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Second Intermetatarsal Morton's Neuroma: Surgical Management of Three Consecutive Cases with MRI and Histopathological Correlation

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ABSTRACT

Background: Morton's neuroma is a common cause of neuropathic forefoot pain and most commonly affects the third intermetatarsal space. Neuromas involving the second intermetatarsal space are uncommon and remain poorly documented in the literature.

This study aimed to describe the clinical presentation, magnetic resonance imaging (MRI) findings, surgical management, histopathological features, and clinical outcomes of three consecutive patients with second intermetatarsal Morton's neuroma treated by dorsal neurectomy.

Methods: A retrospective consecutive case series was conducted at the Department of Orthopaedic and Trauma Surgery, EHS Ben Aknoun Hospital, Algiers, Algeria, from January 2022 to December 2025. Three women aged 50, 54, and 60 years presented with persistent neuropathic forefoot pain localized to the second intermetatarsal space. The mean symptom duration was six months.

Two had right-sided lesions and one had a left-sided lesion. All had failed an adequate course of conservative treatment consisting of analgesics, Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), footwear modification, and corticosteroid injections. Standard radiographs were unremarkable, whereas magnetic resonance imaging (MRI) confirmed the diagnosis in all cases. All patients underwent dorsal neurectomy performed by the same senior orthopaedic surgeon, and histopathological examination confirmed the diagnosis in every case.

Results: After a mean follow-up of 24 months, the mean Visual Analogue Scale (VAS) pain score improved from 8 preoperatively to 0 at final follow-up, with complete pain relief achieved in all patients. No recurrence, wound complications, painful scarring, or clinically significant sensory deficits were observed. All patients returned to unrestricted daily activities and reported complete satisfaction with the surgical outcome.

Conclusion: Second intermetatarsal Morton's neuroma is an uncommon clinical entity that should be considered in patients presenting with chronic neuropathic forefoot pain. MRI accurately confirms the diagnosis, whereas histopathological examination remains the definitive diagnostic standard. Dorsal neurectomy provided excellent pain relief, functional recovery, and no recurrence during a two-year follow-up.

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Introduction

Morton's neuroma is one of the most frequent causes of chronic forefoot pain, affecting the common plantar digital nerve. Despite its name, it does not represent a true neoplasm but rather a chronic compressive neuropathy characterized by perineural fibrosis, vascular proliferation, edema, and degenerative changes resulting from repetitive mechanical irritation. Women in the fifth and sixth decades of life are predominantly affected, with

symptoms often exacerbated by prolonged walking and narrow footwear [1].

The third intermetatarsal space is involved in approximately 70–80% of cases because of its unique anatomical configuration, where the common plantar digital nerve receives communicating branches from both the medial and lateral plantar nerves. In contrast, involvement of the second intermetatarsal space is considerably less frequent and therefore may be overlooked during the diagnostic work-up of metatarsalgia [2].

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Patients typically present with burning forefoot pain associated with paresthesia or numbness radiating toward the adjacent toes. Clinical examination frequently reproduces symptoms through direct compression of the affected intermetatarsal space or by a positive Mulder's maneuver. Nevertheless, the differential diagnosis includes stress fractures, plantar plate injuries, metatarsophalangeal joint instability, inflammatory arthritis, Freiberg disease, and soft-tissue tumors, making imaging an important adjunct to clinical evaluation [3].

Magnetic Resonance Imaging (MRI) has become one of the most reliable imaging modalities for diagnosing Morton's neuroma because of its excellent soft-tissue contrast and ability to exclude other causes of forefoot pain. Conservative treatment—including shoe modification, orthotic support, non-steroidal anti-inflammatory drugs, physical therapy, and corticosteroid injections—remains the initial therapeutic approach. However, persistent symptoms despite adequate conservative management constitute the main indication for surgical treatment [4].

Although several studies have reported favorable outcomes following surgical excision, publications specifically addressing neuromas arising in the second intermetatarsal space remain scarce. The purpose of the present study was therefore to describe the clinical presentation, imaging findings, standardized surgical management, histopathological confirmation, and postoperative outcomes of three consecutive patients treated for this uncommon condition [5].

Materials And Methods

Study Design

This retrospective consecutive case series was conducted at the Department of Orthopaedic and Trauma Surgery, EHS Ben Aknoun Hospital, Algiers, Algeria, between January 2022 and December 2025.

