



Musculoskeletal Injuries of the Kermanshah Earthquake and Orthopedic Management at Trauma Center of Kermanshah, West Iran

Morteza Saeb¹, Monireh Yaghoubi¹, Nima Bagheri² and Seyyed Saeed Khabiri^{1,*}

¹Department of Orthopedic Surgery, Taleghani Hospital, Faculty of Medicine, Kermanshah University of Medical Sciences, Kermanshah, Iran

²Joint Reconstruction Research Center, Tehran University of Medical Sciences, Tehran, Iran

*Corresponding author: Assistant Professor, Department of Orthopedic Surgery, Taleghani Hospital, Faculty of Medicine, Kermanshah University of Medical Sciences, Kermanshah, Iran. Email: saeed.khabiri@gmail.com

Received 2018 August 19; Accepted 2018 December 03.

Abstract

A 7.3-magnitude earthquake recently shook the Ezgeleh district, located about 143 km from Kermanshah city (12/11/2017), in the western part of the country. Due to the severity of the earthquakes and the infrastructure of the nearby cities and villages, a large number of victims needed medical treatment. Since earthquakes are natural disaster, the state of unpreparedness of the health care systems against natural disasters is unusual. Therefore, the aim of this paper was to assess this critical situation and better prepare for subsequent earthquakes.

Keywords: Earthquakes, Disaster Victims, Fractures, Bone

1. Background

A 7.3-magnitude earthquake recently shook the Ezgeleh district, located about 143 km from Kermanshah city (12/11/2017), in the western part of the country. There had been no earthquake of a magnitude greater than 6.6 over the past half-century (1). A historical earthquake in the western regions of the country in 958 AD, with a magnitude of about 6.8 Richter, destroyed Sarpol-e-Zahab and took a heavy toll killing nearly all the settlers. The last historical earthquake in this area occurred in 1226 AD with a magnitude of 6.5 along the Zagros fault (2). Due to the severity of the earthquakes and the old building and infrastructure of the nearby cities and villages, a large number of victims needed medical treatment.

2. Methods

On November 12, 2017, Taleghani Hospital in Kermanshah province, which is a center for the management of trauma in the west of the country, a well-designed and fully-equipped trauma center with experienced medical staff, was faced with a large volume of patients and injuries in the first few hours of the disaster. In the first 48 hours, nearly 700 injured were admitted and treated. This hospital is equipped with ICUs and a well-equipped pathology-hematology laboratory, suitable blood bank, orthopedic

surgery, general surgery, and neurosurgery rooms, and a PACS radiology system. On average, it admits and treats 5000 injured individuals, monthly (3).

In the early hours after the earthquake, a crisis management team was formed under the direction of the hospital management. The heads of the orthopedic and general surgical departments along with orthopedic surgeons, neurosurgeons, and anesthesiologists in the city (on the second day, specialist volunteers from other regions) were asked to visit and treat the patients in shifts, and to prevent and reduce possible medical errors.

In line with the initial visits and after obtaining personal documents and registering the demographic data (surname, name, age, telephone number, etc.), the patients were first visited by the emergency specialist; then, the orthopedic team at the emergency unit visited the patients, who were referred to the emergency department, and additional radiography was performed based on their physical examination. The patients were then referred to a second team in the outpatient operating room, examined by the second group, and after that, a treatment plan was determined. Then, the patients were classified to several groups; a group with minor musculoskeletal trauma was discharged with warning signs and splints (some patients did not need special procedures, and in some cases, splint and bandages were necessary).

The second group of patients with limb abrasions or

soft tissue or crush injuries, after initial repair, debridement, and irrigation by residents and orthopedic surgeons, were discharged or admitted for antibiotic therapy and close follow-up.

The next groups, with dislocation, open fractures and other emergency situations were transferred to the operating room, and the operation was performed. In non-emergency cases, the patients after the initial procedures (closed reduction, splint, debridement, and irrigation) were shifted to the inpatient wards. Eight hours after the earthquake, due to the start of new waves of incoming patients from the nearby cities and the limited number of beds, only patients at the emergency underwent the operation, and other patients with upper extremity fractures, who could be treated as outpatients were sent to other medical centers or were discharged. Patients in an unstable state and need of critical management were admitted.

