Received: 03 July 2023 | **Accepted:** 21 Nov 2023 **Genel Tıp Derg. Volume** 34/**Issue** 1 (February), 27-31
DOI: 10.54005/geneltip.1322059

ORIGINAL ARTICLE

Descriptive Characteristics and Injury Patterns of Earthquake-Related Peripheral Nerve Injuries in the Extremities

Ekstremitelerde Depremle İlişkili Periferik Sinir Yaralanmalarının Tanımlayıcı Özellikleri ve Yaralanma Paternleri

[1]Mehmet Özel, [2]Mustafa Altıntaş

[1]Department of Emergency Medicine, Diyarbakır Gazi Yasargil Training and Research Hospital, University of Health Sciences, Diyarbakır, Turkey
[2]Department of Orthopedic Surgery, Diyarbakır Gazi Yasargil Training and Research Hospital, University of Health Sciences, Diyarbakır, Turkey.

Correspondence

Mehmet Özel, Department of Emergency Medicine, University of Health Sciences, Diyarbakır Gazi Yasargil Training and Research Hospital, Diyarbakır, Turkey

E-Mail: drmehmetozel@yahoo.com.tr

How to cite ?

Ozel M, Altıntaş M. Descriptive Characteristics and Injury Patterns of Earthquake-Related Peripheral Nerve Injuries in the Extremities. Genel Tıp Derg. 2024;34(1):27-31.

ABSTRACT

Background/Aims: Due to the prioritization of limb and life-saving efforts by medical teams, peripheral nerve injuries (PNIs) resulting from earthquakes are frequently overlooked or receive delayed treatment. Thus, we examined earthquake-related PNIs in terms of their descriptive characteristics and injury patterns
Methods: The study was conducted retrospectively in a tertiary hospital after Kahramanmaraş Earthquakes. The study included victims under rubble admitted to the hospital and diagnosed with PNI according to their medical records between 06 February and 28 February 2023.
Results: The study included 70 patients and a total of 98 limbs with PNIs, with a mean patient age of 22.31±14.91 years. 77.6% (n=76) of PNIs involved the lower limb (68 peroneal and 8 sciatic nerves) and 22.4% (n=22) of PNIs involved the upper limbs (14 radial nerves, 5 ulnar nerves, 2 median nerves, 1 brachial plexus). It was found that 45.9% of PNIs (n=45) occurred in the right and 54.1% (n=53) in the left extremities. The average time patients spent under the rubble was 15 hours (IQR 8.75 - 32 hours). Fasciotomy was treated in 54.1% (n=43) of the extremities with PNI. Fasciotomies were most commonly performed on the cruris (42.9%), foot (26.5%), and thigh (16.3%).
Conclusion: This study found that PNIs occurred most frequently in the lower limbs, compared with the upper limbs, among earthquake victims with CLIs. Lower limb PNIs mainly occurred in the peroneal nerve, while upper limb PNIs mainly occurred in the radial nerve.

