VEIN-GRAFT WRAPPING FOR THE TREATMENT OF RECURRENT COMPRESSION OF THE MEDIAN NERVE

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Recurrent compressive neuropathy of the median nerve due to cicatrix is an extremely challenging clinical problem. Available treatment techniques are difficult and results uncertain. Early experience with the autogenous vein graft wrapping technique has shown great promise for the treatment of chronic compressive neuropathy after other procedures have failed. We report on 3 patients with average follow-up of 2 years. Postoperatively, all the patients had significant improvement on electromyograms, and the findings of both subjective and objective assessments were excellent or good for 2 patients. The procedure is simple; the donor is readily available; no complications were noted in the donor area, and the graft tissue has good compatibility. This technique can also be applied for chronic compression of any peripheral nerve.

THE PRIMARY SURGICAL PROCEDURE FOR THE TREATMENT OF A CHRONIC COMPRESSIVE NEUROPATHY, SUCH AS CARPAL TUNNEL SYNDROME, IS SIMPLE DECOMPRESSION.1,2 Although the majority of reports note a high rate of success with simple decompression, some studies have found that 14–32% of patients cannot obtain good long-term results with this treatment alone.3–5 The reported reason for the failure of this procedure is scar tissue formation around the nerve, which results in recurrent nerve compression and traction neuropathy.6 External or internal neurolysis cannot always improve the recovery of nerve function. Therefore, supplementary procedures have been developed for use after the initial simple decompression. These include mobilization of the nerve and encircling of the nerve trunk with a muscle flap, fat flap, or even vascularized omentum.2,5,7–11 However, these techniques are complex, associated with complications, and not always effective, even in the short follow-up period. As first presented by Masear in 1989, we also believe that vein wrapping can protect the nerve from surrounding scar tissue. We performed this technique on 3 patients who had undergone several previous procedures for recurrent median neuropathy. Our minimal follow-up period is 2 years.

MATERIALS AND METHODS

Between 1993 and 1994, 3 patients presented with chronic median nerve entrapment in the distal forearm and wrist. Two of the patients had undergone more than three failed procedures to decompress the median nerve at the carpal tunnel, and the third had a previous traumatic injury of the forearm and wrist. Outcome was determined on the basis of both subjective and objective assessments.2,11 For the subjective assessment, we asked patients about their overall satisfaction, relief of pain and numbness at night and after strenuous activity, and the return to previous work. The objective assessment included the measurement of two-point discrimination (TPD), range of motion, grip strength, and strength of the abductor pollicis and opponens pollicis brevis. In addition, electromyographic (EMG) studies were performed to determine the status of nerve function postoperatively.12

Surgical Technique

Under general anesthesia, a standard carpal tunnel incision is performed. Dissection is carried through the distal forearm, and the median nerve is identified in unscarred tissues deep to the flexor digitorum superficialis fascia. Mobilization of the nerve and internal neurolysis are performed under magnification. The nerve is dissected and fascicles comprising the digital nerves are identified, as is the motor branch to the thenar eminence. The greater saphenous vein is then dissected through a longitudinal incision superolateral to the medial malleolus. With care taken to avoid injury to the associated small nerves and venous branches, the graft is excised from the wound and incised longitudinally (Fig. 6). The length required is three times that of the scarred portion of nerve. Under loupe magnification, the vein is carefully wrapped around the compressed nerve with the endothelial surface of the vein against the nerve. The
procedure is completed by loosely tacking each section of the wrap around the nerve with 7-0 prolene sutures. Post-operatively, the wrist is immobilized for one week in slight extension to prevent prolapse (Fig. 7).

Case 1

A 31-year-old right hand-dominant male laborer was referred to us, after an injury of the forearm and repair of all the extensor tendons of his right upper extremity. Five months later, neurolysis of the median nerve was performed in addition to a tendon transfer to restore thumb abduction. Although the tendon repair procedures had good results, he continued to have symptoms in the median nerve distribution (TPD >15 mm) in all fingers, including pain (8/10 in character), and the grip strength was 50 lb. A revised carpal tunnel release was performed for decompression of the median nerve and for excision of a large painful mass at the distal forearm level, palmarly. The mass appeared to be a neuroma in continuity, and was carefully dissected from the surrounding tissues (Fig. 1). Because of the large amount of scar tissue, an internal neurolysis was performed. Gelberman has demonstrated that internal neurolysis was not always effective as treatment for severe scarring. Due to the extreme scarring observed in these patients an internal neurolysis was performed followed by the vein-wrapping procedure (Fig. 3). The greater saphenous vein was wrapped around the distal median nerve in the neurolysed segment. Twenty-five months later, the patient still had a Tinel’s sign but no associated pain. He had only cold weather symptoms, and his TPD was less than 5 mm in the thumb and index finger and more than 15 mm in the middle and ring fingers. The power grip was 70 lb (50% of the normal hand), and the pain improved to 2/10 in character. His personal estimation was that the results of the procedure were good. He returned to his previous occupation.

Case 2

A 39-year-old right hand-dominant man was referred to us with complaints of numbness and loss of strength in his right hand. Although he had undergone four previous carpal tunnel releases on the right hand and one on the left, he had symptoms upon waking, and both hands were numb at
night. He could not partake in his job as an electrician. Grip strength was 65 lb in the right hand (90 lb in the left), and his pain was 9/10 in character. The TPD was 6 mm in the median nerve distribution, except in the radial aspect of the index finger, where it was greater than 15 mm. EMG findings indicated the presence of chronic median neuropathy. After a revision neurolysis and internal neurolysis, the vein wrapping procedure was performed using 25 cm of the saphenous vein (Figs. 3 and 4). At the 26-month follow-up visit, the patient had no pain (1/10 in character), numbness or other symptoms, and his TPD in the radial aspect of the index finger was 8 mm. Grip strength improved to 80 lb. He had returned to his previous occupation without limitation. He rated his result as excellent.

