

NOV 19 2008

NOTICE:

THIS MATERIAL MAY BE PROTECTED BY  
COPYRIGHT LAW (Title 17 U.S. Code)

REQUEST COMPLIES WITH:  
2005 (a) (2) Guidelines (CCG)  
and provisions of Copyright Law (CCL)

## Long-Term Evaluation of Interdigital Neuroma Treated by Surgical Excision

John W. Womack, MD; David R. Richardson, MD; G. Andrew Murphy, MD; E. Greer Richardson, MD; Susan N. Ishikawa, MD  
Memphis, TN

### ABSTRACT

**Background:** We examined a large cohort of patients who had interdigital neurectomy and evaluated their clinical outcomes by using a previously developed scoring system as well as a visual analog scale (VAS). In addition, we wanted to identify risk factors that may lead to poorer outcomes. **Materials and Methods:** A retrospective review identified 232 patients who had neuroma excision between 1994 and 2004, after failure of conservative treatment. Each patient was contacted via mail and given a Neuroma Clinical Evaluation Score survey as well as a visual analog score. Each patient received a unique identification number, allowing the evaluation process to be single-blinded. **Results:** Of the 232 patients contacted, 120 (52%) returned their completed surveys. The average Giannini neuroma score was 53: 61 feet (51%) had good or excellent results, 12 (10%) had fair results, and 48 (40%) had poor results. The average VAS score was 2.5. The only significant ( $p = 0.027$ ) difference in outcome was the location of the neuroma: second webspace had worse outcomes than third webspace neuromas on both the VAS and neuroma score. **Conclusion:** This retrospective review identified location in the second webspace as a possible prognostic indicator of poor outcome, but the more important finding may be that outcomes of neuroma excision do not appear to be as successful at long-term followup as previously reported

**Key Words:** Interdigital Neuroma; Long-term Followup; Neuroma Excision

### INTRODUCTION

Although interdigital neuromas have been described for over 170 years<sup>5,10</sup> and remain one of the most common

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

Corresponding Author:  
John W. Womack, MD  
Univ. of Tennessee - Campbell Clinic  
Orthopaedic Surgery  
1211 Union Avenue  
Suite 510  
Memphis, TN 38104  
For information on prices and availability of reprints, call 410-494-4994 x226

causes of forefoot pain, their etiology and treatment are still matters of controversy. The most commonly accepted surgical treatment, resection of the neuroma, has reported success rates ranging from 57% to 85%, with recurrence or persistence of pain the most frequent cause of poor outcome.<sup>1-4,6,7,11</sup> A number of factors have been suggested to have an effect on outcome: previous unsuccessful excisions,<sup>8,11</sup> bilateral excisions,<sup>2,6</sup> concomitant forefoot procedures,<sup>11</sup> instability of the second metatarsophalangeal (MTP) joint,<sup>3</sup> duration of symptoms,<sup>1</sup> size of the neuroma,<sup>6</sup> and location of the neuroma (second or third webspace).<sup>9</sup> None has been conclusively shown to have an effect on outcome. Despite deleterious effects on some other surgical procedures of the foot and ankle, we found no studies that investigated diabetes as a possible predictive factor in patients who have neuroma excision.

In addition, few long-term studies have evaluated clinical outcomes of neuroma excision. Comparisons of clinical outcomes are difficult because of the lack of use of standardized and validated scoring systems. We examined a large cohort of patients who had interdigital neurectomy and evaluated their clinical outcomes by using a previously developed scoring system<sup>7</sup> and a visual analog scale (VAS) and attempted to identify risk factors that lead to poorer outcomes.

### MATERIALS AND METHODS

A retrospective review identified all patients who had neuroma excision by the two senior authors (EGR and GAM) between 1994 and 2004. Patients who had revision procedures and patients with rheumatoid arthritis were excluded. Institutional review board approval was obtained, and 232 consecutive patients were contacted by mail and asked to complete a Neuroma Clinical Evaluation<sup>9</sup> form (Table 1) and a VAS. The VAS is a 10-cm scale ranging from 0 (no pain) to 10 (worst pain imaginable). All patients had excision of a neuroma through a dorsal approach, with release of the transverse metatarsal ligament, after failure of conservative measures.

