Clinical Management of the Intermetatarsal Neuroma: Is it just a neuroma?
What is this presentation about?

• Terminology
• Review of anatomy
• Nerve injury classification
• Pathogenesis
• Histopathology
• Surgery
## Terminology

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durlacher</td>
<td>1845</td>
<td>Neuralic affection of … plantar nerve</td>
</tr>
<tr>
<td>Morton</td>
<td>1876</td>
<td>A peculiar and painful affection of the 4th metatarsophalangeal joint</td>
</tr>
<tr>
<td>Dana</td>
<td>1885</td>
<td>Luxation podalgia</td>
</tr>
<tr>
<td>Pollosson</td>
<td>1889</td>
<td>Anterior metatarsalgia</td>
</tr>
<tr>
<td>Bradford</td>
<td>1891</td>
<td>Metatarsal neuralgia</td>
</tr>
<tr>
<td>Morton</td>
<td>1893</td>
<td>Morton’s metatarsalgia</td>
</tr>
<tr>
<td>Hoadly</td>
<td>1893</td>
<td>Morton’s painful affection of the foot</td>
</tr>
<tr>
<td>Tubby</td>
<td>1896</td>
<td>Morton’s disease</td>
</tr>
<tr>
<td>Jones and Robert</td>
<td>1897</td>
<td>Plantar neuralgia</td>
</tr>
<tr>
<td>Stern</td>
<td>1904</td>
<td>Morton’s painful disease</td>
</tr>
<tr>
<td>Cush</td>
<td>1937</td>
<td>Morton’s neuralgia</td>
</tr>
<tr>
<td>Betts</td>
<td>1940</td>
<td>Neuritis of the 4th digital nerve</td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>McElvenny</td>
<td>1943</td>
<td>Morton’s toe</td>
</tr>
<tr>
<td>Bickel and Dockerty</td>
<td>1947</td>
<td>Plantar neuromas</td>
</tr>
<tr>
<td>Kite</td>
<td>1947</td>
<td>Morton’s toe syndrome</td>
</tr>
<tr>
<td>Nissen</td>
<td>1948</td>
<td>Plantar digital neuritis</td>
</tr>
<tr>
<td>May</td>
<td>1948</td>
<td>Metatarsal neuroma</td>
</tr>
<tr>
<td>Sandel</td>
<td>1958</td>
<td>Morton’s neuroma</td>
</tr>
<tr>
<td>Pincus</td>
<td>1962</td>
<td>Plantar metatarsal neuritis</td>
</tr>
<tr>
<td>Hauser</td>
<td>1971</td>
<td>Interdigital neuroma</td>
</tr>
<tr>
<td>Silverman</td>
<td>1976</td>
<td>Morton-Durlacher neuralgia</td>
</tr>
<tr>
<td>Goldman</td>
<td>1979</td>
<td>Intermetatarsal neuroma</td>
</tr>
<tr>
<td>Gauthier</td>
<td>1979</td>
<td>Thomas Morton’s disease</td>
</tr>
<tr>
<td>Milgram</td>
<td>1980</td>
<td>Morton’s neuritis</td>
</tr>
<tr>
<td>Viladot</td>
<td>1982</td>
<td>Plantar interdigital neuroma</td>
</tr>
<tr>
<td>Alexander, Johnson and Parr</td>
<td>1987</td>
<td>Pseudoneuroma</td>
</tr>
<tr>
<td>Miller</td>
<td>1992</td>
<td>Perineural fibroma</td>
</tr>
</tbody>
</table>
Nomenclature – “Morton’s Neuroma”¹

• Diagnosis of nerve compression.

• Further distinguished by naming the involved nerve.

• Although the nomenclature becomes longer, the pathogenesis is correct, and treatment decisions can be made accordingly.

Neural Anatomy

• Peripheral nerves are made up of:
  – Neurons
  – Schwann cells
  – Macrophages
  – Fibroblasts

• Primary function of nerves:
  – the propagation of action potentials

Figure 1  Cross-sectional anatomy of the peripheral nerve. Inset at left shows an unmyelinated fiber. Inset at bottom shows a myelinated fiber. (Adapted with permission from Lundborg G: Nerve Injury and Repair. New York: Churchill Livingstone, 1988, p 33.)
Classification of Injury

• Peripheral nerve injuries are common and can be divided into 3 categories\(^3\):
  
  – Neurapraxia
  
  – Axonotmesis
  
  – Neurotmesis

Pathogenesis

- Aetiological Factors:
  - Chronic trauma
  - Ischaemia
  - Bursitis
  - Entrapment neuropathy

Understanding the pathology

- Chronic nerve compression injury causes proliferation of Schwann cells – these Schwann cells locally demyelinate and remyelinate in the region of injury.

