DOI: https://doi.org/10.30795/jfootankle.2023.v17.1717

Original Article

Patients submitted to Morton neuroma's neurectomy for plantar digital nerve through plantar approach: retrospective clinical evaluation of surgical results

Lucas Pereira de Sá[1], Lerud Frosi Nunes[1], Ricardo Borges Ramalho[1], Vinicius Andretti Zeferino[1], Bernardo Garcia Barroso[1], Jorge Luiz Kriger[1] (*In memoriam*)

1. Instituto de Ortopedia e Traumatologia, Vitória Apart Hospital – VAH, Serra, ES, Brazil.

Abstract

Objectives: Evaluate postoperative clinical outcomes of patients submitted to neurectomy to treat plantar digital nerve neuroma through plantar approach with a minimum of 12 months postoperative.

Methods: Patients submitted to neurectomy through plantar approach between 2011 and 2020 were evaluated. Twenty-eight patients were included, and 29 feet were operated on, totaling 35 resected neuromas. The medical records were evaluated, and the participants answered a form containing questions about the parameters of the Clinical Evaluation for Interdigital Neuroma and classified according to a visual analog pain scale.

Results: A predominance of females (85.71%) was observed, with a mean age of 51.55 at the surgery date. The left side was predominant (62.06%). The most affected intermetatarsal space was the third (77.14%). Clinical evolution was "excellent" (58.62%), "good" (13.79%), "fair" (20.68%), and "poor" (6.89%). A mean of 1.79 corresponding to "mild" was demonstrated.

Conclusion: The patients presented "good" clinical evolution, low pain level, and high patient satisfaction rate after a mean of 44.79 months after surgery.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Foot diseases; Metatarsalgia; Morton neuroma; Pain.

Introduction

Plantar digital nerve neuroma (Morton's neuroma) is an injury to the peripheral nervous system, representing one of the most frequent causes of metatarsalgia[1]. It was first mentioned in literature by Giannini in 1835, described by Durlacher in 1845, and disseminated by Thomas George Morton in 1876 apud Amaral Neto[2].

Morton's neuroma is a benign fibrous lesion that affects the tissue surrounding the common digital plantar nerve at the site where the branches of the medial and lateral plantar nerves anastomose. This anastomosis is believed to predispose to the neuroma development[3]. The condition is characterized by pain and burning in the corresponding interdigital space, exacerbated by constrictive walking and footwear. A mass in the intermetatarsal space can often be palpated. Lateral compression may be accompanied by a painful click, known as Mulder's sign. The etiology of this condition is still uncertain[1].

The group most affected by this pathology are middle-aged women due to the recurrent use of narrow, high-heeled shoes, while men tend to wear wider, shallower shoes. Such women's shoes compress the bone, ligament, muscle, and nerve structures of the forefoot and displace the body weight support axis to it, increasing pressure and causing pain and inflammation[4].

Study performed at the Instituto de Ortopedia e Traumatologia, Vitória Apart Hospital – VAH, Serra, ES, Brazil.

Corresponding author: Bernardo Garcia Barroso. Rodovia BR-101 Norte Km 2,38, s/n, Boa Vista II, 29161-001, Serra, ES, Brazil. **E-mail:** bernardobarroso@yahoo.com.br **Conflicts of interest**: none. **Source of funding:** none. **Date received:** August 31, 2023. **Date accepted:** October 16, 2023. **Online:** October 31, 2023.

How to cite this article: Sá LPD, Nunes LF, Ramalho RB, Zeferino VA, Barroso BG, Kringer JL (*In memoriam*). Patients submitted to Morton neuroma's neurectomy for plantar digital nerve through plantar approach: retrospective clinical evaluation of surgical results. J Foot Ankle. 2023;17(2):103-8.

The diagnosis of Morton's neuroma is essentially clinical, based on detailed anamnesis and complete physical examination[2]. Several studies have shown that clinical examination is highly sensitive and specific. The four clinical signs most frequently associated with neuroma are painful intermetatarsal space on palpation, Mulder's sign with an audible click, painful plantar percussion, and sensory deficit in the tip toes[5]. Magnetic resonance imaging (MRI) and ultrasound (US) are helpful to exclude other causes of metatarsalgia and in cases of suspicion of multiple lesions or involvement of multiple interdigital spaces[2,5].