Twelve hours after the earthquake, considering the large number of injured patients and lower number of beds available, the critical committee decided to send specialist physicians, including orthopedic surgeons and senior residents with expert staff to other hospitals, both private and state-owned, in the town. Also, during this time, the injured patients were labeled as earthquake patients and were distinguished using a red bracelet from other trauma patients. In addition, the patients' information and procedures were precisely recorded in their files.

Clinical rounds were performed several times a day to check the patients after the operation and monitor antibiotic therapy by the orthopedic surgeons and residents, to prevent complications, such as compartment syndrome and infection. Also, following hospital discharge, the summary of treatment and the next referral date was given to the patients (Figure 1).

In this descriptive report, 855 injured patients' files and records at the hospital were evaluated, and collected data were analyzed with descriptive statistics.

3. Results

During the first five days after the earthquake, 1015 injured cases were admitted to the Taleghani Hospital of Kermanshah city. Of these, 855 were earthquake-injured and 160 had musculoskeletal trauma due to other reasons. Of the 855 patients aged between 18 and 89 years old, 149 were over 60 years of age. Unfortunately, five patients (two women and three men) died within the first 24 hours of admission (one in the operation room due to internal bleeding, three in the emergency rooms because of multiple fractures and organ failures, and one in the intensive care unit due to rhabdomyolysis). The patients were classified based on trauma to their head, chest, abdomen, facial, or

musculoskeletal injuries. Tables 1 and 2 show the distribution of musculoskeletal trauma and fracture in the admitted patients. Patients with musculoskeletal trauma and fracture formed in the majority of the patients referred to the hospital. Of the 299 fracture cases, 19 (10 women and 9 men) had trauma and fractures in more than one part of their body; Table 2 shows the number of multiple fractures. Also, 15 patients were treated for crush injury in five days (nine cases with lower extremity and six with upper extremity injury). One of the patients needed above-knee amputation in the first 24 hours, and two patients needed Syme amputation.

Furthermore, two cases with complete upper limb amputation within the first 24 hours were sent to a subspecialty center for implantation. Seven cases of complete amputation of phalanx and toes were treated. Four cases of upper limb trauma and 12 cases of lower extremity trauma suspected to have compartment syndrome were hospitalized and treated. However, emergency fasciotomy was not done and all the patients recovered with conservative treatment.

Nine of the 15 patients with vertebral fractures underwent surgery, and six patients were discharged following conservative treatment. Due to severe traumatic damage, five patients (two men and three women) suffered complete spinal cord impairment. The highest number of trauma patients were recorded in the first two days of the earthquake ($n = 700$). Closed reduction of joint dislocations was performed in 10 patients (one with hip dislocation, three with shoulder, two with ankle, one with elbow, and three with interphalangeal joint dislocation). Two hundred and thirty-four procedures related to soft tissues were carried out under general or local anesthesia, the highest number being for debridement and irrigation, as well as primary repair. The patients with open fractures were hospitalized and treated with antibiotics (cephalosporin with or without aminoglycosides). As the number of patients was too high in the first few days, the duration of hospitalization was reduced as much as possible, and the patients were discharged after initial measures and medical orders over the first 24 hours. Moreover, 197 patients with musculoskeletal trauma (125 men and 72 women) were discharged in less than six hours as their trauma was diagnosed to be minor (Figures 2 and 3).