The study included three consecutive female patients diagnosed with Morton's neuroma located exclusively in the second intermetatarsal space. All surgical procedures were performed by the same senior orthopaedic surgeon using an identical operative technique.

Patient Characteristics

The mean patient age was 54.7 years (range, 50–60 years). Two neuromas involved the right foot, whereas one involved the left foot. The average duration of symptoms before surgery was six months.

One patient had a history of arterial hypertension, while the remaining two patients had no relevant medical history.

Clinical Evaluation

All patients presented with a typical clinical picture characterized by

- Burning plantar forefoot pain
- Electric shock-like sensations radiating toward the adjacent toes
- Pain aggravated by walking and narrow footwear
- Localized tenderness within the second intermetatarsal space
- Positive compression test suggestive of interdigital nerve entrapment

Pain intensity was evaluated using the Visual Analogue Scale (VAS) before surgery and during postoperative follow-up.



Figure 1: Preoperative Clinical Appearance

- A. Dorsal view of the foot showing the absence of obvious bone deformity.
- B. Plantar view illustrating the absence of skin lesions and the painful area corresponding to Morton's neuroma.

Imaging Assessment

Standard weight-bearing radiographs of the affected foot were obtained in every patient and revealed no osseous abnormalities.

MRI was performed in all cases and demonstrated a well-defined soft-tissue lesion arising from the common plantar digital nerve within the second intermetatarsal space, confirming the diagnosis and excluding alternative causes of metatarsalgia.

Conservative Treatment

Before surgery, all patients underwent an adequate trial of conservative treatment consisting of:

- Activity modification
- Footwear adaptation
- Oral analgesics and non-steroidal anti-inflammatory drugs
- Corticosteroid infiltration

Despite these measures, symptoms persisted and significantly impaired daily activities, leading to surgical indication.

Surgical Indication

Open surgical excision was proposed because of:

- Persistent disabling pain
- Failure of conservative treatment
- MRI confirmation of Morton's neuroma
- Patient acceptance of surgical management

Histopathological Examination

All excised specimens were submitted for routine histopathological analysis, which confirmed the diagnosis of Morton's neuroma in every case.

Follow-Up

Patients were reviewed regularly after surgery. The mean follow-up period was 24 months.

Clinical outcome assessment included:

- Pain relief (VAS)
- Functional recovery
- Wound healing
- Sensory disturbances
- Recurrence

Table 1: Patient Characteristics and Outcomes

Patient	Age	Side	Medical history	Symptom duration	Radiographs	MRI	Treatment before surgery	Outcome
1	50 years	Right*	None	~6 months	Normal	Second-space neuroma	Medication + infiltration	VAS 7 to 0; no recurrence
2	54 years	Right*	Hypertension	~6 months	Normal	Second-space neuroma	Medication + infiltration	VAS 8 to 0; no recurrence
3	60 years	Left*	None	~6 months	Normal	Second-space neuroma	Medication + infiltration	VAS 9 to 0; no recurrence

*Two right feet and one left foot were included; patient-side allocation should be verified against the operative records before journal submission. VAS, visual analogue scale.

Surgical Technique

All procedures were performed by the senior author under regional anesthesia with the patient in the supine position. A pneumatic thigh tourniquet was routinely applied after limb exsanguination to provide a bloodless operative field [6].

A 3-cm longitudinal dorsal incision was centered over the second intermetatarsal space. Following careful skin and subcutaneous dissection, the extensor tendons were gently retracted, exposing the Deep Transverse Intermetatarsal Ligament (DTIL).

The DTIL was longitudinally released to improve visualization of the common plantar digital nerve. Gentle blunt and sharp dissection allowed identification of the enlarged neuroma while preserving the adjacent neurovascular structures [7].

The common digital nerve was mobilized proximally and distally. The neuroma was excised en bloc by transecting the nerve proximal and distal to the lesion to minimize the risk of recurrent stump neuroma [8].

Meticulous hemostasis was achieved before irrigation with sterile saline solution. The wound was closed in layers using absorbable sutures for the subcutaneous tissue and interrupted nylon sutures for the skin [9]

All specimens were routinely submitted for histopathological examination.

Patients were encouraged to bear weight immediately using a postoperative shoe according to pain tolerance. Skin sutures were removed after two weeks, followed by progressive return to normal footwear.