Metatarsalgia treatment due to Morton's neuroma is based on conservative and surgical treatments. As the surgical procedure of choice, neurectomy consists of resectioning the interdigital nerve approximately 3 cm proximal to the deep transverse metatarsal ligament[2].

The objective of this study is to evaluate postoperative clinical outcomes of patients submitted to neurectomy to treat plantar digital nerve neuroma through plantar approach with a minimum of 12 months postoperative.

Methods

This retrospective case series was performed at Vitória Apart Hospital in Serra, Espirito Santo, Brazil. The study was approved by the institutional review board under the number 13432519.2.0000.5071.

The information necessary for the study was obtained from the hospital's database, using as reference for patient location the procedures ID number for neurolysis of compressive syndromes and/or multiple microneurolysis between December 2011 and February 2020.

Inclusion criteria were a minimum 12 months follow-up, an attempt at conservative treatment for a minimum of 12 months, positive Mulder's sign, clinical documentation with confirmed neuroma through MRI, an informed consent form signed, and patients over 18 years on the interview.

Patients with other pathologies in the affected foot, submitted to another type of procedure, and unable to walk for other reasons or without telephone contact were excluded from the study.

Patients operated through the curvilinear transverse plantar approach in the load-free zone of the affected space (Figure 1) were evaluated, providing dissection, isolation, and resection of the neuroma (Figure 2). The neurectomy was performed with the widest possible margin by a single surgeon. The load was released on the first postoperative day using a long Baruk sandal (CINIFLEX®, Concórdia, SC, Brazil). Stitches were removed on the fifteenth postoperative day.

The objectives of the study were explained and clarified by reading the informed consent form. If the participant requested it, a copy would be emailed or mailed. Those who agreed to participate answered a form containing questions about the parameters of the Clinical Evaluation for Interdigital Neuroma[6] and were classified according to a visual analog pain scale (VAS), which classifies pain from 0 (no pain) to 10

Figure 1. A curvilinear, transverse incision in the load-free zone.

Figure 2. Isolation of Morton's neuroma in the transverse plantar approach.

(worst imaginable pain) (Figure 3), each question was read and explained by the researcher.

Table 1 and Figure 3 illustrate the questionnaires used. The results of surgical treatment were classified in the clinical evaluation score as follows: "poor" (0–49), "fair" (50–59), "good" (60–69) and "excellent" (70–80)[6].

The collected data were tabulated on Excel® software (Microsoft Corporation, Redmond, Washington, USA) and subjected to simple descriptive statistical analysis.

Results

From December 2011 to February 2020, 31 patients underwent a surgical procedure to remove Morton's neuroma. Three patients were excluded from the sample due to the exclusion criteria or because contact via telephone was not possible.

The sample consisted of 28 patients, one submitted to bilateral surgery, resulting in 29 operated feet. In addition, six patients had two neuromas on the same foot, totaling 35 resected neuromas. None of the patients had complications such as surgical wounds (infection, keloid, sensitive scar, and complex regional pain syndrome); however, some had persistent pain and paresthesias.

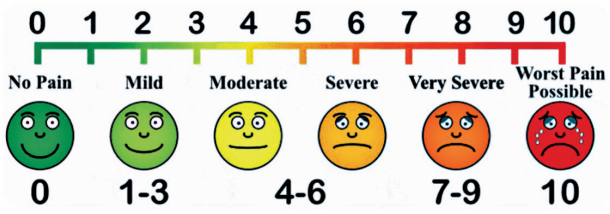

Figure 3. Visual analog scale (VAS).

