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ORIGINAL ARTICLE

An overview of the orthopedic patient profile in the first five days following February 6th, 2023 Kahramanmaras earthquake: A single-center experience in the earthquake zone

Mustafa Akkaya, MD, PhD[1], Umut Öktem, MD[2], Tolga Tolunay, MD[3], Müjde Ocak, MD[4], Duygu Selen Yolaçan, MD[4], Ahmet Gürler, MD[5], Şahin Çepni, MD[5], M.I. Safa Kapıcıoğlu, MD[1], Durmuş Ali Öçgüder, MD[1], Mehmet Ali Acar, MD[6], Selim Safalı, MD[6], Sadettin Çiftçi, MD[6], Ali Özdemir, MD[6], Süha Aktaş, MD[6], Murat Korkmaz, MD[7], Taha Furkan Yağcı, MD[7], Tuğcan Demir, MD[8], Emre Kurt, MD[8], Ahmet Volkan Doğan, MD[9], Mehmet Akif Görgel, MD[9], Abdurrahman Acar, MD[10], Ali İhsan Kuş, MD[10], Ahmet Fırat Berkay, MD[11], Fethi Mıhlayanlar, MD[11], Yunus Yıldırım, MD[12]

[1]Department of Orthopedics and Traumatology, Ankara Yıldırım Beyazıt University, Ankara, Türkiye
[2]Department of Orthopedics and Traumatology, Polatlı Duatepe Hospital, Ankara, Türkiye
[3]Department of Orthopedics and Traumatology, Gazi University Faculty of Medicine, Ankara, Türkiye
[4]Department of Emergency Medicine, Hatay Dörtyol State Hospital, Hatay, Türkiye
[5]Department of Orthopedics and Traumatology, Ankara City Hospital, Ankara Türkiye
[6]Department of Orthopedics and Traumatology, Selçuk University Faculty of Medicine, Konya, Türkiye
[7]Department of Orthopedics and Traumatology, Istanbul University Istanbul Faculty of Medicine, Istanbul, Türkiye
[8]Department of Orthopedics and Traumatology, Giresun University Faculty of Medicine, Giresun, Türkiye
[9]Department of Orthopedics and Traumatology, VM Medical Park Hospital, Düziçi Hospital, Kocaeli, Türkiye
[10]Department of Orthopedics and Traumatology, Bağcılar Hospital, Istanbul, Türkiye
[11]Department of Orthopedics and Traumatology, Okmeydanı Hospital, Istanbul, Türkiye
[12]Department of Orthopedics and Traumatology, Hatay Dörtyol Hospital, Hatay, Türkiye

Earthquakes are among the most destructive natural disasters, leading to catastrophic outcomes due to the lives lost besides causing major psychological, sociocultural, and economical damage. According

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Correspondence: Mustafa Akkaya, MD. Ankara Yıldırım Beyazıt Üniversitesi, Ortopedi ve Travmatoloji Anabilim Dalı, 06690 Bilkent, Ankara, Türkiye.

E-mail: makkaya@outlook.com

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ABSTRACT

Objectives: This study aims to investigate the patient profile at a medium-volume hospital located in the earthquake zone among patients who received orthopedic treatment within the first five days after the natural disaster that was considered a major earthquake.

Patients and methods: Between February 6th, 2023 and February 10th, 2023, a total of 338 patients (156 males, 182 females; mean age: 42.2±9.7 years; range, 0 to 87 years) who received orthopedic treatment in our center were retrospectively analyzed. The patients were divided into four groups according to age as follows: infants (younger than one year of age), children (one to 13 years), adults (14 to 59 years), and elderly (60 years or older).

Results: Considering the age distribution, 291 (86%) patients were young adults. A total of 173 orthopedic surgeries were performed, including internal fixation in 63 patients, external fixation in 11 patients, upper/lower extremity fasciotomy in 47 patients, amputation in 39 patients, and soft tissue debridement in 13 patients.

Conclusion: It is of utmost importance to recognize the principles of emergency fracture fixation and fasciotomy to successfully perform orthopedic surgeries after a natural disaster such as a major earthquake, particularly when the number of earthquake victims is considerably high.