Keywords: Crush injury, Peripheral nerve injury, Earthquake, Victims, Extremity

ÖZ

Amaç: Sağlık ekipler tarafından ekstremite ve hayat kurtarma çabalarının önceliklendirilmesi nedeniyle, depremlerden kaynaklanan periferik sinir yaralanmaları (PSY), sıklıkla göz ardı edilmekte veya tedavileri gecikmektedir. Bu nedenle, depreme bağlı PSY'leri tanımlayıcı özellikleri ve yaralanma paternleri açısından inceledik.
Yöntemler: Çalışma, Kahramanmaraş Depremleri sonrasında bir üçüncü basamak hastanede retrospektif olarak yürütüldü. Çalışmaya 06 Şubat ve 28 Şubat 2023 tarihleri arasında hastaneye kabul edilen ve tıbbi kayıtlarına göre PSY tanısı konulan enkaz altında kalan mağdurlar dahil edildi.
Sonuçlar: Çalışmaya 70 hasta ve toplamda 98 ekstremitede PSY olan hastalar dahil edildi ve hastaların yaş ortalaması 22.31±14.91 yıldı. PSY'lerin %77.6'sı (n=76) alt ekstremiteyi (68 peroneal ve 8 siyatik sinir) etkilerken, PSY'lerin %22.4'ü (n=22) üst ekstremiteyi (14 radial sinir, 5 ulnar sinir, 2 median sinir, 1 brakiyal pleksus) etkilediği bulundu. PSY'lerin %45.9'unun (n=45) sağ ekstremitede, %54.1'inin (n=53) sol ekstremitede meydana geldiği saptandı. Hastaların enkaz altında geçirdiği medyan süre 15 saat (IQR 8.75 - 32 saat) idi. PSY olan ekstremitelerin %54.1'inde (n=43) fasiotomi tedavisi uygulandı. Fasiotomiler en sık olarak krus (42.9%), ayak (26.5%) ve uyluk (16.3%) üzerinde gerçekleştirildi.
Tartışma: Bu çalışmada, deprem mağdurlarında PSY'lerin, üst ekstremitelere kıyasla alt ekstremitelerde daha sık meydana geldiğini bulunmuştur. Alt ekstremite PSY'leri genellikle peroneal sinirde, üst ekstremite PSY'leri ise genellikle radial sinirde meydana geldiği bulunmuştur.

Anahtar kelimeler: Ezilme yaralanması, Periferik sinir yaralanması, Deprem, Mağdurlar, Ekstremite

Introduction

Earthquakes, as natural disasters, can inflict extensive damage to structures and result in numerous casualties (1). In Turkiye, a catastrophic and massive earthquake struck on February 6, 2023, leading to the collapse of thousands of buildings. Tragically, many people were unable to escape or seek safety during one of these earthquakes that occurred in the early morning hours while they were sleeping in their homes. Consequently, a significant number of people became trapped under debris, requiring hours to days for rescue operations (2,3).

Among victims of collapsed buildings, crush limb injuries emerge as the most prevalent type of injury resulting from earthquakes (4). Factors such as individuals' positions during the earthquake or challenges in evacuation and transportation methods for the injured victims could contribute to this trend (5-7). Crushed limb injuries (CLIs) encompass various combinations of injuries involving blood vessels, nerves, bones, and soft tissues in the extremities (8). Notably, peripheral nerve injuries (PNIs) in the extremities play a crucial role in these CLIs caused by earthquakes, necessitating specialized attention during

Peer-Review: Double anonymized - Two External
Plagiarism Checks: Yes - iThenticate
Complaints: geneltip@selcuk.edu.tr

Selcuk University Press
Genel Tıp Dergisi | e-ISSN: 2602-3741
https://dergipark.org.tr/tr/pub/geneltip
https://yayinevi.selcuk.edu.tr/

the treatment and rehabilitation processes (9). PNIs can lead to serious consequences, including sensory loss, restricted mobility, and functional impairments (9,10).

Victims with PNIs often present with multiple injuries or complex crush injuries in disaster situations. As medical or surgical teams prioritize saving limbs and lives, PNI can often go undiagnosed or treated late. A series of symptoms such as muscle weakness, loss of sensation, and decreased reflexes associated with nerve damage and should be considered in early and rapid diagnosis of PNIs (11). PNIs following earthquakes tend to occur more commonly in the lower extremities than in the upper extremities according to recent studies (10,12). After earthquakes, studies on PNIs among earthquake victims have consistently identified radial nerve injury, ulnar nerve injury, and peroneal nerve injury as commonly observed types of nerve damage (2,4,7,13).

This study investigated the descriptive characteristics and injury patterns of earthquake-related PNIs. The results of the study may help in the early recognition, effective management, and rehabilitation of individuals with PNI following future earthquakes.

Material and Methods

This retrospective research was carried out at a tertiary medical facility hosting a level I trauma center in Diyarbakır, one of the ten provinces impacted by the earthquake in the southeastern region of Anatolia, Turkiye. Study procedures were followed by the Declaration of Helsinki. Prior to the implementation of the study, an ethics committee approval (May 5, 2023, number 392), as well as institutional permission were obtained.

