

MORTON'S NEUROMA TREATMENT THROUGH PLANTAR PORT: RETROSPECTIVE ASSESSMENT OF SURGICAL OUTCOMES

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SUMMARY

With the objective of assessing the effectiveness of the surgical technique involving neurectomy through plantar, cross-sectional port out of the load zone in individuals with Morton's neuroma, 217 patients were submitted to this treatment. A total of 264 feet were observed, being 32.2% right feet, 46.1% left feet, and 21.7% bilaterally. Regarding gender, 86.6% of the occurrences were seen in women, and 13.4% in men. Regarding the site, 83.5% (220 neuromas) were present at the third interdigital space, 7.5% at the second space, and 47 patients presented it bilaterally. The average follow-up time was

7.5 years, ranging from 4 to 216 months, with satisfactory and fair outcomes in 95.8% of all patients, with only 11 patients (4.2%) not satisfied with the overall treatment. The authors conclude, therefore, that neurectomy through cross-sectional plantar port is a satisfactory option, with good anatomical view of the neuroma, evolving well to healing, early return to activities and patient satisfaction with the outcome achieved.

Keywords: Morton Neuroma; Foot diseases; Surgical procedures, operative at foot.

Citation: Nery CA, Barroco RS, Furlan C, Tardini CH, Cemin FS, Mombach RG. Norton's neuroma treatment through plantar port: retrospective assessment of surgical outcomes. *Acta Ortop Bras.* [serial on the Internet]. 2007; 15(1):55-58. Available from URL: <http://www.scielo.br/aob>.

INTRODUCTION

The neuroma of the plantar digital nerves was first described by Civinni in 1835, and, subsequently, by Durlacher in 1845. Morton, attributing it to a "condition of the fourth metatarsophalangeal joint"⁽¹⁾, has ultimately led to a description of the injury, which is currently known by his name.

A common cause of metatarsal pain, most frequently triggered by a mechanical compression of the digital branches of the plantar nerves⁽²⁻⁶⁾, being characterized by a non-neoplastic injury, with perineural fibrosis formation on plantar nerve, specially affecting the third digital space, since this is the most frequent site for the union of plantar digital nerves' lateral and medial branches, which, when thickened, become compressed within the third digital space, enhanced by an increased motility of the fourth metatarsal compared to the third metatarsal, causing repeated micro traumas⁽⁶⁻¹⁰⁾. (Figure 1)

Females are the most affected subjects, especially in the age group above the fifth decade of life^(3,8,10,11), and is correlated to "anti-physiological" shoes wearing, characterized by a narrow anterior chamber, resulting in metatarsophalangeal joint hyperextension, which favors nerve compression against intermetatarsal ligament, enhanced by a lifted posterior compartment that is present with this kind of shoes.

The Morton's neuroma is clinically presented by patients with symptoms of forefoot pain, relieved by taking off the shoe and applying massage on toes. It may be irradiated to toes, either accompanied by paresthetic phenomena on areas innervated by involved branches, with burning-like pain that may be worsened by persistently using such "antiphysiological" shoes^(6,9,12).

At physical examination, during palpation, the Mulder's Sign⁽¹³⁾

is found, which is characterized by latero-lateral compression of metatarsal heads with one hand, while the other hand compresses the involved space, on plantar region. This test may produce pain and a palpable click (Mulder-positive), as a result of neuroma displacement during metatarsal heads compression on a thicker interdigital nerve, during its movement by transverse intermetatarsal ligament⁽¹²⁾.

Although most of the times the diagnostics is clinical⁽¹³⁻¹⁶⁾, especially for neuromas bigger than 5 mm in diameter – a fact accredited by the majority of orthopaedic doctors⁽¹⁷⁾ – subsidiary tests such as X-ray imaging, useful for ruling out differential diagnostics of metatarsalgia^(10,15,17,18), the ultrasound, showing a round or ovoid, hypo echoic injury, located juxtaproximal to the metatarsal head⁽⁷⁾, and the nuclear magnetic resonance^(4,6), which is important for diagnosing neuromas smaller than 5 mm in diameter⁽¹¹⁾, and in double neuromas^(11,13,19), where, at the window with fat suppression, resonance shows to be largely important for diagnostic elucidation of the algescic pictures of this topography^(16,14), as well as on re-surgery planning⁽¹⁴⁾ and on the existence of pathologies associated to the neuroma^(11,14).

