

Electrodiagnostic Evaluation of Prognostic Factors Influencing the Surgical Outcomes of Upper Extremity Nerve Injuries Caused by Penetrating Trauma: A Cross-sectional Study

Amin Pahlavani^{1#}, Nahid Hosseini Nejad Mir^{2#}, Arian Karimi Rouzbahani^{3,4}, Golnaz Mahmoudvand⁴, Pardis Rezaei⁴, Ali Pahlevani^{3,4}, Mohammad Kazem Shahmoradi^{1,4**}

1. Department of General Surgery, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran
 2. Department of Internal Medicine, School of Medicine, Lorestan University of Medical Sciences, Khorramabad, Iran
 3. Student Research Committee, Lorestan University of Medical Sciences, Khorramabad, Iran
 4. USERN Office, Lorestan University of Medical Sciences, Khorramabad, Iran
- # These authors contributed equally to the study.

*Corresponding Author:

Mohammad Kazem Shahmoradi.
Department of General Surgery,
Lorestan University of Medical
Sciences, Khorramabad, Iran

Email: Shahmoradi.m@lums.ac.ir

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ABSTRACT

Background: Peripheral nerve damage is a major cause of disability, which can lead to serious limitations in daily and occupational activities. Although primary repair can restore the function of the damaged organ remarkably, factors predicting the prognosis of nerve repair are a topic of constant debate. We aimed to investigate the factors affecting the outcomes of primary nerve repair in patients afflicted by upper extremity nerve injuries following penetrating trauma.

Methods: This cross-sectional study was conducted on 51 patients referred to Shohada-ye Ashayer Hospital in Khorramabad, Iran, from 2016 to 2021. Data including the patient's age, gender, education, type, severity, and mechanism of injury, the damaged nerve, time and of method repair, the surgeon's specialty, as well as the electrodiagnostic findings, were collected and analyzed using SPSS software version 22.

Results: The mean age of the patients was 30.41 ± 12.63 years, and the majority of them (84.3%) were men. A significant relationship was found between the sensory amplitude with education ($P=0.002$), the type of damaged nerve ($P=0.048$), and the severity of injury ($P=0.012$). The positive sharp wave was significantly associated with the surgeon's specialty ($P=0.034$). Besides, the motor amplitude was considerably related to the patient's age ($P=0.040$) and the surgeon's specialty ($P=0.035$).

Conclusion: Factors determining the outcome of peripheral nerve repair following penetrating trauma to the upper extremity include age, education, the type of damaged nerve, the severity of the injury, and the surgeon's specialty.

KEYWORDS

Peripheral nerve; Upper extremity; Electrodiagnosis; Penetrating trauma

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INTRODUCTION

Peripheral nerve injuries are a common neurosurgical condition that can attenuate motor and sensory functions, resulting in physical disability¹. About 20 million Americans are afflicted by peripheral nerve injuries each year, resulting in an annual cost of 150 billion dollars^{2,3}. Peripheral nerve injuries can be caused by different mechanisms such as trauma and iatrogenic interventions. However, most cases of nerve damage in the upper limbs are caused by trauma^{1,4}. These injuries occur mostly in young active individuals and diminish their quality of life^{1,5}. The impaired nerve fibers can regenerate spontaneously, however, this ability is limited by the size of the nerve defect, as well as the formation of neuroma and scar, denoting the importance of early nerve reconstruction^{6,7}.

The reconstruction of impaired peripheral nerves is critical for the achievement of a decent regeneration. Nevertheless, recovery from the injuries is usually dissatisfying. Besides the complications of reconstruction, ambiguity in the prognostic factors is a substantial challenge. Early surgical intervention in affected individuals based on their profile of prognostic factors can ameliorate the outcomes of peripheral nerve injury⁸. Some modifiable and unmodifiable factors such as age, gender, educational level, type of damaged nerve, and site of the injury have been attributed to the success rate of nerve repair^{8,9}. However, the outcomes of nerve reconstruction have been seldom examined using valid and reliable tools¹⁰.

