



Clinical and Electrodiagnostic Outcome after Primary versus Secondary Nerve Repair in Median and Ulnar Nerve Damage during an 18-Month Follow-up

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Keywords

Median nerve; Ulnar nerve; Nerve repair; Clinical findings; Electrodiagnosis

Abstract

Background: Patients who suffer from traumatic peripheral nerve injuries receive temporary treatment after referring to hospital. Peripheral nerve repair surgery in some patients is done immediately after damage but many of them get secondary nerve repair after longer periods of time. In this study we have compared the clinical and electrodiagnostic outcome among primary and secondary nerve repair.

Methods: Patients with primary or secondary repair of median and ulnar nerves were enrolled in a non-randomized clinical trial prospective study. Information used in this study was collected from patients who underwent surgery to repair the peripheral nerve in Alzahra and Kashani hospitals in Isfahan City, Iran. Patients were followed by clinical and electrodiagnostic examination in the third, sixth, twelfth and eighteenth month after surgery and the outcome of recovery in their hand function (sensory and motor) was evaluated.

Results: Of 122 patients (64 men and 58 women)

enrolled in this study, 56 patients (45.9%) had a primary repair surgery and 66 (54.1%) had a secondary repair surgery. The age range was between 7 to 55 years (mean: 24.9 ± 8.9), with the mean of 25.6 ± 7.1 for primary group and 24.4 ± 9.8 for secondary group ($P = 0.59$). The Mann-Whitney test suggested that the primary group had better clinical sensory and motor recovery and also improvement in sensory nerve conduction velocity (NCV) and electromyogram (EMG) findings compared with secondary group ($P < 0.05$), but no significant difference was seen in motor NCV between 2 groups ($P = 0.10$).

Conclusion: In this research, we studied the result of primary and secondary repair in both median and ulnar nerve injuries. We concluded that clinical and electrodiagnostic outcome in primary nerve repair was better than secondary nerve repair, thus we suggest immediate repair after peripheral nerve injuries, when possible.

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Introduction

Some patients with severed peripheral nerves immediately undergo a surgical repair of the damaged nerves after referral to the hospital; however, many others undergo a secondary repair after a longer period of time.^{1,2} In the present study, the clinical and electrodiagnostic outcomes of the primary and secondary nerve repairs were compared. Considering that, up to now, such a study has not been carried out in Iran and due to the high incidence of peripheral nerve injury and severance due to various causes such as trauma, penetrating ulcers, fractures, dislocations and the disabling complications caused by this injury, the present study can be a foundation for further studies on the repair of the peripheral nerves of vital organs.

Methods

This prospective study was conducted on patients who had undergone primary repair of the median and ulnar nerves and also patients undergoing secondary surgery on these nerves. The data used in this study were collected from patients who underwent peripheral nerve repair surgery in Alzahra and Kashani hospitals in Isfahan, Iran. Patients were randomly selected based on the diagnosis. All patients included in the study were subjected to clinical and electrodiagnostic follow-ups in the third, sixth, twelfth, and eighth months, and they were compared in terms of the results regarding the returned function of their hands, including sensation and movement.

In this study, both primary and delayed primary repairs were considered as primary repairs. All nerve repair surgeries were performed as epi-peri neurorrhaphy with 0-8 nylon yarn under loupe magnification. Eventually, patients who had previously undergone surgery were invited with an official invitation to participate in the study. Then, a questionnaire containing questions regarding all the information used in this study, including the status of the patient when entering the study based on the contents of the

patient's health record and the results of repair at different times, was prepared. In addition, for patients who entered after the initiation of the study, a questionnaire was developed and completed in different stages.

In this study, the returned sensory function was measured by a clinical examination with the S0 to S5 criteria as follows:

S0: Lack of sensitivity in the autonomic region; S1: Improvement of cutaneous deep pain sensation in the autonomic region of nerve; S2: Some improvement of light touch sensation in the autonomic region of nerve; S3: Return of some perceptions of cutaneous surface pain and surface cutaneous sensation in the autonomic region of nerve; S4: Superficial sensation return similar to S3 plus relative improvement in the detection of two points in the autonomous region; and S5: Complete sensory function return.

Similarly, the returned movement of the hand was measured through a clinical examination by the criteria M0 to M4 as follows:

M0: No contraction; M1: Return of perceivable contraction in upper muscles; M2: Return of sensible contraction in the upper and lower muscles; M3: Return of function in the upper and lower muscles, so that the important muscles can respond to resistance; and M4: Complete improvement.

