

Article

The Prevalence of Neurological Symptoms in the Presence of Plantar Fasciitis: A Review of 459 Patients

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Abstract

Background: To determine the overall incidence of concomitant neurological symptoms and, if present, their origin. **Methods:** A clinical review was conducted of 459 patients from a large Podiatric Medical practice, who presented with a diagnosis of plantar fasciitis. **Results:** A diagnosis of plantar fasciitis presented clinical neurological findings in 49% (225 of 459) of study patients. With conservative treatment, neurological symptoms resolved in 126 of 225 patients (56%), leaving 99 nonresponding patients having persistent neurological symptoms. Electrodiagnostic studies were obtained in 73 of 99 nonresponding patients. Of those having electrodiagnostic studies, 68 of 73 (93.15%) had positive electrodiagnostic findings, while 5 of the 73 studies performed had no signs of neurological involvement. Of the 68 positive neurological studies, 11.76% (8 of 68) were specific for tarsal tunnel alone; 22.05% (15 of 68) were specific for radiculopathy alone; and 66.17% (45 of 68) of patients had a combination of radiculopathy and tarsal tunnel syndrome. Conservative care treatment in patients with plantar fasciitis alone resulted in plantar heel pain resolution in 87% of study patients. Conservative treatment in the group having plantar fasciitis AND neurological symptoms produced a 75% resolution rate. Using a two-tailed Chi square test, the *p* value for this comparison was 0.00098 (highly statistically significant). **Conclusions:** This author believes the 12% decrease in resolution rate of symptoms in the combined symptom group is the associated difficulties found with neurological involvement. In patients with refractory plantar fasciitis, proximal neurological involvement should be highly considered as an etiology for the pain. Surgical correction, based on the MRI and electrodiagnostic findings, would include nerve release along with plantar fascia release.

Keywords: plantar fasciitis; nerve entrapment; neuritis; radiculopathy; tarsal tunnel syndrome



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1. Introduction

The pain from mechanical plantar fasciitis has long been postulated to be a result of an overload injury to the plantar fascia [1–18]. Causative neurological entities are mentioned in the literature but less well discussed. Perhaps the first mention of associated nerve involvement in the production of plantar heel pain was presented by Roegholt [19]. Reported in 1940, in cadaveric studies, he identified the inferior calcaneal nerve and postulated that, due to its location in relation to the calcaneus, the nerve could be a cause of heel pain.

Kopell and Thompson, Phalen and Kendrick, Tanz, Cohen, Bailie, Rondhuis, Arenson, Przyliucki et al., Henricson and Westlin, and Goecker and Banks, among others, have all contributed to the concept that associated neuritis can be a cause of pain in the plantar heel [7,20–29].

Baxter et al. in 1984 provided the first comprehensive report of the inferior calcaneal nerve contributing to a painful heel through evaluation of its anatomic presentation and results from its surgical release [30]. In his 1984 report, Baxter noted that following release of the inferior calcaneal nerve, 24 of 26 (92%) patients no longer experienced pain and had no functional impairment postoperatively. Owing to this report, the inferior calcaneal nerve is now commonly known as Baxter's nerve.

In a follow up article in 1992, Baxter noted 89% complete post-operative resolution of plantar heel pain symptoms after surgical release of the inferior calcaneal nerve [31]. Significantly, the Baxter study noted that entrapment of the inferior calcaneal branch may occur in two locations. The first is found on the medial aspect of the foot as the nerve courses distally between the abductor hallucis and the quadratus plantae. The second is when the nerve takes a 90-degree turn, laterally sitting anterior to the calcaneal tuberosity with the quadratus plantae dorsally and the plantar fascia on its plantar surface. In this position, the nerve becomes subject to the conditions of the plantar fascia and/or the anterior calcaneal tuberosity.