Electrodiagnostic studies, including electromyography (EMG) and nerve conduction velocity (NCV), are considered the gold standard for detecting nerve injuries and predicting the outcomes of their reconstruction¹¹. Given the infrequent use of valid and reliable tools to determine the factors affecting the outcomes of primary nerve repair in previous studies, we aimed to design to examine the prognostic factors for the outcomes of primary nerve repair in patients afflicted by upper extremity nerve injuries following penetrating trauma.

METHOD AND MATERIALS

Study design and participants

This was a descriptive cross-sectional study conducted at the Shohada-ye Ashayer Hospital

in Khorramabad, Iran, from 2016 to 2021. The inclusion criteria were undergoing primary nerve repair following upper extremity nerve injuries caused by penetrating trauma. The patients were excluded if their medical files were incomplete. The sampling method was census and 51 patients who met the inclusion criteria were included.

Data collection

After obtaining written and informed consent, data including the patient's age, gender, educational level, type, severity, and mechanism of injury, type of damaged nerve, time and of method repair, and the surgeon's specialty were collected from the patient's medical files. All patients were examined using EMG and NCV tests by the same neurologist. Then, the findings were registered into a researcher-made checklist.

Data analysis

The collected data were analyzed using SPSS software version 22 (IBM Corp., Armonk, NY, USA). Descriptive statistics tools including contingency tables, frequency, and percentage as well as mean and standard deviation and were used to describe the data. Furthermore, the Chi-square test was used to examine the relationship between categorical variables. The significance level was considered <0.05 for all statistical tests.

Ethical considerations

This study was approved by the Research Ethics committee of Lorestan University of Medical Sciences with the ethical IR.LUMS.REC.1399.381. Written informed consent was obtained from all participants in this study. The checklists were designed anonymously and patients' personal information was kept confidential.

RESULTS

Fifty-one patients with upper limb nerve injuries due to penetrating trauma were studied. The mean age of the patients was 30.41 ± 12.63 with a minimum age of 11 and a maximum of 68 years. Other demographic characteristics are shown in Table 1.

The frequency distribution of EMG/NCV findings in patients is shown in Table 2. Motor amplitude was normal in 11 patients, while showed a $\leq 50\%$

Table 1: Frequency distribution of demographic variables in patients with the upper limb nerve injury

| Variable | | Frequency | Percentage |
|---------------------|----------------------------------|-----------|------------|
| Gender | Female | 8 | 15.7 |
| | Male | 43 | 84.3 |
| Age (years) | ≤30 | 29 | 56.9 |
| | 30< | 22 | 43.1 |
| Underlying diseases | Yes | 6 | 11.8 |
| | No | 45 | 88.2 |
| Educational level | Lower than a high school diploma | 31 | 60.8 |
| | High school diploma | 15 | 29.4 |
| | College or university degree | 5 | 9.8 |
| Place of residence | Urban | 41 | 80.4 |
| | Rural | 10 | 19.6 |

Table 2: Frequency distribution of EMG/NCV findings in patients with the upper limb nerve injury

| Variable | | Frequency | Percentage |
|---------------------|---------------|-----------|------------|
| Motor amplitude | Normal | 11 | 21.6 |
| | ≤50% decrease | 7 | 13.7 |
| | 50%< decrease | 8 | 15.7 |
| | None | 25 | 49.0 |
| Sensory amplitude | Normal | 7 | 13.7 |
| | Decreased | 5 | 9.8 |
| | None | 39 | 76.5 |
| Positive sharp wave | No | 22 | 43.1 |
| | Yes | 29 | 56.9 |
| Polyphasic wave | No | 26 | 51.0 |
| | Yes | 25 | 49.0 |

decrease in 7, and a 50%< decrease in 8 subjects. Sensory amplitude was normal in 7 patients and reduced in 5 patients.

As shown in Table 3, the frequency of patients with no motor amplitude was higher in those aged >30 years (n=13; 59.1%) The statistical analysis showed a significant relationship between motor amplitude and age ($P=0.040$). Besides, there was a significant association between motor amplitude and surgeon's specialty ($P=0.035$). As the patients operated by plastic surgeons had the highest frequency of normal motor amplitude (n=10; 34.5%).