Macroscopically, the neuroma presents with a spindle-like enlargement of plantar digital nerve in its bifurcation, but, microscopically, we can see a tapering of the epineural fascicle, intermingled by perineural fibrosis, associated to a large amount of collagen (Renaut's Bodies) and lost myelinated fibers^(6,19,20).

The differential diagnosis involves lumbar radiculopathies, tarsal tunnel syndrome, fracture by metatarsal bones stress, plantar callosities associated to hammer- or claw-like fingers, Freiberg's disease, peripheral and reuropathic neuritis, intermetatarsal bursitis, rheumatoid arthritis, and tumors of bones and forefoot's soft parts^(6,16,21).

Study conducted at Clínica Ortopédica Ibirapuera, Medical School, ABC University (FMABC), and University of São Paulo (UNIFESP-EPM)

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Received in: 04/06/06; approved in: 09/19/06

When treating a Morton's neuroma, the change of habits is early introduced, involving physiological shoes wearing combined to the use of non-steroidal anti-inflammatory agents and physical therapy, targeting the elongation of the plantar fascia and fingers' flexor muscles, associated to ultrasound. Inner soles for load suppression at involved metatarsal region, with retrocapital base, may be used as adjuvant (19). The use of injected steroids or the mixture of a hydrocortisone formula and local anesthetics is intended for pain relief; however, its effects last from weeks to months, and its use is controversial (19,22).

If the conservative treatment fails, surgical alternatives for decompression may be employed, such as neurolysis and surgical release of the transverse metatarsal ligament (19).

Nevertheless, surgical resection of the neuroma and the involved segment of the nerve seems to be the treatment of choice, resulting in better outcomes, as reported by some authors in literature (14,19,22,23,24), and may be performed both through dorsal and plantar ports.

The purpose of this study is to show the effectiveness of the transverse plantar port, out of the load area, as a surgical treatment for Morton's neuroma, being presented herein the outcomes seen in the last eighteen years.

MATERIAL

We assessed 217 patients, in a total of 264 feet, diagnosed with Morton's neuroma, being 70 (32.2%) on the right side, 100 (46.1%) on the left side, and 47 (21.7%) bilateral (Figure 2).

Regarding gender, 29 (13.4%) were males, and 188 (86.6%) females (Figure 3). Ages ranged from 22 to 81 years, with an average of 52 years old.

The incidence of neuroma between the third and fourth pododactyli (third interdigital space) was 220 neuromas (83.5%), while between the second and the third pododactyli (second space) the incidence was 20 neuromas (7.5%). The correlation between the second and the third spaces (Figure 4) was 20 neuromas (7.5%). The presence of neuroma on the second, third and fourth spaces was four times (1.5%) according to Table 1.

Bilateral involvement was reported in 47 patients (35%).

METHOD

In addition to clinical assessment, with the presence of a positive Mulder's Sign in more than 90% of the patients, X-ray images of the foot at frontal and lateral planes, ultrasound, and, in the last ten years, due to its increased availability, the nuclear magnetic resonance, neuromas measuring 6 mm to 15 mm (average 10 mm) have been found, with surgical treatment being therefore recommended to patients.

In the surgical treatment for Morton's neuroma, the transverse plantar port has been employed as the access port, which is intended to provide a safe approach concerning nerve location, with scar lying out of the load and cosmetic area (Figure 5). The surgical steps of this technique are summarized below:

1. A tourniquet is applied with an esmarch band on the calf or a pneumatic garrote is applied on thigh root.
2. A cross-sectioned incision is performed distally to the load zone, on the region corresponding to the involved space. This is followed by the dissection of the subcutaneous cell tissue and of the superficial transverse ligament, exposing the vasculo-nervous bundle and the subsequent nerve isolation is performed (Figure 6).
3. Distal and proximal resection of the involved nerve is performed, not requiring deep transverse ligament opening.
4. Hemostasis of the wound site and cavity inventory are useful for preventing postoperative hematoma formation and for locating associated injuries.
5. Closing in planes and the application of a compressive bandage until the first postoperative dressing occurs at the end of the first week.

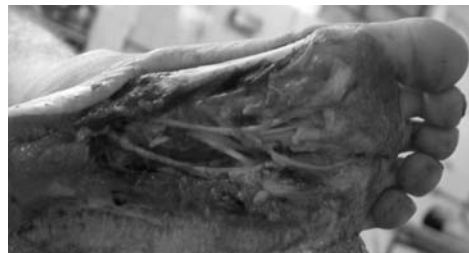


Figure 1 – Anatomical piece showing the confluence of plantar nerves on Morton's neuroma formation.