The results of examination of the senses and movement of the patients were categorized into good, fair, and poor groups based on the Peripheral Nerve Injury Unit of the Royal National Orthopedic Hospital (informally the RNOH). Accordingly, sensory examination results pertaining to S0 to S2, S3, and S4 and S5 were classified as poor, fair, and good, respectively. The motor examination was also categorized on the same basis. In this classification, M0 to M2, M3, and M4 were recognized as poor, fair, and good, respectively.

Electrodiagnostic tests of patients were evaluated in the form of nerve conduction velocity (NCV) in two sensory and motor categories, and ranked from 0 to 2. N0, N1, and N2 were considered as no response, abnormal

response, and normal response, respectively.

Moreover, the electrodiagnostic findings on the patients were also evaluated by electromyogram (EMG) and ranked from 0 to 3. In this classification, 0, 1, 2, and 3 denoted lack of activity, the presence of a small activity or only one motor unit, relative activity, and complete activity, respectively.

After completing the questionnaires and collecting data, the data were analyzed in SPSS software (version 15, SPSS Inc., Chicago, IL, USA). To compare the mean scores of sensation and motion at any time between the two groups, the Mann-Whitney test and, if necessary, the Student's t-test was used. In addition, the Mann-Whitney test was used for comparison of NCV and EMG findings between the two groups.

Results

A total of 280 patients with an experience of a peripheral nerve repair surgery in the above-mentioned centers were invited by telephone call and written letter to participate in the study; however, only 122 were referred for the final examination. Among these, the information of 56 (45.9%) and 66 (54.1%) patients who had undergone primary and secondary repair surgery, respectively, was complete. 64 and 58 of the subjects were men and women, respectively. The age of the patients was in the range of 7 to 55 years with a mean age of 24.9 ± 8.9 years. The mean age of the groups undergoing primary repair and secondary repair was 25.6 ± 7.9 and 24.4 ± 9.8 years, respectively. According to $P = 0.59$ and the results of student's t-test, the mean age of the primary and secondary groups was not significantly different, and this confounding factor could be neglected.

Returned hand sensation was assessed through a clinical examination and S0 to S5 criteria. In the primary group, 26 (46.4%), 22 (39.3%), and 8 (14.3%) individuals were categorized as S3, S4, and S5 sensation status, respectively. None of the individuals in the primary group were categorized into the S0, S1, and S2 sensation status. In the secondary

group, 8 (12.1%), 38 (57.6%), 14 (21.2%), and 6 (9.1%) individuals were categorized as S2, S3, S4, and S5 sensation status, respectively. None of the individuals in this group were categorized into S0 and S1 sensation status. Based on the Mann-Whitney test, the primary repair group had a better response compared to the secondary repair group, and this difference was significant ($P < 0.037$).

The returned hand motion was evaluated through a clinical examination using criteria M0 to M4. In the primary group, 2 (3.2%), 24 (42.9%), and 30 (53.6%) individuals were classified as M2, M3, and M4 motion status, respectively. None of the individuals in the primary group were categorized into M0 and M1 motion status. In the secondary group, 6 (9.1%), 46 (69.7%), and 14 (21.2%) individuals were classified into M2, M3, and M4 motion status, respectively. None of the individuals in the secondary group were categorized as M0 and M1 motion status. According to the Mann-Whitney test, the primary repair group had a better response compared to the secondary repair group, and this difference was significant ($P < 0.010$).

The results of sensation and motion of patients based on the Peripheral Nerve Injury Unit of the RNOH are presented in tables 1 and 2.

Table 1. Results of final sensory examination after the primary and secondary repair of the median and ulnar nerves

Sensory condition	Primary repair number (%)	Primary repair number (%)
Poor	0 (0.0)	8 (12.1)
Fair	26 (46.4)	38 (57.6)
Good	30 (53.6)	20 (30.3)
Total	56 (100)	66 (100)

The results of NCV for sensory nerves in the two groups have been summarized in table 3.

Table 2. Results of the final motor examination after the primary and secondary repair of the median and ulnar nerves

Motion status	Primary repair number (%)	Primary repair number (%)
Poor	2 (3.6)	6 (9.1)
Fair	24 (42.8)	46 (69.7)
Good	30 (53.6)	14 (21.2)
Total	56 (100)	66 (100)

The Mann-Whitney test showed that the primary group had a significant difference in sensory NCV compared to the secondary repair group ($P < 0.001$).