However, there was no significant relationship between motor amplitude with gender ($P=0.845$), place of residence ($P=0.347$), educational level ($P=0.604$), damaged organ ($P=0.111$), the severity of nerve damage ($P=0.295$), mechanism of injury ($P=0.727$), damaged nerve ($P=0.561$), duration between injury and repair ($P=0.357$), and duration

between repair and electrodiagnostic studies ($P=0.097$).

As shown in Table 4, three patients (7.1%) with complete nerve injury had normal sensory amplitude while four patients (44.4%) with partial injury showed normal amplitude. The analysis revealed a significant relationship between the severity of nerve damage ($P=0.012$). There was also a remarkable relationship between sensory amplitude and damaged nerve ($P=0.048$). As eleven patients with ulnar injuries (91.7%) showed no sensory amplitude. Patients with an educational level lower than a high school diploma had the lowest rate of normal sensory amplitude (n=2; 6.5%), and there was a significant relationship between sensory amplitude and educational level ($P=0.002$).

However, there was no significant relationship between sensory amplitude with gender ($P=0.232$), place of residence ($P=0.813$), damaged organ

($P=0.679$), mechanism of injury ($P=0.199$), age ($P=0.886$), duration between injury and repair ($P=0.348$), duration between repair and electrodiagnostic studies ($P=0.870$), and surgeon's specialty ($P=0.400$).

As shown in Table 5, there was a significant relationship between positive sharp waves with damaged organs ($P=0.007$). Arm and Forearm injuries were associated with the highest frequency of positive sharp waves. ($n=1$; 100% and $n=12$;

Table 3: Relationship between motor amplitude and patient's characteristics

| Variable | | | Motor amplitude | | | | P-value |
|--------------------------|----------------------------------|------------|-----------------|---------------|---------------|-------|---------|
| | | | Normal | ≤50% decrease | 50%< decrease | None | |
| Gender | Male | Frequency | 9 | 6 | 6 | 22 | 0.845 |
| | | Percentage | 20.9 | 14.0 | 14.0 | 51.2 | |
| | Female | Frequency | 2 | 1 | 2 | 3 | |
| | | Percentage | 25.0 | 12.5 | 25.0 | 37.5 | |
| Place of residence | Urban | Frequency | 9 | 5 | 5 | 22 | 0.347 |
| | | Percentage | 22.0 | 12.2 | 12.2 | 53.7 | |
| | Rural | Frequency | 2 | 2 | 3 | 3 | |
| | | Percentage | 20.0 | 20.0 | 30.0 | 30.0 | |
| Educational level | College or university degree | Frequency | 2 | 1 | 0 | 2 | 0.604 |
| | | Percentage | 40.0 | 20.0 | .0 | 40.0 | |
| | High school diploma | Frequency | 1 | 2 | 3 | 9 | |
| | | Percentage | 6.7 | 13.3 | 20.0 | 60.0 | |
| | Lower than a high school diploma | Frequency | 8 | 4 | 5 | 14 | |
| | | Percentage | 25.8 | 12.9 | 16.1 | 45.2 | |
| Damaged organ | Wrist | Frequency | 9 | 5 | 7 | 11 | 0.111 |
| | | Percentage | 28.1 | 15.6 | 21.9 | 34.4 | |
| | Forearm | Frequency | 2 | 1 | 0 | 11 | |
| | | Percentage | 14.3 | 7.1 | .0 | 78.6 | |
| | Elbow | Frequency | 0 | 0 | 0 | 1 | |
| | | Percentage | .0 | .0 | .0 | 100.0 | |
| | Arm | Frequency | 0 | 1 | 0 | 0 | |
| | | Percentage | .0 | 100.0 | .0 | .0 | |
| | Shoulder | Frequency | 0 | 0 | 1 | 2 | |
| | | Percentage | .0 | .0 | 33.3 | 66.7 | |
| Severity of nerve damage | Complete | Frequency | 7 | 5 | 7 | 23 | 0.295 |
| | | Percentage | 16.7 | 11.9 | 16.7 | 54.8 | |
| | Partial | Frequency | 4 | 2 | 1 | 2 | |
| | | Percentage | 44.4 | 22.2 | 11.1 | 22.2 | |
| Mechanism of injury | Cut | Frequency | 9 | 7 | 7 | 23 | 0.727 |
| | | Percentage | 19.6 | 15.2 | 15.2 | 50.0 | |
| | Crushing | Frequency | 2 | 0 | 1 | 2 | |
| | | Percentage | 40.0 | .0 | 20.0 | 40.0 | |
| The damaged nerve | Radial | Frequency | 4 | 2 | 0 | 6 | 0.561 |
| | | Percentage | 33.3 | 16.7 | .0 | 50.0 | |
| | Median | Frequency | 5 | 4 | 5 | 13 | |
| | | Percentage | 18.5 | 14.8 | 18.5 | 48.1 | |
| | Ulnar | Frequency | 2 | 1 | 3 | 6 | |
| | | Percentage | 16.7 | 8.3 | 25.0 | 50.0 | |
| Age (years) | ≤30 | Frequency | 5 | 7 | 5 | 12 | 0.040 |
| | | Percentage | 17.2 | 24.1 | 17.2 | 41.4 | |
| | 30< | Frequency | 6 | 0 | 3 | 13 | |
| | | Percentage | 27.3 | .0 | 13.6 | 59.1 | |