While both pedal locations are prime sites of primary distal nerve damage caused by foot structures, distal nerve irritation and/or entrapment is not alone in contributing to neurologically induced heel pain. In 2008, Alshami et al. discussed the neurological causes of heel pain including those from more PROXIMAL origins such as tarsal canal, common peroneal entrapment, and radiculopathy [32]. Rio et al. in 2015 and Snook in 1972 discussed the differential diagnosis of heel pain including neurological sources of pain both proximal and distally derived [11,33].

This author has noted a high incidence of neurological symptoms occurring in patients concomitantly diagnosed with the condition of plantar fasciitis. Using data driven from a large General Podiatric practice, this study was carried out to quantify the presence of associated neurological pathology and to determine if the neurological pain was either proximally (radiculopathy/tarsal tunnel) or distally (plantar fascia) derived.

2. Materials and Methods

A retrospective review was conducted of 459 patients seen over a three and one half year period from 1 January 2017 to 30 June 2020 of those who had as a chief complaint of painful plantar heel(s) clinically diagnosed as plantar fasciitis. These patients were secondarily evaluated for the presence of accompanying neurological pain. All patients were from this examiner to keep findings and terminology consistent.

The demographics of the patients were as follows:

1. The age of patients ranged from 11 to 87 years with an average of 63.9 years.
2. Duration of symptoms ranged from 1 week to 20 years averaging 30 weeks.
3. The ratio of females to males was 60.3% female to 39.69% male.
4. Symptomatic patients in this study had an average BMI of 29.49. A random control group of non-heel pain patients from the same time frame measured BMI at 27.23.

BMI has been used to determine susceptibility to developing plantar fasciitis. An increased BMI has been previously found to be associated with the development of plantar fasciitis. In this study, the BMI was calculated at 29.49 for all patients, while a second independent study of non-heel pain patients found an average of 27.23. While our study group had an elevated BMI compared to the average population, they were below the obese level of 30 [34–36].

All study participants had at initial examination the diagnosis of plantar fasciitis made from their medical history and a physical examination [37–42]. Patients must have had a history of post-static dyskinesia consistently present daily and relieved, at least in part, with activity, together with some resolution of pain via mechanical support. Further, they were

without history of infection, injury, or trauma. On physical exam, the diagnosis was confirmed with pain located under the calcaneal tuberosity, with or without edema (Figure 1).

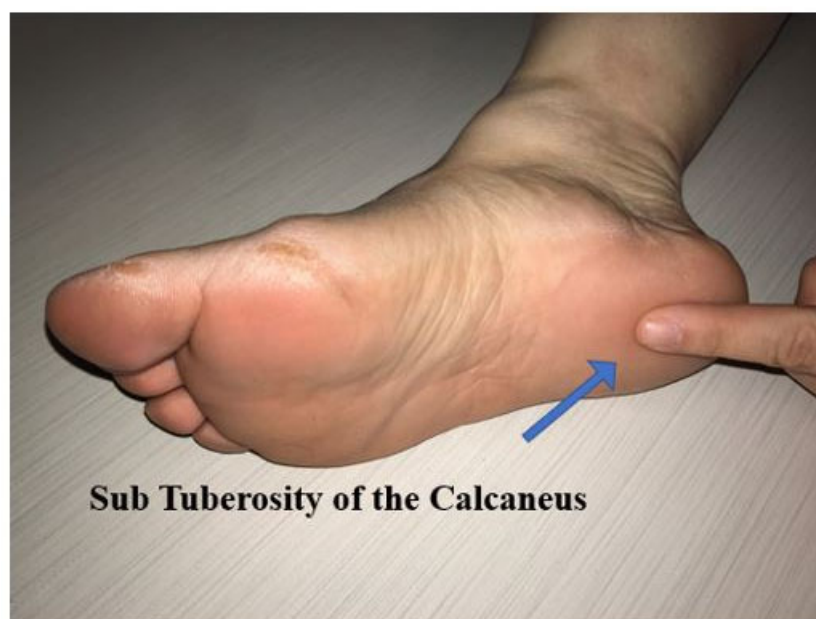


Figure 1. Sub-tuberosity of the calcaneus.

