Original Article

Median and ulnar nerve injuries; what causes different repair outcomes?

Mohammad Hadi Nouraei, Alireza Hosseini, Shadi Salek[1], Farhad Nouraei[2], Roya Bina[3]

Departments of Orthopedic Surgery, [1]Pediatrics and [3]Internal Medicine, Medical School, Isfahan University of Medical Sciences, [2]Students' Research Committee, International Islamic Azad University of Khorasgan, Isfahan, Iran

Abstract

Background: Peripheral nerve injuries have significant effects on patients' life quality. To make patients' therapeutic expectations more realistic, prediction of repair outcome has significant importance.

Materials and Methods: Totally, 74 patients with 94 nerve injuries (44 median and 50 ulnar nerves) were evaluated and followed up for 5 years between 2008 and 2013 in two main university hospitals of Isfahan. Patients' age was 6–64 years. 24 nerves were excluded from the study and among the remaining; 53 nerves were repaired primarily and 17 nerves secondarily. 42 nerves were injured at a low-level, 17 nerves at intermediate and 11 at a high one. Medical Research Council Scale used for sensory and motor assessment. S_{3+} and S_4 scores for sensory recovery and M_4 and M_5 scores for motor recovery were considered as favorable results. The follow-up time was between 8 and 24 months.

Results: There was no significant difference between favorable sensory outcomes of median and ulnar nerves. The difference between favorable motor outcomes of the median nerve was higher than ulnar nerve ($P = 0.03$, odds ratio = 2.9). More favorable results were seen in high-level injuries repair than low ones ($P = 0.035$), and also cases followed more than 18 months compared to less than 12 months ($P = 0.041$), respectively. The favorable outcomes for patients younger than 16 were more than 40 and older, however, their difference was not significant ($P = 0.059$).The difference between primary and secondary repair favorable outcomes was not significant ($P = 0.37$).

Conclusion: In patients older than 40 or injured at a high-level, there is a high possibility of repetitive operations and reconstructive measures. The necessity for long-term follow-up and careful attentions during a postoperative period should be pointed to all patients.

Key Words: Median nerve, ulnar nerve, peripheral nerve injuries, out comes

Address for correspondence:
Dr. Alireza Hosseini, Department of Orthopedic Surgery, Medical School, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: alireza_mui@yahoo.com
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INTRODUCTION

Peripheral nerve injuries (PNIs) of the lower limbs including median, ulnar and radial nerves, and brachial plexus can have significant effects on the lives of patients and present functional limitations placing constraints not only on their personal activities, but also on their ability to earn a living and to contribute to society in their desired occupation.[1]

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Although these injuries have a wide variety of causes, the most common causes center on high-speed vehicular accidents, typically involving motorcycles and affecting young adults.[1,2]

This can cause a substantial loss of upper extremity function that has profound personal consequences. An understanding of the trends reflected in these injuries, and the utilization of complex treatments that can effectively restore function is of prime importance to PNIs patients and surgeons. Establishing and evaluating the effectiveness of treatment modalities is, therefore, central to mitigating the socioeconomic impact of these disorders. Although costs of injury associated with disruption of function and productivity are typically greater for a younger individual, that person also has a greater chance of functional recovery from treatment than an older patient with similar presentation. Despite progress in understanding the pathophysiology of PNI, these lesions remain a major challenge for surgeons, and functional recovery is often unsatisfactory. Even though there are significant advances in the microsurgical techniques and numerous assessment tools, it is difficult to ascertain the success of nerve repair.[2,3]

For both patient and surgeon, it is necessary to prognosticate the chances of recovery so that treatment expectations can be realistic and appropriate rehabilitation measures may be taken. In previous literature, a number of factors have been found to predict motor and sensory recovery after PNI such as age, delay between injury and repair, and surgical technique. However, despite numerous published reports on peripheral nerve repair, there is no agreement on which variables are independent predictors of a successful prognosis, and the effect of the predictors is not quantified. Predictors that should be investigated included age, sex, site of injury, median or ulnar nerve, combined median and ulnar nerve injuries, delay between injury and repair, the use of grafts, gap length, and follow-up period.[4-6]