Earthquake victims from under the rubble and admitted to the hospital between 06 February and 28 February 2023, who were diagnosed with PNI according to the medical records were included in the study. This study excluded patients who underwent amputation and were referred from another medical center, as well as patients who arrived at the emergency department (ED) already intubated. Patients with spinal injuries were also excluded from the study.

Medical records provided information such as age, gender, time under the rubble (time since the earthquake until rescued from under the rubble), ED outcome, and length of hospital stay (LOS). The location and side of the nerve damage and which nerve was affected were also recorded. Medical records indicate that only physical examinations focused on motor deficits for PNIs were conducted in patients with CLIs because sensory examinations were misleading. An entry was made for each limb with a PNI in the data.

Additionally, surgery records were reviewed for the presence of fasciotomy procedures, location and timing of fasciotomies. Orthopedic surgeons evaluate and treat CLIs for compartment syndrome. The treating orthopedic surgeons decided on a fasciotomy according to hospital guidelines. Depending on whether a limb with PNI was treated with fasciotomy, the patients were divided into two groups.

Statistical Analysis

Statistical analyses were performed using the Statistical Program for Social Sciences (SPSS v29, IBM Corp., Armonk, NY). Categorical variables were described using percentages and counts while continuous variables were summarized using mean ± standard deviation or median (Interquartile Range [IQR] 25th – 75th). The assumption of normal distribution was evaluated through a histogram and the Shapiro-Wilk test. For the comparison of independent binary groups, the t-test, and Mann-Whitney U test was employed for continuous variables. In contrast, Fisher's exact test and chi-square tests were utilized for categorical variables. All statistical comparisons were conducted using a two-tailed approach, with a significance level set at <0.05.

Results

290 patients were admitted to the emergency department during the earthquake due to being trapped under rubble, and 105 patients had CLIs. A total of 70 patients and 98 limbs with PNIs were included in the study. The mean age of the patients was 22.31±14.91 years. In this study, males accounted for 45.9% (n=45) and females accounted for 54.1% (n=43). 77.6% (n=76) of PNIs involved the lower limb (68 peroneal and 8 sciatic nerves) and 22.4% (n=22) of PNIs involved the upper limbs (14 radial nerves, 5 ulnar nerves, 2 median nerves, 1 brachial plexus). PNIs were observed in 11.2% (n=11) right upper extremity, 11.2% (n=11) left upper extremity, 34.7% (n=34) right lower extremity, and 42.9% (n=42) left lower extremity. It was found that 45.9% of PNIs (n=45) occurred in the right and 54.1% (n=53) in the left extremities.

The median time under the rubble of the patients was 15 hours (IQR 8.75- 32 hours). Fasciotomy was performed on 54.1% (n=43) of the extremities with PNI. Fasciotomies were most commonly performed on the cruris (42.9%), foot (26.5%), and thigh (16.3%). Among patients who underwent fasciotomy, the median time between hospital admission and fasciotomy was 3 hours (IQR 2 - 6.5 hours). 33.7% (n = 33) of PNIs admitted to the ED were transferred to the ward while 66.3% (n = 65) were transferred to the intensive care unit (ICU). The median LOS was 12.5 days (IQR 9 - 20.5 days), and the median length of ICU stay was 10 days (IQR 6.5 - 12.5 days).

Based on whether a limb with PNI was treated with fasciotomy, the study identified two groups: the fasciotomy group (n=53, 54.1%) and the non-fasciotomy group (n=45, 45.9%). In the non-fasciotomy group, the median age was 21 years (IQR 11 - 31.5) while in the fasciotomy group, it was 17 years (IQR 10 - 29). The age difference between the groups was not statistically significant (p=0.504).