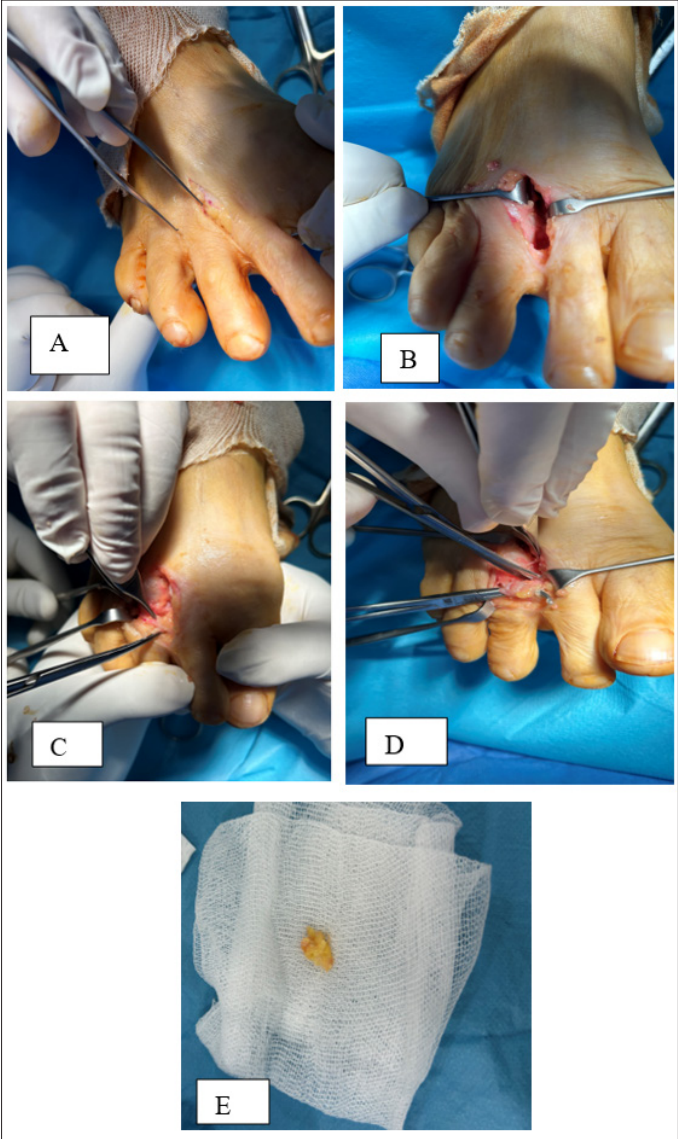


Figure 2: Intraoperative Figures

- A. Dorsal incision and exposure of the second intermetatarsal space.
- B. Opening of the deep transverse intermetatarsal ligament.
- C. Identification, circumferential dissection, and isolation of the neuroma.
- D. Complete resection of the neuroma. E. Surgical specimen sent for histopathological examination.

Results

Three consecutive female patients fulfilled the inclusion criteria during the study period. The mean age was 54.7 years (range, 50–60 years). Two patients presented with right-sided lesions, whereas one had left-sided involvement. The mean duration of symptoms before surgical intervention was six months.

Clinical Presentation

All patients presented with a remarkably homogeneous clinical pattern characterized by chronic burning pain localized to the plantar aspect of the second intermetatarsal space. Pain was associated with intermittent paresthesia and electric shock-like sensations radiating toward the adjacent toes. Symptoms were consistently aggravated by prolonged walking, standing, and the use of narrow footwear, resulting in progressive limitation of daily activities [10].

Clinical examination revealed localized tenderness over the second intermetatarsal space in all patients. Compression of the forefoot reproduced the symptoms and elicited a positive Mulder's maneuver in every case [11].

Imaging Findings

Standard weight-bearing radiographs were normal in all patients and showed no evidence of osseous pathology, stress fracture, metatarsophalangeal joint degeneration, or Freiberg disease.

Magnetic resonance imaging demonstrated a well-circumscribed soft-tissue lesion located within the second intermetatarsal space in each patient. MRI findings were consistent with Morton's neuroma and excluded alternative causes of forefoot pain, including plantar plate rupture, ganglion cyst, synovitis, and soft-tissue tumors [12].

Conservative Treatment

Before surgery, all patients completed an adequate course of non-operative management including:

- footwear modification
- activity modification
- oral non-steroidal anti-inflammatory medication
- analgesics
- corticosteroid injection

Despite these treatments, symptoms remained disabling, and surgical treatment was therefore indicated.

Surgical Findings

All procedures were performed by the first author using an identical standardized dorsal approach under regional anesthesia in an outpatient setting.

