Original Article

Effect of Sensory Re-Education after Low Median Nerve Complete Transection and Repair

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Abstract
Objective: To evaluate the functional outcome after complete median nerve transaction and repair, and sensory re-education.

Methods: We studied 37 patients, aged 22 to 45 years, with median nerve neurotmesis at the wrist. Primary epineural microsurgical repair using 8-0 single-strand sutures was performed in all patients, and a hand and wrist cast was applied for 4 weeks. After cast removal all patients went through physical therapy for 1 month to restore motion and reduce stiffness of the injured hand. After re-innervation was completed, the patients were randomly allocated into 2 equal groups: Group A (19) patients were instructed to a sensory re-education program; Group B (18) patients had no further treatment. Clinical evaluation was done at 18 months postoperatively including the localization test (locognosia), the static and the moving 2-point discrimination tests, the Moberg’s pick-up test (stereognosia) and the hand grip and the opposition strength tests.

Results: All patients were included in the postoperative evaluation. Hand grip and opposition strength, static and moving 2-point discrimination results were not statistically significant between the two groups. The localization test was statistically significant in group A and a trend to statistical significance was observed regarding the Moberg’s pick-up test in group A.

Conclusions: Sensory re-education is essential for patients with median nerve neurotmesis and repair, as it significantly re-educates localization and stereognosia in the shortest time following peripheral nerve injury and repair.

Key words: median nerve, transection, repair, sensory re-education

Purpose

To evaluate the functional outcome of patients with microsurgical repair of low median nerve complete transection and to compare the sensory outcomes in patients with or without sensory re-education.

Methods

We studied 37 patients, aged 22 to 45 years (mean age: 33.5 years) with low median nerve complete transection in the wrist or distal forearm and repair. All
patients gave informed consent and assured compliance for participation in this study after they were informed about the methodology and the objectives of the study.

Within the first 24 hours after injury, primary epineural repair was performed in all patients using 8-0 single-strand sutures and microsurgical technique under regional axillary block anesthesia. Patients with flexor tendon injuries were repaired primarily at the same time.

Postoperatively we used a splint for 4 weeks for immobilization of the hands, followed by physical therapy for 1 month to restore motion and reduce stiffness of the injured hand.

We used Tinel’s sign as a prognostic sign to evaluate progression of nerve regeneration [41].

Using the 256-cycle-per-second tuning fork for pallesthesia, after vibration sense (pallesthesia) was perceived at the fingertips of the 3.5 radial fingers innervated by the median nerve, the patients were randomly assigned to 2 equal groups, at a mean of 3.5 months (range, 3–4 months) after surgery.

Group A patients were rehabilitated with a sensory reeducation program, and group B patients had no further treatment.

The technique of sensory reeducation was performed in 2 phases, according to Dellon’s recommendations [4, 5].

The early phase was initiated when reinnervation was appreciated at the fingertips; it included identification of papers with different roughness and familiar objects, firstly with the eyes open and then with the eyes closed [4] and locognosia [35].

The late phase was initiated as soon as static and moving 2-point discrimination was appreciated at the fingertips [5] and locognosia was good.

In all patients, this was at approximately 3.5 months (range, 3–4 months) after the initiation of the early phase; it included the Moberg pick-up test [36], locognosia exercises [35] and identification of different objects from similar objects, such as coins and keys from within a basket of beans. In addition, during this period, group A patients were encouraged to carry small objects such as different coins, keys and screws in their pocket or purse to practice identifying and picking them out.

The technique of sensory reeducation was taught to the patients by the authors and physical therapists, and performed by the patients themselves,
assisted by their family or a physical therapist 4 times daily, for 10-15 minutes per session. Their progress was evaluated on a weekly basis by the authors.

Clinical evaluation at 18 months after surgery (range, 17.5–18.5 months) included locognosia [35] (the ability to localize touch), the static [37] and moving 2-point discrimination [13, 34, 38] and Moberg’s pick-up test [36].

