

# Chapter 7

## Recovery of sensation and relief of pain

Based on

Valdivia JMV, Dellon AL, Weinand ME, Maloney CT Jr, Surgical treatment of peripheral neuropathy: outcomes from 100 consecutive decompressions. J Amer Podiatric Med Association 95:451-454, 2005.

**ABSTRACT****Objective**

We report the outcome of 100 patients with peripheral neuropathy treated surgically by multiple nerve decompressions of the peroneal and tibial system. This is a promising approach for the treatment of pain, numbness and balance problems from known causes of nerve compression in the lower extremity.

**Methods**

Records of 100 consecutive patients with diabetic and non-diabetic neuropathy, treated surgically by multiple nerve decompression, were reviewed to document changes in the visual analog scale, sensation improvement, reduction in pain medication requirement, and complication rate. All patients underwent tarsal tunnel release and neurolysis of multiple lower extremity nerves of the tibial and peroneal system as a concomitant part of the procedure. Patients offered surgical intervention had documented sensory abnormalities using neurosensory testing by the Pressure-Specified Sensory Device (PSSD) and a positive Tinel's sign on exam over the involved nerve. Patients were contacted by phone to confirm the long-standing symptom relief.

**Results**

Eighty-seven percent of the patients with preoperative numbness reported sensation improvement. Ninety-two percent of patients with balance problems reported improved balance after the procedure. From those patients that underwent the procedure mainly for pain relief, 85.2% reported an improvement in the visual analog scale in more than 50%.

**Conclusion**

Similar to experiences found in the upper extremity, nerve decompression in the lower extremity is a safe and affective procedure to improve the quality of life of patients with peripheral neuropathy secondary to nerve compression. Documentation and staging of the severity of neuropathy with neurosensory testing and the presence of Tinel's sign determines surgical candidates. Decompression and neurolysis of compressed lower extremity nerves improves sensation, and decrease pain much like results of nerve decompression in the upper extremity and other areas. The great majority is very satisfied with the results.

**INTRODUCTION**

The propensity of peripheral nerves in diabetics to be compressed by normal anatomic structures has been well recognized and studied<sup>1-12</sup>. Surgical decompression for treatment of entrapment syndromes in diabetics has been described with good clinical outcomes<sup>5,13-15</sup>.

This case series results reflect the promising alternative for patients with peripheral entrapment syndromes, mostly due to diabetes, who were told at some point that nothing could be done to relieve their pain and numbness, besides tight glycemic control. The clinical improvement in pain and sensation is very dramatic. The patients even show immediate signs of improvement in the recovery room right after the procedures.

**CLINICAL MATERIAL AND METHODS**

A prospective study of the senior authors first one hundred consecutive patients with neuropathy treated surgically was performed to evaluate the efficacy of nerve decompression for the symptomatic treatment of neuropathy. The majority of these patients were diabetics. All patients were evaluated previously for other conditions that may present with peripheral neuropathy. All were evaluated with the Pressure-Specified Sensory Device % (PSSD)<sup>16-20</sup> to confirm the physical findings and evaluate the severity of neuropathy. Patients underwent tarsal tunnel release and decompression of the common peroneal, deep peroneal, tibial, calcaneal, medial plantar and lateral plantar nerves in the lower extremities, in an outpatient setting and wit. An unbiased observer recorded variables for each patient, including pain in the visual analog scale (VAS) before and after the procedures. Other variables analyzed included associated conditions, numbers of years with diabetes, number of years with symptoms, two-point discrimination, previous diagnosis of depression and previous diagnosis of fibromyalgia. The post-operative variables analyzed were: pain in visual analog scale, complication rate, subjective sensation improvement, subjective balance improvement, and reduction in pain medication requirement.

The data was stored and analyzed by an unbiased observer using the SPSS statistical program, and in collaboration with the Epidemiology Department of the University of Arizona.

Each chart was reviewed by the investigator (JMVV), without further reference regarding the outcomes by the surgeon (CTM). Each patient was also contacted by phone to confirm the results and record any change in the surgical outcomes.

**RESULTS**

A total of one hundred records were reviewed. One hundred and thirty-four lower extremities were operated. Sixty percent had the previous diagnosis of diabetes, while forty percent had the diagnosis of idiopathic peripheral neuropathy, confirmed previously by a neurologist. All patients were ruled out as having peripheral vascular disease responsible for their symptoms by the presence of a palpable pedal pulses or acceptable Doppler studies of the lower extremity. Ninety-one percent of the patients had only lower extremity symptoms, without any upper extremity symptoms. Fifty-eight percent had bilateral lower extremity symptoms.

