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Original Research

Pain Relief and Health-Related Quality-of-Life Improvement After Microsurgical Decompression of Entrapped Peripheral Nerves in Patients With Painful Diabetic Peripheral Neuropathy

Wenqiang Yang, MD [1], Zhuangli Guo, MD [2], Yanbing Yu, MD [1], Jun Xu, MD [1], Li Zhang, MD [1]

[1] Department of Neurosurgery, China-Japan Friendship Hospital, Beijing, People's Republic of China
[2] Department of Neurology, Affiliated Hospital of Qingdao University, Shandong, People's Republic of China

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ABSTRACT

Surgery had been shown to be effective for superimposed peripheral nerve entrapment syndrome in patients with diabetic peripheral neuropathy (DPN), with pain relief and sensation restored. Few studies, however, have reported the quality-of-life outcomes of surgery for the treatment of painful DPN (PDPN). The objective of the present study was to evaluate the effects of microsurgical decompression of multiple entrapped peripheral nerves on pain and health-related quality of life in patients with refractory PDPN of the lower limbs. Eleven patients with intractable PDPN of the lower limbs were recruited for the present study. All the patients underwent microsurgical decompression of the common peroneal nerve, deep peroneal nerve, and posterior tibial nerve. The pain intensity was assessed using the visual analog scale and health-related quality of life was measured using the short-form 36-item quality-of-life survey. Six patients experienced >50% pain relief (both daytime pain and nocturnal pain) at 2 weeks after the decompression procedure and 8 patients at 24 months postoperatively. Two patients experienced a >50% decrease in peak pain at the 2 weeks after the procedure and 8 patients at 24 months. Additionally, the scores from the short-form 36-item quality-of-life survey were significantly improved in the following 2 domains: bodily pain and general health at 2 weeks after the decompression procedure. Also, at 24 months postoperatively, 6 domains had significantly improved, including physical function, bodily pain, general health, social function, role emotional, and mental health. No significant side effects were recorded during the study. Microsurgical decompression of peripheral nerves is an effective and safe therapy for intractable PDPN with superimposed nerve compression.

Diabetic peripheral neuropathy (DPN) is the presence of symptoms and signs of peripheral nerve dysfunction occurring in the setting of diabetes mellitus (DM) without other causes for peripheral neuropathy. The symptoms can vary from mild numbness to unremitting pain of extremities. The prevalence of painful DPN (PDPN) has generally ranged from 10% to 20% of patients with DM and 40% to 50% of those with diabetic neuropathy (1,2). Moderate-to-severe pain will be present in 75% of patients with PDPN. Neuropathic pain, often chronic and difficult to manage, represents the most problematic symptom of DPN. Patients with PDPN frequently experience anxiety, depression, fatigue, and sleep disturbance, because all these comorbidities are related—in some cases, bidirectionally—to chronic pain (3,4). The presence of PDPN often leads to diminished work ability and decrements in health-related quality of life (HR-QOL) (5).

No precise mechanism has been delineated for the generation of neuropathic pain in patients with DM. A variety of potential mechanisms have been postulated. Hyperglycemia in DM can lead to accumulation of sorbitol and fructose in the nerves, followed by edema and myelin swelling by increasing polyol pathway activity (6,7). The high sorbitol and fructose concentrations might also directly cause axonal degeneration and demyelization (7). Furthermore, hyperglycemia initiates a nonenzymatic reaction between glucose and collagen, with the resulting products causing increased thickness and stiffness of ligament structures and fascia (8,9). Thus, entrapment of the affected nerves at sites of anatomic narrowness can result, at least in some DM patients. Therefore, in addition to metabolic neuropathy, superimposed nerve compression could also play an important role in the neuropathic pain of patients with PDPN.

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Address correspondence to: Li Zhang, MD, Department of Neurosurgery, China-Japan Friendship Hospital, 2nd Ying Hua East Street, Chao Yang District, Beijing, People's Republic of China 10029.
E-mail address: zrywq1985@yahoo.com (L. Zhang).

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Table 1
Demographic and clinical variables (N = 11 patients)

Variable	Count (%) or Mean ± SD
Gender (n)	
Male	6 (54.6)
Female	5 (43.4)
Age (y)	62.9 ± 9.6
Height (cm)	167.3 ± 7.6
Weight (kg)	68.4 ± 8.6
BMI (kg/m^2)	24.4 ± 1.8
DM type (n)	
1	4 (36.4)
2	7 (63.6)
DM duration (y)	16 ± 6
DPN duration (y)	10 ± 4
PDPN duration (y)	5 ± 2

Abbreviations: BMI, body mass index; DM, diabetes mellitus; DPN, diabetic peripheral neuropathy; PDPN, painful diabetic peripheral neuropathy; SD, standard deviation.

Surgical nerve decompression for the treatment of symptoms due to superimposed peripheral nerve entrapment syndromes in patients with DM has been reported to result in good clinical outcomes (10–14).The target nerves of lower limbs have always included the common peroneal nerve, posterior tibial nerve, and deep peroneal nerve. The results of these studies indicate a promising alternative for patients with symptomatic neuropathy due to DM, who have traditionally been told that in addition to tight glucose control, the only other treatment for their symptoms is neuropathic pain medication. Some studies have reported on the treatment of neuropathic pain in patients with DM using this surgical technique (15–18). However, few studies have reported on the quality-of-life outcomes for decompression of entrapped peripheral nerves in patients with PDPN. The primary objective of the present study was to evaluate the effects of microsurgical decompression of entrapped peripheral nerves for the treatment of pain and the effects on HR-QOL in patients with refractory PDPN in the lower limbs.

