

# Compressive Peripheral Nerve Injuries in Earthquake Victims in Kahramanmaraş Earthquake on February 6, Our Clinical Observations

id Nilüfer Aygün Bilecik<sup>1</sup>, id Meryem Kösehasanoğulları<sup>1</sup>

<sup>1</sup> Department of Physical Medicine and Rehabilitation, University of Health Sciences, Adana City E & R Hospital, Adana, Türkiye

## Abstract

**Aim:** Earthquakes are one of the most common causes of mortality and morbidity due to natural disasters. In particular soft tissue and musculoskeletal injuries are the most common types of injuries following earthquakes and the most common reason for hospital admission. Turkey is a region with a very high risk of earthquakes.

Compression is one of the most common causes of mechanically induced peripheral nerve injuries. Peripheral nerve injuries cause long-term disruptions in daily life, professional development, and education. These injuries are the important causes of labor loss, especially in young adult patients. The purpose of our study is to emphasize the importance of early diagnosis and treatment for these injuries by sharing our observations on compressive peripheral nerve injuries seen in earthquake victims after the Kahramanmaraş earthquakes on February 6.

**Methods:** We included patients with peripheral nerve injury who were admitted to the physical therapy clinic of Adana City Hospital for three months starting from February 6, 2023.

**Results:** The mean age of the injured was 32.64±17.63 years. The median time of being pulled from the rubble was 24 hours. 95.5% were living in Hatay province. The most common sites of peripheral nerve injury were legs (43.3%), arms (17.9%) and forearms (16.4%). 31.3% of the injured had bone fractures. The most common complaints were weakness in the legs (31.3%), foot drops (29.9%), and wrist drops (20.9%).

**Conclusions:** Earthquake is a natural disaster that can cause blunt and penetrating injuries and serious peripheral nerve injuries. Thus, it should be kept in mind that these injuries, which significantly affect the quality of life, are quite common and may be overlooked during the acute phase after earthquakes.

**Keywords:** Earthquake, Peripheral Nerve Injuries, 6 February 2023, Kahramanmaraş

## 1. Introduction

On February 6, 2023, a devastating earthquake with a magnitude of 7.8 on the Richter moment magnitude scale (Mw) struck southern, southeastern, and central Turkey and northwestern Syria. This massive earthquake, with the epicenter in Kahramanmaraş, affected 10 cities with a population of 15 million (approximately 17.6% of Turkey's total population). Nine hours after the first earthquake, a second earthquake with a magnitude of 7.7 Mw occurred 95 km northeast of Kahramanmaraş province, causing an even more devastating picture. Although the numbers are not yet clear, tens of thousands of lives were lost, and the earth-

quake was described as the disaster of the century in terms of material losses<sup>1</sup>. The mainshock was the largest earthquake to hit Turkey since the 1939 Erzincan earthquake, the second most powerful earthquake in the country's history after the 1668 North Anatolian earthquake. It was followed by more than 10,000 aftershocks. It caused widespread damage over an area of approximately 350,000 km<sup>2</sup>, which is almost equal to the size of Germany. As of March 30, more than 50,000 deaths and approximately 115,000 injuries were recorded in Türkiye<sup>2</sup>. In the first earthquake in Türkiye, people were asleep and could not escape. Thousands of buildings and even some hospitals in the affected cities collapsed. Thousands of people were trapped under the rubble for hours or even days. Because hospitals were also damaged, earthquake victims were transferred to hospitals in other provinces<sup>3</sup>.

In particular, soft tissue and musculoskeletal injuries are the most common types of injuries that lead to hospital admission after earthquakes. Many patients with blunt and penetrating trauma and crush injuries have complications leading to additional morbidity and mortality<sup>4</sup>. Peripheral nerve injuries are quite common complications after earthquakes. Peripheral nerve injuries can be divided into subgroups as root injuries and peripheral nerve injuries. Compression is

\* Corresponding Author: Nilüfer Aygün Bilecik, e-mail: drnilaygun@gmail.com  
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one of the most common causes of mechanically induced peripheral nerve injuries. The primary mechanisms of action of compression include the inhibition of axonal transport and vascular flow. The literature shows that the increasing duration and severity of compression causes increasing nerve damage and prolonged recovery time, and nerve damage may be irreversible in continuous compression<sup>5</sup>. Peripheral nerve injuries cause long-term disruptions in daily life, professional development, and education<sup>6</sup>. Lumbar and sacral plexus, sciatic nerve, peroneal nerve, radial nerve, and radial nerve injuries are the major nerve injuries that cause severe loss of limb function, gait disturbance and loss of fine motor skills. These injuries are the important causes of labor loss, especially in young adult patients. These injuries can be treated with early diagnosis and correct rehabilitation techniques; thus, they should not be overlooked in disasters with serious mortality rates such as earthquakes. Lifestyle is dramatically affected after an earthquake due to the necessity of evacuation and relocation. It is reported that this situation results in a decrease in physical activity level<sup>7</sup>. Additionally, complications such as peripheral nerve damage may be overlooked in this process. Thus, earthquake victims in need of rehabilitation should be quickly identified and treated in safe physical therapy and rehabilitation centers. This study aims to examine earthquake victims with peripheral nerve injuries who were admitted to and treated in Adana City Training and Research Hospital, which shouldered nearly the entire burden of the region in the first three months after the earthquake. It is to emphasize peripheral nerve injuries in possible earthquakes that may occur later.