Case 3
A 28-year-old right hand-dominant woman was referred to us, with the chief complaints of pain, swelling, and numbness and tingling in both hands. These symptoms had begun several years earlier. Two carpal tunnel releases on the right hand and one on the left hand had not improved her symptoms and she stated that her right hand, in fact, was worse than preoperatively. She described waking up every night with numb hands, and she had to shake them to relieve these symptoms. A physical examination showed positive Tinel’s and Phalen’s signs bilaterally. The dynamometer reading was 20 lb for the right hand and 24 lb for the left hand. Her TPD was slightly decreased in the thumb and all of her fingers (6 mm). The electrodiagnostic impression was mild focal median neuropathy at the right wrist that has deteriorated since her previous EMG study four months earlier. The diagnosis was recurrent carpal tunnel syndrome and we recommended another carpal tunnel release in the right hand, internal neurolysis, and coverage with a hypothenar fat flap. After this procedure her symptoms were better for the first 3–4 months, but then symptoms recurred. At the 7-month follow-up assessment, she had Phalen’s and Tinel’s sign again, and the TPD in both the right and left hands was between 8 to 15 mm. An EMG study showed no significant changes. Fourteen months after the hypothenar fat flap procedure, the patient underwent a new revision of her right carpal tunnel release with a vein-wrapping procedure, using a 30-cm-long vein graft (Fig. 5). Sixteen months after this, the patient continued to have symptoms in both hands and her subjective assessment was that she felt about the same as she did before the procedure. She described her pain as 6/10 in character (compare to 8/10 in character preoperatively). Her TPD was greater than 6 cm in all fingers of both hands. She had no motor loss of the abductor pollicis and pollicis brevis. The power grip was 18 lb for the right hand and 22 lb for the left. The patient was unable to return to work. However, her EMG (nerve conduction velocity) improved after the vein wrapping procedure. Incidentally, her case is in litigation.

DISCUSSION
Injury to the hand and wrist or multiple procedures for nerve decompression can lead to fibrous fixation of the nerve. The epineurial surface of the nerve may be surrounded by scar tissue and stressed by strenuous work or a new injury. The result is a chronic neuropathy, called a "traction neuropathy," and the optimal treatment may be a combination of procedures. A neuroma in continuity (secondary to nerve injury or neurolysis) also can cause a pathologic condition of the nerve. Mobilization of the nerve followed by internal neurolysis cannot alleviate these problems, due to recurrent scar. Most authors agree that soft-tissue coverage is necessary to prevent this phenomenon, and several options have been suggested for this purpose. The hypothenar fat pad flap can produce good results and is uncomplicated in most cases. Pedicle or free flaps, including the groin flap, lateral arm flap, posterior interosseous flap, provide excellent protection of the nerve,
but the technique is complex and results not always satisfying. Small local muscle flaps such as the abductor digiti minimi, the palmaris brevis, the pronator quadratus and lumbricals also have been used. However, the dissection of these flaps is not always easy, and skin-closing problems have been reported. Use of the implanted peripheral nerve stimulator has been suggested to relieve pain resulting from compressed or injured peripheral nerves, but failures have been reported in many cases because of complications such as nerve injuries, skin problems, and early formation of scar tissue due to silicone.

Masear et al. and Gould have shown that the vein-graft wrapping technique can improve the recovery of nerve function in patients with recurrent nerve compression. Although no experimental study on this subject has been reported, the procedure seems to be an excellent option for recurrent neuropathy. However, the mechanism of its effect is still uncertain. Based on the pathology, pathophysiology, and etiology of chronic nerve compression, we believe that the procedure works by protecting the peripheral nerve from surrounding scar tissue, thereby preventing adhesion between the nerve trunk and the surrounding tissue. In addition, the formation of scar tissue within the peripheral nerve trunk is minimized after decompression, possibly owing to properties of endothelial cells that line the inner surface of the vein. Endothelial cells prevent the adhesion of tissue or blood cells to the inner surface of the vessel in vivo. Perhaps the vein graft also functions in a similar fashion, preventing adhesion and scar tissue formation between the periphery and the nerve. In addition, the autogenous vein graft with this smooth inner surface should improve the gliding function of the nerve trunk during motion of the relevant joint, avoiding the possible damage induced by gliding friction on the nerve trunk. Currently, we are conducting an experimental study to test this hypothesis, and the preliminary results are extremely encouraging. Our clinical experience is also encouraging. The first patient had none of his preoperative discomfort, and has returned to work. The second patient was much improved, with excellent functional recovery and he resumed his previous occupation without limitation. Both had an improvement in EMG findings. The third patient had a less satisfactory result. She subjectively assessed the outcome as fair. Her objectively assessed results, including grip strength, also were fair. However, the EMG findings were significantly improved at the follow-up examination. Her case was in litigation.

CONCLUSION

The use of autogenous vein-graft wrapping as a supplementary technique to treat chronic nerve compression has many advantages. It is a simple technique that causes no complications in the donor area. In addition, the donor is readily available, and the graft tissue is compatible. Furthermore, the technique can be applied to the treatment of chronic nerve compression other than carpal tunnel syndrome. The preliminary results have been encouraging in our first patients with 2 years average follow-up. Our laboratory data will soon be reported.

REFERENCES