TWO-STAGE AUTOGRAFT FOR REPAIR OF EXTENSIVE MEDIAN AND ULNAR NERVE DEFECTS

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(Received for publication May 13, 1947)

EXTENSIVE median and ulnar nerve loss in the forearm, associated with soft tissue destruction, presents a difficult problem in management. The soft tissue defect can be repaired by skin grafting, but the loss of a large portion of both nerves can not be overcome even by extensive dissection. End-to-end suture is impossible.

The hand is useless from a functional standpoint even though flexion of the fingers is still possible with the long flexor tendons. The hand is completely anaesthetic on the palmar surface and the small muscles are paralyzed. It is impossible to effectively pick up or grasp small objects. The anaesthesia makes it dangerous to use the hand, as degrees of temperature and pain are not appreciated. Severe burns are common. Position sense is absent, and any object placed on the hand is soon dropped unless the patient constantly watches the hand and concentrates on active flexion of the fingers.

It is obvious in analyzing the disability that the major portion of the functional loss is due to the median nerve paralysis. If sensation and some motor power could be restored into the thumb and first three fingers, the patient would have a useful hand.

A nerve graft is necessary, due to the great length of nerve destroyed. Homografts in our experience have failed due to rapid fibrosis of the grafts. Free autografts of considerable length usually suffer the same fate because of lack of adequate blood supply. It was thought possible to overcome the problem of vascularity and fibrosis by means of an extensive autograft done in several stages.

The first patient treated by this method was a 23-year-old Marine (R.T.L.), injured 31 July 1944 by shrapnel on Tinian. A massive soft tissue wound of the left forearm destroyed a large portion of the median and ulnar nerves. When seen 7 months later at the National Naval Medical Center, the original wound was well healed by dense scar tissue. No attempt had been made to repair the nerve injury. Complete median and ulnar nerve paralysis was present with marked muscle atrophy of the thenar eminence and moderate flexion contractures of the last three fingers.

The proximal and distal stumps of the median and ulnar nerves were identified at the time of the first exploration, 2 February 1945, and the extent of the defects measured (Fig. 1A). The neuromas were 10 cm. apart, and normal nerve tissue was separated by an even greater distance. A tantalum wire suture was placed through the neuromas of each nerve and gentle

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tension applied. The neuromas were then wrapped with tantalum foil to aid in later identification (Fig. 1B). After partial closure of the wound, the large soft tissue defect was repaired with a split-thickness skin graft. Three months later, 7 May 1945, the wound was reexplored and the proximal portion of the median nerve exposed. The incision was then extended up-

ward on the mesial aspect of the arm and the ulnar nerve exposed and divided 9 cm. above the olecranon process (Fig. 2A). The neuroma was resected from the proximal stump of the median nerve, and the cut end anastomosed to the distal end of the divided ulnar nerve with tantalum wire sutures. Only that portion of the ulnar nerve necessary for anastomosis was mobilized.

During the next 4 months a positive Tinel's sign with tingling referred to the median nerve distribution of the hand could be obtained from the point of anastomosis downward along the course of the ulnar nerve. At the end of this period, tingling in the thumb and the first three fingers could be elicited by tapping the neuroma on the end of the ulnar nerve in the forearm, and it was assumed that the median nerve fibers were present throughout the length of the ulnar segment to be used as a graft.

The wound below the elbow was then reopened and the portion of the ulnar nerve below

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Fig. 1. A, Diagram of extent of combined nerve lesion and soft tissue defect. B, Tantalum foil and sutures to aid later identification.
the point of suture to the median nerve dissected free (Fig. 2B). The neuroma was resected from this composite ulnar-median trunk and free bleeding encountered at the cut end. The neuroma was resected from the distal end of the median nerve just above the wrist, and the ulnar graft sutured to the cut end with tantalum wire sutures (Fig. 2C).

Soon after the sutures were removed, a positive Tinel’s sign could be obtained at the point of suture, 2 cm. above the wrist. Three months later, the Tinel’s sign could be elicited at the base of the thumb and fingers. Return of muscle bulk of the thenar eminence, and return of voluntary action of the flexor pollicis brevis and opponens pollicis muscles, became evident about the same time. Sensation and motor power continued to improve, and 5 months after the second operation the patient was able to write, identify and remove objects from his pockets, use carpenter tools, and play basketball. The result has been gratifying from the functional standpoint (Fig. 8). A detailed report of the end result will be made at a later date.
DISCUSSION

Three patients with almost identical injuries have been treated by this method of autograft in multiple stages. The second patient had a more rapid return of sensation, but motor function was slower, probably due to the extreme degree of thenar atrophy present before operation. When last ex-

amine, palpable muscle tissue had developed over the metacarpal bone of the thumb, and a useful degree of motion was present.

The completion of the nerve graft in the third case was carried out when the Tinel sign had progressed well into the ulnar graft. When last examined one month following this procedure, the Tinel had not progressed into the distal portion of the median nerve. At surgery, however, the graft appeared viable and bled freely from the cut surface.
In all extensive peripheral nerve surgery, it has been our policy to use general anaesthesia. An “S” incision has been employed to allow wide exposure with minimal retraction (Fig. 4). A bloodless field, using a tourniquet, increases the speed and accuracy of the dissection. Tantalum wire sutures for anastomosis have afforded satisfactory approximation of the nerve ends, and less tissue reaction than the usual materials. The wound is closed without drainage after all large vessels have been ligated or coagulated. After closure of the wound, the entire area is well padded with loose gauze dressings and an elastic compression bandage applied. The tourniquet is usually not removed until the dressing is completed. This method, with postoperative elevation of the extremity, has proven very satisfactory.

The postoperative treatment consists of daily physiotherapy and galvanic stimulation of the paralyzed muscles. Galvanic stimulation, if given daily, definitely reduces the amount of muscle atrophy and stimulates more rapid return of voluntary motion.

This method has been employed only when both nerves in the forearm have been injured; but it would be equally well suited to repair of extensive sciatic nerve injury, using the peroneal branch as the source of the graft. It is conceivable that sacrifice of a normal ulnar nerve to obtain return of median nerve function would be justifiable if end-to-end anastomosis could not be obtained by the conventional methods.

The use of a single large autograft has obvious advantages over cable grafts, or any of the frozen or preserved homografts, from both the theoretical and technical standpoints. The added safety of a two-stage procedure has been well demonstrated in skin grafting methods employed by the plastic surgeons. The same principle apparently can be utilized to advantage in nerve grafts to overcome long defects. The free bleeding from the distal cut end of the ulnar graft, when the neuroma is resected, demonstrates the adequate blood supply throughout the entire length of the transplanted segment, and no doubt plays a vital role in the rapid return of function observed in these patients.

The satisfactory functional and anatomical results in these three patients have prompted this preliminary report. When sufficient time has elapsed to evaluate the maximum return of function, a detailed account of each patient will be made.

**CONCLUSION**

Three patients with extensive combined median and ulnar nerve lesions have been successfully treated by a two-stage procedure, using the ulnar nerve as an autograft.

The surgical technique is described.

The possibility of repair of other extensive peripheral nerve lesions by this method is suggested.