# Tarsal Tunnel Syndrome and the Relevance of Electrodiagnostic Studies in Treatment Planning

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**Format:** Retrospective Review
**Level of Evidence:** III

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## INTRODUCTION

Tarsal tunnel syndrome is the entrapment of the tibial nerve coursing through the tarsal tunnel [1-4,6,9,11,12]. It can be further divided into proximal and distal tarsal tunnel syndrome. Proximal tarsal tunnel syndrome is the portion of the tibial nerve that is entrapped deep to the flexor retinaculum. Distal tarsal tunnel syndrome is defined as the entrapment of the terminal branches of the tibial nerve and the distal nerves arising from them [1]. Both proximal and distal tarsal tunnel syndrome can have clinical presentations including: burning, numbness, tingling, positive Tinel's sign, pain or tenderness with palpation overlying the tunnel, positive dorsiflexion-eversion test, increase in symptoms following activity, and worsening at night [1-5,10,12,13]. This can be caused due to intrinsic factors, extrinsic factors, and idiopathic factors [1-4]. Examples of the above factors include soft tissue and osseous space occupying lesions, foot structure, trauma, edema, along with several others [2,3,8,12,13].

The tarsal tunnel is located at the level of the medial malleolus that is enclosed by the flexor retinaculum superficially with the walls consisting of the tibia, posterior process of the talus, and the calcaneus. It not only consists of the tibial nerve, but also other important structures such as the posterior tibial artery and accompanying vein, tibialis posterior tendon, flexor digitorum longus tendon, and flexor hallucis longus tendon [1,7, 12]. The tibial nerve is the symptomatic anatomic structure affected in tarsal tunnel syndrome. It arises from the sciatic nerve proximally [7,12] and travels distally where it splits into its' terminal branches once through an opening called the porta pedis [2].

Tarsal tunnel syndrome is a complicated diagnosis, as there is no standard approach to diagnosing the syndrome that is accepted by all [6]. When clinically suspecting tarsal tunnel syndrome, a good history and physical examination is needed, and all conservative measures need to be exhausted before proceeding to surgical intervention. Utilizing adjunctive tests can be useful in gaining a better understanding to guide in surgical approach. While X-ray, MRI, and ultrasound can be helpful in identifying potential causes of the syndrome, they only serve as an aid in the clinical diagnosis, and they should not dismiss clinical findings consistent with tarsal tunnel syndrome if negative. Another aid in diagnosing, while controversial throughout literature, is electrodiagnostic studies [3,7,8].

Electrodiagnostic studies, including electromyography and nerve conduction studies, shouldn't be used alone in diagnosing tarsal tunnel syndrome due to having results yielding both false positives and false negatives [3,6,10]. Muscle activation is captured using electromyography [14]; with regard to the lower extremity, it detects the muscle activation primarily of abductor hallucis and abductor digiti minimi [1,3]. Nerve conduction studies detect action potentials of nerves [6]. Electrodiagnostic studies are able to tell us whether a muscle may be weakened or where the nerve may be compressed along its course, but it is not specific in its results [11,12]. Because of this fact, it brings us to the question on whether or not electromyography is useful in determining patient outcome when comparing clinical symptoms of tarsal tunnel syndrome with positive or negative results from an electrodiagnostic study. In this paper, we want to determine the efficacy of electrodiagnostic studies, specifically electromyographies (EMG), when compared to positive clinical symptoms of tarsal tunnel syndrome to aid in the treatment planning course.

## PATIENTS AND METHODS

Patients who received a tarsal tunnel release surgery and an EMG from 2012 to 2017 were included in this study. Patients who only received a tarsal tunnel release or those who only received an EMG within those five years were excluded from this study. Within those five years, a total of eleven patients underwent surgery for a tarsal tunnel release. All of the eleven surgeries were performed by one of two surgeons. Four of the eleven cases were excluded from the study due to not having a corresponding EMG for comparison. Patient age, sex, weight, height, BMI, and co-morbities were not taken into account for this study. There were no other exclusion criteria. Seven of the eleven cases had both an EMG performed and underwent surgical decompression of the tarsal tunnel syndrome by one of two surgeons. Seven patient charts were reviewed for the purpose of this study.