Patients and Methods

Patients

A total of 19 patients with DM and chronic neuropathic pain in their lower limbs were referred to our department by their treating specialist for further therapy. All the patients had been treated with medication, such as antidepressants, anticonvulsants, and opioids to alleviate their pain. However, none of the 19 patients had experienced sufficient pain relief. After detailed history, careful physical examination, and adequate communication, 11 patients (Table 1) were included in the present study. After screening, 15 patients met the inclusion criteria, although 4 of these declined to participate after informed consent to research was initiated.

The inclusion criteria were typical clinical pain description and the exclusion of other possible causes (19); a duration of pain of ≥12 months, with an average pain intensity during the day or night of ≥50 on the visual analog scale (score range 0 to 100) and no response to conventional treatment; positive Tinel sign (only patients with a positive Tinel sign over the tibial nerve in the tarsal tunnel were included in the present study) (20); decreased 2-point discrimination (the great toe 2-point discrimination was >8 mm); and electrical testing documenting the presence of neuropathy. The exclusion criteria were obvious limb ischemia characterized by the absence of a main artery pulse; clotting disorders; known immune deficiency; active foot ulceration; unstable blood glucose control; severe cardiac or pulmonary disease; and serious foot edema.

Microsurgical Procedures

The microsurgical procedures were performed with the patient under general anesthesia and a pneumatic thigh tourniquet inflated to a pressure of 300 mm Hg. The target nerves, including the common peroneal nerve, posterior tibial nerve, and deep peroneal nerve, were decompressed as described in detail by Dellon (21) and Valdivia Valdivia et al (22). A 4-cm incision was made obliquely across the fibular neck (Fig. 1*A*) and deepened into the subcutaneous tissue. Next, the superficial and deep fascia were cut to exposure the nerve trunk. The peroneus longus muscle tendon and any fibrous bands around the nerve were excised to release the common peroneal nerve (Fig. 2*A*). Next, intraneural dissection was performed under a microscope. A 6-cm-long incision was made toward the plantar aspect of the foot at the site of the lateral plantar tunnel (Fig. 1*B*). After the superficial fascia, deep fascia, and flexor retinaculum had been excised, the tibial nerve trunk and its 3 branches were identified. The 4 nerve distribution tunnels were all released (Fig. 2*B*) and intraneural decompression was performed if epineurial thickening and stiffing were present. The deep peroneal nerve at the dorsum of the foot was decompressed through a 2-cm longitudinal incision centered over the junction of the first and second metatarsals (Fig. 1*C*). After incising the superficial and deep fascia, the extensor hallucis brevis tendon was excised to expose the deep peroneal nerve and any fibrous constrictions binding the nerve were released (Fig. 2*C*). Intraneural dissection was performed if necessary.

Postoperative Regimen

The postoperative regimen included partial weightbearing and mobilization of the limbs the day after surgery and complete weightbearing at the end of 2 weeks postoperatively; the application of antibiotics for 3 days; and removal of the stiches at 2 weeks postoperatively.

Pain Management

Pain is the primary outcome measure for patients with PDPN (18). In the present study, all the patients were asked to rate their pain intensity using a VAS-based pain dairy (score range 0 to 100). The averages were calculated from the daytime pain scores (recorded 3 times daily for 4 days) and nocturnal pain scores (recorded once daily for 4 days). The peak pain intensity was also scored using a VAS-based pain dairy. These data were collected at baseline and 2 weeks and 3, 6, 12, and 24 months after microsurgical nerve decompression during face-to-face interviews.

Health-Related Quality of Life

HR-QOL was assessed using the 36-item short-form health survey (SF-36). The SF-36 includes 36 questions in 8 health status domains: physical function, role physical (the ability to perform expected physical roles), degree of bodily pain, overall sense of general health, overall sense of vitality, role social (ability to function in social roles), role emotional (the ability to perform expected emotional and social roles), and overall sense of mental health (23). The possible domain scores range from 0 to 100, with higher scores indicating greater health. The reliability and validity of the Chinese version of the SF-36 has been confirmed for measurement of the HR-QOL of Chinese

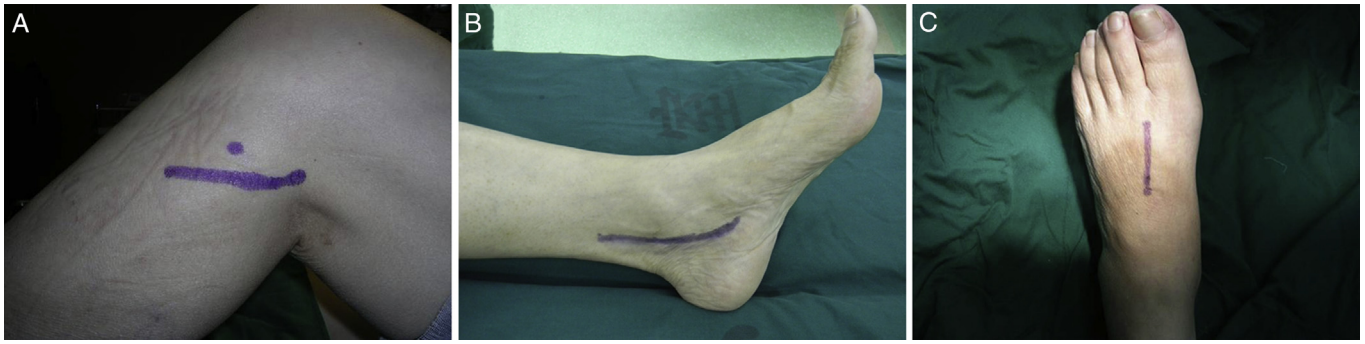

Fig. 1. Incisions marked to decompress the peroneal nerve (*A*), tibial nerve (*B*), and deep peroneal nerve (*C*).