**Table 1:** Interdigital neuroma clinical evaluation score

Parameter	Score
Pain	
None	20
Mild	10
Severe	0
Maximal walking distance	
Without limitation (>6 blocks)	20
Some limitation (2–6 blocks)	10
Severe limitation (<6 blocks)	0
Sensitivity	
Normal	20
Numbness	10
Dysestheisa	0
Footwear requirement	
Fashionable conventional shoes	20
Comfort shoes or shoe insert	10
Difficulty with any shoes	0

From Giannini, S; Bacchini, P; Cecarelli, F; Vannini, F: Interdigital neuroma: clinical examination and histopathologic results in 63 cases treated with excision. Foot Ankle Int. 25:79, 2004.

Of the 232 patients contacted, 120 (52%) returned their completed surveys. The average followup time was 66.7 (range, 14 to 113) months. The 10 men and 110 women had an average age at the time of surgery of 53.7 (range, 31 to 83) years. Twelve (10%) of the 120 patients were diabetic. Of the 121 neuromas (one patient had bilateral neuromas), 105 (87.5%) were in the third webspace and 16 (12.5%) were in the second webspace. Forty-two (35%) patients (42 feet) had additional forefoot procedures at the time of neuroma excision, most often correction of hallux valgus or hammertoe deformity.

The mean scores and standard deviations were calculated for primary outcome measures. In addition, linear regression analysis and Fisher exact tests were used to calculate any statistical differences among the cohorts, with statistical significance set at  $p < 0.05$ .

**RESULTS**

The average neuroma score was  $53.0 \pm 20.3$  (range, 0 to 80). Based on this scoring system (Table 2), 61 feet (50%) had good or excellent results, 12 (10%) had fair results, and 48 (40%) of patients had poor results. The average VAS score was  $2.5 \pm 3.1$  (range, 0 to 10) cm. Statistical analysis revealed no significant difference in outcomes in diabetic and nondiabetic patients according to either the neuroma score

( $p = 0.482$ ) or the VAS ( $p = 0.248$ ). There also was no significant difference in outcomes related to patient age or gender; there was a slight trend toward lower VAS scores in men (mean 1.9 cm) than in women (2.5 cm), but the neuroma scores were similar (52.8 in women and 52.5 in men). The inclusion of concomitant forefoot procedures did not significantly affect outcome scores (Table 3). The only variable that produced a significant ( $p = 0.027$ ) difference in outcome was the location of the neuroma: patients with neuromas in the second webspace (16) had worse outcomes than those with third webspace neuromas on both the VAS and neuroma score.

The neuroma scores were found to correlate with the VAS scores ( $R^2 = 0.59$ ) (Figure 1).

**DISCUSSION**

Although interdigital neuromas and their treatment have been the subject of numerous investigations since the 1800s, no study has provided irrefutable evidence of either optimal treatment or significant risk factors for poor results. Johnson et al.,<sup>8</sup> Coughlin et al.,<sup>3</sup> and Stamatis and Myerson<sup>11</sup> all investigated the effects of previous, concomitant, and adjacent webspace surgery on the outcomes of neuroma excision and found little or no influence of these factors on the clinical results. Bennett et al.<sup>1</sup> determined that the duration of symptoms (more or less than 1 year) had no correlation with the outcome of surgery. In a study of 305 neuroma excisions, Friscia et al.<sup>6</sup> found that the size of neuromas was

**Table 2:** Outcomes of neuroma treatment based on neuroma score\*

Neuroma score	Result
0–50	Poor
50–59	Fair
60–69	Good
70–80	Excellent

As defined by Giannini et al.

