

# Plantar and Dorsal Approaches for Excision of Morton's Neuroma: A Comparison Study

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## Research Article

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# Abstract

**Background:** Morton's neuroma is a painful enlargement of the plantar digital nerve between the metatarsal heads which cause pain of the forefoot. Several approaches have been used to treat the Morton's neuroma, with each having distinct advantages and disadvantages.

**Objectives:** The purpose of this study was to investigate and compare the clinical outcomes of neurectomy for the treatment of Morton's neuroma through plantar and dorsal approaches.

**Material and Methods:** We retrospectively analyzed 20 patients aged averagely  $48.5 \pm 13.0$  years (range: 19-66 years) who underwent excision of a Morton's neuroma that had been unresponsive to conservative treatment from June 2014 to June 2021. All the neurectomies were performed through either a plantar or dorsal approach. Outcomes were evaluated using visual analog scale (VAS) scores, American Orthopedic Foot and Ankle Society (AOFAS) scores, the Foot and Ankle Ability Measure (FAAM), and complications. We also used appearance index (AI) to assess the influence of foot appearance on quality of life after surgery.

**Results:** 8 patients underwent neurectomy through a dorsal approach, and 12 patients underwent neurectomy through a plantar approach. The average follow-up time was  $28.9 \pm 12.9$  months (range: 15-72 months). There were no statistically significant differences between the dorsal and plantar approach groups with respect to postoperative pain measured by VAS scores. The postoperative AOFAS scores and FAAM outcomes showed no significant differences between the groups. The complications reported in the dorsal approach group were significantly fewer than those of plantar group, mainly discomfort wearing shoes. The AI of the plantar group and the dorsal group were significant different.

**Conclusion:** Excision of Morton's neuroma through a dorsal or plantar approach both obtained satisfactory outcomes. But the foot appearance after surgery through a plantar approach have less influence on quality of life than a dorsal approach. We recommend that surgeons choose the approach they are most familiar with and most confident in performing. And we recommend the plantar approach if the patient have great need for the appearance.

**Level of Evidence:** Level III, retrospective comparative case series.

## Introduction

Morton's neuroma is a painful enlargement of the plantar digital nerve between the metatarsal heads, most frequently in the second and third intermetatarsal spaces, which cause pain of the forefoot. <sup>[1]</sup>In 1876, Thomas Morton first described the disease and proposed that it was a result of digital nerve impingement between the metatarsal heads. <sup>[2]</sup>The aetiology and pathogenesis of Morton's neuroma remain controversial. <sup>[3]</sup>The mean age at the time of presentation ranges from forty-five to fifty years, and women are more frequently affected. <sup>[4]</sup>Axial compression may be accompanied by a demonstrable painful click known as Mulder's sign. Ultrasound and magnetic resonance imaging (MRI) scans are used

to diagnose Morton's neuroma, but the clinical history and examination remain the most sensitive and specific methods of correctly diagnosing a neuroma. [5, 6]

Neurectomy is a standard operative technique for the treatment of Morton's neuroma, though many other operative methods were reported. [7] Several surgical approaches have been used to treat Morton's neuroma. The plantar longitudinal approach and the dorsal approach are used most common, which have distinct advantages and disadvantages. [8, 9, 10, 11]

To our knowledge, there's few studies to compare the operative outcomes through a dorsal and a plantar approach. The purpose of this retrospective case series was to investigate and compare the clinical outcomes of neurectomy for the treatment of Morton's neuroma through plantar and dorsal approaches.

## Materials And Methods

We retrospectively analyzed 20 patients in our institute from June 2014 to June 2021 who underwent excision of a Morton's neuroma that had been unresponsive to conservative treatment. All the patients were diagnosed by one orthopedic surgeon based on medical history, physical examination, MRI and ultrasound. 8 patients received 9 neurectomies through a dorsal approach, and 12 patients received 12 neurectomies through a plantar longitudinal approach. All operations were undertaken by one of two specialist foot and ankle consultant surgeons in our institute. The hospital ethics committee approved this study and an internal review board, and informed consent was obtained from all patients.

Each patient's medical notes, which included pre- and postoperative notes, radiographs, and pathology reports, were reviewed retrospectively. The main demographic characteristics were shown in Table 1. The patients' interview were taken on the phone. Visual analog scale (VAS) scores, American Orthopedic Foot and Ankle Society (AOFAS) scores, and the Foot and Ankle Ability Measure (FAAM) for activities of daily living were used to evaluate the outcomes and satisfaction. We also used a questionnaire called appearance index (AI) to assess the influence of foot appearance on quality of life. The AI consists of a questionnaire with five items that estimate the foot appearance's impact regarding the daily activities at public places, leisure, sexual life, work or school, and personal relationships, with four responses scored from 0 to 3, where 0 is the best score attainable.<sup>[12]</sup>The complications were recorded during the follow-up.

