

Relationship between leg-length discrepancy and plantar fasciitis

Relação da dismetria dos membros inferiores com a fasciíte plantar

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ABSTRACT

Objective: This study evaluated the relationship between leg-length discrepancy (LLD) and plantar fasciitis (PF).

Methods: A cross-sectional study was performed that measured the length of the lower limbs via a scanometry of patients with PF. Other risk factors such as body mass index (BMI), foot posture, and the presence of a plantar heel spur on foot X-ray were also evaluated.

Results: Of the 54 participating patients, 44.4% were male with a mean age of 50.38 (23-73 years), 81.5% had pain in one foot, and 53.7% had plantigrade feet. We observed LLD in 88.9% of the sample, with a mean discrepancy of 0.749 cm (SD +/-0.63); 46.3% of the painful feet presented with spurs on X-ray.

Conclusions: Approximately 90% of the patients presented with LLD, and the shorter limb was the affected side in most cases.

Level of Evidence II; Prognostic Studies.

Keywords: Lower Extremity; Fasciitis, plantar; Heel spur syndrome.

RESUMO

Objetivo: Avaliar a relação entre a dismetria dos membros inferiores e a fasciíte plantar.

Métodos: Foi realizado um estudo transversal mensurando o comprimento dos membros inferiores por meio da escanometria em pacientes com diagnóstico de fasciíte plantar. Foram avaliados igualmente outros fatores de risco como o índice de massa corporal (IMC), formato dos pés e a presença do esporão plantar no calcânhar nas radiografias dos pés.

Resultados: Dos 54 pacientes incluídos, 44,4% eram homens com idade média de 50,38 (23 - 73 anos), 81,5% apresentavam dor em um dos pés e 53,7% tinham pés considerados plantígrados. Observamos 88,9% de dismetria na amostra, com média de 0,749 cm (DP +/-0,63); 46,3% dos pés dolorosos apresentavam esporão nas radiografias.

Conclusão: Cerca de 90% dos pacientes apresentaram dismetria dos membros inferiores e na maioria dos casos o lado acometido foi o do membro mais curto.

Nível de Evidência II; Estudos Prognósticos.

Descritores: Membro inferior; Fasciíte plantar; Síndrome do esporão calcâneo.

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INTRODUCTION

Plantar fasciitis (PF) is an inflammatory process at the origin of the plantar fascia and surrounding structures that can present as a painful and debilitating condition⁽¹⁾. It is the most common cause of plantar fascia injury⁽²⁻⁴⁾, accounting for 80% of all cases of heel pain⁽⁵⁾. One in 10 individuals will develop PF in their lifetimes^(1,6), affecting approximately 2 million Americans per year⁽⁷⁾. Its incidence in the general population is more frequent among people between 40 and 60 years old⁽³⁾, military personnel, and runners⁽⁸⁾. PF accounts for approximately 10% of all reported injuries in runners⁽⁸⁾. This pathology can impair the performance of physical activities, restrict work-related tasks, and limit routine activities in more severe cases, thereby greatly affecting patient quality of life^(1,3,4).

The etiology of PF is multifactorial^(3,9-11). PF occurs in association with various rheumatologic diseases, but its etiology is unknown in approximately 85% of cases⁽¹⁰⁾. Several causes have been suggested, the most common being overload due to biomechanical factors that cause excessive tension in the plantar fascia such as foot deformities, inadequate footwear, obesity, high-impact activities such as running, and activities involving prolonged walking or long periods of standing^(9,11).

Leg-length discrepancy (LLD) is relatively common in the general population^(12,13). However, few papers exist in the literature on the subject, and many patients with LLD are asymptomatic; thus, the exact prevalence of this condition is underestimated⁽¹³⁾. Small LLD induces compensatory changes that affect the biomechanics of the spine, pelvis, and lower limb joints⁽¹⁴⁾. Two studies in the literature address the possible relationship between PF and LLD. In both, LLD was evaluated via clinical measurements using tape measure. One observed a higher prevalence of PF in the longer limb, which would explain why many patients present with pain in only one foot⁽¹⁵⁾. However, the second study did not find LLD to be associated with PF⁽¹⁶⁾.

The current study evaluated the relationship between LLD and PF using scanometry to measure leg length.

METHODS

This study was approved by the Research Ethics Committee with registration in the Brazil Platform under CAAE number: 76123617.7.0000.0023.