| Variable | | | Motor amplitude | | | | P-value |
|--|-------------|------------|-----------------|---------------|---------------|------|---------|
| | | | Normal | ≤50% decrease | 50%< decrease | None | |
| Duration between injury and repair (days) | 1 | Frequency | 8 | 4 | 4 | 8 | 0.357 |
| | | Percentage | 33.3 | 16.7 | 16.7 | 33.3 | |
| | 2 | Frequency | 1 | 0 | 1 | 2 | |
| | | Percentage | 25.0 | .0 | 25.0 | 50.0 | |
| | 3 | Frequency | 2 | 2 | 1 | 6 | |
| | | Percentage | 18.2 | 18.2 | 9.1 | 54.5 | |
| | 4≤ | Frequency | 0 | 1 | 2 | 9 | |
| | | Percentage | .0 | 8.3 | 16.7 | 75.0 | |
| Duration between repair and electrodiagnostic studies (months) | ≥2 | Frequency | 1 | 0 | 0 | 0 | 0.097 |
| | | Percentage | 100.0 | .0 | .0 | .0 | |
| | 2-4 | Frequency | 5 | 0 | 2 | 6 | |
| | | Percentage | 38.5 | .0 | 15.4 | 46.2 | |
| | ≥4 | Frequency | 5 | 7 | 6 | 19 | |
| | | Percentage | 13.5 | 18.9 | 16.2 | 51.4 | |
| Surgeon's specialty | General | Frequency | 0 | 1 | 3 | 7 | 0.035 |
| | | Percentage | .0 | 9.1 | 27.3 | 63.6 | |
| | Plastic | Frequency | 10 | 5 | 5 | 9 | |
| | | Percentage | 34.5 | 17.2 | 17.2 | 31.0 | |
| | Orthopedics | Frequency | 1 | 1 | 0 | 9 | |
| | | Percentage | 9.1 | 9.1 | .0 | 81.8 | |

85.7%, respectively). Moreover, patients operated by plastic surgeons showed the lowest frequency of positive sharp waves (n=12; 41.4%). The statistical analysis demonstrated a significant relationship between positive sharp waves and the surgeon's specialty ($P=0.034$).

However, there was no significant relationship between positive sharp waves with gender ($P=0.713$), place of residence ($P=0.556$), educational level ($P=0.544$), the severity of nerve damage ($P=0.150$), mechanism of injury ($P=0.641$), damaged nerve ($P=0.559$), age ($P=0.503$), duration between injury and repair ($P=0.516$), and duration between repair and electrodiagnostic studies ($P=0.727$).