Keywords: Amputation, earthquake, fasciotomy, fixation, orthopedics, trauma.

to the Center for Research on the Epidemiology of Disasters (CRED), major earthquakes are defined as those causing more than 10 deaths, affecting more than 100 individuals, and resulting in international aid or declaration of a state of emergency.[1] The recent earthquakes occurring in Kahramanmaras were among the strongest earthquakes in this area in the last century and they took place as a result of the stress between the Eurasian and African plates in a region that is among the most geologically active regions throughout the world. According to the United States National Oceanic and Atmospheric Administration (NOAA), the region has experienced 58 earthquakes since 1990, including four major earthquakes with a magnitude of 7 or higher.[2] Records from the International Disaster Database show that earthquakes, compared to other natural disasters, affect the highest number of individuals in Türkiye with 655,358 being affected between 2000 and 2018.[3]

In seismically active regions, increased population density makes it more challenging for emergency response teams to intervene after a possible earthquake.[4] Following large earthquakes, local healthcare infrastructure is usually damaged or destroyed.[5,6] In addition, communication and transportation problems lead to disruptions in emergency response opportunities.[7,8] In this respect, planning the methods of emergency response and determining the possible types of injuries would facilitate help to the disaster zone more rapidly.

Nearly 14 million individuals, i.e., 16% of the Turkish population, were affected within an area of approximately 350,000 km^2 with the recent earthquakes in Kahramanmaras. The first earthquake[9] of magnitude 7.8 struck Pazarcik district of Kahramanmaras on February 6th, 2023 at 04:17 A.M. and lasted nearly 100 sec, while the second earthquake[10] of magnitude 7.5 struck Ekinozu district of Kahramanmaras on the same day at 01:24 P.M. and lasted nearly 45 sec (Figure 1). The Turkish government declared a Level 4 alert state.[11] It is estimated that the earthquakes resulted in over 50,000 casualties, 118,000 injuries, and left 175,000 buildings damaged.[9] Therefore, the earthquakes were noted as the second largest earthquakes in Anatolia after the North Anatolia Earthquake in 1668 and the largest earthquakes in the history of the Republic of Türkiye.[11]

As expected, many injuries of survivors are orthopedic injuries. Therefore, orthopedic surgeons play an essential role in the provision of care to earthquake victims. In general, patients can survive long bone fractures, major soft tissue injuries, and crush injuries of the limbs with appropriate treatment.[6] In terms of effective response planning, it is of utmost importance to understand the epidemiology and treatment of orthopedic injuries after an earthquake. In the present study, we aimed to investigate the patient profile at a medium-volume hospital located in the earthquake zone among patients who received orthopedic treatment within the first five days after the natural disaster that was considered a major earthquake.

PATIENTS AND METHODS

This single-center, retrospective study was conducted at Hatay Dortyol State Hospital, Department of Orthopedics and Traumatology