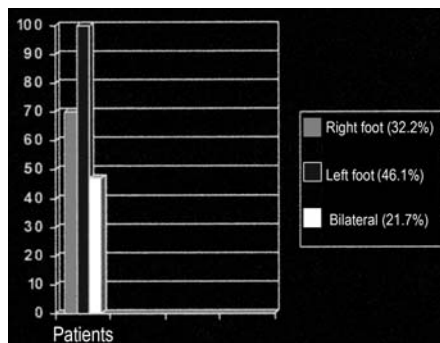


Figure 2 – Frequency of Patients and involved Topography.

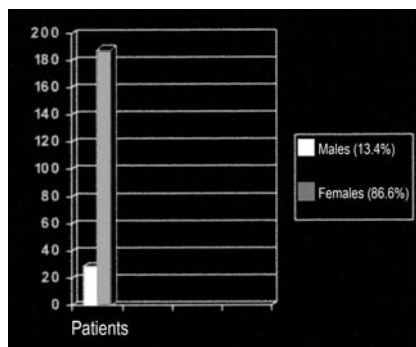


Figure 3 – Frequency of Patients regarding involved Gender..

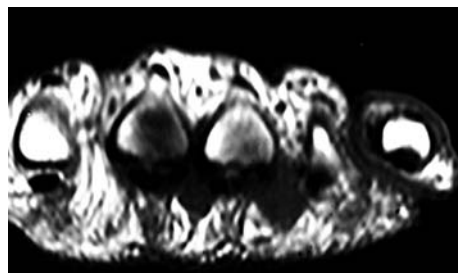


Figure 4 – NMR image showing a Double Neuroma.

Interdigital Space	3rd	2nd	2nd & 3rd	2nd, 3rd, & 4th
Total Neuromas	220	20	20	4
Percent	83.5%	7.5%	7.5%	1.5%

Table 1 – Table comparing the involved Topography and the corresponding cases frequency.

Patients are discharged from hospital twelve hours after the surgical procedure. Stitches are removed after the fifteenth postoperative day.

The postoperative care involves approximately ten days of total load suppression and operated limb lifting, with an average of four weeks wearing Barouk-kind shoes until the previous usual activities can be performed again.



Figure 5 – Scar Away From the Load Area at a Double Neuroma Resection.

After hospital discharge, the follow-up was made on an outpatient basis, inquiring patients by means of questionnaires, assessing their level of satisfaction with the aesthetic appearance of the scar and with treatment outcome, the latter being divided into three groups: the happy group, meaning those reporting no changes regarding shoes wearing; the fair group, meaning those where subtle neu-

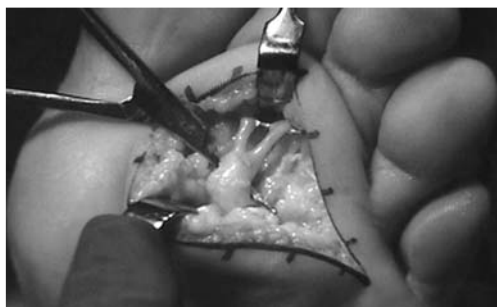


Figure 6 – Isolation of a Morton's Neuroma at the Transverse Plantar Port.

rological changes occurred at the neuroma site, as well as those reporting limitations to some shoes wearing, and; the unhappy group, meaning those who have not perceived any improvement with the employed surgical treatment, being unhappy with the treatment, according to Table 2.

The follow-up time ranged from 4 to 216 months, in an average of 7.5 years.

RESULTS

The aesthetic result was 100% approved by patients, while personal satisfaction was divided into 229 Happy patients (87.4%), 22 Fair (8.4%) and 11 Unhappy (4.2%) with treatment provided (Table 3). The patients returned to their previous activities within 37.3 days (in average) after surgery, ranging from 21 to 70 days, which we consider as a mediate complication.

As an immediate complication, one case of local hematoma formation was considered.

No late complications were reported.

DISCUSSION

First described by Civinni in 1835⁽²⁴⁾, followed by Durlacher in 1845⁽²⁵⁾, who, for many people, was the first to describe the neu-

roma⁽¹⁹⁾, it was Morton⁽²⁶⁾ who disseminated the concept of this condition. Since then, the Morton's neuroma has been studied for years, with several papers addressing its etiology, physiopathology and treatment methods, both conservative and surgical. Nevertheless, few studies in Literature address the surgical outcomes of the employed technique^(6,27).