The best values of the evaluation of locognosia and static and moving 2-point discrimination at the radial 3.5 fingers of the affected hands were recorded. Locognosia was reeducated and evaluated using the modified Marsh’s test [35]: each pulp of the radial 3.5 fingers is divided into 4 quadrants (14 zones) and a stimulus is applied in each zone at random, with the patient blindfolded. Next, the patient is asked to point, on a diagram of the hand, to the zone where the stimulus was felt. For each correctly identified orientation within a quadrant, one point was given; one point was also given for localization to the correct digits (excellent, 28 points). For the assessment of 2-point discrimination, a compass-type instrument with blunt tips was used. Two-point discrimination in each region was examined by lightly touching the patient’s skin with either 1 point or 2 points simultaneously; skin indentation by the compass point of no more than 1 mm was appropriate because additional pressure might be perceived as pain rather than light touch. All light-touch stimuli were delivered parallel to the peripheral nerve trunk innervating the particular area of the skin, perpendicular to the axis of the thumb, index finger, and long finger. The inter-point distance was increased or decreased until the patients were able to correctly indicate whether they had been touched by 1 point or 2 points simultaneously, and the smaller distance was recorded. The score for 2-point discrimination testing was calculated as the mean value from the 3.5 radial fingers. For static 2-point discrimination, normal value (excellent) is 6 mm, good is 7 to 15 mm, fair is 16 to 30 mm, and poor is absent. For moving 2-point discrimination, normal (excellent) is 3-5 mm, good is 4-7 mm, fair is 8-15 mm, and poor is absent [31]. The Moberg pick-up test [36] was performed by picking up objects using the thumb, index finger and long finger and putting them into a box, first with the eyes open and then with the eyes closed; the time to complete the task was measured and the mean values with the eyes open and closed were recorded. Excellent is less than 10 seconds. Good is
10-20sec, fair is 20-30sec and poor is more than 30sec.

For the statistical analysis we used the simple, non-variate analysis of variance (ANOVA). In order to compare the excellent and good versus fair and poor results of static and moving 2-point discrimination and Moberg’s pick-up test for group A versus group B the chi-square test was used. All patients were included in the postoperative evaluation.

Results

Statistical analysis showed no significant difference between the two groups regarding the static 2-point discrimination merging the excellent and good versus fair and poor results of static and moving 2-point discrimination and Moberg’s pick-up test and performing the chi-square test (p=0.113, chi-square test p=0.0112 simple, non-variate ANOVA).

A statistical trend was identified in group A regarding the moving 2-point discrimination (p=0.058, chi-square test p=0.034, simple, non-variate ANOVA test) and the Moberg pick-up test (p=0.057, chi-square test p=0.063 simple, non-variate ANOVA). This might indicate a positive effect of sensory re-education that might have reached statistical significance had the sample size been larger.

Locognosia was statistically significant in group A compared to group B (p=0.007, simple, non-variate ANOVA).

Conclusions

The median nerve is considered the “third eye.” The sensibility of the human hand makes identification of tactile gnosis, or stereognosia: it is usually not regained in adult patients after injury to a major nerve trunk [1–3]. Following nerve injury and repair the transmission of nerve impulses to the brain is altered. Patient remains confused and unable to interpret the new patterns of sensory input without training.

Usually, in the management of peripheral nerve injuries, motor function is emphasized more than sensory recovery [6–10].

Many tests have been described to evaluate functional sensibility in the hand, following nerve repair [5, 13–22, 30], digital replantation [9, 10, 23, 24], toe-to-hand transfer [23,25–27] and free flap transfer [20, 28, 29], each of them measuring a separate sensory submodality.

In our study, we have used the locognosia [35, 39], the static [37] and
moving 2-point discrimination [13, 38] and the Moberg pick-up test [36] to evaluate functional outcome following repair of low median nerve complete transection and sensory reeducation.

The Weber 2-point discrimination test gives accurate information on the functional value of the sensibility in the hand [32, 36, 42–44]. The Moberg pick-up test primarily requires performance of a static grip, not object recognition; if the hand has normal sensibility, it can “see” even with the eyes closed [36]. The moving 2-point discrimination test gives information concerning the results of nerve repair sooner than the static 2-point discrimination test because it is recovered distally sooner. Thus, it is an accurate monitor of gains in function during sensory reeducation [4, 5, 15, 33].

Sensory reeducation is not a method that can induce axonal regeneration or reinnervation, but a method that helps patients with a sensory impairment to learn to interpret the altered neural impulses reaching the brain [4,5] and reeducates stereognosia and locognosia in as short a time as possible after peripheral nerve injury and repair [4, 5, 11, 12].

Sensory reeducation appeared to have significant value only in reeducation of locognosia at 18 months after low median nerve complete transection and repair. (J Hand Surg 2009; 34A:1210–1215. Copyright © 2009 by the American Society for Surgery of the Hand. All rights reserved.)

Sensory recovery continues to improve slowly for many years after nerve repair [44, 47, 48] in part because of maturation of the newly reestablished fiber-receptor systems and primarily because of the cortical reeducation that attends the daily use of the injured hand [15, 24, 40, 45, 46]. The further continued improvement in sensation is usually for a time period of 5 to 6 years [44, 47, 48]. Over this time period, we speculate that the difference in locognosia would not be significantly different between patients with and without sensory rehabilitation. However, as this study has shown, at 18 months following repair of the median nerve at the wrist, sensory re-education significantly improves locognosia (Mavrogenis et al., presented at the American Academy of Orthopaedic Surgeons - AAOS annual meeting, 2009).

Because the median nerve is considered the “third eye,” the best results should always be pursued after median nerve partial or complete transection and repair for functional sensibility of the
hand. We suggest that sensory reeducation must be an integral part of the care of every patient with low median nerve complete transaction and repair.

References


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