This cross-sectional study evaluated consecutive patients of the Foot and Ankle Surgery outpatient clinic diagnosed with PF after signing an informed consent document.

All patients with a clinical diagnosis of PF confirmed on imaging (ultrasound and/or magnetic resonance imaging [MRI]) who agreed to participate in this study were included.

All patients with histories of trauma that triggered the symptoms of PF or orthopedic surgery to alter leg length or gait were excluded.

All patients selected for this study were recruited and received foot X-rays and scanometries of the lower limbs. In addition, we recorded demographic characteristics and anthropometric data such as weight, height, and body mass index (BMI) as well as identified the symptomatic feet.

Diagnosis of Plantar fasciitis

PF was diagnosed through a clinical history and physical examination of the feet to identify the painful area as well as the foot posture in an orthostatic position and during walking⁽¹⁷⁾. The foot posture was classified as plantigrade, pes planus, or pes cavus based on a clinical evaluation of the medial longitudinal arch of the feet. In addition, a neurological examination of the lower limbs was performed to evaluate the deficits associated with compressive syndromes that should be considered as a differential diagnosis from PF such as Baxter's nerve entrapment (i.e., the compression of the first branch of the lateral plantar nerve), L5-S1 radiculopathy, and tarsal tunnel syndrome.

Foot X-rays were taken to aid in the diagnosis and screen for associated deformities (e.g., osteoarthritis) and the presence of a spur in the plantar region of the heel near the origin of the plantar fascia in the calcaneus. Ultrasound and MRI were also used for some patients to evaluate the structure of the plantar fascia and confirm the diagnosis⁽¹⁷⁾.

Scanometry of the lower limbs

The length of the lower limbs was measured for all patients using the method described by Farril^(18,19). The measurements were taken with the patient in the supine position, taking separate X-rays of the hips, knees, and ankles (in that order). The length of the lower limbs was calculated based on the three X-rays. For each lower limb, we first measured the distance between the highest point of the femoral head and the projection of the center of the intercondylar notch on a line touching the femoral condyles (femoral measurement). Next, the distance from the same point on the line between the femoral condyles to the lowest point of the tibial articular surface in the ankle was measured (tibial measurement). The third measurement was made directly from the highest point of the femoral head to the lowest point on the tibial articular surface.

Farill⁽¹⁹⁾ named the differences in these distances between the limbs “functional shortening”.

Statistical analyses

The collected data were arranged in a Microsoft Excel 2013 spreadsheet; this software was also used to construct the graphs. Statistical analyses were performed using the IBM Statistical Package for the Social Sciences (SPSS), version 22.0. The descriptive analyses included the construction of graphs, frequency distributions, and calculation of descriptive statistics.

The chi-square test was used to determine whether a significant association existed between two qualitative variables; when the results were inconclusive, Fisher’s exact test was applied.

RESULTS

The frequency distributions of the variables characterizing patients with PF are shown in table 1.

Of the 54 patients included, 24 were men (44.4%), and 30 were women (55.6%). The mean age was 50.38 years (range 23 to 73 years). The mean BMI was 26.3. The right limb was dominant for 43 (79.6%) patients, and the left limb was dominant for 11 (20.4%). A total of 44 (81.5%) patients complained of pain in one foot (24 in the right foot and 20 in the left), and 10 (18.5%) reported bilateral pain. Of the patients with unilateral pain, 20 (37%) reported pain in their dominant foot, and 24 (44.4%) reported pain in their nondominant foot ($p>0.05$).

Of the total sample, 29 patients (53.7%) had plantigrade feet, 19 (35.2%) had pes planus feet, and six (11.1%) had pes cavus feet. A total of 26 participants (48.1%) reported that they were not physically active, whereas 28 (51.9%) reported regular physical activity. The sports practiced are shown in Figure 1.

Table 1. Frequency of the sample variables (n=54)

Variable	Minimum	Maximum	Mean	Median	SD
Age	23	73	50.3	54	13.0
Weight	55	98	74.6	75	11.29
Height	1.54	1.90	1.68	1.68	0.80
BMI	19.48	34.51	26.3	26.2	3.21
Leg length discrepancy	0	3.0	0.749	0.60	0.63

SD: standard deviation; BMI: body mass index

Source: Prepared by the author based on the results of the research.