## Statistical analysis

Statistical analysis was performed using the IBM SPSS version 22 software for Windows (SPSS Inc.). The numerical data are reported as mean  $\pm$  standard deviation. Independent-samples t-test was used to evaluate the difference of VAS, AOFAS, FAAM and AI scores. The level of significance was set at  $p < 0.05$ .

Table 1  
Patient Demographics

	Dorsal Group	Plantar Group
Variable	n = 8	n = 12
Average age, years	46.38 ± 12.93	50.00 ± 13.48
Duration of follow-up, months	31.5 ± 8.35	27.08 ± 15.34
Male, n(%)	3(37.5)	2(16.7)
Female, n(%)	5(62.5)	10(83.3)
Laterality, n (%)		
Left	5(62.5)	6(50)
Right	3(37.5)	6(50)
Location of neuroma,n(%)		
First interspace	0(0)	1(8.3)
Second interspace	4(50)	4(33.3)
Third interspace	3(37.5)	7(58.4)
Second and third interspace	1(12.5)	0(0)

## Results

The mean follow-up duration of the both groups was  $28.9 \pm 12.9$

months (range, 15–72 months). The dorsal approach group was composed of 3 males and 5 females with an average age of  $46.38 \pm 12.93$  years ,

and the plantar approach group was composed of 2 males and 10 females with an average age of  $50.00 \pm 13.48$  years. One neuroma was located in the first interspace in the plantar group, while others were located in the second or third interspace. And both the second and third interspaces were involved in one patient.(Table 1)

Table 2  
Clinical Variables of Dorsal Group and Plantar Group

Variable	Dorsal Group	Plantar Group	P value
Preoperative VAS score	5.25 ± 0.71	4.83 ± 0.72	
Postoperative VAS score	1.00 ± 0.76	0.67 ± 0.65	0.307
Preoperative AOFAS score	65.00 ± 5.93	65.58 ± 4.44	
Postoperative AOFAS score	90.38 ± 4.78	94.42 ± 2.27	0.052
Preoperative FAAM score	72.38 ± 4.60	72.42 ± 2.97	
Postoperative FAAM score	92.75 ± 3.28	94.08 ± 3.03	0.363
Postoperative AI score	8.62 ± 1.06	1.58 ± 0.67	0.000
VAS = visual analog scale.			
AOFAS = American Orthopedic Foot and Ankle Society			
FAAM = Foot and Ankle Ability Measure			
AI = Appearance Index			

All histological results of neurectomy confirmed by pathologist were identified as Morton's neuroma. The postoperative mean VAS pain scores and AOFAS scores were reduced significantly compared with preoperative values in both groups. Also, the postoperative mean FAAM scores had improved significantly in both groups. There was no significant difference between the two groups for postoperative VAS pain scores, AOFAS scores and FAAM scores. But significant difference was found between the groups for the AI scores. (Table 2)

Few complications were reported in both groups. Two cases of postoperative numbness and paresthesia were reported in the dorsal group, while no patient underwent reoperation for this. There were no patients complaining the scar problems in the plantar group.

## Discussion

A morton's neuroma is a multifactorial paroxysmal neuralgia of one or more intermetatarsal spaces (typically the second and the third space), occurring where the plantar digital nerve divides to supply the adjacent sides of the toes.<sup>[1]</sup> Its etiology, incidence, and prevalence are unknown.<sup>[3]</sup> Ultrasound and magnetic resonance imaging (MRI) scans are widely used to diagnose morton's neuroma.<sup>[5, 6]</sup> In our series, 95 percent of the neuromas were found on the ultrasound, while 85 percent were detected on MRI. So the author prefer to use ultrasound to diagnose the morton's neuroma.

In 1940, Betts<sup>[13]</sup> first reported the successful neurectomy results in treating morton's neuroma. From then, neurectomy has been a standard operative technique for the treatment of Morton's neuroma. And many

different approaches has been reported, including dorsal approach, plantar longitudinal approach, plantar transverse approach, distal interdigital approach, and so on.<sup>[14, 15, 16, 17]</sup> The dorsal approach and the plantar longitudinal approach were used most often .