## 2. Materials and methods

We retrospectively analyzed the records of 67 earthquake survivors with peripheral nerve injuries, who were admitted to the Physical Therapy Clinic of Adana City Training and Research Hospital for 3 months as of February 6, 2023. We evaluated patients' demographic data, the duration of being under the rubble, fasciotomy and fracture history, level of injury, strength and sensory examinations, electromyography (EMG) results, if any, and VAS pain scores. We excluded patients with pre-existing peripheral nerve injury and those with peripheral nerve injury secondary to any trauma other than entrapment during or after the earthquake.

### 2.1. Statistical Analysis

Continuous variables mean  $\pm$  standard deviation, median (min-max); categorical data number and expressed as a percentage.

## 3. Results

The mean age of the injured was  $32.64 \pm 17.63$  years (min=1-max=75). The median time of being pulled from the rubble was 24 hours (1-180 hours). The median VAS pain score was 5 (0-10). 61.2% of the injured were female. 95.5% were living in Hatay province. 50.7% of the injured had a history of surgery (31.3% fasciotomy, 19.4% fracture surgery). The most common sites of peripheral nerve injury were legs (43.3%), arms (17.9%) and forearms (16.4%). 31.3% of the injured had bone fractures. The most common complaints were weakness in the legs (31.3%), foot drops (29.9%), and wrist drops (20.9%). EMG results were available only for 44.8% of the injured (most commonly brachial plexus neuropathy/lesion with 12%, followed by sciatic neuropathy with 7.5%). 58.2% had crush syndrome. 79.1% had a loss of muscle strength ranging from 1 to 4 out of 5. 52.2% had hypoesthesia in the sensory examination. 81.8% had pain and 51.5% had numbness (Table 1).

## 4. Discussion

Earthquakes are devastating natural disasters that have caused the loss of more than a million lives over the past few decades<sup>8-11</sup>. Peripheral nerve injuries are one of the important causes of morbidity induced by compression for a long time after an earthquake. Acute compressions occur after a short-term compression, as seen in radial mononeuropathy. It is typically manifested by numbness, tingling, or severe loss of strength. The healing process can take weeks and even years<sup>12</sup>.

Apart from the high number of people injured in earthquakes, damaged and unusable buildings of medical facilities that respond to these injured people cause the disruption of health services<sup>(13,14)</sup>. Additionally, post-earthquake chaos and the insufficient number of medical personnel due to injuries and deaths cause the disruption in the health service to deepen even more. The impact of the earthquake on medical personnel, the need to transport a large number of patients at the same time, traffic and logistics problems, as well as the disruption of the communication system between health centers and the damage to other administrative buildings in settlements cause the adverse effects of the earthquake to increase even more<sup>13,14</sup>. In this study, 95.5% of the patients were transported to Adana from Hatay, which is one of the provinces with the highest damage caused by the earthquake. Important causes of morbidity such as peripheral nerve injuries may have been ignored in this process in which life-threatening injuries were first treated.

Apart from mortality, long-term morbidity is also a devastating effect of earthquakes. In our study, we found that 31.3% of the patients had a loss of strength in the leg, 29.9% had foot drops, and 20.9% had wrist drops.

Peripheral nerve injuries may occur secondary to crushing, ischemia, bone fractures and compartment syndromes<sup>15</sup>. In persistent ischemic nerve conduction block, there is a slow progressive process such as an enlarging hematoma, bleeding in the compartment or scar formation. Nerve damage lasts for weeks or months<sup>16</sup>. In our study, 31.3% of the patients had a history of fasciotomy and 19.4% had a history of bone fracture.

Crush injuries are the most common type of peripheral nerve injuries. It is accepted that two mechanisms, namely mechanical crushes and ischemia, could be the primary factors in these injuries. In short-term ischemia, changes are usually reversible. According to the literature, as the duration and severity of compression increase, nerve damage increases and the time of recovery is prolonged, and nerve damage may be irreversible in cases of continuous compression<sup>17</sup>.

However, in this study, we observed that the duration of being trapped under the rubble was quite variable and extended and ranged from 1 to 180 hours. We believe that the healing process of nerve injuries that may be due to crushing and ischemia that occur during this process may be long.