4. Discussion

Orthopedic surgery plays a crucial role in treating earthquake-related damages. A review by MacKenzie *et al.*'s study on earthquake reports from 1970 to 2016 revealed that 87% of trauma, which needed treatment was musculoskeletal with 65% being fractures; the most common

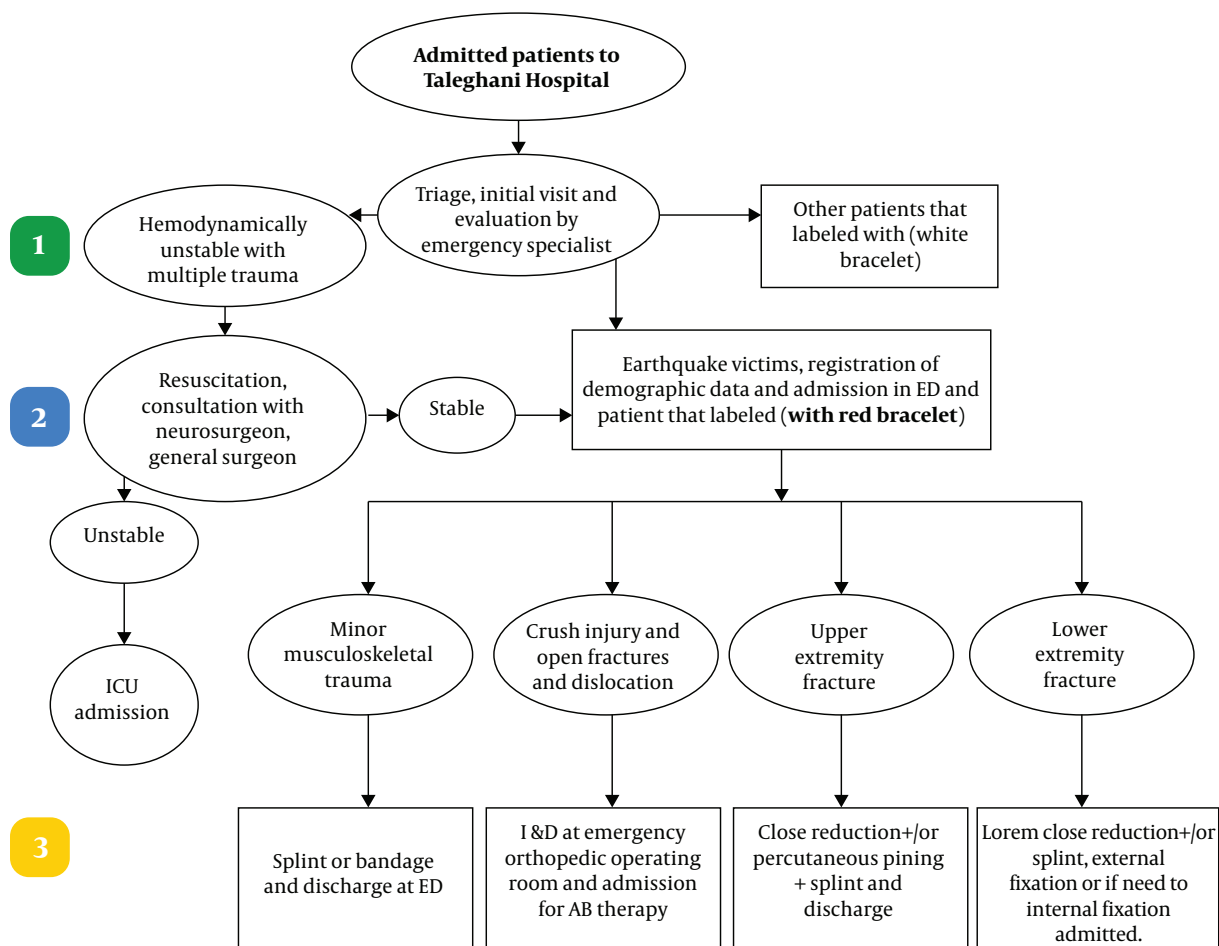


Figure 1. Management of earthquake patients in ED. Level 1 emergency specialists, level 2 orthopedic surgeons, and residents in ed, level 3 orthopedic operating room.

Table 1. Distribution of Injuries

Gender	Musculoskeletal Trauma ^a	Fractures	Spine Trauma ^b	Head Trauma ^b	Abdomen Trauma ^b	Thoracic Trauma ^b	Facial Trauma ^b
Female							
Outpatient	114	10	26	28	-	6	2
Inpatient	70	70	15	18	1	7	4
Male							
Outpatient	94	7	22	37	1	5	2
Inpatient	105	92	14	22	6	12	5

^a Patients with musculoskeletal trauma without fracture.