Most of our patients (81%) were over 50 years old when they underwent surgery, with a mean age of 63. Fifty-six percent were males, and forty-four percent were females. The mean number of years with the diagnosis of diabetes was 12, and the mean number of years with symptoms for the group was 6 (Table 1).

In the pre-operative period, most of the patients were in severe pain. The mean rate in the visual analog scale before surgery was 8.4 points over 10. Forty-four percent had 10 out of 10 of pain rate, ninety-five percent had 6 or more points in the visual analog scale (Table 2). Their pain was mostly in the plantar surface (posterior tibial nerve), dorsum of the foot and first web space (deep peroneal nerve), and lateral calf (common peroneal nerve). Most of them reported to have severe impairment in the daily activities due to pain. All of the patients had a positive Tinel's sign over the compressed nerves on exam.

	<b>Age</b>	<b>Visual Analog Scale</b>	<b>Years with Diabetes</b>	<b>Years with Symptoms</b>
Mean	62.97	8.48	12.1	6.36
Minimum	30	0	1	1
Maximum	84	10	30	23

<b>V.A.S</b>	<b>Frequency</b>	<b>Valid Percent</b>
0	1	1%
4	2	2%
5	2	2%
6	10	10%
7	4	4%
8	31	31%
9	6	6%
10	44	44%
Total	100	100

All patients underwent neurolysis of the common peroneal nerve at the fibular head, the deep peroneal nerve on the dorsum of the foot, tarsal tunnel release and decompression of the medial and lateral plantar, and calcaneal nerves. A total of 134 lower extremities underwent surgery. None of the patients reported worsening of pain or previous symptoms after surgery. All surgeries were performed under general anesthesia, with a tourniquet to minimize blood loss, in an outpatient setting.

**Pain**

Ninety-nine patients had pain before the procedure, from these, 85 (85.8%) reported clinical improvement in pain, measured by a decrease in pain in more than 50 % from the preoperative pain rate. Also, in 71 of these 99 patients (71.7%) the pain improved in more than 5 points in the visual analog scale. The group improved their pain after surgery in an average of 6.4 points in the visual analog scale. Remarkably, the percentage of patients with pain rate of 10 out of 10 decreased from a 44% preoperatively to a 2% after the procedure. Moreover, 36 patients (36%) had no pain at all (0/10) after the lower extremity nerve decompressions. These patients reported verbally that they felt very satisfied and happy with the results, which were confirmed in most of them as soon as in the immediate post-operative period, in the recovery room.

Statistical analysis revealed a significant difference in the number of patients with 6 or more points in the VAS between the pre (95%) and the post-operative period (10%) ( $P \leq 0.001$ ) (Table 3). Only one patient had a pain rate of 2 or less in the pre-operative period, while 66 patients fell under this category in the post-operative period; this difference was statistically significant ( $P \leq 0.001$ ) (Table 4).

As a group, we compared the pain scales in the VAS between the pre and post-operative period. Analysis of the distribution of pain using the Wilcoxon signed-rank test and the t-test revealed a statistically significant difference between the 2 periods ( $P < 0.001$ ) (Figure 1).

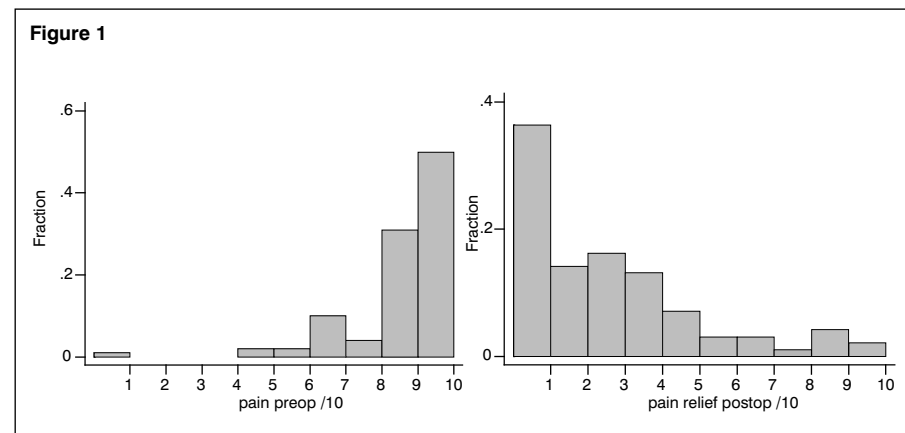
Since the indications for surgery were both pain and numbness in the lower extremities, in order to evaluate the efficacy of the procedure to improve each symptom, we assess pain improvement in those patients where the procedure was performed mainly to treat severe pain. Eighty-one of 100 patients had 8 or more points in the visual analog scale at presentation, which objectively reflects high levels of pain. In this group, the procedure was successful in reducing pain in more than 50% from the pain rate before surgery in 85.2% (69 of 81) of patients (Figure 2).