Of the 54 patients, 48 (88.9%) presented with LLD on lower limb scanometry. The right side was shorter for 55.6%, and the left side was shorter for 33.3%. Among the 41 cases of unilateral pain, the shorter side was painful side in 65.8% of the cases, whereas the contralateral side was painful in 34.2% of the cases ($p>0.05$). Finally, the presence of a plantar spur was observed on foot X-ray, and its relationship to pain was evaluated. Of the 54 painful feet, only 24 had a plantar spur; 25 painless feet showed this radiographic abnormality, and neither result was significant ($p>0.05$; Figure 2).

DISCUSSION

PF is the most common cause of plantar pain in the heel^(9,10); although several risk factors have been described in the literature, no consensus exists on its exact etiology^(15,20). Figure 3 shows the main risk factors associated with PF.

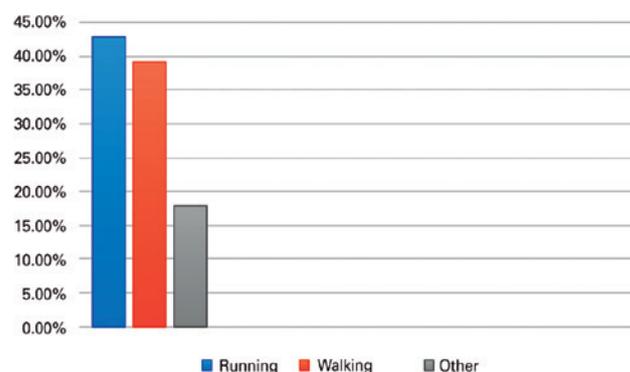


Figure 1. Frequencies of the sports performed by participants.

Source: Prepared by the author based on the results of the research.

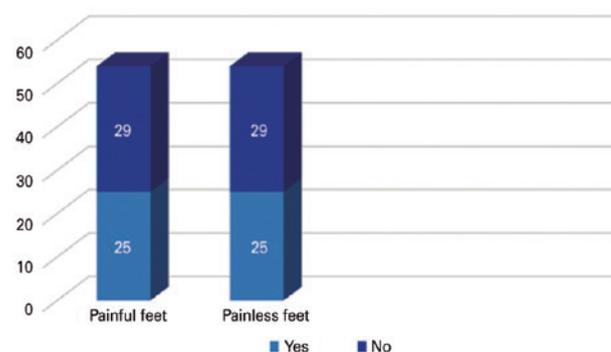


Figure 2. Presence of a plantar spur in painful and painless feet.

Source: Prepared by the author based on the results of the research.

The intrinsic factors include age, obesity, foot posture, and LLD^(3,4,9,10,17,20,21). According to the literature, PF primarily affects patients between 40 and 60 years old in the general population^(1,22). Although sex is not a risk factor, Imamura⁽²³⁾ found that 90% of patients with PF were female. In our study, we observed a higher prevalence of women (55.6%), with a mean age of 50.3 years.

Sadat-Ali⁽²⁴⁾ suggested that obesity causes heel pain and PF, and these effects are aggravated by the use of inadequate footwear. Although Riddle's prognostic study⁽²¹⁾ showed that obesity is an independent risk factor for PF, our sample revealed a mean BMI of 26.3. This difference is likely because 52% of the patients regularly performed physical activities, especially running, walking, and sports associated with PF^(16,20,25).

Prichasuk e Subhadrabandhu⁽²⁶⁾ performed a prospective study of patients with pes planus to evaluate their calcaneal pitch and presence of spurs. The author concluded that this foot posture is a cause of PF development. In our sample, 53.7% of the patients had plantigrade feet, and 35.3% had pes planus feet. Taunton et al.⁽²⁵⁾ argued that pes planus and subtalar joint pronation are the most significant intrinsic factors for the development of PF.

Although most of the possible risk factors cause a systemic effect or bilateral overload, the involvement of both feet is relatively uncommon, occurring in up to 30% of cases⁽²²⁾, and few studies have tried to explain this finding^(15,16). In the present study, 81.5% of the patients reported pain in only one foot (37% in the dominant foot and 44.4% in the nondominant foot). This difference was significant ($p>0.05$).