**Table 3:** Effect of additional procedures on outcomes measurements

	Neuroma score	VAS score
No additional procedure (42)	54.26	2.37
Additional procedure (78)	52.98	2.67
	$p = 0.082$	$p = 0.156$

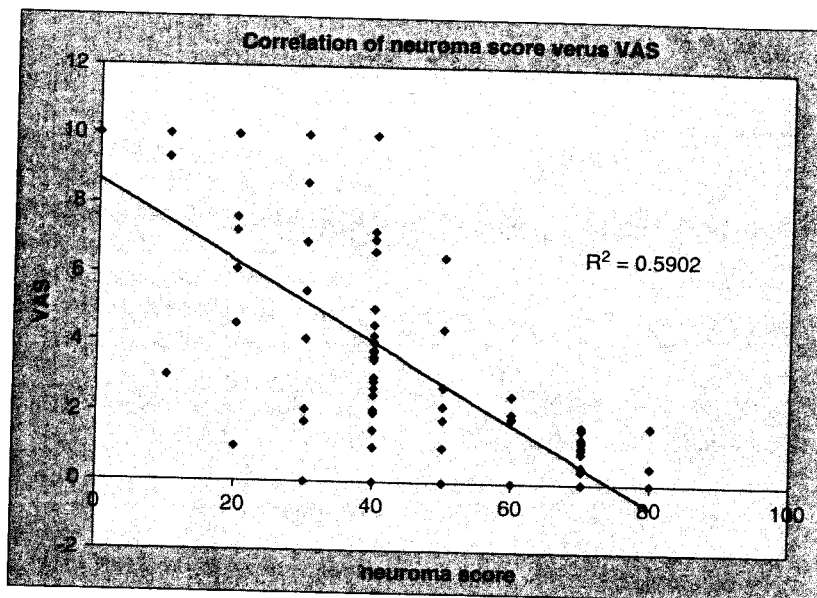


Fig. 1: Correlation of neuroma scores with VAS scores - Correlation of neuroma scores with VAS scores.

related to patient satisfaction, as were bilateral surgeries, but neither was shown to be a statistically predictive factor. Our study found no significant differences in outcomes between men and women, between patients older or younger than 50, or between patients with and without concomitant forefoot procedures. Whether or not outcomes are affected by diabetes mellitus has not, to our knowledge, been investigated. Because diabetes mellitus is known to adversely affect the outcomes of many operative procedures about the foot and ankle, we theorized that outcomes of neuroma excision in diabetic patients might be worse than in nondiabetic patients. However, the outcomes were not significantly different in these two groups of patients.

Most interdigital neuromas are located in the third webspace. In five large series including 642 neuromas, the occurrence of second webspace neuromas was 21%, with ranges from 8% to 50%.<sup>2-4,6,9</sup> Only one of these studies investigated neuroma location as a predictor of results: Mann and Reynolds<sup>9</sup> found no difference in outcome between second and third webspace neuromas. We, however, found that patients with second webspace neuromas had significantly lower scores on both the neuroma scoring system and the VAS. It is possible that these patients had a higher rate of metatarsalgia and other concomitant disease processes that were not treated by neuroma excision but had an effect on outcome, although we had a similar low rate of second web neuromas.

Postoperative pain levels, shoe wear requirements, and walking limitations in our 120 patients were similar to those reported by others (Table 4). Our 50% rate of good and excellent results is lower than that cited in most studies, which have reported 66% to 85% good or excellent results (Table 5). This may be partially due to the higher rate of numbness (78%) reported by our patients, who were

asked about its presence or absence, than in previous studies, which ultimately resulted in lower scores on the neuroma evaluation scale. The reported rate of numbness is, however, consistent with Mann and Reynolds's findings of 67% interspace numbness on followup examinations. This finding may not have been considered in determining outcomes in other series.

Comparison of the results of neuroma excision is difficult because of the differences in evaluation methods used. The lack of a standardized, validated scoring system for neuroma excision, such as the AOFAS hindfoot score for hindfoot procedures, complicates study design and comparison across different cohorts. We chose to use a VAS to evaluate pain, because it has been shown to be a valid measure of pain. Although the neuroma scoring scale developed by Giannini et al.<sup>7</sup> has not been formally validated, it does contain many of the same items evaluated by other investigators (pain, footwear requirement, maximal walking distance, and numbness). We found a strong correlation ( $R^2 = 0.59$ ) between the VAS and the neuroma score: all patients with scores of more than 5 cm on the VAS had scores of less than 40 (poor) on the neuroma score. Because pain is the most common complaint in patients with neuromas and has an effect on most other evaluated parameters (shoewear, walking distance), it is reasonable that pain relief would be the primary component of a satisfactory surgical outcome. Patient satisfaction after any foot and ankle procedure usually is linked to relief of pain, regardless of objective or radiographic outcomes. In addition, intrasurgeon reliability appears to be present, with no statistical difference in either VAS or neuroma score outcomes between the two senior authors (Table 5).