## RESULTS

From the seven cases included in this study, four cases had a positive EMG for tarsal tunnel syndrome. Three cases had a negative EMG for tarsal tunnel syndrome. Four patients relayed that they were still experiencing some pain after the tarsal tunnel release; however, two of those four stated that the overall pain, though still present, had improved compared to pain prior to surgery. Three patients had no pain after surgical intervention for the tarsal tunnel release. One of the three patients with no pain after surgery was lost to follow up after the second post-operative appointment.

Of the four cases that had a positive EMG for tarsal tunnel syndrome, three patients still had pain after the tarsal tunnel release while one patient did not. Of those three that still experienced pain, two patients stated that the pain had improved when compared to pain experienced prior to surgery. Out of the three cases who had a negative EMG for tarsal tunnel syndrome, one patient still experienced pain, and two patients were pain free.

| | *Patient 1* | *Patient 2* | *Patient 3* | *Patient 4* | *Patient 5* | *Patient 6* | *Patient 7* |
|---|---|---|---|---|---|---|---|
| *EMG* | + | + | + | - | + | - | - |
| *Pain after surgery* | Improved pain | Pain present | Improved pain | Pain present | No pain | No pain | No pain |

(+) indicates positive EMG result for tarsal tunnel syndrome

(-) indicates negative EMG result for tarsal tunnel syndrome

## DISCUSSION

While electromyography studies can be beneficial to aid in diagnosing entrapments and nerve diseases in extremities, our study shows no direct correlation between a positive EMG and a positive clinical suspicion of tarsal tunnel syndrome. As seen above in the results section, two-thirds of the patient who had a negative EMG were pain free following tarsal tunnel release consistent with false negative EMGs. False positives were also present in our results showing that three-fourths of the patient who had a positive EMG still experienced some pain following surgical intervention. Consistent with the findings of our own study, Fantino refers to a study of 81 patients, of which 25 had electromyography studies available to analyze. Of those 25, 48% had negative results while displaying clinical symptoms consistent with the diagnosis of tarsal tunnel syndrome [8]. The false negative electrodiagnostic studies within this study did not represent the clinical presentation of the patients as seen with our patient population. Our patient population showed no correlation between EMG results and pain following surgical decompression of the nerve, which leads us to believe history and physical exam is more important when trying to determine whether one should proceed with surgical intervention. This thought is supported by Skalley et al, who looked at revisional tarsal tunnel syndrome surgeries and determined that electrodiagnostic studies were not as beneficial as a good clinical history and physical examination [16]. Another study by Paolasso helps to support our findings. Paolasso et al refers to a patient who underwent electrodiagnostic testing, specifically nerve conduction studies. This patient in reference had one asymptomatic limb, and the nerve conduction study was positive for said asymptomatic limb. This study shows the possibility of false negatives from electrodiagnostic studies [6]. This further corroborates the false negatives and positives seen in our results leading one to further question the benefit of using electrodiagnostic studies. Limiting the use of electrodiagnostic studies would decrease the patient's medical expense while not affecting the outcome of their care or prognosis.

Contrary to our findings, Sammarco and Chang's study evaluated and treated 62 patients with a total of 72 tarsal tunnel releases. They're findings suggest a good correlation between electrodiagnostic studies with a patient's history and physical exam. However, they did recognize that there were patients with a positive electrodiagnostic study who did not feel their symptoms were severe enough to undergo a surgical procedure [13]. One thought as to the opposing findings from our study would be the sample size difference between the two studies. The comparing study has significantly more patients included in their study when compared to our study.

In conclusion, electrodiagnostic studies are helpful in aiding clinical suspicions for certain nerve related injuries and diseases; however, our study shows that they are not valuable when trying to determine a patient's post-operative pain following surgical intervention. The limitation of this study is the small sample size. Further investigative work should be done with a larger sample size and could potentially look into clinical outcomes of tarsal tunnel release compared with post-surgical electromyography studies. When diagnosing and treating tarsal tunnel syndrome, utilizing a thorough history and physical examination is more important in clinical outcomes for patients when compared with using electrodiagnostic studies alone. Overall, the conclusion of this study indicates that electrodiagnostic studies should not be the primary reason of support in considering surgical intervention for tarsal tunnel syndrome.

## CONFLICT OF INTEREST

None.

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