Among the non-fasciotomy group, 28.9% (n=13) of PNIs occurred in the upper extremities and 71.1% (n=32) in

the lower extremities. Among the fasciotomy group, it was found that 17% (n=9) of PNIs occurred in the upper extremities and 83% (n=44) in the lower extremities. The groups did not differ statistically (p=0.159). In the non-fasciotomy group, It was determined that 46.7% (n=21) of PNIs occurred in the right and 53.3% (n=24) in the left extremities. In the fasciotomy group, 45.3% (n=24) of PNIs occurred in the right and 54.7% (n=29) in the left extremities. No statistically significant difference was observed between the groups (p=0.891). In terms of time spent under the rubble, no statistically significant difference was observed between the non-fasciotomy group [15 hours (IQR 9 - 30 hours)] and the fasciotomy group [15 hours (IQR 8 - 32 hours)] (p=0.645). The median LOS in the non-fasciotomy group (11 days [IQR 9 - 15 days]) was statistically significantly lower than the fasciotomy group (13 days [IQR 10 - 26 days]) (p=0.033). Non-fasciotomy group (10 days [IQR 6.75 - 13.25 days]) and the fasciotomy group (10 days [IQR 6.75 - 13.25 days]) had no statistically significant difference in median length of ICU stay (p=0.107).

Table 1. Descriptive Characteristics, Injury Patterns, and Clinical Features of Patients

		n=98
Age		22.31±14.91
Gender	Male	45 (45.9%)
	Female	43 (54.1%)
Location of peripheral nerve injury (extremity)	Right Upper	11 (11.2%)
	Left Upper	11 (11.2%)
	Right Lower	34 (34.7%)
	Left Lower	42 (42.9%)
Peripheral nerve injury/Upper extremity	Total	22 (22.4%)
	Radial	14 (14.3%)
	Ulnar	5 (5.1%)
	Median	2 (2.0%)
	Brachial	1 (1.0%)
Peripheral nerve injury/Lower Extremity	Total	76 (77.6%)
	Peroneal	68 (69.4%)
	Sciatic	8 (8.2%)
Side	Right	45 (45.9%)
	Left	53 (54.1%)
Time under the rubble		15 (8.75-32)
Fasciotomy		53 (54.1%)
	Cruris	42 (42.9%)
	Foot	26 (26.5%)
	Thigh	16 (16.3%)
	Hand	8 (8.2%)
	Forearm	5 (5.1%)
	Arm	2 (2%)
Timing of fasciotomy		3 (2 - 6.5)
Admission	Ward	33 (33.7%)
	ICU	65 (66.3%)
Length of hospital stay		12.5 (9 - 20.25)
Length of ICU stay		10 (6.5 - 12.5)

ICU: Intensive Care Unit

Table 2. Evaluation of Non-Fasciotomy and Fasciotomy Groups with Descriptive Characteristics, Injury Patterns, and Clinical Features

		Non-fasciotomy group (n=45)	Fasciotomy group (n=53)	P
Age		21 (11 - 31.5)	17 (10 - 29)	0.504
Gender	Female	20 (44.4%)	33 (62.3%)	0.078
	Male	25 (55.6%)	20 (37.7%)	
Location of peripheral nerve injury (extremity)	Upper	13 (28.9%)	9 (17%)	0.159
	Lower	32 (71.1%)	44 (83%)	
Side	Right	21 (46.7%)	24 (45.3%)	0.891
	Left	24 (53.3%)	29 (54.7%)	
Time under the rubble		15 (9 - 30)	15 (8 - 32)	0.645
Admission	Ward	18 (40%)	15 (28.3%)	0.222
	ICU	27 (60%)	38 (71.7%)	
Length of hospital stay		11 (9 - 15)	13 (10 - 26)	0.033
Length of ICU stay		8 (6 - 10)	10 (6.75-13.25)	0.107

ICU: Intensive Care Unit

Discussion

Patients with complex polytrauma following earthquakes can face challenges in diagnosing and treating PNIs. To minimize further neurological damage and secondary complications, early detection and intervention are crucial in the early stages of PNIs. In this study, earthquake victims of collapsed buildings with peripheral nerve injuries were examined for their descriptive characteristics, injury patterns and clinical manifestations. The results showed that PNIs more commonly occurred in the lower limbs than in the upper limbs. The majority of PNIs involved the lower limb (77.6%), particularly the peroneal nerve. In contrast, a smaller percentage of PNIs affected the upper limbs (22.4%). PNIs in the upper limb mostly occurred in the radial nerve. Fasciotomies were performed on 54.1% of extremities with peripheral nerve injuries caused by being trapped under rubble. Cruris, foot, and thigh were the most common sites for fasciotomy. A significant proportion (66.3%) of PNIs were transferred to the intensive care unit while the rest were sent to the ward.

