

# Surgical Treatment of Peripheral Neuropathy

## *Outcomes from 100 Consecutive Decompressions*

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Since 1992 it has been reported that patients with diabetes mellitus recover sensibility and obtain relief of pain from neuropathy symptoms by decompression of lower-extremity peripheral nerves. None of these reports included a series with more than 36 diabetic patients with lower-extremity nerves decompressed, and only recently has a single report appeared of the results of this approach in patients with nondiabetic neuropathy. No previous report has described a change in balance related to restoration of sensibility. A prospective study was conducted of 100 consecutive patients (60 with diabetes and 40 with idiopathic neuropathy) operated on by a single surgeon, other than the originator of this approach, and with the postoperative results reviewed by someone other than these two surgeons. Each patient had neurolysis of the peroneal nerve at the knee and the dorsum of the foot, and the tibial nerve released in the four medial ankle tunnels. After at least 1 year of follow-up, 87% of patients with preoperative numbness reported improved sensation, 92% with preoperative balance problems reported improved balance, and 86% whose pain level was 5 or greater on a visual analog scale from 0 (no pain) to 10 (the most severe pain) before surgery reported an improvement in pain. Decompression of compressed lower-extremity nerves improves sensation and decreases pain, and should be recommended for patients with neuropathy who have failed to improve with traditional medical treatment. (*J Am Podiatr Med Assoc* 95(5): 451-454, 2005)

The susceptibility and propensity of peripheral nerves in patients with diabetes mellitus to be compressed by normal anatomical structures has been well recognized and reviewed.<sup>1-22</sup> Surgical decom-

pression for the treatment of symptoms due to superimposed peripheral nerve entrapment syndromes in patients with diabetes has been described as having good clinical outcomes.<sup>23-29</sup> The results of these stud-

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Dr. Dellon has a proprietary interest in the Pressure-Specified Sensory Device described in this article.

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ies reflect a promising alternative for patients with symptomatic neuropathy due to diabetes, who have traditionally been told that besides tight glycemic control, the only other treatment for their symptoms is neuropathic pain medication. However, none of these reports included a series with more than 36 diabetic patients with lower-extremity nerves decompressed, and only recently has a single report appeared of results of this approach in patients with nondiabetic neuropathy.<sup>29</sup> No previous study has described a change in balance associated with restoration of sensibility, although the intuitive relationship of progressive loss of plantar sensibility and progressive loss of balance (sway) has been demonstrated recently.<sup>30</sup> This article evaluates peripheral nerve decompression in the lower extremity of a consecutive series of patients with diabetic and nondiabetic neuropathy, examining the outcomes of pain relief, decrease in pain medication use, improvement in sensibility, and improvement in balance.

## Materials and Methods

A prospective study was performed by medical record review and telephone interviews (J.M.V.V.) of one of the authors' (C.T.M.) first 100 consecutive patients with neuropathy. Patients were accrued beginning in July 2002. Sixty of these patients were diabetic, with 5 having type 1 and 55 having type 2 diabetes. The other 40 patients had a neuropathy of unknown etiology. Included in this study were 1) patients with a large-fiber, distal, diffuse, sensorimotor neuropathy confirmed by a neurologist; 2) patients under best glycemic control and pain management by their primary-care physicians; 3) patients without pedal edema; 4) patients weighing 300 pounds or less; 5) patients without renal failure or congestive heart failure; 6) patients with either palpable dorsalis pedis or posterior tibial artery pulses or an ankle-brachial index of 0.70 or greater (no patient had a previous vascular bypass procedure in the leg); and 7) patients with a positive Tinel sign over the tibial nerve in the tarsal tunnel. Patients with confounding neurologic diseases, such as multiple sclerosis, and cerebrovascular accident were excluded (previous lumbosacral spine disease was not a contraindication to inclusion). A minimum of 1 year of follow-up after surgery was required. Data analysis began in July 2004.

Regarding patient age, 81% were older than 50 years when they underwent surgery (mean, 63.1 years; range, 30–84 years). Fifty-six percent of patients were men, and 44% were women. The mean number of years since the diagnosis of diabetes was 12.1 (range, 1–30 years), and the mean number of

years with symptoms for the group was 6.4 (range, 1–23 years). Of the 100 patients included in the study, at the time of data analysis, 34 had their opposite leg treated by surgical decompression of peripheral nerves, so that 134 surgical extremities were available for inclusion.

All of the patients had sensory symptoms of neuropathy, including numbness or paresthesia, which was documented by preoperative measurement of large-fiber function using the Pressure-Specified Sensory Device (Sensory Management Services LLC, Baltimore, Maryland).<sup>31–35</sup> This testing was repeated after surgery. Neuropathic pain symptoms were recorded using a visual analog scale from 0 (no pain) to 10 (the most severe pain). For statistical analysis, the presence of significant pain was defined as a visual analog scale score of 5 or greater, and patients were asked about their pain before and after surgery. Postoperative reduction in pain medication use was asked about in the postoperative interview. Subjective evaluation of improvement in balance was also included in the postoperative interview. The presence of motor symptoms and findings are not included in this article.