Intrinsic factors	Extrinsic Factors
Age	Footwear
Weight/body mass index	Physical activity
Pes planus	Frequency of physical activity
Pes cavus	Intensity and duration of physical activity
Subtalar joint pronation	Trauma
Leg length discrepancy	
Tibial and subtalar varus	
Femoral/tibial torsion	
Shortened Achilles tendon	
Ankle dorsiflexion limitation	
Increased plantar flexion of the ankle	

Figure 3. Risk factors for plantar fasciitis. **Source:** Author's personal archive.

Supporting our initial hypothesis, approximately 90% of patients presented with LLD, with a mean of 0.749 cm (SD +/-0.63). Of these patients, 65.8% presented with pain only on the side of their shorter limb; however, this result was not significant ($p>0.05$). The literature includes only two previous studies that have evaluated the relationship between LLD and PF. Mahmood et al.⁽¹⁵⁾ evaluated 26 patients and observed a strong correlation between LLD and PF. In the second study⁽¹⁶⁾, the authors investigated the anatomical factors associated with fasciitis in 21 long-distance runners. The results revealed that LLD was not related to fasciitis. Importantly, however, both studies measured leg length clinically by recording the actual length of the limbs with a tape measure. In our study, we used lower limb scanometry because it is a more reliable method that provides measurements with precision, reliability, and accuracy; these characteristics are necessary for both research and clinical practice^(27,28). In addition, our sample had a much larger number of participants, although it was still low.

Finally, we evaluated the presence of heel spurs on X-ray. Curiously, we found the same number of X-rays showed plantar spurs in painful as in painless feet. Only 46.3% of the X-rays of painful feet showed a spur, which was not significance. Baptista et al.⁽²⁹⁾ found a similar rate (44.4% of X-rays showed a spur). Spurs manifest via endochondral ossification, which is more common in the origin of the abductor hallucis and flexor hallucis brevis, well below the plantar aponeurosis⁽³⁰⁾. Thus, the presence of a spur on conventional X-ray is not a pathognomonic sign of PF⁽³¹⁾.

We are aware of the limitations of the present study. The major limitation is the lack of a control group to confirm our results. Another limitation was the way in which we evaluated participant foot posture without an objective measurement such as the Moreau-Costa-Bertani angle (Baptista et al.)⁽²⁹⁾ or the use of a plantar pressure measurement such as baropodometry. According to the windlass mechanism classically described by Hicks⁽³²⁾, the foot takes a pronated position during the gait cycle, and the plantar aponeurosis resists tensile forces, thereby keeping the longitudinal arch elevated. Thus, patients with pes planus and subtalar pronation suffer greater tension in the plantar fascia, predisposing them to PF. Although the highest prevalence of pain in this study was among patients with plantigrade feet, we found that patients with pes planus outnumbered those with pes cavus by three to one.

Small LLD induces compensatory changes that affect the biomechanics of the spine, pelvis, and joints of the lower limbs^(33,34). Although LLD is common in the general population, few studies have analyzed this topic, especially

with regard to foot pathologies^(12,13,35). Sanhudo et al.⁽³⁵⁾ showed that LLD is more prevalent and severe among patients with posterior tibial tendon dysfunction and suggested that even lower degrees of LLD are not as harmless as some authors have postulated.

Additional studies evaluating lower limb length in patients with PF, including a control group, should be performed to better define this correlation and determine a

possible explanation for the unilateral presentation of this disease.

CONCLUSIONS

The length of the lower limbs on scanometry showed that approximately 90% of patients with PF have LLD. In addition, the shorter limb was most often affected.

Authors' contributions: Each author contributed individually and significantly to the development of this article: HM ^{*}(<https://orcid.org/0000-0001-7527-969X>) conceived and planned the activities that led to the study, wrote the article and approved the final version; GFC ^{*}(<https://orcid.org/0000-0002-2984-7091>) wrote the article, participated in the review process and approved the final version; TCPL ^{*}(<https://orcid.org/0000-0003-1238-2475>) participated in the review process and approved the final version; CBG ^{*}(<https://orcid.org/0000-0003-2587-5586>) participated in the review process and approved the final version; JLQD ^{*}(<https://orcid.org/0000-0002-7511-5289>) participated in the review process and approved the final version; IMCJ ^{*}(<https://orcid.org/0000-0002-7815-6086>) participated in the review process and approved the final version. ^{*}ORCID (Open Researcher and Contributor ID).

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