The diagnosis of neurological pain was also made from medical history and physical examination [7,12,24,27,42,43]. The most consistent physical neurological findings were pain on palpation of the porta pedis with or without radiation to the plantar of the foot, or pain on percussion of the tarsal canal, also with or without radiation to the plantar of the foot (Figure 2). Further, patients were without history of infection, injury, or trauma.



Figure 2. Opening of the Porta Pedis.

Items from their medical history helping in the diagnosis of neurological impairment were

1. Pain that occurred inconsistently regardless of activity or time;
2. Patients frequently noting they were unable to pinpoint the actual location of pain, instead using several fingers to represent the distribution of pain as being 'all over';

3. Patients often reporting that there were abnormal sensations, or pain at rest or in bed at night.

To be considered as resolved and discharged from care, all eligible patients must have verbally stated, and confirmed by physical exam, that there was a complete resolution of all symptoms identified as painful on initial exam, all symptoms being either the mechanically induced pain of plantar fascia from under the tuberosity and/or pain radiating from the tarsal canal or porta pedis occurring from neurological origin.

While under care, each separate condition, mechanical or neurological, if present, was evaluated and treated concurrently. Resolution of one condition would not necessarily provide resolution of the other so each was evaluated and treated separately.

As plantar fasciitis is acknowledged to be incurred due to an overload injury, all patients with the original diagnosis of plantar fasciitis were treated mechanically [12,44–48]. Initial treatment included supportive shoes, always worn when out of bed, initially supplemented by an over-the-counter in-shoe arch support [4,49]. This author prescribes softer over-the-counter inserts initially to take advantage of the softer support to cushion, while also supporting, the painful areas. Patients with neurological symptoms, in particular, were initially treated with the use of shoes and softer over-the-counter inserts to limit pressure and irritation against the Baxter's nerve while also attempting to limit excessive pronation and the resultant narrowing of the tarsal canal and tension on the nerve branches.

For all patients, Functional Custom Orthotic devices were recommended and utilized later in treatment, taking advantage of the more exact fit and increased long-term stability provided by the more durable and longer-lasting materials [50–52]. Night splints were often used to break the morning pain cycle and increase the response to treatment [53,54]. Physical therapy was heavily employed to maintain flexibility of the lower leg muscles to relieve pain and speed up response to treatment; the neurological group in particular was asked to develop their core muscle groups to relieve strain in the lower back, potentially decreasing radicular symptoms [55,56].

Cortisone injections were infrequently utilized by this author and disregarded if the symptoms were greater than 12 weeks [8,57,58].

3. Results

Each patient chart was reviewed, and relevant information obtained, analyzed, and computed by one individual to maintain consistency in analysis.

3.1. Incidence of Neurological Symptoms

Of the total 459 patients evaluated, 225 patients, or 49%, of all study patients had a history and examination consistent with both plantar fasciitis and neurological pathology. Conversely, 234 of 459 or 51% of all study patients had pain in the plantar tuberosity without pain in the porta pedis or tarsal canal, indicating mechanical plantar fasciitis without neurological involvement (Figure 3).

3.2. Treatment Results of All Patients

Looking at the overall treatment results of all patients (neurological and non-neurological), 74.95% (344 of 459) of patients fully responded to combined conservative treatment, leaving 25.05% (115 of 459) of study patients failing to respond to treatment. Other studies have reported successful treatment rates varying between 40% and 100% [5,12]. A breakdown of the 25.05% (115 of 459) of patients in the entire study who failed to fully respond to treatment presented a greater number of patients (84 patients) experiencing both neurological and plantar fasciitis symptoms while a lesser amount (31) experiencing only mechanical plantar fasciitis symptoms.