**Table 3**

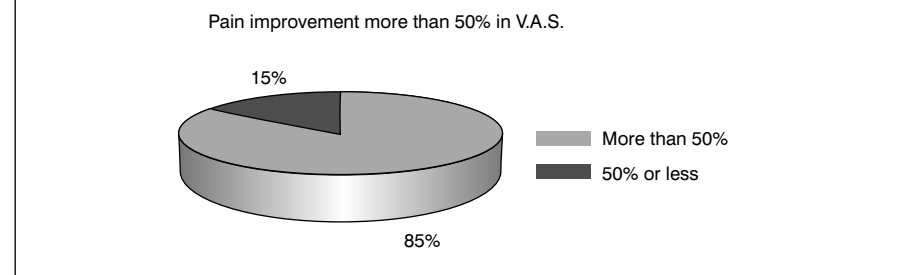
VAS	Preop	Postop
≥6	95	10
<6	5	90
Total	100	100

**Table 4**

VAS	Preop	Postop
≤2	1	66
>2	99	34
Total	100	100



**Figure 2**



Also, pain was reduced in more than 5 points in the VAS in 61 patients (75.3%). The mean pain improvement in this group was  $6.8 \pm 2.6$  (0-10). 87.3% of these patients either stopped or decreased their dose of pain medication required. In this group, balance improvement was reported by 48 (92.3%) of 52 patients who reported balance and station problems due to pain while walking or prolonged standing position.

**Sensation**

Ninety-three percent had decreased 2-point discrimination as evaluated by the Pressure-Specified Sensory Device (PSSD) (Sensory Management Services L.L.C., Baltimore, MD). All the patients had increased pressure threshold by the

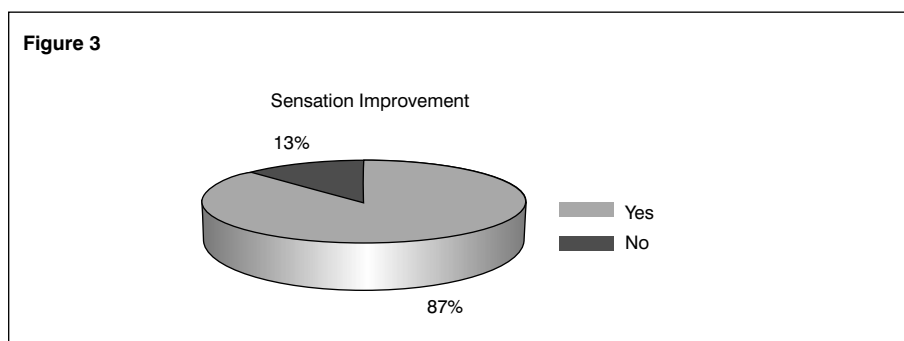
PSSD. Analysis of the patients in which surgery was performed mainly to improve sensation (95), revealed that sensation was improved in 83 (87.4%) (**Figure 3**). Balance was reported to improve in 58 (92.1%) of 63 patients who reported balance and station problems due to numbness in the lower extremities. No patient had normal sensation prior to surgery, while 83 (83%) either recovered or improved their sensation in the lower extremities. This was also statistically significant ( $P \leq 0.001$ ).

#### Pain medication requirement

Ninety-nine patients in the pre-operative period required pain medication, while only 22 continued the same dose of pain medication after the surgery. Seventy-seven (78%) stopped or decreased their pain medication requirement; this difference between the pre and postoperative periods was statistically significant ( $P \leq 0.001$ ).

#### Diabetics vs. Non-diabetics

There was no difference in improvement of pain in more than 5 points or more than 50 % between diabetics and non-diabetics ( $P = 0.7$ ). Also, there was no difference in pain improvement in the VAS between age groups (< 50, 50-60, 61-70, 71-80, 81-90, > 90 years old) ( $P = 0.5$ ). Improvement in more than 5 points in the VAS was more prevalent in females than in males ( $P=0.02$ ).



