few risk factors that are involved in increased incidence of plantar fasciitis, these are Weight gain, Overexertion, few occupations requiring vigorous activity of lower limbs, Poor biomechanics, anatomical variations, inadequate footwear and sedentary lifestyle.<sup>1,2</sup> Females are more prone to Plantar fasciitis in comparison to males.<sup>3</sup> In young individuals, the fibres of Plantar Fascia are thicker and as age progresses, the thickness of fibres decreases.<sup>4</sup>

In foot, plantar fascia works as a shock absorber. Repeated trauma leads to wear and tear of this fascia. Minor trauma to this fascia heals naturally within the due course of time. Some people, after developing pain, change their posture and gait to decrease pain, however, these changes further aggravate the trauma to fascia and they further develop osteoarthritis.

Clinical diagnosis of plantar fasciitis is made with history and patient's examination. The main symptom of this disease is the pain on the sole, especially the plantar side of heel. Pain increases on weight bearing. There is tenderness noted at the medial side of the calcaneum on clinical examination. Musculoskeletal sonography is a low cost, non-invasive, non-hazardous and accurate method for diagnosing plantar fasciitis. On high resolution ultrasound of the heel, in a prone position, plantar fasciitis can be evaluated by measuring plantar fascia thickness at its proximal attachment site, within 1 cm of its calcaneal insertion. Feet of all included individuals were in hanging position from the edge of the ultrasound couch in a prone position with dorsiflexed ankles. Ultrasound was performed by placing a probe in Longitudinal position to get sagittal images taking the mean of the 2 measurements for each individual. Plantar fasciitis was labelled as positive with increased plantar fascia thickness more than 4mm.<sup>5,6</sup> Other findings include perifascial fluid collections, hypoechoic texture of fascia, discontinuity of fascial fibres and calcifications. The role of ultrasonography is limited for evaluation of calcaneal spurs.<sup>7</sup>

Ultrasound is not only used as a diagnostic tool in cases of plantar fasciitis, but also proved successful in guiding local injection treatment and in follow-up to assess the response of treatment. Furthermore, ultrasound guided injections have better response in comparison to unguided injection treatment. The rationale of this study was to establish the diagnostic accuracy of high-resolution ultrasonography in patients who were clinically suspected cases of plantar fasciitis.

## METHODS

This study was conducted in the Department of Radiology, FJMU/Sir Ganga Ram Hospital, Lahore, from April 2022 to September 2022. after taking approval from

the institutional review board (IRB). The study design was comparative analytical. Total 50 patients were included in this study. Informed consent was obtained from all patients included in this study or from their guardians where applicable.

All adult patients including females and males (with the age ranging from 30 years to 55 years) having chronic heel pain of more than 3 months duration and those who had heel pad tenderness on clinical examination, were included.

Patients with long standing neuromuscular disease, systemic inflammatory arthritis and diabetes mellitus were excluded from this study. Sonographic images were taken in prone position, at proximal end of plantar fascia by using high resolution ultrasound 7 MHz linear array probe of Toshiba Aplio 300, in longitudinal plane and plantar fascia thickness was measured near its insertion into calcaneum with dorsiflexed ankles and heels hanging down from ultrasound couch edge. In patients with plantar fasciitis following features can be noted which include increased thickness of plantar fascia, reduced echogenicity of fascia, fluid collections adjacent to fascia, calcifications and rupture of fascial fibres.

## RESULTS

Total 50 patients were enrolled in this study during the period of 6 months. All individuals were imaged with the same machine and two readings for plantar fascia thickness were taken, after that mean was calculated. Out of 50 patients in the study, maximum plantar fascia thickness was 6.1 mm, while minimum plantar fascia thickness was 4.7mm with mean value of 5.3 mm. while normal thickness of plantar fascia should be less than 2.9 mm. A 2x2 table (table 1) was used to calculate the sensitivity, specificity and diagnostic accuracy of high resolution sonography in diagnosing plantar fasciitis. The calculated sensitivity was 97%, specificity as 100% and diagnostic accuracy 86%.

**Table 1: 2x2 table to calculate sensitivity, specificity and diagnostic accuracy of high resolution ultrasound in plantar fasciitis**

Clinical Assessment	Ultrasound assessment		Total
	Positive (n=44)	Negative (n=6)	
Positive (n=49)	TP 43	FP 06	49
Negative (n=1)	FN 01	TN 0	01
<b>Total</b>	44	06	50

**Table 2: Frequency of sonographic findings in plantar fasciitis**

Sonographic findings	Frequency (%)
Thickening of plantar fascia	84%
Reduced echogenicity	81%
Perifascial fluid collection	63%
Torn fibres	47%

The distribution of the gender in study participants and increased prevalence in females is tabulated below in Table 3.

**Table 3: Gender distribution of participants in the study (n=50)**

Gender	Frequency (N)	Percentage (%)
Females	28	56%
Males	22	44%
Total	50	100%

In this study, the patient's age range was 30 years to 55 years and mean age was 40 years. In Table 4, the distribution of the age in this study is tabulated.

**Table 4: Age distribution of participants in the study (n=50)**

Age	Frequency (N)	Percentage (%)
< 40 years	29	58%
> 40 years	21	42%
Total	50	100%

In our study, the majority of patients having plantar fasciitis were using uncomfortable flat shoes like slippers frequently, proving their association. Very few were those, who were wearing joggers.

Sedentary life-style was the main factor to develop plantar fasciitis. In our study, out of 50 patients, 38 patients had sedentary lifestyle (76%) while 12 patients had an active lifestyle (24%), suggesting its relation with lifestyle. The occupational history of the individuals is tabulated in Table 5.