Surgical decompression included neurolysis of the common peroneal nerve at the fibular neck and the deep peroneal nerve over the dorsum of the foot, release of the four medial ankle tunnels (tarsal tunnel, medial and lateral plantar tunnels, and calcaneal tunnel), and internal neurolysis of the tibial nerve (separating the tibial nerve from the posterior tibial artery, opening the epineurium, and continuing with an intraneural neurolysis if intraneural fibrosis was present). Surgery was performed using general anesthesia, a pneumatic tourniquet at the thigh level, bipolar coagulation, and ocular loupes. Statistical analysis was performed using a software program (SPSS; SPSS Science, Chicago, Illinois) in collaboration with the Epidemiology Department of the University of Arizona, Tucson.

## Results

Ninety-nine patients had some degree of pain before surgery. The mean visual analog scale score before surgery was 8.4 for the entire group. Eighty-six percent of these patients reported clinical improvement in pain (a decrease of at least 50% in the preoperative visual analog scale score). After surgery, pain was improved by an average of 6.4 points on the visual analog scale. The percentage of patients with a score of 10 decreased from 44% before surgery to 2% after the procedure, and 36 patients had a visual analog scale score of 0 after surgery. Statistical analysis re-

vealed a significant difference in the percentage of patients scoring 6 or higher on the visual analog scale between the preoperative (95%) and postoperative (10%) periods, with a change in the mean pain level from 8.4 before surgery to 0.9 after surgery ( $P \leq .001$ ). There was no difference in improvement in pain of more than 5 points or more than 50% between diabetic and nondiabetic patients ( $P = .7$ ). Also, there were no differences in pain improvement on the visual analog scale among age groups (<50, 50-60, 61-70, 71-80, 81-90, and >90 years old) ( $P = .5$ ). Improvement of more than 5 points on the visual analog scale was more prevalent in women than in men ( $P = .02$ ).

Ninety-three percent of the patients had decreased two-point discrimination (in millimeters of distance), and 100% had increased pressure (in grams per square millimeter) documented using the Pressure-Specified Sensory Device. Sensation was improved in 87% of the patients as documented by postoperative Pressure-Specified Sensory Device evaluation. Balance was reported to improve in 58 (92%) of 63 patients who reported balance problems due to numbness in the lower extremities, which was statistically significant ( $P \leq .001$ ).

Ninety-nine patients required pain medication in the preoperative period, whereas only 22 continued taking the same dose of pain medication after surgery. Seventy-seven patients (78%) stopped or decreased their pain medication; this difference between the preoperative and postoperative periods was statistically significant ( $P \leq .001$ ).

## Discussion

The results of this study reinforce the now more than 12-year history of clinical studies that have demonstrated that decompression of multiple peripheral nerves in the lower extremity of patients with symptomatic diabetic neuropathy can improve sensibility and relieve pain. The statistically significant ( $P \leq .001$ ) relief of pain (obtained in 86% of patients with a preoperative pain level  $\geq 5$  on the visual analog scale) and improvement in sensation (obtained in 87% of patients above the 99% confidence limit for sensibility in the big toe) are in line with or better than previously reported findings. In addition, reported for the first time in this study is the decrease in pain medication use (as would be predicted from the improvement in pain) and the improvement in balance (as would be predicted from the improvement in sensation).

Recently, it has been reported that diabetic patients who have this type of result from peripheral nerve decompression do not develop ulcers or undergo amputation in the surgical extremity, whereas

they are statistically significantly more likely to develop ulcers or undergo amputation in the contralateral extremity.<sup>36</sup> Although follow-up in the present group of patients is less than 2 years in those followed the longest, so far, none of these patients has had an ulceration or an amputation. The results of the present study lend support to the conclusion that decompression of the peripheral nerves in the patient with symptoms of diabetic neuropathy due to superimposed nerve compression can change the natural history of this clinical problem, previously considered to be progressive and irreversible. Furthermore, the observation that 90% of patients had improvement in balance suggests that these patients are at reduced risk of falling, with its resultant hip and wrist fractures.<sup>30</sup>

This is the second study<sup>29</sup> to report improvement in sensibility and the first to report improvement in pain in patients with idiopathic peripheral neuropathy after decompression of multiple lower-extremity peripheral nerves. This observation extends the work performed in diabetic patients with symptomatic neuropathy to those with neuropathy whose etiology cannot be determined medically and who, therefore, have remained without hope for relief of symptoms by methods other than narcotic and nonnarcotic pain medications. It is unknown how many people are affected by such disorders. It is likely that many of these patients, in time, will be categorized as having what used to be termed *borderline diabetes*, which is now called either *hyperinsulinemia* or *metabolic syndrome*. Neuropathy has been reported in patients with hyperinsulinemia.<sup>37</sup> Although it may not be surprising, therefore, for this subgroup of patients with idiopathic neuropathy to improve after peripheral nerve decompression, it is likely that there are many patients with idiopathic peripheral neuropathy whose pathogenesis will be found to have mechanisms similar to those of the diabetic patient that render their nerves susceptible to compression, as has been reported recently for chemotherapy-induced neuropathy.<sup>38</sup> Therefore, the results of this study offer hope to a new population of patients, who, if they are found to have a positive Tinel sign, may expect to experience symptomatic improvement through peripheral nerve decompression.

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