FAULTY SENSORY LOCALIZATION IN NERVE REGENERATION*

AN INDEX OF FUNCTIONAL RECOVERY FOLLOWING SUTURE

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Serial sensory examinations in a large number of cases of nerve injury and suture, which were observed during a two and a half year period in an Army Neurosurgical Center, have shown that faulty localization of tactile stimuli after nerve suture is a valuable prognostic aid in determining the effectiveness of regeneration. By faulty localization is meant marked disturbance in the ability to localize a tactile stimulus within the cutaneous distribution of the involved nerve. Within the limits of the cutaneous distribution of a regenerated nerve, faulty reference occurs for both touch and pain. In the ensuing case reports both pain and touch modalities were tested systematically.

The phenomenon of faulty localization has often been attributed to poor regeneration of nerve fibers. As a matter of fact, it may be the earliest demonstrable evidence of nerve regeneration, and thus assumes considerable practical significance. On the other hand, when accurate localization accompanying a return of sensation occurs soon after nerve suture, it has been often misinterpreted as evidence of nerve regeneration. Despite the fact that faulty localization was described as early as 1895 and has been noted frequently since then by various workers, its true significance has not been common knowledge. John Mitchell,12 in reviewing certain Civil War cases of his father, Weir Mitchell, described in 1895 a brachial plexus injury showing this phenomenon, and noted a communication from W. H. Howell ascribing it to misdirection of regenerated nerve fibers. Trotter and Davies24 reported the phenomenon after experimental section and suture of cutaneous nerves in man. They say that faulty localization of cutaneous stimuli "... is by far the most valuable and least equivocal of all the evidences of regeneration.... Peripheral reference is the earliest phenomenon of recovery and the last sign of abnormality." Boring2 in 1916 also described faulty reference as occurring 135 days after experimental section and suture of a human cutaneous nerve.

CASE REPORTS

Four illustrative cases will be reported. The first case demonstrates the fallacy of accepting ordinary sensory return in the cutaneous distribution of the involved nerve as a prognostic sign of regeneration after suture. The second case demonstrates that faulty localized sensations are carried by the

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pathway of the sutured nerve. The third case illustrates the character of faulty localization, proving that the phenomenon is restricted to the limits of maximum distribution of the nerve involved. The fourth case shows the persistence of faulty localization after regeneration within the area of distribution of the involved nerve.

Case 1. C.B., a 20-year-old male, incurred a wound at the junction of the middle and lower thirds of the right forearm on Nov. 13, 1944, following which he had total anesthesia of the distal 2 phalanges of the 2nd and 3rd digits of the right hand. On Mar. 1, 1945, an extensive neuroma in continuity was resected and a 3 cm. gap was overcome in a suture of the median nerve. Five months following suture there was return of sensation in the entire median nerve distribution. Although the sensation was still definitely hypesthetic, ability to perceive touch was present throughout the median nerve distribution. Localization of tactile stimuli was not as accurate as on the opposite normal hand, but the limit of error was consistently less than 2 cm. Wide misses of 5 or more cm., or misses from one finger to another, as occur with typical faulty localization, were never observed. Additional doubts of the success of the neurorrhaphy were aroused by the absence of a rapidly advancing Tinel’s sign. Furthermore, apparent sensory recovery had occurred gradually over a considerable period of time, rather than appearing suddenly with a rapid burst.

Because of the foregoing factors, the median nerve was re-explored in August 1945. Operation was performed under local anesthesia. Tantalum foil was removed and the enclosed suture line was found to be intact and appeared adequate. The nerve was infiltrated with procaine above the suture line. Electrical stimulation below the point of procaine infiltration gave no sensory response, indicating an effective nerve block. Sensory examination of the undraped hand was then carried out. There was no change in sensation in the median cutaneous area from that which was present prior to nerve block. The patient himself could detect no subjective sensory change.

Comment. This case demonstrates conclusively that the recovery of “accurate” localization of sensation—“accurate” in contrast to the marked faulty localization seen in regeneration after nerve sutures—must have been carried by pathways reaching the point stimulated through nerves other than the one sutured.

Case 2. L.W.S., a 28-year-old male, received a laceration of the right forearm on May 11, 1944. Because of a severe wound infection, surgery was delayed until Sept. 24, 1944, when a suture of the ulnar nerve was performed, overcoming a 4 cm. defect. Eleven months following operation there was sensory return with a good concentration of pain and touch spots in the previously anesthetic area. Marked faulty localization of stimuli was present with misses of as much as 8 cm. frequently being made.

Reoperation was performed on Sept. 7, 1945 under local anesthesia. Electrical stimulation of the nerve distal to the suture line gave a good sensory response. The nerve was then blocked with procaine following which electrical stimulation gave no response. Following the effective nerve block, examination of the hand demonstrated total anesthesia of the distal 2 phalanges of the 5th digit with complete disappearance of the faulty localization, even in the hypesthetic intermediate zone of the ulnar nerve. When the effects of the procaine block wore off, anesthesia of the hand regressed and faulty localization returned to its former status.

Comment. This case demonstrates that sensory recovery characterized by faulty localization had occurred over the pathway of the sutured nerve.

Case 3. E.A.T., a 19-year-old male, was wounded in the left forearm on Jan. 21, 1945.