



MORTON'S NEUROMA

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SUMMARY

Introduction: In 1876 American surgeon Thomas George Morton first detailed compressive neuropathy of the interdigital nerve of the forefoot. Morton's neuropathy occurs mostly. The condition is generated secondary to repeated pressure or irritation that leads to thickening of the nerve, located in the second or third intermetatarsal space. It is suggested that the use of pointed heel shoes could be a triggering factor for the development of this pathology due to the increased pressure on the forefoot.

Objective: to describe the current information related to Morton's neuroma etiology, epidemiology, presentation, diagnosis, management and treatment.

Methodology: a total of 39 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 29 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: Morton, neuroma, neuritis, neuralgia, interdigital.

Results: it is more frequently present in the female sex, presenting a female:male ratio of 4:1 in some bibliographies and 5:1 in others. The average age at the time of surgery is 50 years old. In 21% of the cases the neuroma is bilateral, in 66% of the cases it is related to the third space, 2% to the fourth and 32% to the second. A study showed that the average diameter of Morton's neuroma was 4.1 mm in the asymptomatic staff versus 5.3 mm in the symptomatic group.

Conclusions: This condition is certainly not a neuroma as it is a degenerative rather than neoplastic condition due to fibrosis of the digital nerve. The diagnosis is primarily clinical, where there may be altered sensation and a dorsal bulge. Examinations, investigations and non-surgical treatment are the same as those used in a primary neuroma. The use of orthoses and footwear modifications is indicated for conservative treatment. For surgical treatment, dorsal and plantar approaches are used, each with their advantages and disadvantages. The dorsal incision should be extended proximally to observe the residual limb, however sometimes exposure becomes difficult. The plantar approach provides better exposure for the nerve to be easily identified and resected, however the presence of painful scarring is notable. Other complications that may occur are atrophy, recurrence and chronic pain.

KEY WORDS: Morton, neuroma, neuritis, neuralgia, interdigital.



INTRODUCTION

In 1876 the American surgeon Thomas George Morton detailed for the first time the compressive neuropathy of the interdigital nerve of the forefoot. This disease is variously called Morton's metatarsalgia, Morton's entrapment, interdigital neuralgia, interdigital neuroma, interdigital neuritis, interdigital nerve compression syndrome, intermetatarsal neuroma and Morton's neuroma. This condition is certainly not a neuroma as it is a degenerative rather than neoplastic condition due to fibrosis of the digital nerve. Morton's neuropathy is mostly caused by irritation and compression on the plantar aspect of the transverse intermetatarsal ligament. This altered tissue gives painful discomfort related to weight bearing. Histologically, the neuroma has perineural fibrosis, neural edema and demyelination due to axonal injury. In other words, the condition is generated secondary to repeated pressure or irritation that gives way to thickening of the nerve, located in the second or third intermetatarsal space. Most of the time, interdigital neuromas are located between the 3rd and 4th metatarsal heads. It is also suggested that the use of pointed heel shoes could be a triggering factor for the development of this pathology due to the increased pressure on the forefoot(1-9).

METHODOLOGY

A total of 39 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 29 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: Morton, neuroma, neuritis, neuritis, neuralgia, interdigital.

The choice of bibliography exposes elements related to Morton's neuroma, definition, etiology, presentation, diagnosis, management and treatment.

DEVELOPMENT

Etiology.

The origin of Morton's neuroma is still to be clarified, at the moment 4 hypotheses are presented that would help to better understand the pathology. The first of them and the most accepted is the theory of the chronic trauma where the mechanical effects of the march cause chronic microtraumas in the intermetatarsal plantar digital nerves, which are compressed between two heads of the metatarsals and the metatarsophalangeal joints, the second theory is that of the intermetatarsal bag which proposes that the bursitis located in the intermetatarsals cause compression and inflammation with subsequent fibrosis of the afflicted common plantar digital nerve. Memorably, the bursae are proximal to the neurovascular bundle in the second and third intermetatarsal spaces, where Morton's neuromas are more likely to occur, but interdigital neuromas are rare in the fourth intermetatarsal space, where the

bursa infrequently has a nexus to the neurovascular bundle. The third is the entrapment theory, which proposes that interdigital neuromas occur due to compression of the interdigital nerve against the anterior end of the deep transverse metatarsal ligament and plantar soft tissue structures. The ischemic theory is the fourth theory based on histopathological findings of the common plantar digital artery showing degenerative changes prior to fibrous thickening of the nerve. Among the reasons commonly related to the pathology are hyperextension of the toes in high heeled shoes, high impact sports activities, narrow toe shoes, toe deviation, thickening of the transverse metatarsal ligament, inflammation of the intermetatarsal bursa, forefoot trauma, metatarsophalangeal joint pathology and lipoma(5,10-14).