As shown in Table 6, patients with forearm injury had the lowest frequency of polyphasic waves (n=3; 21.4%). There was a significant relationship between polyphasic waves with damaged organs ($P=0.014$).

However, there was no significant relationship between polyphasic waves with gender ($P=0.626$), place of residence ($P=0.725$), educational level ($P=0.836$), the severity of nerve damage ($P=0.075$), mechanism of injury ($P=0.668$), damaged nerve ($P=0.404$), age ($P=0.779$), duration between injury and repair ($P=0.710$), duration between repair and

electrodiagnostic studies ($P=0.523$), and surgeon's specialty ($P=0.091$).

DISCUSSION

We investigated the factors affecting the outcomes of primary nerve repair in 51 patients afflicted by upper extremity nerve injuries following penetrating trauma. Prognostic factors of the outcomes of nerve repair following penetrating trauma to the upper extremity included age, education, the type of damaged nerve, the severity of the injury, and the surgeon's specialty. In our study, most of the patients aged ≤30 years. Previous studies have widely demonstrated the highest proportion of peripheral nerve injuries in young people, especially in the age group of 20 to 30 years, who comprise the most active members of societies¹²⁻¹⁴. In the studied population, the frequency of men was about 5 times that of women. The male predominance among patients afflicted by peripheral nerve injuries is widely reported in the literature^{15, 16}. In most societies, men are more involved in occupational activities compared to women. In addition, most of the victims of accidents are reported to be young men, which leads to an increased risk of trauma and

subsequent nerve injury¹⁷. However, except for an association between older age and higher frequency of lack of motor amplitude, the present study showed no significant relationship between electrodiagnostic findings with gender and age. Where physical

examination and questionnaires have been used to evaluate postoperative neurological function, women and younger individuals have shown a better recovery from peripheral nerve injuries⁸. However, few studies that have utilized electrodiagnostic tests

Table 4: Relationship between sensory amplitude and patient’s characteristics

| Variable | | | Sensory amplitude | | | P-value |
|--------------------------|----------------------------------|------------|-------------------|-----------|-------|---------|
| | | | Normal | Decreased | None | |
| Gender | Male | Frequency | 6 | 3 | 34 | 0.232 |
| | | Percentage | 14.0 | 7.0 | 79.1 | |
| | Female | Frequency | 1 | 2 | 5 | |
| | | Percentage | 12.5 | 25.0 | 62.5 | |
| Place of residence | Urban | Frequency | 6 | 4 | 31 | 0.813 |
| | | Percentage | 14.6 | 9.8 | 75.6 | |
| | Rural | Frequency | 1 | 1 | 8 | |
| | | Percentage | 10.0 | 10.0 | 80.0 | |
| Educational level | College or university degree | Frequency | 1 | 3 | 1 | 0.002 |
| | | Percentage | 20.0 | 60.0 | 20.0 | |
| | High school diploma | Frequency | 4 | 0 | 11 | |
| | | Percentage | 26.7 | .0 | 73.3 | |
| | Lower than a high school diploma | Frequency | 2 | 2 | 27 | |
| | | Percentage | 6.5 | 6.5 | 87.1 | |
| Damaged organ | Wrist | Frequency | 5 | 2 | 25 | 0.679 |
| | | Percentage | 15.6 | 6.3 | 78.1 | |
| | Forearm | Frequency | 2 | 3 | 9 | |
| | | Percentage | 14.3 | 21.4 | 64.3 | |
| | Elbow | Frequency | 0 | 0 | 1 | |
| | | Percentage | .0 | .0 | 100.0 | |
| | Arm | Frequency | 0 | 0 | 1 | |
| | | Percentage | .0 | .0 | 100.0 | |
| | Shoulder | Frequency | 0 | 0 | 3 | |
| | | Percentage | .0 | .0 | 100.0 | |
| Severity of nerve damage | Complete | Frequency | 3 | 5 | 34 | 0.012 |
| | | Percentage | 7.1 | 11.9 | 81.0 | |
| | Partial | Frequency | 4 | 0 | 5 | |
| | | Percentage | 44.4 | .0 | 55.6 | |
| Mechanism of injury | Cut | Frequency | 5 | 5 | 36 | 0.199 |
| | | Percentage | 10.9 | 10.9 | 78.3 | |
| | Crushing | Frequency | 2 | 0 | 3 | |
| | | Percentage | 40.0 | .0 | 60.0 | |
| The damaged nerve | Radial | Frequency | 4 | 0 | 8 | 0.048 |
| | | Percentage | 33.3 | .0 | 66.7 | |
| | Median | Frequency | 2 | 5 | 20 | |
| | | Percentage | 7.4 | 18.5 | 74.1 | |
| | Ulnar | Frequency | 1 | 0 | 11 | |
| | | Percentage | 8.3 | .0 | 91.7 | |
| Age (years) | ≥30 | Frequency | 3 | 3 | 23 | 0.886 |
| | | Percentage | 10.3 | 10.3 | 79.3 | |
| | 30< | Frequency | 4 | 2 | 16 | |
| | | Percentage | 18.2 | 9.1 | 72.7 | |
| | | Frequency | 6 | 2 | 16 | 0.348 |