The mean operative time was 30 minutes (range, 25–35 minutes).

Following division of the deep transverse intermetatarsal ligament, a fusiform enlargement of the common plantar digital nerve was identified in every patient.

Complete en bloc excision was successfully achieved in all cases.

The excised specimens measured between 8 and 12 mm in maximal diameter.

Routine histopathological examination confirmed the diagnosis of Morton's neuroma in every patient.

Postoperative Recovery

No intraoperative complications occurred.

Patients were discharged on the day of surgery following recovery from regional anesthesia.

Progressive weight bearing was resumed according to pain tolerance after resolution of postoperative inflammatory symptoms.

Normal footwear was resumed approximately 21 days after surgery.

Clinical Outcomes

The mean follow-up period was 24 months.

Pain relief was immediate and progressive.

The mean preoperative Visual Analogue Scale (VAS) score improved from 8/10 preoperatively to 0/10 at final follow-up.

No patient experienced

- wound infection
- hematoma
- delayed wound healing
- painful scar
- clinically significant sensory deficit
- symptomatic stump neuroma
- recurrence

All three patients resumed unrestricted daily activities and reported complete satisfaction with the surgical outcome.

Table 2: Demographic and Clinical Characteristics

Variable	Result
Number of patients	3
Sex	Female
Mean age	54.7 years
Right foot	2
Left foot	1
Mean symptom duration	6 months
MRI confirmation	100%
Histopathological confirmation	100%
Surgical approach	Dorsal
Anesthesia	Regional
Setting	Ambulatory
Mean operative time	30 min
Neuroma size	8–12 mm
Mean follow-up	24 months

Return to footwear	21 days
VAS preoperative	8/10
VAS postoperative	0/10
Recurrence	0
Patient satisfaction	100%



Figure 3: Immediate Postoperative Clinical Result and at 6 Months Postoperative Showing a Discreet Scar, the Absence of Clinical Recurrence and an Excellent Aesthetic result.

Discussion

Morton's neuroma is a common cause of chronic forefoot pain; however, involvement of the second intermetatarsal space remains distinctly uncommon. Although the third intermetatarsal space accounts for approximately 70–80% of cases, second-space lesions are reported far less frequently and therefore receive comparatively little attention in the literature. This rarity contributes to diagnostic delay because symptoms often overlap with other causes of metatarsalgia, including plantar plate insufficiency, metatarsophalangeal joint instability, stress fractures, inflammatory arthropathies, Freiberg disease, and soft-tissue tumors. The present case series emphasizes that clinicians should maintain a high index of suspicion for second-space Morton's neuroma when evaluating persistent neuropathic forefoot pain [13].

All patients in the present study demonstrated the classical clinical features of Morton's neuroma, including burning plantar forefoot pain, paresthesia, radiation of symptoms toward the adjacent toes, and symptom exacerbation during walking or while wearing narrow footwear. A positive Mulder's maneuver was present in every patient. These findings are consistent with previous reports indicating that careful history taking and physical examination remain the foundation of diagnosis. Although imaging has become increasingly important, it should complement rather than replace clinical assessment [14].

Radiographs were normal in all patients, confirming that plain radiography primarily serves to exclude osseous pathology rather than establish the diagnosis of Morton's neuroma. Magnetic resonance imaging accurately demonstrated the lesion in every case and excluded alternative causes of metatarsalgia. MRI is particularly valuable in atypical presentations and in uncommon locations such as the second intermetatarsal space because of its excellent soft-tissue resolution. Previous systematic reviews have reported high diagnostic accuracy for both MRI and ultrasonography, although MRI provides superior visualization of associated forefoot pathology. In our series, MRI findings correlated perfectly with intraoperative observations and histopathological examination [15].

Current treatment algorithms recommend conservative management as first-line therapy. All patients in our series underwent footwear modification, activity modification, oral analgesics, non-steroidal anti-inflammatory drugs, and corticosteroid injection before surgery was considered. Despite these measures, symptoms remained disabling. This experience is consistent with contemporary systematic reviews demonstrating that conservative treatment may provide temporary symptom relief but often fails to achieve durable improvement in patients with persistent interdigital nerve compression. Consequently, surgery remains the definitive treatment in appropriately selected patients [16].