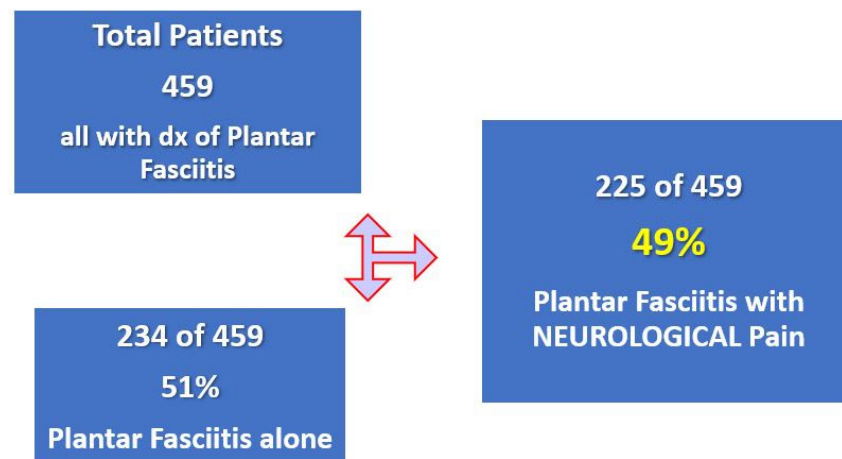


Figure 3. Incidence of neuritis.

3.3. Treatment Results of Plantar Fascia Patients

Of the initial group of patients with only plantar fascia symptoms (234 of 459 patients or 51%), 87% (204 of 234) were noted to have fully resolved their plantar fasciitis symptoms with conservative treatment such as inserts/orthotics, supportive shoes, physical therapy, decreased/alterd activity, cortisone, NSAIDS/CBD, Shock Wave Therapy.

3.4. Treatment Results of PF/Neurological Patient

Forty-nine percent (49%) of all patients had both plantar fascia and neurological symptoms. Neurological patients were given more time and modalities (physical therapy (especially core strengthening), Tens, Iontophoresis, NSAIDS, soft inserts, supportive shoes, and cortisone) to respond to treatment. A total of 99 of 225 patients did not respond to treatment, and 73 of the 99 had an electrodiagnostic examination which exhibited 68 of the 73 having positive neurological findings. These 68 were offered surgical decompression of the tarsal canal and porta pedis for resolution of their condition.

3.5. Summary of Treatment Results

The approximate 12% (87 – 75%) difference in symptomatic resolution between plantar fasciitis alone, and plantar fasciitis and neurological symptoms, 87% vs. 75%, respectively, is the suspected and recognized neurological presence of pain generation (Figure 4).

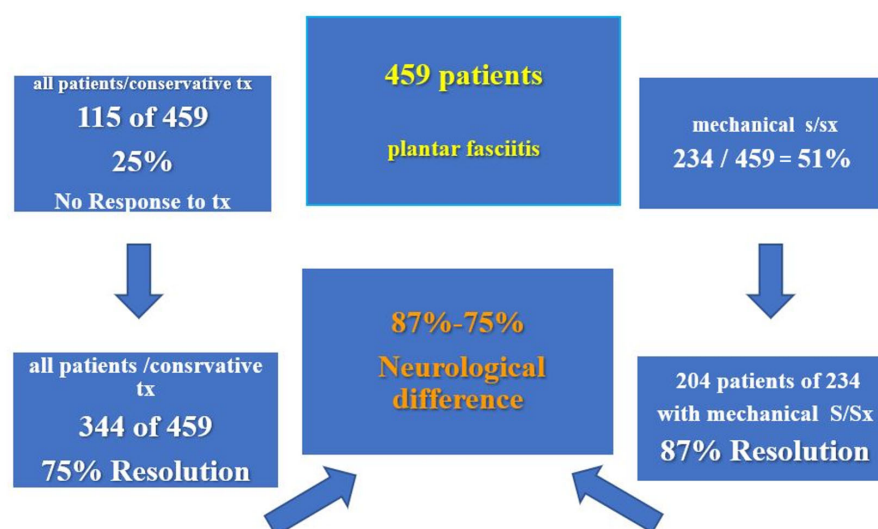


Figure 4. Response to treatment.