Epidemiology.

Epidemiologically, Morton's neuroma is more frequently present in the female sex, with a female:male ratio of 4:1 in some bibliographies and 5:1 in others, and the average age at the time of surgery is 50 years. In 21% of the cases the neuroma is bilateral, in 66% of the cases it is related to the third space, 2% to the fourth and 32% to the second. The presentation in multiple sites is infrequent, in spite of the fact that it is not unusual to find two neuromas in the same foot(5,9,12,15,16).

Presentation.

It usually presents with paresthesia in the region of the damaged digital nerve, as well as pain in the forefoot, being more frequent in women. A considerable percentage, approximately 17% of those affected with Morton's neuroma report having been the victim of a previous trauma, confirming the cause of the symptoms. Burning pain is distinctive and frequent, however the pain can also be described as stabbing or tingling with electrical sensations, and in almost half of the patients there is a sensation of "stone in the shoe" or similar to walking on a marble or a stone. Similarly, in a little less than 50% of patients there is numbness between the toes. The pain can be directed towards the leg or rearfoot, generating cramps, because of walking for a considerable time. Other factors besides walking that increase pain in this condition are wearing tight shoes or high heels, as well as being an athlete as in the case of runners who increase the weight load on the front part of the foot while doing their activity. The pain can be relatively relieved by resting the foot or removing the footwear, particularly when the condition has just begun. In patients with a chronic condition, the pain may be constant. Approximately 25% of cases report pain at night and at rest(5,8,17).

Pathophysiology.

Morton's neuroma is frequent in the third space due to the fact that this space is narrower than the other spaces. The common digital nerve in the third space accepts branches of the medial and lateral plantar nerves, being the site of anastomosis between the branches of the two nerve trunks. It is comparatively thicker, which increases the possibility of trauma and compression. The



development of Morton's neuroma has been related to trauma caused by:

- A. Repetitive trauma from running.
- B. Penetrating injury.
- C. Thickened transverse metatarsal ligament.
- D. Crush injury.
- E. Enlarged bursa in the interspace.

The constant trauma and compression of the nerve give responses such as endoneural edema, vascular variations and excessive bursal thickening leading to perineural fibrosis (5,12,18).

Histopathology.

Microscopically, the common plantar digital artery has sudden disruption of the arterial wall, inconclusive recanalization and thrombosis, these are criteria that protect the ischemic theory. It can also be found:

- Fibroblast and Schwann cell dissemination.
- Fibrosis adjacent to and within the nerves.
- Aggravation of myelinated nerve fibers.

Macroscopically it shows a fusiform tumefaction proximal to the division of the plantar interdigital nerve with thickening of the adjacent tenosynovial tissues(5,19).

Diagnosis.

First hand diagnosis is essentially clinical, sensitivity is assessed and a dorsal prominence can be found; in addition to an increase of the interdigital space. By palpating the affected space, the symptoms can be reproduced. Crushing the forefoot mediolaterally while palpating the affected space usually generates a snapping or crunching impression called Mulder's click. It is really important to recognize the value of anamnesis and physical examination, however the contribution of imaging techniques such as ultrasound and nuclear magnetic resonance imposes a greater accuracy in the correct diagnosis.

The use of weight-bearing X-rays is recommended when suspecting or trying to differentiate from subluxations, dislocations, bony masses, deformities or arthritis. In addition, Sullivan's sign, which consists of splitting of the distal intermetatarsal area and/or divergence of the contiguous toes, may be seen. A radiopaque foreign body may also be seen. Ultrasound can be used for both diagnosis and steroid administration. It also shows a non-compressible dumbbell-shaped soft tissue lesion with hypoechogenicity within the intermetatarsal space, and a "Mulder's click" can be obtained on palpation with the probe. On the other hand, nuclear magnetic resonance imaging, primarily used to rule out other pathologies, also presents a soft tissue lesion in the form of a dumbbell inside the intermetatarsal area. Here the T1 signal is usually low, the T2 signal is usually low or intermediate and the enhancement is variable(5,11,12,18-20).

There are no exact clinical visual signs that demonstrate the presence of a neuroma, so it has to be well differentiated, because some foot deformities, especially hallux valgus, can

cause overcrowding of the toes and increased pressure on the toes. Plantar calluses proximal to the metatarsal heads suggest a diagnosis of synovitis, transfer metatarsalgia, subluxation or dislocation of the metatarsophalangeal joint of the second or third toe. In addition, other differential diagnoses such as Freiberg's disease or avascular necrosis of the metatarsal head, plantar plate tears and metatarsal stress fractures can be appreciated(8,17).