^b Associated trauma in musculoskeletal trauma and fracture group.

fractures were that of tibia/fibula (27%), femur (17%), and ankle (16%). Also, debridement, the highest number of surgeries, was reported to be done during the earthquake (33%) (4). In the article by Ho et al. (5), after investigating 12 reports and articles on Haiti earthquake in 2010, fracture and

laceration were reported to be the most common trauma; musculoskeletal injuries comprised 25.9% of the trauma and they were treated in the affected area itself. In the Gujarat earthquake study by Roy et al. (6), the highest registered trauma was musculoskeletal, followed by chest, ab-

Table 2. Distribution of Fractures

Fracture Types	Closed		Open		Comminuted	
	Male	Female	Male	Female	Male	Female
Upper Limb						
Clavicle/scapula						
Outpatient	3	1				
Inpatient	5	7			1	
Humerus						
Outpatient	1	1				
Inpatient	5	3			1	1
Hand						
Outpatient	4	6				
Inpatient	25	8	3	4	1	2
Forearm						
Outpatient	1					
Inpatient	5	7			2	
Lower Limb						
Pelvic						
Outpatient						
Inpatient	7	13				1
Femur						
Outpatient						
Inpatient	10	13		1	2	1
Patella						
Outpatient						
Inpatient	1				1	
Tibia/fibula						
Outpatient	1	1				
Inpatient	12	10	4	5	4	4
Foot/ankle						
Outpatient		1				
Inpatient	9	7	4	1	3	1
Spine						
Outpatient						
Inpatient	7	8				

domen, and head injuries. Also, the highest number of fractures were in the lower extremity, and most surgeries were for internal fixation, reduction, and debridement. Moreover, in the study of Elmi et al. (7) of the East Azerbaijan earthquake in 2013, and the study by Li et al. (8) in China in 2010, fractures and their types were similar to the above-mentioned study, and the highest number of injuries were reported to be in the lower extremity. In most of the published reports, the expert teams of orthopedic surgeons along with the relief forces attended the earthquake-stricken areas and started the duty of managing the treatment teams and treating the patients and preventing the complication of fractures and injuries (9,10).

Owing to the fact that in natural disasters and incidents of fractures, especially of the lower extremity, laceration, and crush injuries constitute the highest number of cases requiring surgeries, the Taleghani Center for trauma

automatically and with no prior planning started the treatment of the earthquake victims in the very early hours of the Kermanshah earthquake, and after a few hours, the hospital crisis team took the responsibility of the hospital management and lessened the burden of activities on the hospital by establishing medical expert teams at the hospital emergency. Due to overcrowding at the emergency department of the hospital, the emergency medical team discharged some patients with minor injury without taking a radiograph, by clinical examination and splinting or bandaging. Also, to reduce the load of radiography, the least number of radiographs was requested for the patients and in cases where it was necessary, the patients' radiographs were completed after the visits by the experts and initial evaluations. The length of hospitalization of patients with fractures or musculoskeletal trauma varied between 3 and 24 hours. The patients, who needed lengthy hospitaliza-