For the dorsal approach, it is easier to operate in supine position. But, more structures must be dissected to reach the nerve, including the intermetatarsal ligament.<sup>[18]</sup> Mann and Reynolds<sup>[19]</sup> reported excellent or good results in 86% of cases, while failure or poor results in 14%. Giannini et al.<sup>[20]</sup> reported that the clinical outcome was excellent or good for 78 percent, fair for 19 percent, and poor for 3 percent in a study of sixty-three patients who received neurectomy through a dorsal approach for the treatment of severe pain. Disadvantages of the dorsal approach include amputation neuroma, inadequate resection of the digital nerve and damage to cutaneous nerves in the web space that may become painful. Friscia et al<sup>[21]</sup> reported 8% complications, and Nashi et al<sup>[22]</sup> reported 19% complications with this approach.

For the plantar approach, the transected nerve endings is placed in a well-protected intermuscular space, away from the weight-bearing area. In addition, as the transverse metatarsal ligament is not sectioned, forefoot splaying is avoided.<sup>[23]</sup> Kundert et al.<sup>[24]</sup> reported that complications occurred in 7.1% of the patients with a plantar approach and scar problems were described in 5.2%, including delayed wound healing, hypertrophic scar formation, and inclusion cyst. Jarde O et al<sup>[25]</sup> reported 0–27% painful incisional scars in the plantar longitudinal approach, while Nashi et al<sup>[22]</sup> reported 8% complications. Beskin et al<sup>[26]</sup> reported that 39 patients had recurrence of neuropathic pain symptoms, 65% of which the pain occurred within 1 year after the planter surgery, and between 1 and 4 years for the remaining 35%.

In terms of our knowledge, there are very few publications comparing a dorsal approach and a plantar approach for the resection of a painful Morton's neuroma. Nashi et al<sup>[22]</sup> prospectively compared 52 patients alternatively assigned to either a dorsal or plantar approach, and found that patients treated through a dorsal approach needed less time to return to work, had shorter hospital stay, better subjective satisfaction, and fewer complications. Akermark et al<sup>[27]</sup>. concluded that both approaches have comparable results. Wilson and Kuwada<sup>[28]</sup> retrospectively compared the results and complications of a dorsal approach and a plantar approach. 68% of the patients in the dorsal group achieved complete relief of symptoms, while 100% of the patients in the plantar group achieved complete remission of symptoms. Complications in the dorsal group included 6 cases of amputation neuromas. No amputation neuromas were reported in the plantar group, but 2 painful scars were reported. Habashy et al.<sup>[29]</sup> retrospectively compared a plantar approach to a dorsal approach using the FFI and SF-36 outcome assessments. They 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. The plantar approach reduces the chance of recurrent neuroma and has a similar incidence of incisional complications.

Our study retrospectively compared the clinical outcomes of neurectomy for the treatment of Morton's neuroma through plantar and dorsal approaches using Visual analog scale (VAS) scores, American Orthopedic Foot and Ankle Society (AOFAS) scores, and the Foot and Ankle Ability Measure (FAAM) for

activities of daily living. We also used appearance index (AI) firstly to assess the influence of foot appearance on quality of life. There was no significant difference between the two groups for postoperative VAS pain scores, AOFAS scores and FAAM scores. We suggest that both approaches can be used to perform the operation, and the operator should select their experienced approach. But significant difference was found between the groups for the AI scores. There were no patients complaining the scar problems in the plantar group, because we made the incision in the nonweightbearing area. So if a patient has cosmetic needs, a plantar approach is recommended.

The limitations of our study were that it was a retrospective study with possible recall bias and the small sample size. And the investigation of the data was performed with mid-term rather than long-term follow-up. All patients in our plantar approach group received a longitudinal plantar incision, so we can't comment on the transverse plantar approach.

In conclusion, our study demonstrated that both a dorsal and a plantar approach obtained good outcomes. But the foot appearance after surgery through a plantar approach have less influence on quality of life than a dorsal approach. We recommend that surgeons select the approach they are most familiar with and most confident in performing. If a patient has cosmetic needs, a plantar approach is recommended.

## Abbreviations

VAS

visual analog scale.

AOFAS

American Orthopedic Foot and Ankle Society

FAAM

Foot and Ankle Ability Measure

AI

Appearance Index

## Declarations

**Ethics approval and consent to participate:** The experimental protocol was established, according to the ethical guidelines of the Helsinki Declaration and was approved by the Human Ethics Committee of the second hospital of Shandong university. Written informed consent was obtained from individual or guardian participants.

**Consent to publication:** Not applicable. No informed consent was required, because the data are anonymized.

**Availability of data and materials:** The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

**Competing Interests:** The authors declare that they have no competing interests.

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**Authors' contributions:**

YF. W and Y. W collected the patient data. N. Z and XC. L analyzed and interpreted the patient data. ZX. L and Y. H performed the operation. WP. X was a major contributor in writing the manuscript. HP. S gave many advises in writing the manuscript.

All authors read and approved the final manuscript.

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