One study showed that the average diameter of Morton's neuroma was 4.1 mm in the asymptomatic staff versus 5.3 mm in the symptomatic group. The diagnosis of interdigital neuroma is considerable only in those occasions when the transverse diameter in a nuclear magnetic resonance is 5 mm or greater and it is linked to the patient's clinic(8,21,22).

Management and treatment

For the moment, the best non-surgical treatment for the pathology continues to be custom-made orthoses, metatarsal off-loading plantar orthosis, footwear modifications and injections of local anesthetic substances in addition to sclerosing agents and corticosteroids. Corticosteroid injections had a good clinical outcome in those with Morton's neuroma, however 30% of the patients had to undergo surgery(12,23,24).

Budin splinting and toe taping may decrease secondary neuralgia in patients with synovitis, instability or deformity of the toe. Anti-inflammatory medications, anticonvulsant medications such as gabapentin, tricyclic antidepressants such as amitriptyline are recommended to decrease the severity of related symptoms. Some side effects have been reported in these treatments such as skin discoloration and rupture of the joint capsule adjacent to the injection site causing deformity of the toe, in addition to atrophy of the subcutaneous fat and plantar fat pad. Lately, other less invasive and more conservative techniques have also been used to treat neuromas, such as cryotherapy, alcohol injections in the nerves and radiofrequency ablation (5,9,25,26).

Recent literature indicates that the extension of the lesion is not always directly related to the importance of the symptoms, however smaller neuromas react better to steroid injections compared to larger ones(8,17,20,27).

Surgery is indicated to treat recalcitrant cases, when non-surgical management does not have good results. Two approaches are the most common for Morton's neuroma, one dorsal and the other plantar, the scar in the dorsal approach is better tolerated since the plantar scar is sometimes very painful. First the approach begins with an incision of 3 cm to 4 cm proximal to the space where the neuroma is located, this incision should preferably be in the midline so as not to cause lesions in the dorsal cutaneous nerves. Subsequently the incision is deepened to cut transversely the transverse metatarsal ligament. We then identify the common digital nerve in the proximal portion of the wound and follow it distally until its division; if we find the presence of any soft tissue adhesion it has to be

released from the nerve. Some medical specialists will end up here without any further intervention on the nerve itself, bony

after nerve decompression or neurolysis(5,12,28).

Figure 1. Plantar approach in the left foot where Morton's neuroma is visualized.



Source: The Authors.

Surgical excision of Morton's neuroma should include resection of the common digital nerve as proximal as possible. Large volumes of fatty tissue should not be excised to avoid scarring and subsequent atrophy of the plantar pad. To intervene the nerve, the common digital nerve proximal to the metatarsal heads is cut. Some specialists suture the cut ends of the nerve to the side of the metatarsal or one of the intrinsic muscles to avoid the formation of a painful stump neuroma. It is generally recommended to use postoperative footwear for the removal of stitches for approximately 7 to 14 days, in addition to using compressive bandage for 2 to 6 weeks (5,12).

The plantar approach is generally used in those who present recurrent neuromas or there is a painful trigger point close to the

focus. This approach reduces the rate of lost neuroma and does not require cutting the transverse metatarsal ligament. The plantar incision achieves a more proximal resection and a closer exposure of the nerve, in addition to the vein and artery is more easily observed so it preserves better. Among the disadvantages of the plantar approach are painful scars and plantar keratosis in almost 5% of cases(5).

The plantar approach is less used, presenting a post-excision success rate of 51% to 85%. The dorsal approach is usually used because, besides being better tolerated by those who undergo surgery, it allows immediate weight bearing in the postoperative period(8,15,29).

Figure 2. Morton's neuroma after incision.



Source: The Authors.

Complications.

Among the most frequent complications of surgical treatment we have:

Chronic pain

Infection, pain, bleeding and other complications related to surgery.

Recurrence of deformity due to inadequate cutting or change of a Morton's neuroma into a true neuroma.

Skin atrophy and discoloration, fat pad atrophy, and other alterations associated with corticosteroid injections.

CONCLUSIONS

The origin of Morton's neuroma is still to be clarified, at the moment 4 hypotheses are presented that would help to better understand the pathology. Morton's neuroma is more frequently present in the female sex, presenting a female:male ratio of 4:1 in some bibliographies and 5:1 in others. The average age at the time of surgery is 50 years. In 21% of the cases the neuroma is bilateral, in 66% of the cases it is related to the third space, 2% to the fourth and 32% to the second. One study showed that the average diameter of Morton's neuroma was 4.1 mm in the asymptomatic group versus 5.3 mm in the symptomatic group.

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however sometimes exposure becomes difficult. The plantar approach provides better exposure for the nerve to be easily identified and resected, however the presence of painful scarring is notable. Other complications that may occur are atrophy, recurrence and chronic pain.

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