Limitations of the study include the lack of preoperative data for comparison to postoperative outcomes and the lack

**Table 4:** Shoewear requirements

	Fashionable shoes	Comfort shoes or insert	Difficulty with any shoes
Womack et al. (120 patients)	49% (59 patients)	44% (53 patients)	7% (8 patients)
Giannini et al. (60 patients)	57% (34 patients)	40% (24 patients)	3% (2 patients)
Mann & Reynolds (56 patients)	59% (33 patients)	37% (21 patients)	4% (2 patients)

**Table 5:** Reported results of treatment of interdigital neuromas

Year	Author(s)	# feet	FU (mos)	Good outcomes
2004	Giannini et al.	63	47	78%
2004	Stamatis/Myerson	49	40	57%
2002	Coughlin et al.	21	80	85%
2001	Coughlin/Pisonneault	66	70	85%
1995	Bennett et al.	115	42	85%
1991	Frischia et al.	305	71	79%
1988	Johnson et al.	33	76	76%
1983	Mann/Reynolds	56	22	80%
1976	Bradley et al.	85	85	66%
		<b>783 (total)</b>	<b>59 (avg)</b>	<b>77% (avg)</b>

of physical examination of the patients at followup. The scoring systems used did not directly elicit information about patient satisfaction with their outcomes. The long-term retrospective review also introduces recall bias as a risk.

Although this retrospective review identified location in the second webspace as a possible prognostic indicator of poor outcome, the more important findings may be that outcomes of neuroma excision do not appear to be affected by the gender or age of the patient or by concomitant forefoot procedures and that outcomes in patients with diabetes mellitus are equivalent to those in nondiabetic patients. Also, the long term results were not as favorable as some series.

#### REFERENCES

1. **Bennett, GL; Graham, CE; Mauldin, DM:** Morton's interdigital neuroma: a comprehensive treatment protocol. *Foot Ankle Int.* **16:**760-763, 1995.
2. **Coughlin, MJ; Pinsonneault, T:** Operative treatment of interdigital neuroma. A long-term followup study. *J. Bone Joint Surg.* **83A:**1321-1328, 2001.
3. **Coughlin, MJ; Schenck, RC Jr; Shurnas, PS; Bloome, DM:** Concurrent interdigital neuroma and MTP joint instability: long-term results of treatment. *Foot Ankle Int.* **23:**1018-1025, 2002.
4. **Dereymaeker, G; Schroven, I; Steenwerckx, A; Stuer, P:** Results of excision of the interdigital nerve in the treatment of Morton's metatarsalgia. *Acta Orthop. Belg.* **62:**22-25, 1996.
5. **Durlacher, L:** Treatise on corns, bunions, the diseases of nails, and the general management of the feet. London. Simpkin, Marshall, 1945.
6. **Frischia, DA; Strom, DE; Parr, JW; Sattzman, CL; Johnson, KA:** Surgical treatment for primary interdigital neuroma. *Orthopedics* **14:**669-672, 1991.
7. **Giannini, S; Bacchini, P; Ceccarelli, F; Vannini, F:** Interdigital neuroma: clinical examination and histopathologic results in 63 cases treated with excision. *Foot Ankle Int.* **25:**79-84, 2004.
8. **Johnson, JE; Johnson, KA; Unni, KK:** Persistent pain after excision of an interdigital neuroma. Results of reoperation. *J. Bone Joint Surg.* **70A:**651-657, 1988.
9. **Mann, RA; Reynolds, JC:** Interdigital neuroma—a critical clinical analysis. *Foot Ankle* **3:**238-243, 1983.
10. **Morton, JG:** A peculiar and painful affliction of the fourth metatarsophalangeal articulation. *Am. J. Med. Sci.* **71:**37-45, 1976.
11. **Stamatis, ED; Myerson, MS:** Treatment of recurrence of symptoms after excision of an interdigital neuroma. A retrospective review. *J. Bone Joint Surg.* **86B:**48-53, 2004.