Although a consensus exists towards surgical treatment^(13,19), some

Happy	Fair	Unhappy
PAIN relief and Total satisfaction with Shoes wearing	Subtle neurological change and Limitations to some kinds of shoes wearing	No improvement with treatment in general

Table 2 – Classification of surgical outcomes according to symptoms and return to previous activities.

authors report a satisfactory experience with the use of decompressive surgeries (ligamentotomies)^(28,29) and microneurolyses^(7,18), the neuromectomy is the approach of choice accepted by the vast majority of authors^(6,8,12,13,15,16,30,31).

Regarding the surgical technique, we found in Literature the dorsal port as the approach of choice when performing the neuromec-

Happy	Fair	Unhappy
229 (87.4%)	22 (8.4%)	11 (4.2%)

Table 3 – Summary of surgical outcomes according to patients' own assessment.

tomy of Morton's neuroma^(6,8,12,13,14), and, for some authors, the longitudinal plantar port being used only for re-surgeries^(6,23). In our study, we considered the transverse plantar port anterior to the load zone as an alternative providing better anatomical visibility compared to the dorsal port, because, additionally to the potentially safer access to the neuroma, it allows a more thorough and extended resection, enabling the probing of other metatarsal spaces in cases of associated diseases and of double neuroma (Figures 5 and 6), avoiding the risk of an incomplete resection of the neuroma and of injury of the deep transverse ligament, a complication that is present when using the dorsal port, which may trigger metatarsalgia symptoms as a result of the diastase of metatarsal bones⁽¹²⁾.

Lelivre⁽³²⁾, Viladot⁽¹²⁾ and Barroco⁽¹⁴⁾ had previously reported the need to re-operate cases of Morton's neuroma not thoroughly resected and presenting with residual pain, leading to a new approach, through the plantar port. In this sense, Johnson states the possibility of neuroma recurrence after surgery, where 31% of the patients reported improvement of pain, and 47% remained with residual pain due to an incomplete resection of the neuroma^(14,19). In our series, one patient (AJH) who had been operated through dorsal port and evolving with no clinical picture improvement, sought us, and, two years after the first surgery, a procedure was performed through plantar port, where we verified that the neuroma had not been removed. After its resection, total pain relief was achieved, and the patient was satisfied with the appearance of the scar resulting from that second approach.

In our study, after 7.5 years of follow-up, there were no cases of neuroma recurrence.

Among the operated patients, most were females (86.6%), with a slight prevalence of the left side (46.1%). The mean age was 52 years, and a high prevalence of the third intermetatarsal space involvement was found, these data showing similarity with those described in literature^(2,13,14,19). We did not find, however, reports in literature addressing experiences with the treatment of double and triple unilateral neuromas through plantar port; nevertheless, our

study showed that this port provides an excellent therapy alternative.

Neuromas measuring 6 to 15 mm in diameter have been resected. According to literature, it is reported that neuromas smaller than 5 mm in diameter do not present good outcomes^(2,14,19) with neuromectomy. Thus, we conclude that the outcomes achieved were resultant from an accurate surgical recommendation, based on a precise clinical diagnosis^(14,19,23).

As complications of the transverse plantar port, the following can be listed: (Table 4)

- Immediate: Suture dehiscence, hematoma and local infection
- Mediate: Longer healing time for plantar skin compared to dorsal skin, which determines a longer period before resuming previous activities
- Late: Presence of thick scar or vesicles

Our follow-up time ranged from 4 to 216 months, in an average of 7.5 years, with a period of 21 – 70 days (average: 37.3 days) for our patients to return to their previous activities, thus being considered as a mediate complication. We had a satisfaction rate of 100% concerning the aesthetic outcome of the scar, and personal satisfaction of 95.8% involving happy and fair groups of patients, according to our assessment, which matches with the findings in literature^(14,19).

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Immediate	Mediate	Late
<ul style="list-style-type: none"> • Dehiscence • Hematoma • Infection 	<ul style="list-style-type: none"> • Longer healing time 	<ul style="list-style-type: none"> • Scar thickening • Local nodules

Table 4 - Summary of the major complications resulting from the surgical technique employed.

However, there was one case of hematoma at incision site, attributed to an early load, resulting from the patient's non-compliance to medical recommendations. We didn't find any other complications described with the use of the plantar port^(1,13,19,20).

CONCLUSION

The plantar transverse incision, away from the load area, enables an excellent surgical access to involved structures, warranting a good visibility of the neuroma, and a high rate of patient satisfaction with treatment (95.8% patients in the happy and fair groups), as well as minor complications, thus showing to be a good option for surgical treatment of the Morton's neuroma.

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