Electroneuromyography (ENMG) is an important technique to evaluate the neurophysiological condition of the peripheral nervous system. It is indispensable for determining the diagnosis and prognosis, deciding on treatment, and monitoring the effectiveness of the current treatment<sup>18,19</sup>. However, in our study, 55.2% of the patients did not have an ENMG. Brachial plexus injury was detected in 12% of the patients who underwent ENMG. Considering that the majority of the patients were young adults, this situation means a significant loss of labor force. The scarcity of similar studies in the literature requires attention. We believe that peripheral nerve injuries may have been overlooked in the acute period due to the high number of damaged buildings, including hospitals, and the high rate of life-threatening situations during the Kahramanmaraş earthquakes on February 6.

**Table 1****Some Demographic and Clinical Characteristics of the Patient Group**

		Patient Group (n=67)
Age (years) (Mean±Sd)		32.64±17.63
Time of being pulled from the rubble (hours) [median (min-max)]		24 (1-180)
Pain VAS [median (min-max)]		5 (0-10)
Sex (n, %)	Female	41 (61.2)
	Male	26 (38.8)
Province of the earthquake (n, %)	Hatay	64 (95.5)
	Kahramanmaraş	3 (4.5)
	No	33 (49.3)
History of surgery (n, %)	Yes (fasciotomy)	21 (31.3)
	Yes (fracture surgery)	13 (19.4)
	Ankle	1 (1.5)
	Leg	29 (43.3)
	Cruris	9 (13.4)
Location of peripheral nerve injury (n, %)	Elbow	1 (1.5)
	Lower foot	1 (1.5)
	Lower hand	1 (1.5)
	Hip	1 (1.5)
	Arm	12 (17.9)
	Arm and leg	1 (1.5)
	Forearm	11 (16.4)
	No	46 (68.7)
	Acetabulum	1 (1.5)
	Femur	3 (4.5)
Bone Fracture (n, %)	Humerus	3 (4.5)
	Clavicle, Pubis	2 (3.0)
	Pelvis	1 (1.5)
	Pubis	4 (6.0)
	Radius	3 (4.5)
	Sacrum	1 (1.5)
	Tibia	3 (4.5)
	Leg weakness	21 (31.3)
	Foot drop	20 (29.9)
	Wrist drop	14 (20.9)
Complaints (n, %)	Hand weakness	1 (1.5)
	Arm and leg weakness	2 (3.0)
	Arm weakness	9 (13.4)
	N/A	37 (55.2)
	Brachial plexus neuropathy/lesion	8 (12.0)
	Brachial plexus and lumbosacral plexus neuropathy	1 (1.5)
	Severe deep peroneal neuropathy	1 (1.5)
	Lumbosacral plexus damage	3 (4.5)
	Partial peroneal neuropathy	1 (1.5)
	Radial neuropathy	3 (4.5)
EMG results (n, %)	Radial and ulnar neuropathy	1 (1.5)
	Sacral plexus neuropathy	3 (4.5)
	Sacral plexus neuropathy - sciatic neuropathy	1 (1.5)
	Sciatic neuropathy	5 (7.5)
	Sciatic and peroneal neuropathy	2 (3.0)
	Severe ulnar neuropathy	1 (1.5)
	No	28 (41.8)
	Yes	39 (58.2)
	0/5	14 (20.9)
	1/5	15 (22.4)
Muscle strength (n, %)	2/5	25 (37.3)
	3/5	9 (13.4)
	4/5	4 (6.0)
	Normal	30 (44.8)
Sensory examination (n, %)	Hypoesthesia	35 (52.2)
	Anesthesia	1 (1.5)
	Not assessed	1 (1.5)
Pain (n, %)	No	12 (18.2)
	Yes	54 (81.8)
Numbness (n, %)	No	32 (48.5)
	Yes	34 (51.5)

## 5. Conclusions

Hospitals are specialized facilities that must be designed to resist earthquakes and remain operational during and after a seismic event. To minimize the risk of damage and disruption, hospitals should be constructed to meet the standards of seismic safety. In addition to building designs, emergency response plans for earthquakes and other disasters should be prepared in advance. Mortality and morbidity can be reduced through the rapid and effective triage of patients and prompt identification and treatment of life-threatening conditions. The possibility of peripheral nerve injuries, which are important causes of morbidity, should be considered during patient follow-up.

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## Statement of ethics

The study was approved by the University of Health Sciences, Adana Education and Research Hospital Ethics Committee (IEAH-2023-128-2631).

## Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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## Author contributions

Concept: NAB,MK, Design: NAB,MK, Writing: NAB, Critical review: NAB,MK, All authors read and approved the final manuscript.

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