Table 3. Results of sensory nerve conduction velocity after primary and secondary repair of median and ulnar nerves

Sensory NCV results	Primary repair number (%)	Primary repair number (%)
0	9 (16.1)	42 (36.6)
1	28 (50)	12 (18.2)
2	19 (33.9)	12 (18.2)
Total	56 (100)	66 (100)

NCV: Nerve conduction velocity

The motion NCV results are also presented in table 4.

The Mann-Whitney test showed that the primary and secondary groups did not differ in terms of motion NCV ($P = 0.100$).

Table 4. Results of motion nerve conduction velocity after primary and secondary repair of median and ulnar nerves

Motion NCV results	Primary repair number (%)	Primary repair number (%)
0	6 (10.8)	16 (24.2)
1	25 (44.6)	33 (50)
2	25 (44.6)	17 (25.8)
Total	56 (100)	66 (100)

NCV: Nerve conduction velocity

Furthermore, the results of EMG in the two groups are presented in table 5.

Based on the Mann-Whitney test, the primary repair group had a greater improvement in EMG findings compared to the secondary repair group and this difference was significant ($P = 0.001$).

Table 5. Results of electromyogram after primary and secondary repair of median and ulnar nerves

EMG results	Primary repair number (%)	Primary repair number (%)
0	0 (0.0)	2 (3)
1	0 (0.0)	17 (25.8)
2	28 (50)	35 (53)
3	28 (50)	12 (18.2)
Total	56 (100)	66 (100)

EMG: Electromyogram

Discussion

Due to the high incidence of injuries and peripheral nerve damage due to penetrating ulcers from various causes, and also fractures, dislocations and resulting disabling complications, repair is performed in the primary and secondary forms based on the time of patient referral after nerve injury.¹⁻⁴ The present study was conducted to compare these two categories of patients.

Supporters of primary repair believe that the duration of denervation of the lower organs is shorter, and that during this time, it is also easier to place the fascicles in one route, since less nerve is removed.⁵ Therefore, the interval between injury and nerve repair surgery should be as short as possible.² In contrast, the supporters of secondary repair believe that primary repair is not as efficient compared to secondary repair, since primary repair is often performed in an environment without adequate preparation, but secondary repair is performed under better circumstances.

In a study by Omer, it was declared that each 6-day delay in repair was equal to 1% loss in nerve function.⁶ Jongen and Van Twisk showed that primary nerve repair can be considered as a selective treatment for ulnar and median nerve damage in the wrist.⁵ Birch et al., in a study on the microscopic examination of secondary repair of ulnar nerve damage, indicated that good and poor results were obtained among 51.8% and 30.9% of patients, respectively.⁷ In their study, the patient's age, the size of the injury, the delay in operation, and the level of injury had a significant effect on the results.⁷ Nevertheless, Yuan et al., in an investigation on the immediate repair of damage of the peripheral nerves of the hand in the wrist, stated that the primary repair of peripheral nerve damage is more efficient.⁸

Mohseni et al., in a 2 to 10-year study on 105 patients with median and ulnar nerve cuts, concluded that patients with primary repair showed faster recovery in comparison to those with secondary repair.⁹ Ertem et al. stated that, in cases with clean cuts of the

peripheral nerves, the primary repair was the preferred treatment.¹⁰

In the present study, the damage of both median and ulnar nerves was considered and compared, and the results were similar to those obtained in other studies and the statistical differences were significant and citable. In this study, poor sensory outcome was obtained in 0% and 12.1% of the primary and secondary groups, respectively. In addition, the good sensory outcome was obtained in 53.6% and 30.3% of the primary group and the secondary group, respectively. In terms of the returned motion outcome, the poor outcome for the primary and secondary groups was 3.6% and 9.1%, respectively. Moreover, the good outcome was obtained as 53.6% and 21.2% for the primary group and the secondary group, respectively, which indicated the better outcome of the primary compared to the secondary repair.

Conclusion

The present study confirms that in peripheral nerve lesions, in case of suitable treatment conditions, it is better to treat the damaged

nerve as soon as possible. Evidently, the presence of appropriate equipment (including ultra-thin surgical instruments, a surgical microscope or a loupe with adequate magnification), and also the availability of experienced surgeons have a significant effect on the outcome of repair. In case of the lack of any of the abovementioned equipment or personnel, the nerve repair surgery is better to be postponed.

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Conflict of Interest

Authors have no conflict of interest.

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