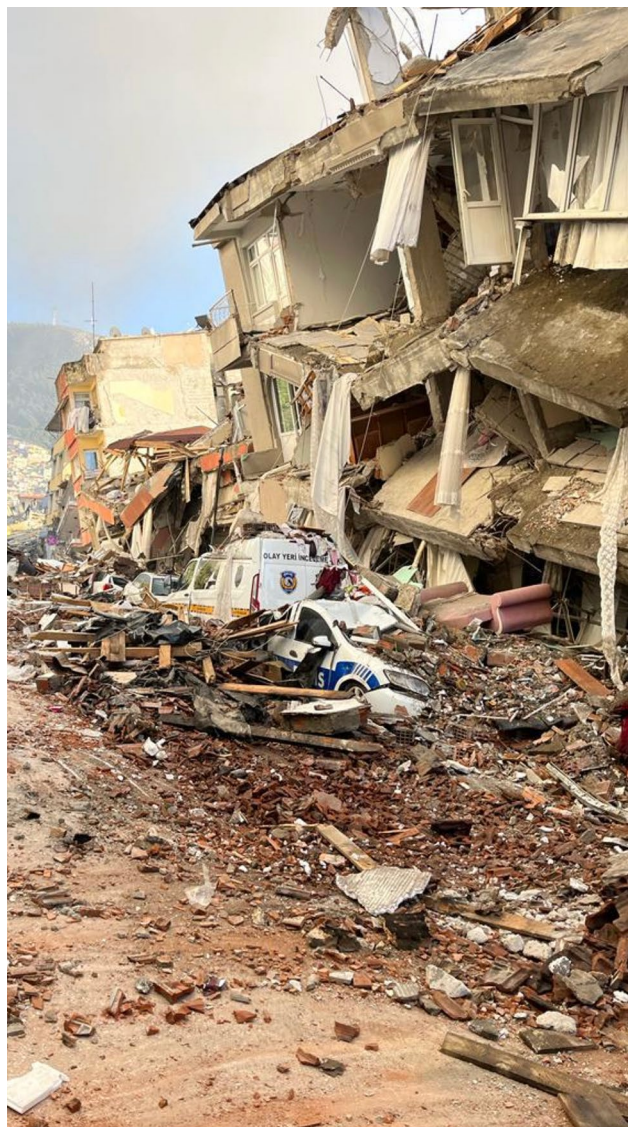


FIGURE 1. An image of severely damaged and collapsed buildings in Hatay Province, Türkiye.

between February 6th, 2023 and February 10th, 2023. A total of 2,981 earthquake survivors (1,369 males, 1,612 females; mean age: 43.4±2.6 years; range, 0 to 97 years) were admitted from the emergency department within the first five days after the earthquakes. Of these patients, 338 (156 males, 182 females; mean age: 42.2±9.7 years; range, 0 to 87 years) who received orthopedic treatment (conservative and surgical) were included. The patients were divided into four groups according to age as follows: infants (younger than one year of age), children (1 to 13 years), adults (14 to 59 years), and elderly (60 years or older). Orthopedic surgeries were performed by 21 surgeons specialized in orthopedics and traumatology from eight different centers in Türkiye. A total of 173 orthopedic surgeries were performed, including internal fixation in 63 patients, external fixation in 11 patients, amputation in 39 patients, and lower or upper extremity fasciotomies in 47 patients.

The initial triage assessment of the earthquake victims rapidly admitted from the emergency department was performed by emergency physicians. The first orthopedics team assigned in the emergency department was consulted for all patients with suspected trauma/history of trauma, open/closed extremity injuries, and crush injuries due to the compression of an extremity under the rubble and the decision to perform an emergency procedure was also made by the first team. The patients who were planned to undergo an emergency surgery were referred to the second orthopedics team assigned in the operating room with notes and surgeries were urgently performed. The patients who were scheduled to be followed in the ward and those who were planned to undergo surgery after admission were referred to the third orthopedics team assigned in the ward with a notes and admitted to the hospital. The orthopedists in these three teams worked at the hospital as volunteers in 8-h shifts.

Data included demographic information, such as age and sex and orthopaedic surgery types within the first five days after the earthquake (internal/external fixation, fasciotomy, amputation and debridement).

Statistical analysis

Statistical analysis was performed using the SPSS version 25.0 software (IBM Corp., Armonk,

TABLE I
Total distribution of orthopedic patients by age groups

	<1 year		1-13 years		14-59 years		≥60 years		Total	
	n	%	n	%	n	%	n	%	n	%
Number of patients	6		19		291		22		338	
Percent of total		1.8		5.6		86		6.5		100
Sex										
Male	0	0	12	7.7	137	87.8	7	4.5	156	100
Female	6	3.3	7	3.8	154	85	15	8.2	182	100

TABLE II
Total distribution of orthopedic patients by a surgical treatment technique

	Internal fixation		External fixation		Fasciotomy		Amputation		Soft tissue debridement		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Number of patients	63		11		47		39		13		173	
Percent of total		36.4		6.4		27.2		22.5		7.5		100
Earthquake days												
Day 1	5		2		1		-		-		8	
Day 2	19		6		25		6		-		56	
Day 3	14		1		8		15		2		40	
Day 4	17		2		13		14		2		48	
Day 5	8		-		-		4		9		21	

NY, USA). Continuous variables were expressed in mean ± standard deviation (SD) or median (min-max), while categorical variables were expressed in number and frequency.