**Table 5: Occupational history of participants in the study (n=50)**

Occupation	Frequency (N)	Percentage (%)
Outdoor/ field work	12	24%
Online work from home	16	32%
Housewife	15	30%
Lecturer	02	04%
Receptionist	05	10%
TOTAL	50	100%

## DISCUSSION

15 % of patients diagnosed with plantar fasciitis are having heel pain, but no adequate clinical data on the demographic and diagnostic basis is available in the Pakistani population. It is significant to diagnose plantar fasciitis as, Subcalcaneal bursitis, osteomyelitis, calcaneal stress fractures, Tarsal tunnel syndrome and gout are its main differential diagnoses.

The plantar fascia is aponeurosis that contains a large amount of collagen fibres<sup>8</sup> and maintains the arch of the foot. It is a connective tissue for the intrinsic muscles of the foot, which absorbs the shock and distributes the weight bearing forces to the small joints of the foot. It helps the individuals during walking to maintain their gait. Females are more prone to develop plantar fasciitis and this is likely the result of repeated trauma. A person who frequently does a lot of physical activity presents with chronic heel pain and further diagnosed as a case of plantar fasciitis.

The sonographic features of plantar fasciitis are thickening of the plantar fascia and its reduced echogenicity. There are many factors that can affect the echogenicity of the plantar fascia. Among these factors, the most common factor is thickened keratinized skin which can cause decreased echogenicity on sonography. So, recent research suggests that on ultrasound examination, the main finding of plantar fasciitis is the thickening of the plantar fascia to diagnose plantar fasciitis.

The effectiveness of high-resolution ultrasound imaging in diagnosing plantar fasciitis is sometimes influenced by sonologist-dependent error. However, previous studies reveal that values of plantar fascia thickness on ultrasound are reproducible, with high inter and intra-observer accuracy.<sup>9</sup> During this study, ultrasound examination of all patients was performed by a single sonologist to eliminate sonologist-dependent variation in the measurements.

High resolution ultrasound is considered as the first modality of choice for diagnosing plantar fasciitis, because it is a dynamic, quick and low-cost imaging technique that gives high-resolution assessment of the plantar fasciitis.

The plantar fascia is a superficial structure which can be seen by high resolution ultrasound imaging. According to a study, Sabir *et al.*, it is seen that ultrasound and magnetic resonance imaging are equally valuable to diagnose plantar fasciitis.<sup>10</sup> Due to easy availability of ultrasound, it is becoming investigation of choice to diagnose plantar fasciitis.<sup>11</sup> Another study of Osborne *et al.* it is revealed that the radiographic findings of plantar fasciitis are the thickening of plantar fascia, cortical bony

changes noted in the calcaneum and fat pad abnormalities noted, which is present beneath the plantar fascia.<sup>12</sup>

In this study, the majority of patients diagnosed as plantar fasciitis are those who had sedentary lifestyle, which is according to the study by Belhan *et al.* Sedentary lifestyle is an established risk factor to develop plantar fasciitis.<sup>13</sup>

Plantar Fasciitis is more extensive and common in adult diabetic patients. However, its management is the same for diabetic and non-diabetic patients.<sup>14</sup> Treatment of plantar fasciitis can be done by physiotherapy, NSAID (non-steroidal anti-inflammatory drugs), and minimally invasive non-surgical methods including local steroid or dextrose injections, platelet-rich plasma, and Botox.<sup>15</sup>

In our study, improper footwear is a major risk factor of developing plantar fasciitis which is also reported by Rajput *et al.*<sup>16</sup> According to another study, improperly selected shoes can increase the heel pain in patients with plantar fasciitis and cause reduction in treatment response.<sup>17</sup> Patients of plantar fasciitis should prefer increased shoe heel height. Women are more commonly affected by plantar fasciitis, which coincides with the study of Barrett *et al.*<sup>18</sup> According to Khatiwada *et al.* 40 years was the mean age to develop plantar fasciitis which is similar to mean age described in our study.<sup>19</sup> In our study, the majority of patients were obese which is in accordance with another study by Belhan *et al.*<sup>13</sup> According to Ahmed *et al.*<sup>20</sup> Ultrasound could be as good a modality as MRI (magnetic resonance imaging) in the diagnosis of Plantar fasciitis, if performed by a skilled radiologist.

In a study by Tsai *et al.* the specificity of ultrasound in detecting plantar fasciitis was 90.5% and the sensitivity was 91.9%.<sup>17</sup> Another study by Aggarwal P *et al.* Revealed that ultrasound sensitivity to detect plantar fasciitis was 96% and specificity was 100%.<sup>21</sup>

## CONCLUSION

Plantar fasciitis is a major psychological burden to the patients. It can be diagnosed on the basis of clinical assessment and radiological investigations. High resolution ultrasound is proved to have 97% sensitivity, specificity of 100% and diagnostic accuracy of 86 % in diagnosing Plantar fasciitis. In real time ultrasound, sonographic findings include increased thickness of plantar fascia more than 4mm, and decreased echogenicity of fascia. High resolution ultrasonography is highly sensitive and specific to diagnose plantar fasciitis. It helps referring clinicians to confirm their clinical diagnosis of plantar fasciitis. By using ultrasound, we can also see the response of local treatment. It also helps the clinician to decide the management and access follow-up.

## LIMITATIONS

Few limitations noticed in our study were that the study was single hospital based with a relatively small sample size. However, our radiological findings in the Pakistani population was very informative for diagnosing plantar fasciitis and for guiding clinicians regarding selection of treatment options. Our study will also help to plan large-scale studies in Pakistani population on plantar fasciitis in the future.

## SUGGESTIONS / RECOMMENDATIONS

We recommend high resolution ultrasound as an accurate diagnostic modality in patients diagnosed with plantar fasciitis.

## CONFLICT OF INTEREST / DISCLOSURE

There was no inter author conflict of interest.

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