Several surgical techniques have been described for Morton's neuroma, including dorsal and plantar approaches. The dorsal approach was selected in all cases because it provides excellent exposure after release of the deep transverse intermetatarsal ligament while avoiding a weight-bearing plantar scar. Early postoperative mobilization and faster return to normal footwear represent additional advantages. Recent meta-analyses have reported comparable pain relief with both approaches but suggest lower morbidity related to plantar scarring following the dorsal technique. Our findings support these observations, as none of our patients developed painful scar formation, wound complications, or symptomatic stump neuroma [17].

A notable strength of the present study is the use of a standardized surgical technique. All procedures were performed by the same surgeon under regional anesthesia in an ambulatory setting. Operative time averaged 30 minutes, demonstrating that dorsal neurectomy can be performed efficiently while maintaining meticulous surgical dissection. The neuromas measured between 8 and 12 mm, corresponding to the size range commonly described in surgical series. Histopathological examination confirmed the diagnosis in every patient, reinforcing the accuracy of the clinical and radiological assessment [18].

Clinical outcomes were excellent. Mean VAS pain scores improved from 8/10 preoperatively to 0/10 at final follow-up, and all patients resumed unrestricted daily activities without recurrence. Normal footwear was resumed approximately three weeks after surgery, reflecting rapid functional recovery. These results compare favorably with published success rates of 80–95% following surgical excision. The absence of recurrence or clinically significant sensory disturbance further supports the reliability of the dorsal approach when meticulous technique and adequate proximal nerve resection are performed [19].

An additional strength of this study is the comprehensive photographic documentation of the clinical examination, operative procedure, and postoperative evolution. Such visual documentation is uncommon in published case series and enhances the educational value of the manuscript by illustrating each key stage of diagnosis and treatment [20].

Nevertheless, this study has limitations. The principal limitation is the small number of patients, which reflects the rarity of second-space Morton's neuroma rather than selection bias. The retrospective design also limits the level of evidence. Furthermore, validated functional outcome instruments, such as the American Orthopaedic Foot and Ankle Society (AOFAS) score or the Foot and Ankle Ability Measure (FAAM), were not prospectively recorded. Finally, the original MRI and histopathological images were unavailable for publication, although both examinations were systematically performed and confirmed the diagnosis [21,22].

Despite these limitations, this study contributes meaningful clinical information because it focuses exclusively on second

intermetatarsal Morton’s neuroma, a location infrequently described in the literature. Consecutive patient inclusion, standardized surgical management by a single surgeon, histopathological confirmation, outpatient treatment, and medium-term follow-up strengthen the reliability of our observations [23,24].

Future multicenter prospective studies with larger patient cohorts and standardized patient-reported outcome measures are warranted to confirm these findings and further define the optimal management of this uncommon condition.

Table 3: Representative Published Studies on Morton’s Neuroma Surgery

Study	Year	Study design	Patients (n)	Second-space neuroma	Surgical approach	Main outcome
Kasperek & Schneider	2013	Retrospective	81	Mixed locations	Dorsal	Excellent pain relief in most patients
Reichert et al.	2016	Retrospective	78	Mixed locations	Dorsal	High long-term satisfaction
Habashy et al.	2016	Comparative	98	Mixed locations	Plantar vs dorsal	Comparable outcomes
Xu et al.	2022	Comparative	72	Mixed locations	Plantar vs dorsal	Similar functional outcomes
Zhang et al.	2023	Systematic review	>700	Mixed locations	Plantar vs dorsal	No clear superiority of either approach
Lee et al.	2024	Meta-analysis	>900	Mixed locations	Plantar vs dorsal	Excellent outcomes with both techniques
Present study	2026	Consecutive case series	3	Second space only	Standardized dorsal	100% pain relief, no recurrence at 24 months

Conclusion

Morton's neuroma of the second intermetatarsal space is an uncommon but important cause of neuropathic forefoot pain. Normal radiographs do not exclude the diagnosis, and MRI can be helpful when the clinical presentation is typical but the location is unusual. In this three-patient series, dorsal neurectomy after failed conservative treatment resulted in complete pain relief and no recurrence at a mean follow-up of 2 years. This location should be actively considered in patients with second-space neuropathic metatarsalgia [25].

Declarations

Ethics approval

To be completed according to the requirements of EHS Benaknoun and the target journal. Many journals require institutional approval or a documented waiver for retrospective case series.

Consent for publication

Written informed consent for publication of anonymized clinical data and operative images should be obtained and documented before submission.

Availability of Data

Data are available from the corresponding author on reasonable request, subject to institutional and ethical restrictions.

Competing interests

The authors declare no competing interests.

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