Use of the Anterior Branch of the Medial Antebrachial Cutaneous Nerve as a Graft for the Repair of Defects of the Digital Nerve*

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ABSTRACT: Using the anterior branch of the medial antebrachial cutaneous nerve, grafting was performed on twenty-one digital nerves. The goal of the procedure was to repair a traumatic defect of greater than one centimeter in the digital nerves of fourteen patients. The patients were followed for twenty-four to eighty-nine months (average, fifty-seven months). All but one nerve graft restored the ability to distinguish between sharp and dull stimuli, and all but three restored two-point discrimination of between five and fifteen millimeters (average, nine millimeters). No painful neuromas developed at the donor site.

Primary repair of a lacerated digital nerve usually yields a good result. Usually there is a return of sensibility, and a neuroma does not form. Often, however, the area of damage is so wide that end-to-end coaptation of the digital nerves is not possible or is possible only with extensive proximal and distal mobilization of the nerves and acute flexion of the digit. As Terzis et al., Berger and Millesi, and Millesi et al. demonstrated, neurorrhaphies that are performed under tension generally yield poor results. It is for this reason that we believe that gaps in digital nerves should be managed with nerve grafts.

Many cutaneous nerves have served as donor grafts for the repair of digital nerves. Seddon used the proximal branch of the medial antebrachial cutaneous nerve, but he was disappointed in the results. The sural nerve was used both by Bunnell and by Buncke, but the disadvantage of using that nerve is that additional anesthesia and an incision in the lower extremity are needed. Wilgis and Maxwell, McFarlane and Mayer, and Tenny and Lewis used the lateral antebrachial cutaneous nerve, but some patients lost sensibility in the thumb. Wilgis and Maxwell also used the terminal portion of the posterior interosseus nerve, but this necessitated an extensive exposure beneath the extensor tendons. Greene and Steichen used the dorsal cutaneous branch of the ulnar nerve but, as with the use of the lateral antebrachial cutaneous nerve, sensibility was lost from already compromised hands.

Because of the unsatisfactory results with the use of other nerves, we report our experience with the use of the anterior division of the medial antebrachial cutaneous nerve as a donor graft for the repair of a digital nerve.

The Medial Antebrachial Cutaneous Nerve

The medial antebrachial cutaneous nerve is a branch from the medial cord of the brachial plexus that consists of sensory fibers from the first thoracic level. The nerve accompanies the basilic vein down the arm and pierces the deep fascia in the middle of the proximal part of the arm. The nerve then splits into anterior and posterior branches in the distal third of the arm. The anterior branch supplies the anteromedial aspect of the forearm, while the posterior terminal branch provides sensation to the postero-ulnar surface.

Methods and Materials

Between December 1977 and August 1982, at the Duke University Medical Center, fourteen patients had grafting of twenty-one traumatic defects of a digital nerve, using the medial antebrachial cutaneous nerve as the donor graft. There were six female and eight male patients, and the ages ranged from sixteen to fifty-one years old. In one patient, the nerve-grafting was done immediately after injury, while in the others it was delayed for two to eleven months after injury (Table I). Grafting was done in all of the five digits of the hand when the gap in the digital nerve was greater than one centimeter or if excessive tension or acute digital flexion was needed to oppose the ends of the nerve after excision of the neuroma and glioma.

Surgical Procedure

With a pneumatic tourniquet applied well proximal to the elbow, the severed ends of the digital nerves are exposed both proximally and distally and are carefully incised under the operating microscope until healthy fascicles are identified proximally and the sheath looks normal distally. The
<table>
<thead>
<tr>
<th>Case</th>
<th>Age at Operation (%)</th>
<th>Time Interval from Injury to Operation (Mos.)</th>
<th>Length of Graft (cm)</th>
<th>Site of Repair (Digital Nerve, Digit)</th>
<th>Two-Point Discrim. (mm)</th>
<th>Result of Semmes-Weinstein Filament Test*</th>
<th>Discrim. between Sharp and Dull Stimuli</th>
<th>Length of Follow-up (Mos.)</th>
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*Log₁₀ force, 0.1 milligram.

digit is then maximally extended and the neural gap is measured.

The donor graft from the medial antebrachial cutaneous nerve is obtained by making a longitudinal incision in the skin two centimeters anterior and two to three centimeters distal to the medial epicondyle (two fingerbreadths cephalad and distal to the medial epicondyle with the elbow in extension). The anterior branch of the medial antebrachial cutaneous nerve is found in the subcutaneous tissue. An appropriate length of nerve is harvested, the tourniquet is released, and hemostasis is obtained. The wound in the forearm is closed using absorbable suture in the subcutaneous tissue and subcuticular nylon suture in the skin.

Using an operating microscope, the graft is sutured to
both severed ends of the digital nerve with two or three peripheral epineural sutures of 9-0 nylon. The wound in the digit is closed, and a bulky splint is applied to the hand. Postoperatively, motion is allowed on the basis of what is appropriate after concomitant digital procedures.

Postoperatively, the patients were routinely examined for the return of sensibility. At the latest assessment, the ability to distinguish between sharp and dull stimuli and static two-point discrimination were determined and Semmes-Weinstein monofilament testing was done. The ability to distinguish between sharp and dull stimuli was tested for each nerve with the point and hub of a sterile 20-gauge needle. A good score meant that eighteen of twenty tests were positive and a poor score meant that less than eighteen were positive. Weber two-point discrimination was determined according to the method of Moberg.

