

# Neurectomy Outcomes in Patients With Morton Neuroma: Comparison of Plantar vs Dorsal Approaches

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**Background:** Morton neuroma is a compressive neuropathy of the plantar digital nerve. Several surgical approaches have been used to treat painful Morton neuroma, with each approach having distinct advantages and disadvantages. For this study, we used validated outcome assessment tools to retrospectively compare patient satisfaction with 2 approaches.

**Methods:** The medical records and survey responses of 37 patients with 42 neuromas were evaluated with respect to outcomes and patient satisfaction after neurectomies performed through either a plantar or dorsal surgical approach by one Ochsner Clinic Foundation attending physician. Outcomes were evaluated using the 36-Item Short Form Health Survey (SF-36) and the Foot Function Index (FFI) self-assessments.

**Results:** Twenty patients underwent neurectomy through a dorsal approach, and 17 patients underwent neurectomy through a plantar approach. We found no statistically significant differences between the dorsal and plantar approach groups with respect to outcomes and patient satisfaction as measured by the SF-36 or the FFI.

**Conclusion:** This study supports the use of either the plantar or dorsal approach for the resection of Morton neuroma and suggests that a plantar approach for neurectomy can produce satisfactory results.

**Keywords:** *Neuritis, neuropathy, tibial nerve*

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## INTRODUCTION

Morton neuroma, or interdigital neuritis, is a compressive neuropathy of the plantar digital nerve caused by perineural fibrosis and interdigital nerve inflammation. In 1876, Thomas Morton first described the condition and proposed that it was a result of digital nerve impingement between the metatarsal heads.<sup>1</sup> Although its exact etiology is unknown, Morton neuroma is a condition that can involve several structures in the region of the transverse intermetatarsal ligament. Several intrinsic and extrinsic causes have been theorized. Intrinsic causes include entrapment of the plantar nerve beneath the distal edge of the transverse intermetatarsal ligament as the toes dorsiflex during toe-off and compression from scar tissue formed from repetitive neurovascular trauma.<sup>2</sup> Extrinsic causes include compression or tethering from a ganglion or cyst, metatarsophalangeal bursitis, a subluxating metatarsophalangeal joint, and a malunited metatarsal fracture.<sup>3</sup> Although primarily occurring among women aged 45-50 years, Morton neuromas have been noted in younger patients, particularly athletes in their late teens and twenties.<sup>4,5</sup> The majority of neuromas occur in the second or third interspace.<sup>1</sup>

Several surgical approaches have been used to treat Morton neuroma. The 3 most common surgical approaches

are the plantar longitudinal approach, the plantar transverse approach, and the dorsal approach. In our study, only the plantar longitudinal approach was used because of the surgeon's preference, so when we mention a plantar approach, we are referring to a plantar longitudinal approach. Each approach has inherent advantages and disadvantages.

Some authors maintain that the dorsal approach is technically easier than the plantar approach, but the nerve must be adequately resected at least 3 cm proximal to the intermetatarsal ligament.<sup>1,2</sup> The principal advantages of the dorsal approach are the prevention of painful scar formation or keratosis on the plantar surface of the foot and the ability to bear weight immediately after surgery.

The most frequently cited complication related to the dorsal approach is an amputation neuroma.<sup>6</sup> Amis et al explained the recurrence of Morton neuroma anatomically.<sup>7</sup> They contend that the plantar branches of the digital nerve can tether the transected nerve distally within the forefoot, resulting in recurrent neuromas that remain under the weight-bearing portion of the foot rather than retracting proximally into the intrinsic musculature. Consequently, some authors recommend transecting the digital nerve 1-3 cm proximal to the bifurcation.<sup>1,7</sup> This transection can be

**Table 1. Patient Demographics**

Variable	Dorsal Group n=20	Plantar Group n=17
Average age, years	54.14	53.35
Male, n (%)	2 (10)	9 (53)
Female, n (%)	18 (90)	8 (47)
Location of neuroma		
First interspace	0	1
Second interspace	9	9
Third interspace	12	11

difficult to achieve via a dorsal approach, as the proximal dissection can be limited. Consequently, disadvantages of the dorsal approach include inadequate resection of the digital nerve and damage to cutaneous nerves in the web space that may become painful.<sup>7</sup>

Plantar approaches have traditionally been reserved for recurrent Morton neuromas or amputation neuromas.<sup>6</sup> The plantar approach is more direct than the dorsal approach because the nerve lies superficial to the intermetatarsal ligament.<sup>6</sup> Plantar approaches were first described by Betts in 1940, and Nissen reinforced the description in 1948.<sup>8,9</sup> The plantar approach provides a more direct exposure of the nerve than the dorsal approach, as the nerve lies on the plantar surface of the intermetatarsal ligament and just beneath the plantar fascia.<sup>7</sup> The incision must be accurately placed in the intermetatarsal space so that it does not pass directly beneath the metatarsal head. Dissection performed medially or laterally can create scarring of the fatty tissue; as a result, the scar may become inverted, or the fat pad beneath a metatarsal head may become atrophic.<sup>6</sup> The most frequent complications include localized scar tenderness, wound drainage, and plantar keratosis.<sup>6</sup>

To our knowledge, no studies have used the 36-Item Short Form Health Survey (SF-36) or the Foot Function Index (FFI) survey to compare outcomes following neurectomy using a dorsal approach vs a plantar approach. We used these validated outcome assessment tools to retrospectively compare patient satisfaction with a dorsal or plantar longitudinal approach.