RESULTS

The distribution of the patients included in the study is shown in Table I.

A total of 173 patients underwent orthopedic surgery: 74 (42.8%) underwent fracture fixation (63 internal and 11 external), 47 (27.2%) underwent upper/lower extremity fasciotomy, 39 (22.5%) underwent upper/lower extremity amputation, and 13 (7.5%) underwent soft tissue debridement. Distribution of surgical cases by days after the earthquake is provided in detail in Table II.

DISCUSSION

In this study, we shared the distribution of orthopedic trauma cases admitted from the emergency department and an investigation of the surgical treatments performed within the first five days after the 2023 Kahramanmaras earthquakes, which are the second largest earthquakes recorded in Anatolia.

Considering the natural disasters that took place in the last two decades, there have been 552 earthquakes, making earthquake the third most common disaster with 8% among other natural disasters (3,254 floods - 44% and 2,043 storms - 28%) throughout the world.[12] Although earthquakes constitute a smaller portion of all natural disasters that occurred worldwide between 2000 and 2019, they remain to be one of the deadliest events, as they may lead to mega-disasters with thousands of casualties, injuries, and homeless individuals in regions affected by earthquakes.[13] Considering the figures relating to earthquakes worldwide, earthquakes have led to more than three million human casualties with at least 800 million individuals affected so far,[14] with nearly 630 billion Dollars of total damage.[12] In this respect, earthquakes are among the most destructive natural disasters. It is estimated that the 2023 Kahramanmaras earthquake with a magnitude of 7.8 that took place on February 6th led to more than 50,000 human casualties, 119,000 injuries, and nearly 34 billion Dollars of total damage.[9] After this catastrophe, most of the healthcare facilities in Hatay Province became unusable, whereas our center had seismic isolators installed and remained intact, thereby becoming the main center that the earthquake survivors were referred to. We could collect accurate data due to diligent keeping of medical records, although the hospital had a high number of patients presenting as of the first day after the earthquake.

Following an earthquake, rapid planning of the primary treatment for patients admitted to the hospital from emergency departments within the first five days is of utmost importance in terms of reducing mortality and morbidity.[15,16] In this respect, 2,981 earthquake survivors received healthcare services at our center within the first five days after the earthquake. A total of 76% of these patients (n=2,264) were young adults. The literature also shows that patients of the similar age group constitute the majority of natural disaster survivors after various disasters.[15,17] Of the young adults, 1,028 (45.4%) were male and 1236 (54.6%) were female. According to the literature, women have a 2.4-fold increased risk of injury compared to men in an earthquake, making them more susceptible to injuries in such natural disasters.[18] Therefore, efforts should be made to be prepared in terms of the provision of healthcare services after such colossal disasters, particularly for female young adults.

The continuity of emergency healthcare services is essential in major natural disasters. Considering the fact that healthcare personnel located in the disaster zone are also survivors, healthcare personnel coming for help from other centers play a key role in the provision of treatment.[19] In this study, 21 orthopedists coming from eight centers throughout Türkiye as volunteers to provide healthcare services used conservative or surgical treatment methods to treat earthquake survivors with trauma. Considering the distribution of injuries, 173 patients underwent orthopedic surgery, which constituted 51.2% of 338 wounded earthquake victims who needed orthopedic treatment. Seventy-four patients (42.8%) were diagnosed with fracture and underwent internal or external fixation. This finding indicates that besides being highly common after earthquakes, fracture is also a quite important earthquake-related injury, as it constitutes the majority of medical needs, also consistent with previous reports.[17,20,21]

