Research Article ISSN 2693-2490

Journal of Psychology and Neuroscience

Plan of Investigation of the Plantar Fascia in Rehabilitation/ Treatment/ Prevention

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Submitted : 17 Sept 2025 ; **Published :** 3 Oct 2025

Citation: Malek Mohammadi, S. (2025). Plan of Investigation of the Plantar Fascia in Rehabilitation/Treatment/Prevention. *J Psychol Neurosci; 7*(4):1-5. DOI : https://doi.org/10.47485/2693-2490.1129

Abstract

It is assumed plantar fascia has important role to support the arched structure of the foot (Gefen, 2002). Plantar fascia changes along its extension. It divides into splits either in horizontal or in sagittal plane. It attaches to the bones and soft tissues (Wearing et al., 2006).

The objective of this research is to design a plan of investigation according to the non weight bearing landmarks and measurements of the foot which can be effective in lower limb rehabilitation/treatment/ prevention schedule.

Method

1. *To identify non weight bearing landmarks.*
2. *To identify the mid line of the plantar aspect of the foot.*
3. *To calculate the measurements of the foot.*
4. *To identify the location of the plantar fascia along its length in unloading and before modification in both feet.*
5. *To register identified location of the plantar fascia in ultrasound image.*

The out come of this research can be resulted in more effective treatment in a short time, increasing successful team work in rehabilitation and increasing the percentage of prevention.

Keywords: Plantar fascia; Unloading landmarks; Evaluation; Plan of investigation; Ultrasound image.

Introduction

Plantar fascia is a thick, multilayered and inelastic band of fibrous tissue that extends along the plantar surface of the foot (Jeswani et al., 2009). It forms a strong mechanical linkage between calcaneus and toes and because of its morphology, it has different mechanical properties (Langevin et al., 2009). Plantar fascia sustains the complex arch system of the foot and locks the arch during supination and distribution of the force in mid-stance. It is effective in one's balance throughout all phases of the gait and acts as a shock absorber and supports the body's weight in both static and dynamic weight-bearing positions (Bolgla et al., 2004). Plantar fascia has important role in dynamic and static positions of the foot through maintaining the height of the medial longitudinal arch (Gefen, 2002). It is auto supportive, also (Aquino et al., 1999). Through the stance phase plantar fascia resupinates the foot for propulsion (Bartold, 2004). The direction of the plantar fascia is effective to maintain the arch throughout the gait and contributes in amount and timing of pronation and supination during the gait cycle (Bolgla et al., 2004). Plantar fascia is made up of different types of connective tissues. It attaches either to the bone or to the soft tissue and covers the underlying structures. From its origin it continues longitudinally, horizontally and vertically. The depth of the locations of the plantar fascia is not equal along its length (Wearing et al., 2006). It carries the nerves and blood vessels to and from the skin (Porta et al., 2005). Plantar fascia includes of collagen and elastic fibers. Elastic fibers are shaped as strands and networks with different thicknesses. The elastic fibers in compare with the collagen fibers have lower modulus of elasticity (Wright et al., 1964).

As for irregular morphology, it has been decided to design the plan of investigation to collect data about plantar fascia in both feet.

Method

The aims of identification of non weight bearing landmarks are:

- To reduce the error of palpation to find anatomical landmarks.
- To scan ultrasound image in sagittal and frontal plane in one point.
- Handheld calipers are used to calculate the measurements of the foot. (Butler et al., 2008) The resolution of calipers is 1mm.