#### DISCUSSION

Entrapment neuropathies are distinctive clinical neuropathic sensory and motor syndromes caused by compression or irritation of a peripheral nerve<sup>21-23</sup>. The factors involved in the pathogenesis of nerve damage secondary to compression include demyelination, wallerian degeneration<sup>6-7, 24-26</sup>, compression of the vasa nervosa, impairment of axonal transport<sup>9, 27, 28</sup> and intraneural connective tissue formation<sup>29</sup>. Moreover, the double crush hypothesis describes the susceptibility of a nerve to injury when it is compressed at more than one site<sup>7,23,30-32</sup>.

Peripheral nerve entrapment is frequent in patients with diabetes mellitus<sup>33,34</sup>. Excess of intracellular sorbitol alters the Na-K ATPase activity producing the axonal swelling due to osmotic gradient, making nerves more prone to entrapment than in non diabetics<sup>1,4,35-37</sup>, and impairing axonal transport<sup>38</sup>.

We analyze patients with peripheral nerve entrapment syndrome, most of them having diabetes acting as one the “crush” in the neuropathy according to the double crush phenomenon theory<sup>7,30</sup>. The study aims to describe the clinical results of patients with disabling lower extremity neurological symptoms, after undergoing decompression of the tibial nerve at the tarsal tunnel, and the common and deep peroneal nerve<sup>39</sup>. Most of our patients were told at some point that nothing could be done for their pain and loss of sensation besides tight glucose control. What is amazing is the dramatic recovery when the nerves are decompressed. Patients start walking again, recovering sensation, and regaining their capacity to work in society. It is surprising how fast these changes take place. One can even test the success of sensation improvement in the recovery room.

Several inclusion criteria were used to define surgical candidates. These include: **1)** history of pain or decreased sensation in the distribution of the posterior tibial (medial and lateral plantar surface), common and superficial peroneal (lateral calf and dorsum of the foot), and deep peroneal (dorsum of the foot, first web space); **2)** Abnormal neurosensory testing by the Pressure-Specified Sensory Device (PSSD); **3)** Positive Tinel’s sign on exam; **4)** Muscle weakness in those innervated by the mentioned nerves; **5)** Absence of severe peripheral vascular disease or radiculopathy that might explain the patient’s symptoms.

As an alternative to the electrodiagnostic testing (EDT), the Pressure-Specified Sensory Device can be used with great sensitivity. It is a valid and reliable instrument when compared with the gold standard<sup>16-20</sup>. Also, the Tinel’s sign was used as an inclusion criteria. The presence of this sign has a sensitivity of 88%, specific-

ity of 50%, and a positive predictive value of 88% in predicting which patient would have a good or excellent outcome <sup>40</sup>.

As we see in the series results, the great majority of the patients were satisfied with the procedures. The clinical improvement was analyzed for each individual group where surgery aimed primarily to improve either pain or sensation. Symptoms of a group of patients with peripheral entrapment syndrome can be viewed as Gaussian distribution for pain and another for numbness, both overlapping at the center. When evaluating the patients that underwent the procedure primarily for pain relief, 85.2% reported pain improvement and indeed improved more than 50% in the visual analog scale. Also most of them decreased their pain medication requirement, which further prevents side effects and dependency to these drugs.

Regarding those patients presenting mostly with sensation problems, 87.4% reported a good clinical improvement. Moreover, from those who reported balance problems, 92.1% improved their balance. Balance in these patients was mainly affected because they could not feel their legs, could not sense their position in space.

These results show a significant benefit due to surgical decompression of entrapment neuropathy in this group, and the data is comparable with previous reports of human surgical results <sup>13-15,41, 42</sup>.

Nevertheless peripheral entrapment syndromes is considered a rare entity, it is a very common and important pathology that causes emotional distress and poor quality of life. It is a condition that is often misdiagnosed and mistreated <sup>21</sup>.

## CONCLUSIONS

Decompression of the posterior tibial nerve together with decompression of the deep and common peroneal nerves in the lower extremity decreases pain in patients with peripheral entrapment neuropathy. This approach to peripheral entrapment neuropathy opens a new door for patients under severe stress and handicap due to this condition. The dramatic clinical improvement and enhanced quality of life is the main objective of these surgical interventions. In the future, we predict surgical nerve decompression of the extremities, when indicated, will be the standard of care in patients with debilitating symptoms of peripheral nerve entrapment, due to diabetes or other causes. To compare which alternative is better for the patient, we are developing a prospective-randomized study to compare surgical decompression of peripheral nerves versus medical treatment and tight glyce-mic control in patients with diabetic neuropathy.

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