Earthquakes can entrap victims under the rubble, resulting in peripheral nerve injuries. These injuries can be caused by complex limb trauma, crush injuries, or deep soft tissue injuries (14). Mechanical compression and ischemia are thought to be the pathological mechanisms underlying these injuries. It is possible to lose both motor and sensory function completely, but the pathophysiology behind these deficits is unclear since nerve continuity is preserved (15). In a recent research, the authors claimed that earthquake-induced PNIs could be caused by three factors. Firstly, diffuse forces directly affected nerve bundles. The vascular bed of the nerve was damaged by most soft tissue injuries, affecting the blood supply to the nerve. Lastly, intense compression damages nerves in and around them (16). The prolonged period of rescue time under the rubble, there is a high risk of peripheral nerve injury from mechanical compression and ischemia.

Further, it is crucial to consider that nerve damage after recovery from an ischemic limb occurs during the reperfusion period (15,16). In this study, the median time under the rubble of the victims was 15 hours. It was observed that 70 victims had PNIs with 98 limbs affected. These findings suggest that the prolonged period of time spent under the rubble is a major factor in peripheral nerve injury. Therefore, it is essential to prioritize rescue efforts for trapped individuals.

In this study, the majority of PNIs involved the lower limb (77.6%). Recent studies suggest that PNIs occur more frequently in the lower extremities after earthquakes (10,12,13,17). This is probably because the lower limbs are usually in more direct contact with the ground during an earthquake, increasing the risk of injury.

In this study, lower limb PNIs mainly occurred in the peroneal nerve and sciatic nerve. In the lower extremities, sciatic nerve and peroneal nerve injuries have been identified as the most common forms of PNI caused by earthquakes (13,16,18,19). During hip flexion, the sciatic nerve on the extensor side is under tension. As a result of squatting under rubble to protect themselves from earthquakes, the sciatic nerve remains tense. Sciatic nerve injury can occur if tension is placed on it for an extended period of time (16). The peroneal nerve crosses the gastrocnemius muscle on the outside of the popliteal fossa, branching off the sciatic nerve. Only the skin and superficial fascia protect the nerve below the knee, around the head and neck of the fibula (20). This is because the peroneal nerve is most vulnerable in this area as it is relatively unprotected compared to other nerves in the body.

In this study, PNIs in the upper limb mainly occurred in the radial nerve. According to recent studies, radial nerve injury has been identified as one of the most prevalent nerve damages in the upper limbs following earthquakes (4,7,13). This is likely because the radial nerve is located close to the bone, and therefore it is more susceptible to damage from compression between soft tissue and bone in crush injuries. The radial nerve is also more vulnerable to friction and stretch injuries, which is one of the most common causes of nerve injury in crushed limb trauma. Moreover, this nerve is relatively superficial in the upper limb, and thus more prone to direct trauma.

During compartment syndrome, ischemia leads to muscle and nerve necrosis because pressure builds up in a non-compliant osseofascial compartment. In cases of acute compartment syndrome, fasciotomy is performed as an emergency procedure. Forearm volar compartments, posterior compartments, and anterior compartments of the cruris are the most common places where it is performed (21). In this study, approximately 54% of extremities with PNIs were treated with fasciotomy and fasciotomy was most commonly performed in the cruris and the foot sites in extremities with PNIs. Neither the non-fasciotomy nor fasciotomy groups showed significant differences in terms of location and side of PNIs. Additionally, neither group had a statistically significant difference in time spent under the rubble. This suggests that the decision of fasciotomy is not influenced solely by the site of nerve injury or the time spent under debris. In deciding whether to perform a fasciotomy, several factors need to be taken into account. These factors include the patient's hemodynamic status, the type and severity of the injury mechanism, associated injuries, soft tissue factors, and neurovascular injury (22).