If the patient had a normal, apparently uninjured nerve on the opposite side of the finger, this normal nerve was anesthetized with infiltration of a local anesthetic solution. The sensory testing was then repeated for the grafted digital nerve. In addition, the donor site in the forearm was assessed to determine whether a painful neuroma had formed, the degree of any hypersensitivity, and the size of the anesthetic area.

Results

Twenty-one digital nerves were grafted in the fourteen patients. The minimum length of follow-up was twenty-four months; the longest, eighty-nine months; the average, fifty-seven months; and the median, fifty-six months.

Sensibility

All but one patient regained the ability to distinguish between sharp and dull stimuli to the digit. Three of the twenty-one nerve grafts resulted in five millimeters of two-point discrimination; nine, six to ten millimeters; six, eleven to sixteen millimeters; and three, no two-point discrimination (Table 1).

Only fifteen of the grafted digital nerves were examined with Semmes-Weinstein filaments. Two nerves were normal (1.65 to 2.83), eight provided diminished light touch (3.22 to 3.61), four provided diminished protective sensation (3.84 to 4.31), and one provided no protective sensation (4.56 to 6.65) (Table 1).

There was no correlation between the length of the graft (range, 1.5 to 4.0 centimeters) and the recovery of sensibility (Fig. 1). There was also no definite correlation between the length of time from injury to the repair and the return of two-point discrimination (Fig. 2).
The site of the incision in the forearm for the removal of a three-centimeter-long graft from the medial antebrachial cutaneous nerve. The cross-hatched area shows the zone of hypoesthesia that will result from the procedure.

Defect at the Donor Site

No patient complained of discomfort or paresthesia at the donor site. In many patients, the hypoesthesia diminished in some areas in the donor forearm as progressive cross-over coverage from adjacent sensory nerves occurred, but no patient had completely normal sensibility in the forearm. Figure 3 illustrates a typical area of hypoesthesia.

Discussion

When Seddon used the medial antebrachial cutaneous nerve for grafting digital nerves, the result was satisfactory in only eleven of twenty-six digits. He attributed the unsatisfactory results to poor vascularity of the digits. McFarlane and Mayer used the lateral antebrachial cutaneous nerve as a graft in thirteen patients and stated that the "funicular content is somewhat less than that of the sural nerve, but in shape and diameter it more nearly approximates a digital nerve". However, their report did not include measurements on cadaver or histological measurements. McFarlane and Mayer followed their patients for seven to twenty-three months. Two patients did not regain two-point discrimination, and the remaining eleven had between seven and twenty millimeters.

Buncke used the sural nerve in two patients and reported that one obtained five millimeters of two-point discrimination and the other, twenty millimeters. Wilgis and Maxwell used the sural nerve, the lateral antebrachial cutaneous nerve, and the terminal portion of the posterior interosseous nerve for grafts of lesions distal to the distal interphalangeal joint. After anesthetic block of the other digital nerve in the digit, eight of eleven grafts provided six millimeters of two-point discrimination. Greene and Steichen reported that, of fifteen digital nerves that were grafted with the dorsal cutaneous branch of the ulnar nerve, one failed to provide any two-point discrimination and the others provided an average of 9.5 millimeters of two-point discrimination. However, Greene and Steichen pointed out that "nerve block of the uninjured digital nerve in the same finger was not performed as crossover innervation was not considered to be significant".

After an average of fifty-seven months, the results in our series of twenty-one digital nerves that were grafted with the anterior branch of the medial antebrachial cutaneous nerve were comparable with those of the cited studies. Eighteen grafts resulted in two-point discrimination of five to fifteen millimeters. The average two-point discrimination was nine millimeters, a finding similar to that of Greene and Steichen, and our results did not change when the contralateral digital nerve was locally anesthetized.

We agree with the functional assessments of Buncke and of Wilgis and Maxwell, who characterized normal static two-point discrimination as two to six millimeters, fair as seven to ten millimeters, and poor as more than ten millimeters. In the combined series of Buncke, McFarlane and Mayer, Wilgis and Maxwell, and Greene and Steichen, which consisted of forty-one nerve grafts, there were thirteen (32 per cent) normal results, twelve (29 per cent) fair results, and sixteen (39 per cent) poor results for two-point discrimination. Our twenty-one nerve grafts compare favorably, with six (29 per cent) normal results, six (29 per cent) fair results, and nine (42 per cent) poor results.

There are several advantages to using the anterior branch of the medial antebrachial cutaneous nerve as a donor graft: (1) unlike the situation with the use of the sural nerve, all of the incisions are made in the upper extremity, so regional anesthesia can be used; (2) unlike the situation with the use of the lateral antebrachial cutaneous nerve or the dorsal cutaneous branch of the ulnar nerve, after which sensibility may be lost from either the thumb or the small finger, sensibility is not lost anywhere in the hand; and 3) unlike the situation with use of the posterior interosseous nerve, for which the dissection is more complicated and deep to the extensor retinaculum, the medial antebrachial cutaneous nerve, which is subcutaneous, is easy to isolate.

In conclusion, we found the medial antebrachial cutaneous nerve to be an excellent donor graft for the repair of digital nerves. After a long-term follow-up, the results were comparable with those of other grafts, and there were no adverse effects at the donor site. However, before the operation is done, the patient should understand that there will be a scar on the forearm.

References

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