Despite improved microsurgical techniques, functional outcomes after nerve injuries in human patients are frequently disappointing, the outcomes varying widely depending on extent and severity of the injuries and the distance and time required for axons to regenerate.[7]

In children, however, primary epineural repair leads to very satisfactory motor and sensory results. A recent meta-analysis has shown that age at injury was the strongest predictor of functional outcome after nerve injury and repair. Better peripheral nerve regeneration in children has earlier been suggested, but most data in the literature underscore a greater capability of reorganization of the somatosensory system as the main reason for a superior functional outcome in children. It has also recently been shown that with early sensory reeducation programs, functional outcome in adults with nerve injuries can be improved by training-induced plasticity.[8]

Functional recovery in adults can take up to 7 years and is often incomplete. The socioeconomic impact of nerve injuries can be significant as these injuries can require many months off work and a high probability of work loss, so it is important to evaluate the patients reported outcome and factors associated with disability after an upper extremity nerve injury.[9]

Outcome analysis after PNI frequently includes only measurement of nerve impairment such as sensory and motor function. Patient-reported outcome and disability using valid and reliable measurement tools are rarely included in published reports, and few studies have evaluated functional outcome after PNI treatment.[10]

Regarding to the significant differences between the results of various studies about these factors and also considering the biological, environmental, cultural, and social differences of the patients which can affect the results, we decided to evaluate the present status of the median and ulnar nerves repair in educational hospitals of Isfahan University of Medical Sciences. The aim of this study is detecting the desired results of median and ulnar nerves repair and also the effects of different variables such as nerve type, age, repair time, lesion level, and follow-up duration on the outcomes.

MATERIALS AND METHODS

This analytical descriptive cohort study was done on all the patients with median, ulnar or both nerves injuries that were hospitalized or undergone surgery during 2008–2013 in Al-Zahra and Kashani University Hospitals. The inclusion criteria were patients with total rupture of median or ulnar nerves by penetrating trauma undergoing nerve repair surgery in the mentioned hospitals during the implicit duration with desirable compliance for follow-up and free from current psychiatric or cognitive disorders. The exclusion criteria were concurrency of any kinds of peripheral neuropathies and systemic diseases causing neuronal dysfunction such as diabetes mellitus (diabetes is the most common cause of peripheral neuropathy) and suffering from

other serious disorders that might overshadow the experience of the nerve injury.

There were totally 89 patients with mentioned PNIs and after excluding of patients who did not meet the criteria, 74 persons (94 nerves) with 44 median and 50 ulnar injuries were finally included. All of the patients' records were studied and needed information including name, age, the type of injured nerve, level of the injury, date of the lesion and repair, address and telephone number were extracted from their records and they were called based on nerve repair date to explain about the study, encourage them to cooperate and participate in the examination and follow-up.

Twenty patients (24 nerves) did not follow the examination, so 54 patients (70 nerves) with 38 medium and 32 ulnar nerves were finally evaluated. Age of the patients was between 6 and 64 years with the mean of 31 years old. They were divided to three groups: 6–16 years (12 nerves) 16–40 years (47 nerves) and higher the 40 years (11 nerves). 53 nerves were repaired primarily, and 17 were undergone secondary repair. The minimum time of delay in nerve repair was 3 weeks, and the maximum was 7 months. Repairing of 15 nerves was done by loupe, and all of the nerves were repaired by the epiperineurial method. Injury level was low in 42 nerves (1/3 of distal forearm and wrist) 17 nerves had an intermediate injury (2/3 of proximal forearm), and 11 nerves were involved in high level (arm).

The follow-up duration was 8–24 months (mean 16 months). It was between 8 and 12 months for 13 nerves, 12–18 months for 31 nerves and 18–24 months for 26 nerves after repairing.

The follow-up examinations were done entirely by a fixed person (second examiner with the first examiner supervision).

Following examination identification of motor and sensory recovery levels were conducted on the base of Medical Research council scale (MRCS) which is scored from S_0 to S_4 for sensory and M_0 to M_5 for motor recovery [Tables 1 and 2].