3.6. Evaluation of Neurological Patients

Of the 225 initial patients (225 of 459) with neurological findings, 126 patients resolved their condition (56%), while 99 patients (99 of 225 or 43.56%) failed conservative treatment. These 99 were referred for electrodiagnostic testing. Electrodiagnostic studies were conducted on 73 of the 99 neurologically symptomatic patients (73.73%).

Evaluations of these 73 studies were notable in that, while there were 5 negative electrodiagnostic results (5 of 73 or 6.8%), 95.15% (68 of 73 patients) had positive electrodiagnostic findings, conclusively supporting the diagnosis and presence of neurological injury. Significantly, the electrodiagnostic nerve findings indicated neurological pathology consisting of the following:

1. 11.76% (8/68 patients) having tarsal tunnel alone;
2. 22.05% (5/68 patients) have radiculopathy alone;
3. 66.16% (45/68 patients) having a combination of radiculopathy and tarsal tunnel syndrome (Figure 5).

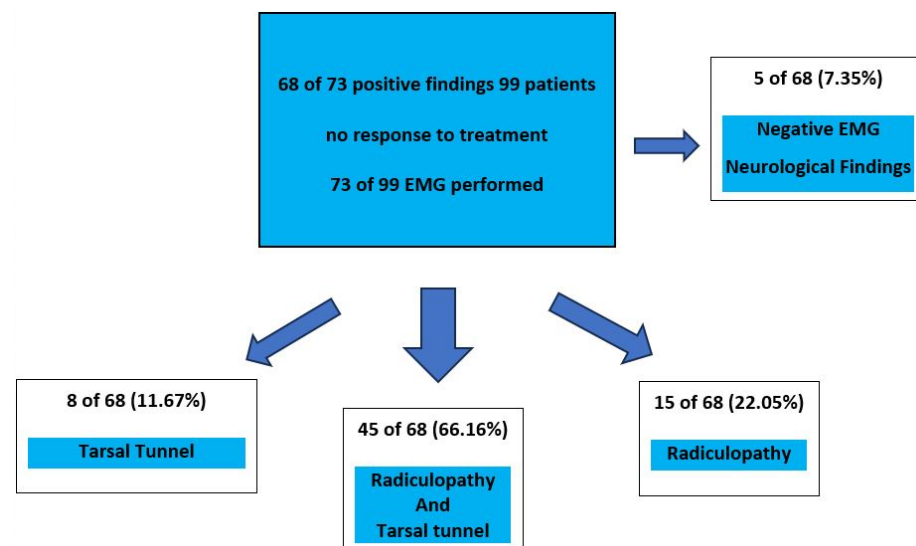


Figure 5. EMG analysis syndrome.

Selected patients who were referred and had performed electrodiagnostic evaluation and testing were seen by a singular, independent, Board-Certified Neurologist/Pain Specialist with a certification in Neurophysiology (EMG/EEG) and utilizing consistent equipment and procedures. Electrodiagnostic examinations are critically based on the skill and knowledge of the examiner and the ability to test below the malleoli. Therefore, an individual fluent in the anatomy of the tarsal canal and with the ability to identify potential contributions of small nerve branches to the presentation of pain, as was chosen for this study, is essential to the identification of the presence and location of the neurological component, thus allowing successful therapy to be employed.

4. Discussion

Previous authors have noted an average age range for plantar fasciitis cohort study patients of less than 60 years of age. This study noted a slight increase in cohort average age range at 63.9 years of age. The ratio of female (60%) to male (40%) found in this study is consistent with several already published works where like-random evaluations were conducted.

The BMI findings of this study are like others in that the symptomatic group had a higher BMI over the control group. The evidential theme regarding weight through these

studies was that the overall BMI of affected patients was not necessarily in the obese range or beyond, but it was higher than the control group.

It was expected that there would be some amount of confirmable neurological contributions to plantar heel pain in the presence of plantar fasciitis. This study provided an answer to how much of a contribution neurological finding made, as 49% of study patients (225 of 459) presented with both clinically present neurological and plantar fasciitis symptoms.

