

Scientific Basis for Nerve Compression in Diabetic Neuropathy



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Selection of the Patient for Decompression

Over the past twenty years, an approach to selection of the patient for decompression of peripheral nerves has been developed. This approach begins with the measurement of peripheral nerve function in order to stage the degree of nerve impairment. The model developed for staging the degree of nerve impairment in patients with chronic nerve compression but without a neuropathy has been found to be valid in patients with neuropathy too. Since 1989, the approach to this measurement has been with computer-assisted sensorimotor testing. While vibrometry is useful for evaluating a single patient and comparing that patient to a group of patients, vibrometry does not help the surgeon interested in decompressing a particular nerve. This is because the vibration travels as a wave. If the vibration is not perceived well in the index finger, is it because of a lesion of the median or of the radial nerve? If the vibration is not perceived well in the big toe, is it because of a lesion of the tibial or of the peroneal nerve? While the Semmes-Weinstein monofilament number 5.07 (10 gm of force)

may be useful in identifying an individual with diabetes who has lost protective sensation, and is therefore at risk of ulceration in the foot, this filament represents a cutaneous pressure threshold of greater than 90 gm/mm. At this advanced stage of chronic nerve compression, the patient has lost two-point discrimination, has severe axonal loss, and is most often past the point at which surgical intervention to restore sensation and relieve pain is still possible.

In contrast, we have found that the Pressure-Specified Sensory Device(TM) can identify the earliest degree of chronic nerve compression by measuring the pressure required to distinguish one from two points touching the skin. Normative values for the Pressure-Specified Sensory Device(TM) (PSSD)(Sensory Management Services, LLC, Baltimore, Maryland) have been reported for the upper extremity and for patients with carpal and cubital tunnel syndrome, and for the lower extremity and for patients with tarsal tunnel syndrome. The PSSD is at least as sensitive as traditional electrodiagnostic studies,³³ and is not invasive and therefore not painful. No electric shocks are used.

The American Diabetes Association has indicated for the past seven years in its annual Standards of Care for the Foot in Diabetes that even the diabetic at low risk for ulceration should have a yearly somatosensory (quantitative sensory testing) measurement of the foot. A guideline, based upon a cross-sectional study of people with diabetes with and without foot ulceration is available for application of measurement with quantitative sensory testing for the diabetic foot. (Figure 2.)

As the cutaneous pressure threshold for the big toe increases above the 99% confidence limit for normal (but axonal degeneration has not yet occurred), the patient with diabetes is referred in order first to a diabetes educator and Podiatrist for evaluation of orthotic use, and then to the Podiatrist for fabrication of special shoes. Once the 99% confidence limit is exceeded for the distance at which one from two points can be distinguished, indicating that axonal degeneration has occurred, then a referral to a surgeon knowledgeable in peripheral nerve decompression is appropriate to determine whether the patient would be a candidate for restoration of sensation and relief of pain.

The most valid prognostic sign for a good result from decompression of a nerve in the diabetic with symptoms of

neuropathy is the presence of a positive “Tinel sign”. This test is done by tapping the region of known anatomic tightness, like the tarsal tunnel, with the examiners finger (not with a percussion hammer). A “positive” test occurs when the patient can feel a radiating sensation, painful or not, into the territory supplied by that nerve, e.g., the arch of the foot, the heel, or the big toe when the percussion is done over the tarsal tunnel. The simple perception by the patient that a thumping occurred is not a positive sign. Tapping over several “control” sites, ie. areas of skin without a known anatomic region of compression beneath them, should be done. For the common peroneal nerve at the fibular head, often the nerve is just tender, and a distally radiating perception does not occur. Tenderness of this nerve is sufficient to suggest entrapment at this location. In my experience with patients with diabetic neuropathy, when a superimposed nerve compression is identified by a positive Tinel sign, there is an 80% chance of a good to excellent result, meaning relief of pain and restoration of sensation to the feet.

Results of Decompression of Peripheral Nerves in the Diabetic

Since 1992, there have been several studies that have evaluated the results of decompression of peripheral nerves in the diabetic. These studies have been reviewed, and their patient populations regrouped to permit comparison of nerve-specific results. These results are presented in Table 1 for carpal tunnel decompression, in Table 2 for cubital tunnel decompression, and in Table 3 for tarsal tunnel decompression.

Table 1

Results of Peripheral Nerve Decompression
In Diabetic Neuropathy Median Nerve: Carpal Tunnel Syndrome

Subjective

Two-point

Study	Nerves	Patients	Results:		discrimination		Recurrence
			Excellent	Good	Excellent	Good	
Dellon, 1992	44	34	96%	2%	96%	4%	0%
Aszman, 2000	8	7	88%	12%	88%	12%	0%

Table 2
 Results of Peripheral Nerve Decompression
 In Diabetic Neuropathy Ulnar Nerve: Cubital Tunnel Syndrome

Study	Number of:		Subjective Results:		Two-point discrimination		Strength	
	Nerves	Patients	Excellent	Good	Excellent	Good	Excellent	Good
Dellon, 1992	11	8	82%	18%	82%	9%	54%	36%
Aszman, 2000	7	7	88%	12%	88%	12%	N/A	N/A

Table 3
 Results of Peripheral Nerve Decompression
 In Diabetic Neuropathy Posterior Tibial Nerve: Tarsal Tunnel Syndrome

Study	Number of:		Pre-operative:		Results Improved*	Ulcer Recurrence
	Nerves	Patients	Ulcers	Amputations		
Dellon, 1992	31	22	0	0	Pain 85%	0%
Wiemann, 1995	33	26	13	0	Pain 92% 2PD 72% Ulcer 83%	0%
Chaffe, 2000	58	36	11	6	Pain 86% Touch 50% Ulcer N/A	0%
Aszmann	16	12	0	0	2PD 69%	0%

*2PD = two point discrimination

The results of decompression of the median nerve in the carpal tunnel in the diabetic gives excellent relief of sensory symptoms in about 95% of patients and good results in the remaining 5%, with 95% of the patients recovering useful two-point discrimination. These results are what one would expect in the non-diabetic having carpal tunnel decompression.