The S_{3+} and S_4 were considered as desired results for sensory recovery and M_4 and M_5 for motor recovery. The electromyography of 24 patients (30 nerves) was according to the clinical examination results.

RESULTS

The exact fisher and Chi-square tests were used for statistical analyzes. For median nerve, desired sensory recovery and motor recovery were 45.7% and 57.1%, respectively. About ulnar nerve, they were 31.4% for both sensory and motor recoveries. There was no significant difference between favorable sensory recovery for median and ulnar nerves ($P = 0.220$), but the favorable motor recovery between ulnar and median nerves was significantly different ($P = 0.03$, odd ratio = 2.9).

Table 1: Classification of nerve sense recovery based on MRCS

Grade of sensory recovery	Clinical examination results
S_0	No sensory recovery in the autonomous zone of nerve
S_1	Recovery of deep cutaneous pain sensibility in autonomous zone of nerve
S_2	Recovery of superficial cutaneous pain sensibility
S_{2+}	Similar to S2 only with some touch sensibility
S_3	Recovery of pain and touch sensibility with disappearance of over response, two-point discrimination >15 mm
S_{3+}	Similar to S3 only with good localization of stimulation, 7 mm <two-point discrimination <15 mm
S_4	Complete recovery, two-point discrimination <7 mm

MRCS: Medical research council scale

Table 2: Classification of motor recovery based on MRCS

Grade of motor recovery	Clinical examination results
M_0	No contraction
M_1	Return of perceptible contraction in proximal muscles
M_2	Return of perceptible contraction in proximal and distal muscles
M_3	Return of perceptible contraction sufficiently power full act against gravity
M_4	Muscles power to act against strong resistance
M_5	Full recovery in all muscles

MRCS: Medical research council scale

Desired result in patients younger than 16, 16–40 and older than 40 years old is compared in Figure 1. The difference of desired results between patients lower than 16 and higher than 40 was considerable ($P = 0.059$). Although this P value did not reach the significant level (0.05), it was so close.

Desired result was 47.6% in low-level injuries, 35.3% in moderate injuries, and 0.9% in high-level injuries. There was a significant difference between the low and high-level injuries ($P = 0.035$).

Desired result in patients with follow-up duration of 8–12 months, 12–18 months, and 18–24 months can be seen in Figure 2. There was a significant difference between the first and the third groups ($P = 0.041$).

After the primary repair, there was 41.5% of desired result and 29.4% after secondary repair, which their difference was not significant ($P = 0.373$).