Table 1. Interdigital neuroma clinical evaluation score

Parameter	Score
Pain	
None	20
Mild	10
Severe	0
Maximum walking distance	
No limitation > 6 blocks	20
Some limitation 2–6 blocks	10
Severe limitation < 2 blocks	0
Sensibility	
Normal	20
Numbness	10
Dysesthesia	0
Shoes	
Conventional	20
Comfortable	10
Difficulty with any shoes	0
"Poor" (0–49)/"Fair" (50–59)/ "Good" (60–69)/"Excellent" (70–80)	

Source: Giannini S, Bacchini P, Ceccarelli F, Vannini F. Interdigital neuroma: clinical examination and histopathologic results in 63 cases treated with excision. Foot Ankle Int. 2004;25(2):79-84

The results can be seen in Table 2. Twenty-four female and four male patients were evaluated, ranging from 32 to 64 years (mean 51.55, standard deviation (SD) 8.92) at the time of surgery. A predominance of females was observed, corresponding to 85.71% of the sample.

As for the affected side, the left side was predominant (18 feet, 62.06%) compared to the right (11 feet, 37.93%). The most affected intermetatarsal space was the third (77.14%), followed by the second (22.85%). The sizes of the resected neuromas measured by MRI are also shown in Table 2, but some records did not contain this information.

The mean follow-up was 44.79 months (SD 36.45), with a minimum of 12 months and a maximum of 100 months during research data collection.

Regarding the clinical evolution, the results showed that 17 (58.62%) feet presented an "excellent" result, 4 (13.79%) a "good" result, 6 (20.68%) a "fair" result, and 2 (6.89%) a "poor" result. The mean score was 64.13 points (SD 13.23), corresponding to a "good" classification.

Regarding the type of footwear currently used, 16 patients (55.17%) answered that they use any footwear, 13 patients (44.82%) need more comfortable footwear, and none reported difficulty with any footwear.

When asked about sensitivity, 13 patients (44.82%) reported paresthesias and 16 (55.17%) reported normal sensitivity. None had dysesthesia.

Regarding the pain, according to (VAS) scale, a mean value of 1.79 (SD 2.52) ranging from 0 to 8 was demonstrated, corresponding to "mild" pain.

Finally, regarding possible late deterioration of the clinical results obtained, the statistical analysis showed the following results: eight patients (28%) considered the results poor or fair, of these patients using our mean follow-up of the study as a cutoff point, four patients (50%) had ≥ 44 months of surgical treatment. Regarding the clinical deterioration related to pain, 13 patients (46%) evolved with some degree of postoperative pain, of these, only five patients (38%) had ≥ 44 months of surgical treatment.

Discussion

The objective of this study was to evaluate the clinical results of neurectomy and demonstrate the effectiveness through the plantar approach.

It is known that the golden standard of Morton's neuroma treatment is essentially surgical, with neurectomy being the procedure of choice[7]. Valisena et al.[8] recommend starting with conservative treatment and local infiltration, complementing with surgery only secondarily, and employing MRI to locate and measure the neuroma. According to Di

Table 2. Sample data

N	Age (Years)	Sex	Side	IMS**	Size (cm)	Postop (Months)	Score	Pain
1	32	F	L	2º	2.5	25	50	4
2	60	M	L	3º	0.7	100	80	0
3	60	F	L	3º	N***	98	80	0
4	50	F	R	3º	1	89	50	1
5	52	F	L	3º	1.3	81	60	0
6	58	F	L	3º	N***	79	70	0
7	44	F	L	2º + 3º	0.7 + 0.6	44	40	4
8	34	F	R	3º	0.7	44	70	0
9	56	F	L	3º	N***	44	80	0
10	46	F	L	3º	0.5	41	30	8
11	50	F	R	3º	N***	37	70	1
12	37	F	R	3º	0.6	32	70	0
13	53	F	R	2º + 3º	1.2 + 0.5	27	70	0
14	58	F	R	2º + 3º	0.5 + 0.7	20	60	0
15	36	M	L	3º	1.2	19	70	0
16	66	F	L	3º	0.7	20	60	7
17	54	F	R	2º + 3º	0.4 + 0.4	19	60	3
18	58	F	L	3º	1.1	17	80	0
19	56	F	R	2º + 3º	0.5 + 0.8	15	70	4
20	59	M	R	2º + 3º	0.7 + 0.6	56	70	0
21	59	F	L	3º	1.4	60	80	0
22	48	F	L	3º	N***	53	80	0
23	51	F	L	3º	1	55	70	0
24	50	F	R	3º	1.4	72	50	5
25	51	F	L	3º	2.2	65	50	5
26	40	F	L	3º	0.5	31	70	0
27	55	F	L	2º	0.8	30	70	0
28	58	F	L	3º	1.3	14	50	5
29	64	M	R	3º	0.4	12	50	5
Mean	51.55	24F/4M	11R/18L	8(2º)/27(3º)	-	44.79	64.13	1.79
SD	8.92	-	-	-	-	36.45	13.23	2.52