to determine the prognostic factors of peripheral nerve injury confirm our findings¹⁸.

In patients with low-level nerve injuries (forearm and wrist), the frequency of polyphasic waves was lower than in those with high-level injuries. Nerve

regeneration occurs at a rate of 1 mm per day while muscle atrophy initiates immediately after denervation. Owing to the longer time needed for the motor endplate to be reinnervated in traumas to the proximal parts of the extremities; it is not

Table 5: Relationship between the presence of positive sharp waves and patient's characteristics

| Variable | | Positive sharp wave | | P-value | |
|--------------------------|----------------------------------|---------------------|-------|---------|-------|
| | | No | Yes | | |
| Gender | Male | Frequency | 18 | 25 | 0.713 |
| | | Percentage | 41.9 | 58.1 | |
| | Female | Frequency | 4 | 4 | |
| | | Percentage | 50.0 | 50.0 | |
| Place of residence | Urban | Frequency | 18 | 23 | 0.556 |
| | | Percentage | 43.9 | 56.1 | |
| | Rural | Frequency | 4 | 6 | |
| | | Percentage | 40.0 | 60.0 | |
| Educational level | College or university degree | Frequency | 2 | 3 | 0.544 |
| | | Percentage | 40.0 | 60.0 | |
| | High school diploma | Frequency | 7 | 8 | |
| | | Percentage | 46.7 | 53.3 | |
| | Lower than a high school diploma | Frequency | 13 | 18 | |
| | | Percentage | 41.9 | 58.1 | |
| Damaged organ | Wrist | Frequency | 16 | 16 | 0.007 |
| | | Percentage | 50.0 | 50.0 | |
| | Forearm | Frequency | 2 | 12 | |
| | | Percentage | 14.3 | 85.7 | |
| | Elbow | Frequency | 1 | 0 | |
| | | Percentage | 100.0 | .0 | |
| | Arm | Frequency | 0 | 1 | |
| | | Percentage | .0 | 100.0 | |
| | Shoulder | Frequency | 3 | 0 | |
| | | Percentage | 100.0 | .0 | |
| Severity of nerve damage | Complete | Frequency | 16 | 26 | 0.150 |
| | | Percentage | 38.1 | 61.9 | |
| | Partial | Frequency | 6 | 3 | |
| | | Percentage | 66.7 | 33.3 | |