## METHODS

We obtained institutional review board approval for the study and queried the computerized medical records to identify patients presenting to the orthopedic surgery clinic from August 1995 to July 2004 with the ICD-9 (International Classification of Diseases, version 9) code for Morton neuroma (355.6). This group of patients was cross-referenced against patients who underwent surgical intervention under the current procedural terminology (American Medical Association) code for excision of a Morton neuroma (28080).

After the entire group of surgical patients was identified, only patients who had surgery performed by the same Ochsner Clinic Foundation attending physician (R.J.T.) were included in the study group. The patients' medical records were reviewed for age, sex, procedure date, and involved web space. These data points were entered into our database. Each patient was contacted via mail and asked

to complete 2 surveys: the SF-36 and the FFI. The surveys were distributed with a letter explaining the purpose of the study and postage-paid return envelopes.

Returned surveys were scored according to the instructions for scoring the SF-36 and FFI.<sup>10</sup> We calculated scores for each subcategory in the 2 assessments, as well as total SF-36 and FFI scores, and entered them into our database. The mean, median, and standard deviation for each subcategory score and for the total score were calculated. The *t* test was used to compare the subcategory scores and total score of the plantar and dorsal approach groups. We defined statistical significance as  $P < 0.05$ . Several patients had multiple neurectomies on the same foot in a single operation. The survey data from these patients were included as a single data point because the SF-36 and FFI surveys do not distinguish patients who had a single neurectomy from patients who had multiple neurectomies.

## RESULTS

One hundred sixty-one patients were identified as having undergone a neurectomy to treat Morton neuroma and were mailed the study survey materials. Eighty-nine patients underwent neurectomy via a dorsal approach, 11 patients had both a dorsal and plantar neurectomy at different operative times, and 61 patients had a plantar neurectomy. No patients who had both approaches responded to the survey.

Demographic information for the dorsal and plantar groups is presented in Table 1. Of the 37 patients who responded to the survey, 20 patients underwent 21 neurectomies through a dorsal approach, and 17 patients underwent 21 neurectomies through a plantar approach. The dorsal approach group was composed of 2 males and 18 females with an average age of 54.14 years ( $\pm 11.04$ ), and the plantar approach group was composed of 9 males and 8 females with an average age of 53.35 years ( $\pm 13.77$ ). All neuromas but one were found in the second or third webspace, consistent with previously reported studies.<sup>1,2</sup>

The average SF-36 total scores were 66.67 ( $\pm 24.78$ ) for the dorsal group and 65.11 ( $\pm 25.58$ ) for the plantar group ( $P = 0.18$ ). The average FFI total scores were 62.10 ( $\pm 40.09$ ) for the dorsal group and 61.77 ( $\pm 38.51$ ) for the plantar group ( $P = 0.12$ ). The mean, median, standard deviation, and *P* values for each of the subcategories within the SF-36 and FFI for the plantar and dorsal groups are listed in Tables 2 and 3. No significant difference was found between the groups for any of the subcategory scores.

## DISCUSSION

Few reports in the literature directly compare a dorsal approach vs a plantar approach for the resection of a painful Morton neuroma. Nashi et al prospectively compared 52 patients alternatively assigned to either a dorsal or plantar approach.<sup>11</sup> Their criteria for assessment were duration of hospital stay, time until return to work and activity, the patients' subjective assessments, and complications. The authors found that patients in the dorsal group had a faster return to work, shorter hospital stay, better subjective satisfaction, and fewer complications. This study, however, made no statistical comparisons between the groups and employed no validated outcome assessments such as the FFI or SF-36.