- Schwann cell function also is altered secondary to ischaemia.

- Ischaemic and mechanical stimuli directly affect the proliferation and gene expression of chronically compressed Schwann cells.

The role of the intermetatarsophalangeal bursa

• The intermetatarsophalangeal bursa was investigated by dissection, radiography and injection.

• In the web spaces between the 2nd and 3rd and the 3rd and 4th digits the bursa lies superior to the transverse metatarsal ligament but projects distally to it, closely applied to the neurovascular bundle.

• It is suggested that inflammatory changes in this bursa could account for the pathological and histological findings in this condition.³

The Communicating Branch of the Lateral Plantar Nerve

- An anastomotic branch between the medial and lateral plantar nerves.

- The presence or absence of the communicating branch made no qualitative difference in the diameters of the common plantar digital nerves.

- Various anatomical variations, including accessory branches that attached to deeper structures in the foot.

The Communicating Branch of the Lateral Plantar Nerve

Histopathology – the report

- Epineural fibrosis
- Perineural fibrosclerosis
- Loss of Schwann cell cylinders from nerve bundles
- Nerve tissue with disordered schwannian architecture
- Fibrointimal thickening with luminal narrowing
- Focal myxoid degeneration
- Foci of organising fat necrosis in the adjacent soft tissue
- Inflammatory infiltrate identified in the bursal tissue
Clinical Intra-operative Photographs
Clinical Intra-operative Photographs
Clinical Intra-operative Photographs
Clinical Management

• Surgery may involve:
  – Decompression
  – Neurolysis
  – Excision

• Dorsal incision allowed earlier weight bearing and return to work, less painful scarring and less duration of hospital stay, than the plantar incision group.\(^9\)

• Surgical resection via a plantar approach lead to good and reproducible results\(^{10}\)

• Neurectomy V neurolysis based on macroscopic changes - may be a valid option.\(^{11}\)
Clinical Management

• Not just for forefoot compressive neuropathies.

• Entrapment of the inferior calcaneal nerve (nerve to abductor digiti quinti) has been implicated as a common and treatable cause of anterior heel pain syndrome.\textsuperscript{12}

• Not just excision of nerve involved in surgery - Observational study using anatomical dissection. While degeneration (not inflammation) of the plantar fascia is thought to be the most common cause of chronic heel pain, there is anatomical support for multi-layer involvement and in particular, nerve entrapment. Support for surgical release.\textsuperscript{13}

• Neurilemmoma (eg. of first branch of the lateral plantar nerve causing tarsal tunnel syndrome).\textsuperscript{14}
The Evidence for Surgery

- Cochrane review\(^\text{15}\) limited evidence from 1 randomised controlled trial indicated that surgery involving cutting the relevant nerve and implanting it into a muscle tendon may yield better long-term results that standard surgical removal of the nerve.

- The evidence base for interventions for this common condition – both surgical and non-surgical, is currently weak.\(^\text{15}\)

- However, several studies indicate a satisfactory outcome of surgical management ranging from 80\(^\text{16}\) to 96\(^\text{17}\).

---

**Thompson et al 2008.** Cochrane Database Review – Interventions for the treatment of Morton’s neuroma.


Success rates

• Surgical success rates of up to 90 percent are also reported in uncontrolled studies.¹⁸⁻²¹


Conclusion

- Studies have shown that surgical excision is very successful, with satisfactory outcomes ranging from 80% to 96%. Despite this, randomised control trials are lacking.\textsuperscript{15}

- Inform the patient

- Mechanical aetiology\textsuperscript{4}

- Review of forefoot anatomy assists in understanding the pathogenesis of forefoot nerve entrapment. Specifically, the role of the intermetatarsal phalangeal bursa\textsuperscript{5} can be explained. Additionally, the idea that the communicating branch of the lateral plantar nerve plays a role in the formation of nerve entrapment in the third interspace is not supported by anatomic data.\textsuperscript{7}

- Foot orthoses

- Histology

- Ultrasonography

- Link to clinical assessment
References