The results of anterior submuscular transposition of the ulnar nerve at the elbow, using the musculofascial lengthening technique, in the diabetic, gives excellent relief of sensory symptoms in about 77% of patients and good results in the another 22%, with about 95% of the patients recovering useful two-point discrimination. These results are what one would expect in the non-diabetic having this type of ulnar nerve surgery for moderate to severe degree of ulnar nerve compression. Recovery of motor function is not as good with just 55% of the patients recovering normal grip strength and 40% recovering normal pinch strength.

The results of decompression of the four medial ankle tunnels, related to the tibial nerve and its medial and lateral plantar and calcaneal branches, is determined by restoration of sensation to the sole of the foot, and relief of pain in the foot. For all four reported groups of patients, each of whom was decompressed using the same surgical technique, pain was relieved in 86% of patients and 72% recovered useful two-point discrimination.³⁸⁻⁴¹ Two studies included patients that had a history of ulceration, and the percentage of patients having relief of pain was the same in these patients, however, many of these patients recovered just protective sensation (no two-point discrimination). Among the 62 patients in this combined series that had never had an ulcer or amputation, none reported an ulceration or an amputation during the follow-up period of observation. Among the 24 patients in this combined series that had a previous ulcer or amputation (4%) reported a recurrent ulceration during the follow-up period of observation.

The ability to restore sensation to the feet of a diabetic holds the promise of prevention of ulceration and amputation. Over the period of time that I have been doing this type of nerve decompression in the feet of patients with diabetes, there have

been a series we have been able to follow for a mean of 4.5 years who have only had a unilateral set of peripheral nerves decompressed. Figure 3 is an example of such a patient who had the right leg decompressed 7 years prior to this photograph. Sensation had been recovered in this foot. Because of the distance he lived from our office, he never came back to have his opposite foot have the nerve decompression surgery. He developed an ulceration in the contralateral foot, and went on to require amputation of two toes on that foot. Our series to the present includes 43 patients. None of these patients have had an ulcer or an amputation in the side that was decompressed. In contrast, there have been 7 ulcerations and 2 amputations in their contralateral limbs. The statistical significance of the success of peripheral nerve decompression in prevention of ulcer and amputation in this group of 43 patients has a p value of .002.41

Discussion

The realization that the peripheral nerve in the patient with diabetes is susceptible to compression can offer the patient, who suffers with unrelieved symptoms of neuropathy, a new source of optimism. Over the past twenty years, progressing from clinical observations to basic science research, and then back to clinical treatment of the diabetic with symptomatic lower extremity neuropathy, experience has been gained that can now be translated into the regular care of the patient with diabetes. Independent surgical centers have reported essentially the findings; decompression of the tibial nerve and its branches at the ankle and foot level can relieve pain and restore sensibility in about 80% of the patients.

As with the treatment of most diseases, the earlier a patient can be referred for treatment, the better is the chance that the symptoms of the disease can be helped. With regard to diabetic neuropathy, once the patient has developed an ulceration, we know that sufficient sensory axons have degenerated that we may only be able to restore protective sensation by decompression of the peripheral nerve. By contrast, if sensibility can be done earlier in the patient with symptoms of neuropathy in the feet, then the ability to restore sensation can be offered at an earlier stage in the pathophysiology. The reason that the results of decompression of the median nerve in the carpal tunnel has a higher success rate than

decompression of the tibial nerve in the tarsal tunnel is that patient's usually present to their physician earlier with hand problems than with feet problems.

This earlier presentation of the patient with hand problems than with feet problems may be related to the general pessimism that accompanies the teaching the diabetic neuropathy is "progressive and irreversible".

The observation that patients who have had restoration of sensation to their feet through decompression of peripheral nerves have not developed ulcers or had an amputation suggests that the natural history of diabetic neuropathy may be able to be changed. To affect this change, clinicians responsible for the care of the patient with diabetes will need to measure sensibility in the foot, evaluate the foot for the presence of a Tinel sign over known sites of peripheral nerve compression, and refer the patient to a surgeon trained in lower extremity peripheral nerve decompression techniques. If this concept can be introduced into clinical practice, we should see a significant decrease in foot ulcerations and amputations.

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He specializes in the treatment of diabetic neuropathy as well as other painful peripheral nerve disorders and has trained many surgeons worldwide in the procedures he has developed to relieve pain.

Dr. Dellon completed his BS at John Hopkins University and received his Medical Degree from Johns Hopkins University School of Medicine in 1970. He Completed General Surgery, Plastic Surgery and Hand Surgery Residencies at Columbia Presbyterian Hospital, John Hopkins Hospital and Union Memorial Hospital respectively. He has been in practice since 1978 and has been on the faculty of Johns Hopkins since that time.