| Variable | | | Positive sharp wave | | P-value |
|--|-------------|------------|---------------------|------|---------|
| | | | No | Yes | |
| Mechanism of injury | Cut | Frequency | 9 | 7 | 0.641 |
| | | Percentage | 19.6 | 15.2 | |
| | Crushing | Frequency | 2 | 0 | |
| | | Percentage | 40.0 | .0 | |
| The damaged nerve | Radial | Frequency | 7 | 5 | 0.559 |
| | | Percentage | 58.3 | 41.7 | |
| | Median | Frequency | 10 | 17 | |
| | | Percentage | 37.0 | 63.0 | |
| | Ulnar | Frequency | 5 | 7 | |
| | | Percentage | 41.7 | 58.3 | |
| Age (years) | ≤30 | Frequency | 13 | 16 | 0.503 |
| | | Percentage | 44.8 | 55.2 | |
| | 30< | Frequency | 9 | 13 | |
| | | Percentage | 40.9 | 59.1 | |
| Duration between injury and repair (days) | 1 | Frequency | 13 | 11 | 0.516 |
| | | Percentage | 54.2 | 45.8 | |
| | 2 | Frequency | 1 | 3 | |
| | | Percentage | 25.0 | 75.0 | |
| | 3 | Frequency | 4 | 7 | |
| | | Percentage | 36.4 | 63.6 | |
| 4≤ | Frequency | 4 | 8 | | |
| | Percentage | 33.3 | 66.7 | | |
| Duration between repair and electrodiagnostic studies (months) | ≥2 | Frequency | 1 | 0 | 0.727 |
| | | Percentage | 100.0 | .0 | |
| | 2-4 | Frequency | 5 | 8 | |
| | | Percentage | 38.5 | 61.5 | |
| | ≥4 | Frequency | 16 | 21 | |
| | | Percentage | 43.2 | 56.8 | |
| Surgeon's specialty | General | Frequency | 3 | 8 | 0.034 |
| | | Percentage | 27.3 | 72.7 | |
| | Plastic | Frequency | 17 | 12 | |
| | | Percentage | 58.6 | 41.4 | |
| | Orthopedics | Frequency | 2 | 9 | |
| | | Percentage | 18.2 | 81.8 | |

surprising that they are associated with poorer motor recovery^{8,19}.

Consistent with the prior assumptions, patients with partial injury showed a higher chance of presenting normal sensory amplitude than those with complete injury. In severe limb trauma, which

leads to complete nerve injury, multiple tissues are usually damaged. Peripheral nerve components of this mixed injury type are often the most difficult to diagnose and treat. This fact is justified by the difficulty in differentiating partial from complete damages without surgical exploration and the

dubious nature of nerve healing^{20, 21}. In the current study, the majority of patients with ulnar nerve injury showed no sensory amplitude. A vast body of evidence indicates that the outcome of radial nerve injuries is better than the median

nerve and the ulnar nerve has the poorest prognosis. However, the existing data are mostly focused on the motor component of the nerves, and there is a lack of data on factors affecting the rate of recovery of peripheral nerve function after primary repair due

Table 6: Relationship between the presence of polyphasic waves and patient's characteristics

| Variable | | | Polyphasic wave | | P-value | |
|----------------------------------|------------------------------|------------|-----------------|-------|---------|-------|
| | | | Yes | No | | |
| Gender | Male | Frequency | 21 | 22 | 0.626 | |
| | | Percentage | 48.8 | 51.2 | | |
| | Female | Frequency | 4 | 4 | | |
| | | Percentage | 50.0 | 50.0 | | |
| Place of residence | Urban | Frequency | 21 | 20 | 0.725 | |
| | | Percentage | 51.2 | 48.8 | | |
| | Rural | Frequency | 4 | 6 | | |
| | | Percentage | 40.0 | 60.0 | | |
| Educational level | College or university degree | Frequency | 3 | 2 | 0.836 | |
| | | Percentage | 60.0 | 40.0 | | |
| | High school diploma | Frequency | 7 | 8 | | |
| | | Percentage | 46.7 | 53.3 | | |
| Lower than a high school diploma | Frequency | 15 | 16 | 0.014 | | |
| | Percentage | 48.4 | 51.6 | | | |
| Damaged organ | Wrist | Frequency | 17 | 15 | 0.014 | |
| | | Percentage | 53.1 | 46.9 | | |
| | Forearm | Frequency | 3 | 11 | | |
| | | Percentage | 21.4 | 78.6 | | |
| | Elbow | Frequency | 1 | 0 | | |
| | | Percentage | 100.0 | .0 | | |
| | Arm | Frequency | 1 | 0 | | |
| | | Percentage | 100.0 | .0 | | |
| Shoulder | Frequency | 3 | 0 | | | |
| | Percentage | 100.0 | .0 | | | |
| Severity of nerve damage | Complete | Frequency | 18 | 24 | 0.075 | |
| | | Percentage | 42.9 | 57.1 | | |
| | Partial | Frequency | 7 | 2 | | |
| | | Percentage | 77.8 | 22.2 | | |
| Mechanism of injury | Cut | Frequency | 22 | 24 | 0.668 | |
| | | Percentage | 47.8 | 52.2 | | |
| | Crushing | Frequency | 3 | 2 | | |
| | | Percentage | 60.0 | 40.0 | | |
| The damaged nerve | Radial | Frequency | 8 | 4 | 0.404 | |
| | | Percentage | 66.7 | 33.3 | | |
| | Median | Frequency | 12 | 15 | | |
| | | Percentage | 44.4 | 55.6 | | |
| | Ulnar | Frequency | 5 | 7 | | |
| | | Percentage | 41.7 | 58.3 | | |
| Age (years) | ≥30 | Frequency | 15 | 14 | 0.779 | |
| | | Percentage | 51.7 | 48.3 | | |
| | 30< | Frequency | 10 | 12 | | |
| | | Percentage | 45.5 | 54.5 | | |
| | | | Frequency | 13 | 11 | 0.710 |