*Postop:Postoperative; **IMS: Intermetatarsal space; ***N: Not informed on magnetic resonance imaging; SD: Standard deviation.

Caprio et al.[9], MRI demonstrates 68% specificity and 93% sensitivity, while Mulder's test has 94%–98% sensitivity. Radiography is used to exclude other pathologies.

The mean age in our study was 51.55 years on the surgery date, and 85.71% were female, data similar to Bucknall et al.[1]. The incidence is approximately ten times higher in women than in men. The pathology typically begins between 45 and 50 years[2].

In our case series, the lesion was found in the third intermetatarsal space (77.14%) and in the second (22.85%), data compatible with Pace et al.[3], who evaluated 78 patients (82 feet), showing the lesion in the third space (53%) and in the second (25%). Higher mobility in the fourth metatarsal in relation to the third favors the microtraumas, which may be involved in the neuroma's pathogenesis[2].

The clinical evolution after a mean of 44.79 months was "excellent" in 58.62% (17/29), "good" in 13.79% (4/29), "fair" in 20.68% (6/29), and "poor" in 6.89% (2/29). Similar results were observed by Amaral et al.[2], who evaluated 25 patients, eight submitted to bilateral surgery, totaling 33 operated feet. In their study, 48.48% (n = 16) was "excellent", 24.24% (n = 8) was "good", 18.18% (n = 6) was "fair", and 9.09% (n = 3) was "poor", resulting in a mean of "good" result.

Barbosa et al.[7] included 19 patients with Morton's neuroma and, after a mean of nine months, showed that 89.5% of the patients were satisfied with the treatment.

Regarding footwear currently used, 16 patients (55.17%) answered that they use any footwear without any difficulty, while 13 patients (44.82%) need more comfortable footwear. No patient reported having difficulty even with comfortable

shoes. In the study by Amaral et al.[2], on the other hand, 16 patients (48.48%) wore any footwear, 17 patients (52.52%) wore only more comfortable footwear, and no patient reported difficulty and intolerance to any footwear, a result lower than that observed in our sample.

Di Caprio et al.[9] reported sensitivity or numbness reduction in the area innervated by the resected nerve in 72% of the feet, while only 44.82% of the feet in our sample evolved with numbness.

Finally, regarding the pain according to the (VAS) scale, a mean of 1.79 was observed, higher than the mean of 2.09 observed by Amaral et al.[2]

According to Valisena et al.[8], surgical treatment has the best results. In our study, corroborating with Nery et al.[4] and Akermark et al.[10], we believe the transverse plantar approach anterior to the loading zone is a safe access, allowing a better anatomical visualization than the dorsal approach for complete resection and making it possible to explore other intermetatarsal spaces in case of more than one neuroma.

Di Caprio et al.[9] reported in their study that postoperative complications such as surgical wound infection, hematoma, and healing problems are significantly higher in the plantar approach, but in our study, the main complaint was paresthesia (44.82%), a complaint more associated with the dorsal approach than the plantar according to Akermark et al.[10] (53% vs. 73%).

Regarding possible late deterioration of the clinical results obtained, the statistical analysis showed the following results: eight patients (28%) considered the results poor or fair, of these patients using our mean follow-up of the study as a cutoff point, four patients (50%) had ≥ 44 months of surgical treatment. Regarding the clinical deterioration related to pain, 13 patients (46%) evolved with some degree of postoperative pain, of these, only five patients (38%) had ≥ 44 months of surgical treatment. Corroborating with what is presented by Reichert et al.[11] that the result does not change in the postoperative, and still disagrees with Lee et al.[12], who state that the long-term results of Morton's neuroma neurectomy are slightly worse than the short and mid-term results.