In this study, fracture fixation constituted a large proportion of orthopedic surgeries performed to treat earthquake survivors, followed by fasciotomies for crush injuries (27.2%) and amputation (22.5%). According to the literature, crush syndrome is frequently seen in earthquake survivors with injuries and it is a common cause of delayed

death in earthquake victims with considerable tissue damage.[22] In the present study, considering the fact that amputation was performed due to extremity necrosis resulting from crush injuries, it is evident that an acute decision has been made to save patients' lives. In addition, that orthopedic surgeries differed among the first five days after the earthquakes. While surgical treatments for fracture fixation constituted the majority of surgeries performed on the first day, fasciotomies were more common on the second day, and amputations from the third day onwards. In the literature, 78% of the orthopedic patients were reported to be those with fractures in a study investigating the orthopedic patient profile in the first three days after an earthquake.[23] In another study, debridement and fasciotomy procedures constituted 58% of all orthopedic treatments provided within the first 10 days after an earthquake.[24] In this respect, it should be kept in mind that orthopedic surgeons can encounter patients in need of similar procedures after potential mega-disasters.

Nonetheless, this study has some limitations. First, medical history of the patients could not be properly obtained from unconscious patients and those whose relatives were still under the rubble, since patients underwent emergency orthopedic surgery after the earthquakes. Second, some patients had missing laboratory data in their medical records, which made it impossible to make an adequate clinical assessment. Finally, proper record keeping was unable to be achieved in terms of postoperative follow-up in operated patients. On the other hand, the data obtained are still highly valuable and enough to identify the orthopedic patient profile after such enormous earthquakes.

In conclusion, our study results show the varying orthopedic patient profile in the first five days after the earthquake at an actively working hospital, which was the only one providing healthcare services in the earthquake zone. Fracture fixation constituted the majority of the procedures performed within the first days after the earthquakes, followed by an increase in the number of soft tissue debridement and amputation procedures in the following days. Taken together, it is of utmost importance to recognize the principles of emergency fracture fixation and fasciotomy to successfully perform orthopedic surgeries after a natural disaster such as a major earthquake, particularly when the number of earthquake victims is considerably high.

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Ethics Committee Approval: The study protocol was approved by the Ethics Committee of Ankara Yıldırım Beyazıt University, Yenimahalle Training and Research Hospital (Date: 16.03.2023, No: 2023-13). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from the parents and/or legal guardians of the patients.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Centre for research on the Epidemiology of Disasters - EM-DAT , The International Disaster Database. 2022; Available at: https://public.emdat.be/about.
2. Buchholz K. The countries hit by the most earthquakes. 2023 [cited 2023 Feb 6]; Available at: https://www.statista.com/chart/29243/countries-with-most-earthquakes/.
3. The EM-DAT Atlas. 2023; Available at: https://www.emdat.be/emdat_atlas/sub_html_pages/sub_html_TUR.html.
4. MacKenzie JS, Banskota B, Sirisreetreerux N, Shafiq B, Hasenboehler EA. A review of the epidemiology and treatment of orthopaedic injuries after earthquakes in developing countries. World J Emerg Surg 2017;12:9. doi: 10.1186/s13017-017-0115-8.
5. Najafi I, Safari S, Sharifi A, Sanadgol H, Hosseini M, Rashid-Farokhi F, et al. Practical strategies to reduce morbidity and mortality of natural catastrophes: A retrospective study based on Bam earthquake experience. Arch Iran Med 2009;12:347-52.
6. Missair A, Pretto EA, Visan A, Lobo L, Paula F, Castillo-Pedraza C, et al. A matter of life or limb? A review of traumatic injury patterns and anesthesia techniques for disaster relief after major earthquakes. Anesth Analg 2013;117:934-41. doi: 10.1213/ANE.0b013e3182a0d7a7.
7. Naghii MR. Public health impact and medical consequences of earthquakes. Rev Panam Salud Publica 2005;18:216-21. doi: 10.1590/s1020-49892005000800013.
8. Altntaş KH, Delooz H. The problems faced by three government disaster response teams of Ankara city during the Marmara earthquake - 1999 response. Eur J Emerg Med 2004;11:95-101. doi: 10.1097/00063110-200404000-00008.