**Table 2. Summary of 36-Item Short Form Health Survey (SF-36) Scores**

Subcategory	Dorsal Group			Plantar Group			P Value
	n=20			n=17			
	Average	Median	SD	Average	Median	SD	
Physical functioning	64.8	61.11	28.59	63.92	61.11	28.31	0.44
Role-physical	79.09	100.00	35.96	82.65	100.00	31.71	0.09
Bodily pain	66.72	68.75	26.10	66.29	68.13	26.02	0.41
Social functioning	80.10	100.00	34.77	81.18	100.00	34.61	0.32
Mental health	65.60	68.48	25.63	62.37	66.80	25.87	0.43
Role-emotional	84.31	100.00	34.08	81.17	100.00	34.71	0.41
Vitality	49.33	53.81	25.60	49.33	53.21	25.09	0.32
General health	63.33	67.02	24.06	61.00	65.18	24.81	0.41
Composite	55.22	50.00	25.86	51.83	50.00	25.07	0.26
Total score	66.67	68.19	24.78	65.11	68.05	25.58	0.18

Note: The SF-36 consists of 8 scaled scores that are the weighted sums of the questions in their section. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight: the lower the score, the more disability and the higher the score, the less disability.

Wilson and Kuwada retrospectively compared the results and complications of a dorsal approach vs a plantar approach in 29 and 15 patients, respectively.<sup>4</sup> In the dorsal group, 68% of the patients achieved complete resolution of symptoms. Complications in the dorsal group included 6 cases of amputation neuromas. In the plantar group, 100% of the patients achieved relief of preoperative symptoms. Complications in the plantar group included 2 painful scars; no amputation neuromas were reported for this group. Although operative time was not one of the outcome criteria for the study, the authors noted that operative time was approximately 15 minutes for the plantar group compared to 30-45 minutes for the dorsal group.

Our study retrospectively compared a plantar approach to a dorsal approach using the FFI and SF-36 outcome assessments. We hypothesized that there would be no difference in FFI or SF-36 scores related to approach and found no significant difference in FFI total scores, SF-36 total scores, or subcategory scores for the 2 assessments. This study supports the use of either approach for the resection of Morton neuroma and suggests that a plantar approach for the primary resection of Morton neuroma can produce satisfactory results. In our opinion, the plantar approach is technically easier than the dorsal approach because the nerve is more accessible with the plantar

approach than with the dorsal approach. In addition, the plantar approach reduces the chance of recurrent neuroma and has a similar incidence of incisional complications.

Our study has several limitations. First, the survey had a low response rate, a fact that almost certainly contributed to the wide standard deviations seen in the SF-36 and FFI score averages. Thirty-seven of 161 patients returned their completed surveys. Accounting for the outcomes of patients who did not return their surveys is not possible. Second, the respondents in the plantar group were composed of 53% men and 47% women. As previously stated, most data indicate that the typical patient with Morton neuroma is a woman aged 45-50.<sup>4</sup> We are unable to account for this male-female distribution in our plantar approach group and cannot determine its effect on the study results. This study also did not consider complications as outcome criteria. We therefore cannot comment on the rate of incisional pain or healing complications in either study group or any direct effect of those complications on the overall outcome. Presumably, any complications would be reflected in lower FFI and SF-36 scores. All patients in our plantar approach group received a longitudinal plantar incision; thus, we cannot comment on the transverse plantar approach and how this approach may have affected postoperative scores.

**Table 3. Summary of Foot Function Index (FFI) Scores**

Subcategory	Dorsal Group			Plantar Group			P Value
	n=20			n=17			
	Average	Median	SD	Average	Median	SD	
Pain	44.18	61.11	25.14	44.01	52.65	24.35	0.18
Disability	63.21	79.09	39.41	62.55	71.15	37.57	0.20
Activity limitation	46.71	66.28	27.79	46.76	56.50	26.88	0.09
Total score	62.10	80.10	40.09	61.77	71.10	38.51	0.12

Note: The FFI consists of 23 self-reported items divided into 3 subcategories: pain, disability, and activity limitation. The patient has to score each question on a scale from 0 (no pain or difficulty) to 10 (worst pain imaginable or so difficult it requires help) that best describes his/her foot during the past week. Scores are recorded on a visual analog scale and range from 0-100, with higher scores indicating worse pain.

In addition, our study took only postoperative FFI and SF-36 scores into account. A statistical analysis of preoperative vs postoperative FFI and SF-36 scores could have potentially strengthened our data and could have garnered more insight to the success of the different approaches. A prospective, randomized study with a minimum 1-year follow-up and at least a 90% response rate to preoperative and postoperative FFI and SF-36 surveys would result in more valuable information.

## CONCLUSION

This study suggests that both dorsal and plantar approaches produce satisfactory outcomes as measured by the FFI and SF-36 assessments. In light of previously reported literature, we recommend that surgeons choose the approach they are most familiar with and most confident in performing. If the rate of incisional complications is significantly higher with a plantar approach, it was not reflected in the SF-36 or FFI scores of our study group. Furthermore, we believe that the risk of recurrent neuroma is less with a plantar approach. This study supports the contention that a plantar approach can be used to achieve satisfactory resolution of Morton neuroma symptoms as effectively as a dorsal approach and therefore should be considered for primary resection of Morton neuromas.

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