Conclusion

Plantar neuroma neurectomy, when well indicated and technically well performed, presents "good" clinical evolution, low pain level, and high patient satisfaction rate after a mean of 44.79 months after surgery.

We believe the transverse plantar approach anterior to the loading zone is a safe access, allowing a better anatomical visualization than the dorsal approach for complete resection and making it possible to explore other intermetatarsal spaces in case of more than one neuroma.

It is extremely important that the surgeon has a good doctor-patient rapport and clearly explains that despite the good results of surgical treatment, situations such as maintenance of mild pain, a certain degree of anesthesia/dysesthesia, and difficulty in using certain shoes may remain even after surgical treatment without complications; in relevant percentages as presented in this study.

However, it is worth mentioning that 100% of the patients noticed an improvement in the clinical condition compared to the preoperative period, denoting that, with some reservations, it is still a treatment with good results remaining in the long term.

Authors' contributions: Each author contributed individually and significantly to the development of this article: LPS *(https://orcid.org/0000-0003-4274-6137), and VAZ *(https://orcid.org/0000-0001-9703-6752), and LFN *(https://orcid.org/0000-0003-2822-5976), and RBR *(https://orcid.org/0000-0002-0893-7872) Data collection, wrote the article; BGB *(https://orcid.org/0000-0002-8447-7660), and JLK *(https://orcid.org/0000-0001-7369-1525) Approved the final version. All authors read and approved the final manuscript.*ORCID (Open Researcher and Contributor).

References

1. Bucknall V, Rutherford D, MacDonald D, Shalaby H, McKinley J, Breusch SJ. Outcomes following excision of Morton's interdigital neuroma: a prospective study. Bone Joint J. 2016;98-B(10):1376-81.
2. Amaral Neto MF, Demore AB. Late clinical outcome of patients undergoing neurectomy for Morton's neuroma. Rev ABTPé. 2017;11(2):84-8.
3. Pace A, Scammell B, Dhar S. The outcome of Morton's neurectomy in the treatment of metatarsalgia. Int Orthop. 2010;34(4):511-5.
4. Nery CAS, 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. 2007;15(1):55-8.
5. Recognizing and treating Morton's neuroma. Harv Womens Health Watch. 2009;16(6):5-6.
6. Giannini S, Bacchini P, Ceccarelli F, Vannini F. Interdigital neuroma: clinical examination and histopathologic results in 63 cases treated with excision. Foot Ankle Int. 2004;25(2):79-84.
7. Barbosa GG, Tiradentes GM, Ignacio H, Carvalho Filho G, Chueire AG. Retrospective study of surgery treatment im monrton's neuroma by plantar approach. Acta Ortop Bras. 2005;13(5):258-60.
8. Valisena S, Petri GJ, Ferrero A. Treatment of Morton's neuroma: A systematic review. Foot Ankle Surg. 2018;24(4):271-81.

9. Di Caprio F, Meringolo R, Shehab Eddine M, Ponziani L. Morton's interdigital neuroma of the foot: A literature review. Foot Ankle Surg. 2018;24(2):92-8.
10. Akermark C, Crone H, Saartok T, Zuber Z. Plantar versus dorsal incision in the treatment of primary intermetatarsal Morton's neuroma. Foot Ankle Int. 2008;29(2):136-41.
11. Reichert P, Zimmer K, Witkowski J, Wnukiewicz W, Kuliński S, Gosk J. Long-Term Results of Neurectomy Through a Dorsal Approach in the Treatment of Morton's Neuroma. Adv Clin Exp Med. 2016;25(2):295-302.
12. Lee KT, Kim JB, Young KW, Park YU, Kim JS, Jegal H. Long-term results of neurectomy in the treatment of Morton's neuroma: more than 10 years' follow-up. Foot Ankle Spec. 2011;4(6):349-53.