Limitations

The study had some limitations. First, the study utilized a retrospective design, which relies on existing medical records. This retrospective design limits the control over data collection and may introduce bias or missing information. Moreover, during the time of the earthquake, there was confusion and a high demand for health care, which led to incomplete and inaccurate record keeping. In addition, during disaster situations where there are many victims and resources are limited it is difficult to determine if the nerve injury is caused by necrosis of the nerve or mechanical compression caused by the CLI. Second, the sample size of the study was relatively small, with 70 patients and 98 limbs included. A larger sample size would provide more robust results and enhance the generalizability of the findings. Third, the study primarily focused on descriptive characteristics, injury patterns, and clinical manifestations of earthquake-related PNIs. It did not explore long-term functional outcomes, quality of life measures, or specific rehabilitation interventions, which are important factors in assessing the impact and effectiveness of treatment and rehabilitation strategies. We were unable to provide long-term follow-up to earthquake victims due to their referral from outside the province, as their first treatment was performed during the disaster period. As a result, these patients did not undergo electrodiagnostic tests like electromyography (EMG) or nerve conduction studies (NCS). Large-scale, prospective, multicenter studies with longer follow-up periods would provide a more comprehensive understanding of the outcomes associated with earthquake-related PNIs.

Conclusion

This study found that PNIs occurred most frequently in the lower limbs, compared with the upper limbs, among earthquake victims with CLIs of collapsed buildings. Lower limb PNIs mainly occurred in the peroneal nerve while upper limb PNIs mainly occurred in the radial nerve. In extremities with PNIs, fasciotomy was most commonly performed in the cruris and the foot. Non-fasciotomy groups had significantly shorter LOSs than fasciotomy groups. The findings may help inform future management and rehabilitation strategies for those suffering from earthquake-related PNIs.

Statements and Declarations

Conflict of interest: The authors declare that they have no conflict of interest.

Funding: This study was not funded by any grant.

Ethics approval: This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Gazi Yasargil Training and Research Hospital Ethical Committee before the study (Decision Date: May 5, 2023 No: 392).

Consent to participate: As this study has a retrospective design, the need for informed consent was waved by the institutional review board.

Availability of data and material: The dataset used and analyzed during the current study is available from the corresponding author on reasonable request.

Author contributions: OZEL M and ALTINTAŞ M: Design of the work, acquisition, analysis, interpretation of data for the work, and accountability for all aspects of the work. ALTINTAŞ M: Revising the work critically for important intellectual content, data collection, interpretation, and drafting the work. OZEL M: Analysis and interpretation of data, revising the work critically. All the authors have approved the final version of the manuscript to be published and are equally accountable for all aspects of the work.

References

1.Doocy S, Daniels A, Packer C, Dick A, Kirsch TD. The human impact of earthquakes: a historical review of events 1980-2009 and systematic literature review. PLoS Curr. 2013 Apr 16;5:ecurrents.dis.67bd14fe457f1db0b5433a8e.

2.Türkiye acil tıp derneği. Acil Tıp Uzmanları Saha Gözlem Raporu 6 ŞUBAT 2023 Kahramanmaraş Merkezli Depremler. Ulaşım adresi: https://tatd.org.tr/wp-content/uploads/2023/02/2386ba4ace1f5b53491d0d62eb432dfb.pdf

3.Ministry of Interior Disaster and Emergency Management Presidency, PRESS BULLETIN 01.03.2023 About the Earthquake in Kahramanmaraş - 36 https://en.afad.gov.tr/press-bulletin-36-about-the-earthquake-in-kahramanmaras

4.Zhang L, Zhao M, Fu W, Gao X, Shen J, Zhang Z, et al. Epidemiological analysis of trauma patients following the Lushan earthquake. PLoS One. 2014 May 20;9(5):e97416.