9. NOAA National Centers for Environmental Information (NCEI). 2023; Available at: https://www.ngdc.noaa.gov/hazel/view/hazards/earthquake/event-more-info/10662.
10. NOAA National Centers for Environmental Information(NCEI). 2023; Available at: https://www.ngdc.noaa.gov/hazel/view/hazards/earthquake/event-more-info/10663.
11. Atik OŞ. Which articles do the editors prefer to publish? Jt Dis Relat Surg 2022;33:1-2. doi: 10.52312/jdrs.2022.57903.
12. The human cost of disasters: an overview of the last 20 years (2000-2019). Switzerland: United Nations Office for Disaster Risk Reduction; 2020. p. 30.
13. Mavrouli M, Mavroulis S, Lekkas E, Tsakris A. The impact of earthquakes on public health: A narrative review of infectious diseases in the post-disaster period aiming to disaster risk reduction. Microorganisms 2023;11:419. doi: 10.3390/microorganisms11020419.
14. Li T, Jiang X, Chen H, Yang Z, Wang X, Wang M. Orthopaedic injury analysis in the 2010 Yushu, China earthquake. Injury 2012;43:886-90. doi: 10.1016/j.injury.2011.11.020.
15. Xu S, Shi B, Yuxian J, He M, Yang P, Xu W, et al. Comparative analysis of the wounded in patients and deaths in a hospital following the three major earthquakes in Western China. Front Public Health 2022;10:775130. doi: 10.3389/fpubh.2022.775130.
16. Liu X, Tang B, Yang H, Liu Y, Xue C, Zhang L. The technical efficiency of earthquake medical rapid response teams following disasters: The case of the 2010 Yushu earthquake in China. Int J Environ Res Public Health 2015;12:15390-9. doi: 10.3390/ijerph121214991.
17. Mohebbi HA, Mehrvarz S, Saghafinia M, Rezaei Y, Kashani SM, Naeeni SM, et al. Earthquake related injuries: Assessment of 854 victims of the 2003 Bam disaster transported to tertiary referral hospitals. Prehosp Disaster Med 2008;23:510-5. doi: 10.1017/s1049023x00006336.
18. Peek-Asa C, Ramirez M, Seligson H, Shoaf K. Seismic, structural, and individual factors associated with earthquake related injury. Inj Prev 2003;9:62-6. doi: 10.1136/ip.9.1.62.
19. Hotz GA, Moyenda ZB, Bitar J, Bitar M, Ford HR, Green BA, et al. Developing a trauma critical care and rehab hospital in Haiti: A year after the earthquake. Am J Disaster Med 2012;7:273-9. doi: 10.5055/ajdm.2012.0100.
20. Sami F, Ali F, Zaidi SH, Rehman H, Ahmad T, Siddiqui MI. The October 2005 earthquake in Northern Pakistan: Patterns of injuries in victims brought to the Emergency Relief Hospital, Doraha, Mansehra. Prehosp Disaster Med 2009;24:535-9. doi: 10.1017/s1049023x00007470.
21. Liu Y, Jiang W, Liu S, Zhou Y, Zhang J, Yang L, et al. Clinical features and early treatment for 596 patients with fracture in Wenchuan earthquake. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi 2009;23:198-200.
22. Sever MS, Erek E, Vanholder R, Akoğlu E, Yavuz M, Ergin H, et al. The Marmara earthquake: Epidemiological analysis of the victims with nephrological problems. Kidney Int 2001;60:1114-23. doi: 10.1046/j.1523-1755.2001.0600031114.x.
23. Kang P, Tang B, Liu Y, Liu X, Shen Y, Liu Z, et al. Profile and procedures for fractures among 1323 fracture patients from the 2010 Yushu earthquake, China. Am J Emerg Med 2016;34:2132-9. doi: 10.1016/j.ajem.2016.07.064.
24. Gao R, Yang L, Yuan W, Li T, Fu Q. Overview of polytrauma patients in the first 10 days after the Sichuan earthquake: A report from the No. 903 Military Hospital, Jiangyou. Eur J Trauma Emerg Surg 2012;38:85-8. doi: 10.1007/s00068-012-0182-1.