Figure 1: Ankle is put in 90°

Figure 2: Knee is put in 90 degree flexion

Figure 3: Two non weight bearing land marks aa'

Figure 4: Two non weight Bearing land marks bb'

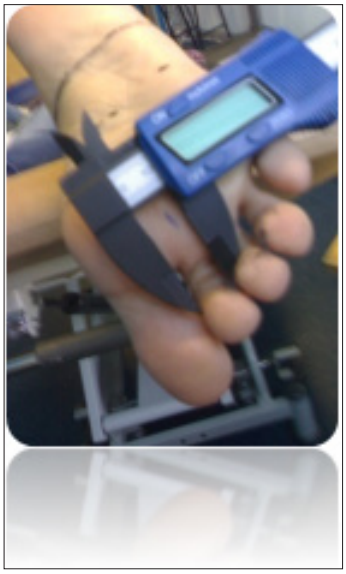

Figure 5: Identifying and marking the middle of the 2nd toe /o

The subject is positioned in prone, calcaneus aligned straight with the lower leg and dorsum of the foot is put adjacent to the table (Glasoe et al., 2002).

(a) (b) (c)

Figure 6: Identifying and marking the middle of the heel (a, b, c) / o'

For reliability of the plan, two orthotists with different levels of experience, take blinded measurements and depict the plan. Landmarks are transferred on transparent paper in short sitting position. For validity of the plan, the distance between landmarks is compared with distance in x-ray in short sitting position. Putting thin and flexible soft metal on landmarks and taking x-ray from both medial and lateral sides with equal conditions (medial side x-ray for checking distance of a and b and vice versa) (Williams, 2000).

oo' is the mid line of the plantar aspect of the foot. b and b' are distal non weight bearing land marks. a and a' are proximal non weight bearing land marks. lateral medial line is the middle of the distance between aa' and bb'.