5.Celikmen MF, Yilmaz S, Tatliparmak AC, Unal Colak F. Drop, Cover, and Hold On versus Fetal Position in the Triangle of Life to Survive in an Earthquake: A Delphi Study. Prehosp Disaster Med. 2023 Jun;38(3):287-293.

6.Moitinho de Almeida M. "Recovering, not recovered" Hospital disaster resilience: a case-study from the 2015 earthquake in Nepal. Glob Health Action. 2022 Dec 31;15(1):2013597.

7.Dai ZY, Li Y, Lu MP, Chen L, Jiang DM. Clinical profile of musculoskeletal injuries associated with the 2008 Wenchuan earthquake in China. Ulus Travma Acil Cerrahi Derg. 2010 Nov;16(6):503-7.

8.Langer V. Management of major limb injuries. ScientificWorldJournal. 2014 Jan 5;2014:640430.

9.Kimuli Balikuddembe J, Zeng X, Chen C. Health-Related Rehabilitation after the 2008 Great Wenchuan Earthquake in China: A Ten Year Retrospective Systematic Review. Int J Environ Res Public Health. 2020 Mar 29;17(7):2297.

10.Ahrari MN, Zangiabadi N, Asadi A, Sarafi Nejad A. Prevalence and distribution of peripheral nerve injuries in victims of Bam earthquake. Electromyogr Clin Neurophysiol. 2006 Jan-Feb;46(1):59-62.

11.Castillo-Galván ML, Martínez-Ruiz FM, de la Garza-Castro O, Elizondo-Omaña RE, Guzmán-López S. Study of peripheral nerve injury in trauma patients. Gac Med Mex. 2014 Nov-Dec;150(6):527-32.

12.Uzun N, Savrun FK, Kiziltan ME. Electrophysiologic evaluation of peripheral nerve injuries in children following the Marmara earthquake. J Child Neurol. 2005 Mar;20(3):207-12.

13.Özdemir G, Karlıdağ T, Bingöl O, Sarıkaya B, Çağlar C, Bozkurt İ, et al. Systematic triage and treatment of earthquake victims: Our experience in a tertiary hospital after the 2023 Kahramanmaras earthquake. Jt Dis Relat Surg 2023;34(2):480-487.

14.Lathia C, Skelton P, Clift Z. Early Rehabilitation in Conflicts and Disasters. Handicap International: London, UK. 2020

15.Burnett MG, Zager EL. Pathophysiology of peripheral nerve injury: a brief review. Neurosurg Focus. 2004 May 15;16(5):E1.

16.He CQ, Zhang LH, Liu XF, Tang PF. A 2-year follow-up survey of 523 cases with peripheral nerve injuries caused by the earthquake in Wenchuan, China. Neural Regen Res. 2015 Feb;10(2):252-9.

17.Mulvey JM, Awan SU, Qadri AA, Maqsood MA. Profile of injuries arising from the 2005 Kashmir earthquake: The first 72 h. Injury 2008;39:554-60.

18.Tang P, Wang Y, Zhang L, He C, Liu X. Sonographic evaluation of peripheral nerve injuries following the Wenchuan earthquake. J Clin Ultrasound. 2012 Jan;40(1):7-13.

19.Liu L, Tang X, Pei FX, Tu CQ, Song YM, Huang FG, et al. Treatment for 332 cases of lower leg fracture in "5.12" Wenchuan earthquake. Chin J Traumatol. 2010 Feb;13(1):10-4.

20.Deutsch A, Wyzykowski RJ, Victoroff BN. Evaluation of the anatomy of the common peroneal nerve. Defining nerve-at-risk in arthroscopically assisted lateral meniscus repair. Am J Sports Med. 1999 Jan-Feb;27(1):10-5.

21.Ormiston RV, Marappa-Ganeshan R. Fasciotomy. 2023 Apr 17. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 January.

22.Scalea TM, DuBose J, Moore EE, West M, Moore FA, McIntyre R, et al. Western Trauma Association critical decisions in trauma: management of the mangled extremity. J Trauma Acute Care Surg. 2012 Jan;72(1):86-93.