| | Variable | | Polyphasic wave | | P-value |
|--|-------------|------------|-----------------|------|---------|
| | | | Yes | No | |
| Duration between injury and repair (days) | 1 | Percentage | 54.2 | 45.8 | |
| | | Frequency | 2 | 2 | |
| | 2 | Percentage | 50.0 | 50.0 | |
| | | Frequency | 6 | 5 | |
| | 3 | Percentage | 54.5 | 45.5 | |
| | | Frequency | 4 | 8 | |
| 4≤ | Percentage | 33.3 | 66.7 | | |
| | Frequency | 1 | 0 | | |
| Duration between repair and electrodiagnostic studies (months) | ≥2 | Percentage | 100.0 | .0 | 0.523 |
| | | Frequency | 5 | 8 | |
| | 2-4 | Percentage | 38.5 | 61.5 | |
| | | Frequency | 19 | 18 | |
| | ≥4 | Percentage | 51.4 | 48.6 | |
| | | Frequency | 3 | 8 | |
| Surgeon's speciality | General | Percentage | 27.3 | 72.7 | 0.091 |
| | | Frequency | 18 | 11 | |
| | Plastic | Percentage | 62.1 | 37.9 | |
| | | Frequency | 4 | 7 | |
| | Orthopedics | Percentage | 36.4 | 63.6 | |
| | | Frequency | | | |

to penetrating trauma of the upper limb^{22, 23}.

Based on the findings of this study, the duration between injury and repair did not appear to have a significant influence on the surgical outcomes. However, it should be noted that the majority of our subjects had undergone nerve repair within days of injury, while many studies have demonstrated that delay of up to 6 months does not affect the repair outcomes¹⁹.

The patients operated by plastic surgeons showed the highest frequency of normal motor amplitude and the lowest frequency of positive sharp waves. Peripheral nerve injury is a multi-disciplinary condition, which can be managed by several clinical disciplines, including plastic surgeons, orthopedic surgeons, and neurosurgeons. Although surgeon's experience can highly affect the surgical success rate, the surgeon's speciality has not been linked to the patient's outcomes previously^{24, 25}. Hence, our finding may be due to the limited sample size in this study.

LIMITATIONS

The limitation of this study was the use of data from a single center and limited sample size. However, different demographic and clinical variables were investigated to aid in determining the prognostic factors of nerve injury in the studied population.

CONCLUSION

Factors affecting the outcome of peripheral nerve repair following penetrating trauma to the upper extremity include age, education, the type of damaged nerve, the severity of the injury, and the surgeon's speciality.

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CONFLICT OF INTEREST

The authors attest that they have no conflict of interest to declare.

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