Review showed that of 225 neurological patients prescribed conservative care, 126 of those 210 patients, or 56%, had resolution of their neuropathic pain and no further testing was performed. Of the remaining 44% (99) of patients, neurological pain persisted and electrodiagnostic testing was utilized to assess the level of neurological injury. There were seventy-three (73) electrodiagnostic tests performed. Positive electrodiagnostic results were seen in 68 of 73 (93.15%) evaluated patients, with 5 neurological tests negative for neurological pathology.

On review, it is specifically noted that over 88% of positive electrodiagnostic findings indicated some form of proximal neurological injury. That pain presented in the form of radiculopathy alone (22.05%), or tarsal tunnel and radiculopathy (double crush) combined (66.16%). Tarsal tunnel syndrome alone, 11.76%, was infrequently found compared to the incidence of radiculopathy alone or radiculopathy combined with tarsal tunnel syndrome.

In patients who had non-resolving pain, specifically pain in the plantar fascia, further analysis was conducted with MRI examination. As MRI can provide a superior delineation of tissue structure when compared with Ultrasound and CT, MRI was utilized as the modality that can best show the composition of the fascia tissue [59]. MRI therefore became the modality of choice to identify plantar fascia derangements. All diagnoses of chronic plantar fasciitis, or instances nonresponding to treatment, in this study were confirmed via MRI as Plantar Fasciosis with deep surface tear of the plantar fascia. These patients were treated with multiple modalities primarily for support and stabilization, and reduction in inflammation. Nonresponding neuropathic pain was treated with multiple modalities for temporary control of pain, ultimately followed by surgical decompression if not responding. Treatment was enacted as soon as reasonable for the compressed tarsal canal as the longer the condition persists, the more nerve damage occurs. Directed surgical treatments, to either the plantar fascia or the tarsal canal, or both, were based on both MRI and electrodiagnostic findings. In all instances of non-resolving pain, non-surgical attempts at resolution of the condition were enacted provided tolerance to the condition. When treatment was ineffective, surgical intervention was carried out as expediently as possible for pain relief. For patients with refractory neurological pain, suggestions were asked of Pain Control Specialists, a spinal stimulator was used, and/or further referral was made to spine surgeons.

A 12% difference in non-surgical resolution rates was seen between the plantar fasciitis group (87% resolution) and the neurological/plantar fasciitis group (75% resolution). This author submits that based on the information obtained, neurological contributions towards pain are prevalent and will contribute to the erroneous formation of a clinical diagnosis and resultant noncontributory treatment options. A two-tailed Chi square test was performed with a p value of 0.00098, indicating a statistically significant difference between the two groups.

5. Conclusions

An analysis of 459 patients with a diagnosis of plantar fasciitis identified 49% (225 of 459) as also having neurological symptoms. Simultaneous treatment of both conditions for all patients produced a 75% success rate for resolution of all symptoms. Those 51% of patients with only plantar fasciitis findings responded to treatment, and full resolution

of symptoms was achieved at an 87% rate. The p value of the two groups was 0.00098, indicating statistical significance. The 12% difference in the two groups is attributed to neurological causes resulting in the lower resolution rate. In nonresponding patients with clinical neurological findings, 73 electrodiagnostic tests were conducted. The results of 73 electrodiagnostic tests had 5 negative and 68 positive study findings, indicating that 93.15% of patients (68 of 73) had positive electrodiagnostic findings, confirming clinical diagnostic suspicion. Specifically, of the findings, 11.76% (8 patients) had tarsal tunnel alone; 22.05% (15 patients) had radiculopathy alone; and 66.16% (45 patients) had both radiculopathy and tarsal tunnel present together.

In patients with nonresponding plantar fasciitis symptoms, a neurological cause including the lower back and tarsal canal should be considered for the etiology of symptoms.

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Informed Consent Statement: Patient consent was waived due to this being a chart review of prior treatment, practice, and results.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the author on request.

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