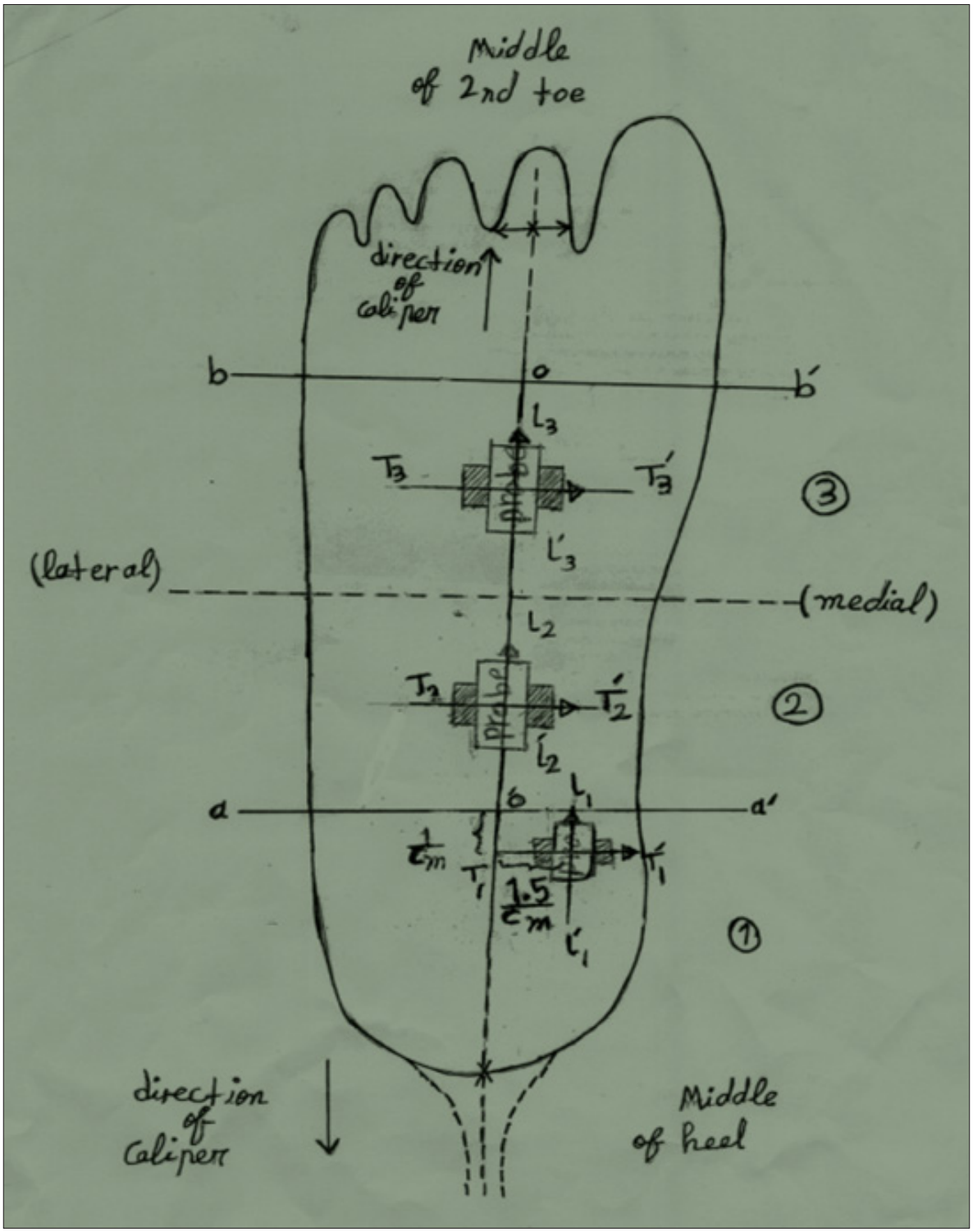

Figure 7: Plan of investigation

The plan of investigation includes of three sections. (1, 2, 3) LL' means, the probe of the ultrasound machine is put longitudinally on identified location of the plantar fascia. TT' means, the probe of the ultrasound machine is put on the same identified location of the plantar fascia transversely.

To register identified location of the plantar fascia in ultrasound image, ultrasound scanning can be done in prone position with flexed knees and ankles (Huerta, 2007).

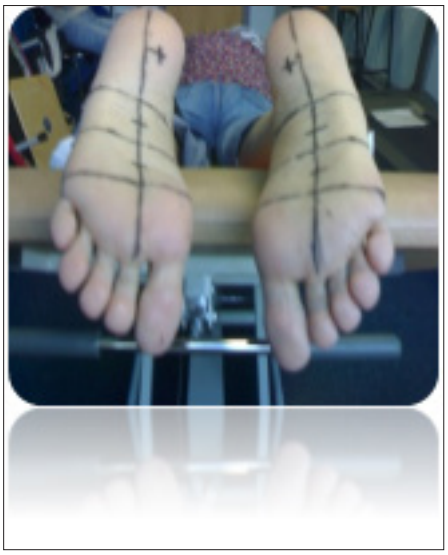

Figure 8: Position of subject for ultrasound scanning

The aim is scanning ultrasound images in sagittal and frontal planes (Gibbon, 1999, Vohra et al., 2002). While the examiner is sitting in front of the monitor, in longitudinal image, the plantar aspect of the foot is upward so that its direction is side to side. Heel is cleared in the right and toe is cleared in the left side of the monitor so the marker of the probe is put to the toes. In transverse image, the plantar aspect of the foot is upward so that the heel is put to the monitor and the toes to the examiner. The marker of the probe is put to the big toe in the right foot and to the 5th toe in the left foot. The thickness of the plantar fascia /identified location is evaluated via "Image J" soft ware with the resolution of tenth of a millimeter. The oo' line is registered on the mid line of the monitor in ultrasound. For reliability, the evaluation is repeated seven times.

For validity, the evaluation is done from left to right and from right to left, every 5mm.

(The mean of the plantar fascia thickness in each location is calculated after seven times evaluation then SD of that area is computed).

Conclusion / Discussion

Identified location / thickness of the plantar fascia along its length and its equivalent location in opposite foot in living individual can be evaluated. To increase the precision of evaluation, identified location of the plantar fascia is evaluated both in sagittal and frontal planes.

Via identified location, the percentage of the body weight applied in identified location and the angle of lower limb joints, in static and locomotion, can be recorded and calculated, simultaneously.

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