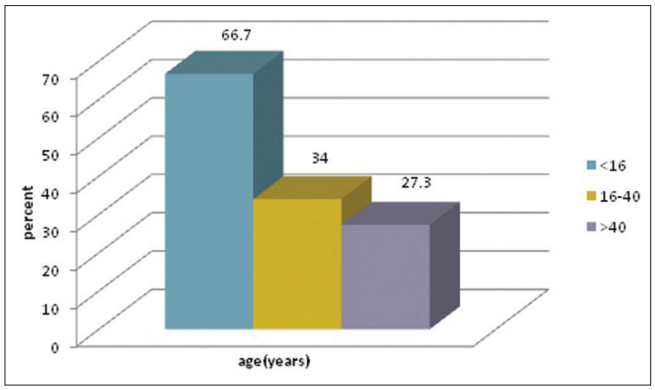

Figure 1: Percent of desired nerve repair based on age

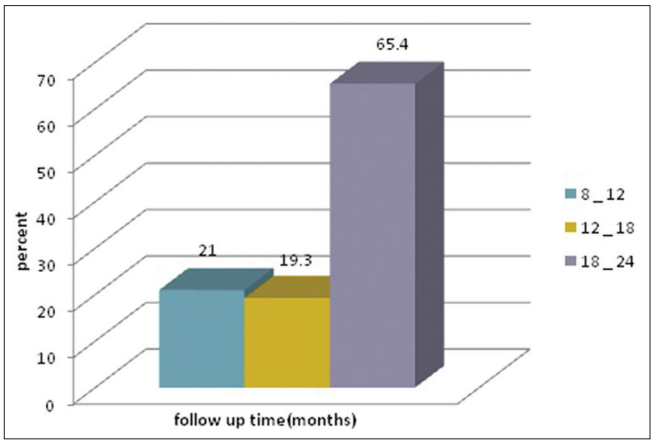

Figure 2: Percent of desired nerve repair based on follow-up time

DISCUSSION

Although there are many evaluation methods by various researchers to assess the nerves function after repair, we used the British MRCS for both motor and sensory recovery testing, because it is the most widely accepted scale for classification and scoring the peripheral nerves recovery.[11] In this method, sensory recovery is classified from S_0 to S_4 and motor recovery is scored from M_0 to M_5.[5-11]

There are many significant prognostic factors that influence the outcomes of motor and sensory recoveries like age, delay in repair, site and type of injured nerve.[12] Based on this study results, it seems that the variables such as the level of injury and age have a prognostic importance in repair outcome. On the other hand, delay in nerve repair did not have a significant influence on it. Hence, it is necessary to pay attention that the maximum time of delay in nerve repair was 7 months in our study as many studies have shown that delay of lower than 6 months has not significantly affected the repair outcomes.[11]

In contrast, some studies have mentioned almost 6% of failure for each week of delay. Furthermore, it should be considered that major of delayed repairs have done in elective operating situations with better equipment and microsurgical methods by expert surgeons rather than emergency operating rooms which make some bias in the results mean, while some studies even showed that secondary repair is better than the primary with similar reasons.[5,11] Overall, primary repair is suggested for sharp injuries and secondary for blunt or severe ones.[5,6,11,12]

In this study, the number of desired outcomes was significantly higher in the patients lower than 16 years old in comparison to the patients higher than 40. Although the difference was not in significant level, it is was so close which may be due to the limited sample size in this study. Better outcomes in children can be related to the short regeneration distant and more potency of the nervous system for regeneration.[11]

It is so important for both patients and physicians to know if the repaired nerve reach the final point of recovery or not, that is why the patient can think wisely about own prognosis, and also the physician can make a good decision for next procedures such as tendon transfer immediately.[1,9] According to the literature, it is expected to reach significant repair after 5 years.[1] In this study, we found that there is an increasing recovery at least 2 years after repair which may be due to the long process of nerve regeneration and continues rehabilitation procedures that can be approved by longer next follow-up. Injury level was considered as the most important factor of repair identification as these study showed.[5,11,13,15] As the nerve regeneration occurs 1-month after surgery with the speed of 1 mm/day, a muscle can be atrophic during 1.5–2 years of denervation. If innervations do not occur during this process, recovery would be very bad especially in motor function.[11] In this study, motor recovery (not sensory) of the median nerve was better than ulnar which is explainable by innervations of intrinsic hand muscles by ulnar nerve which is responsible of the elegant function of the hand.[1-6,11]

Desired outcomes in this study were lower than the mentioned values in references especially in the motor factor of the median nerve. It should be considered that major participants in this study were the patients who have not reached the favorite outcomes and they were referred for follow-up examination and it is not easily possible to include such affecting factors like the type and severity of the injuries, cooperation and motivation of the patients, rehabilitation, sensory capacity, stresses and other associated disorders such as coronary diseases and smoking.

CONCLUSION

The result of this study showed that almost one-third of the patients with ulnar nerve injury and almost half of the patients with median nerve injury gave desired outcome after repair which may be affected by level of injury, follow-up duration and age. Ulnar nerve injury, arm level injury, and older than 40 years old patients had the worst outcome, and it should be followed exactly after surgery to catch desired outcome.

Regarding these facts physicians should explain it for the patients to make the logic expectations. And do suitable and immediate rehabilitation procedures for a relatively long time.

In general, it is suggested that further wide prospective studies with larger sample size and union situations conduct to evaluate the repair outcomes and functional test use in addition to sensory and motor test with regarding to the signs such as continuous pain, low cold tolerance after nerve injury and also measuring the quality-of-life and the ability of doing personal and occupational activities.

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Conflicts of interest
There are no conflict of interest.

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