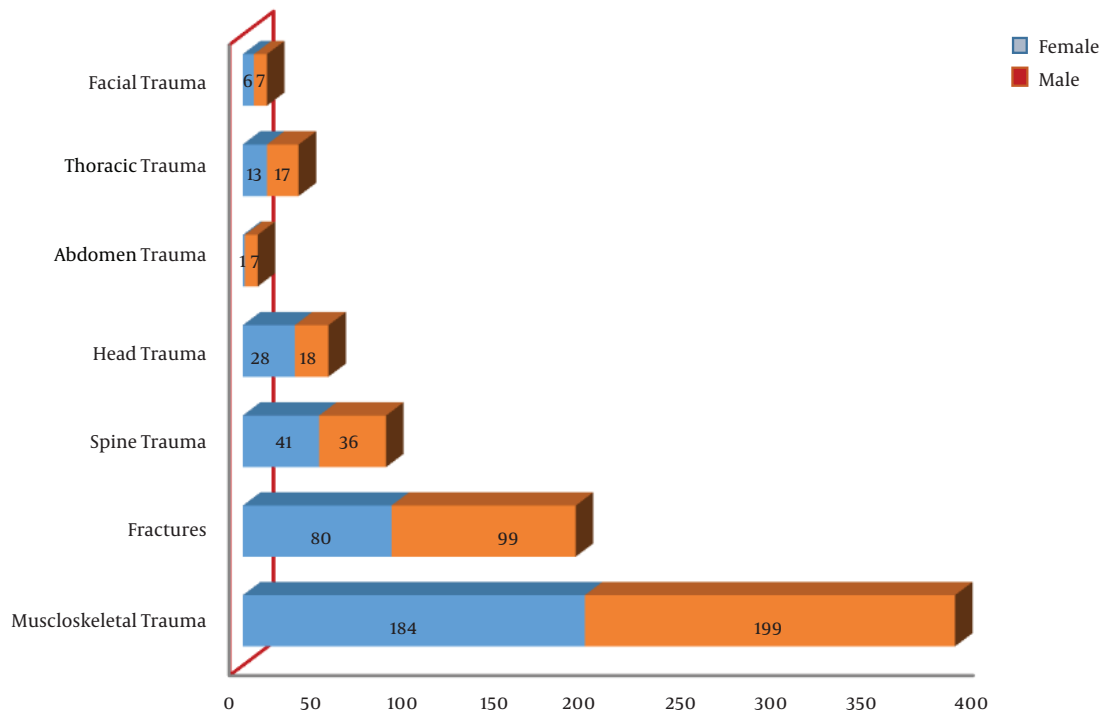


Figure 2. Bar graph of trauma distribution in admitted patients

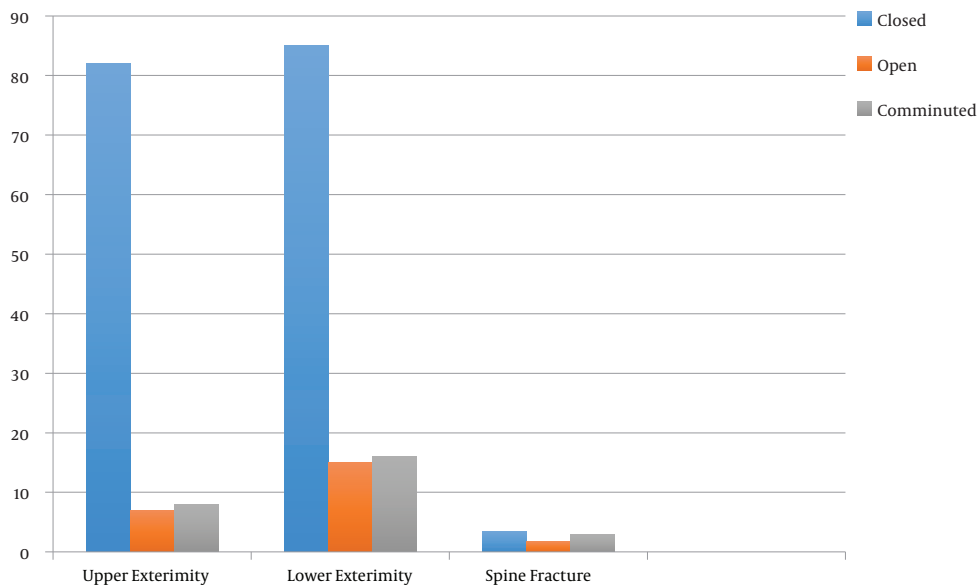


Figure 3. Upper and lower extremity and spine fractures based on open, close and comminuted fracture

tion were transferred to other medical centers in the city and were visited by orthopedic specialists and the residents, and the treatment was carried out in a manner that

over the first five days after the earthquake, 212 patients in need of more than 24 hours of hospitalization were sent to other hospitals (because of the limited number of beds).

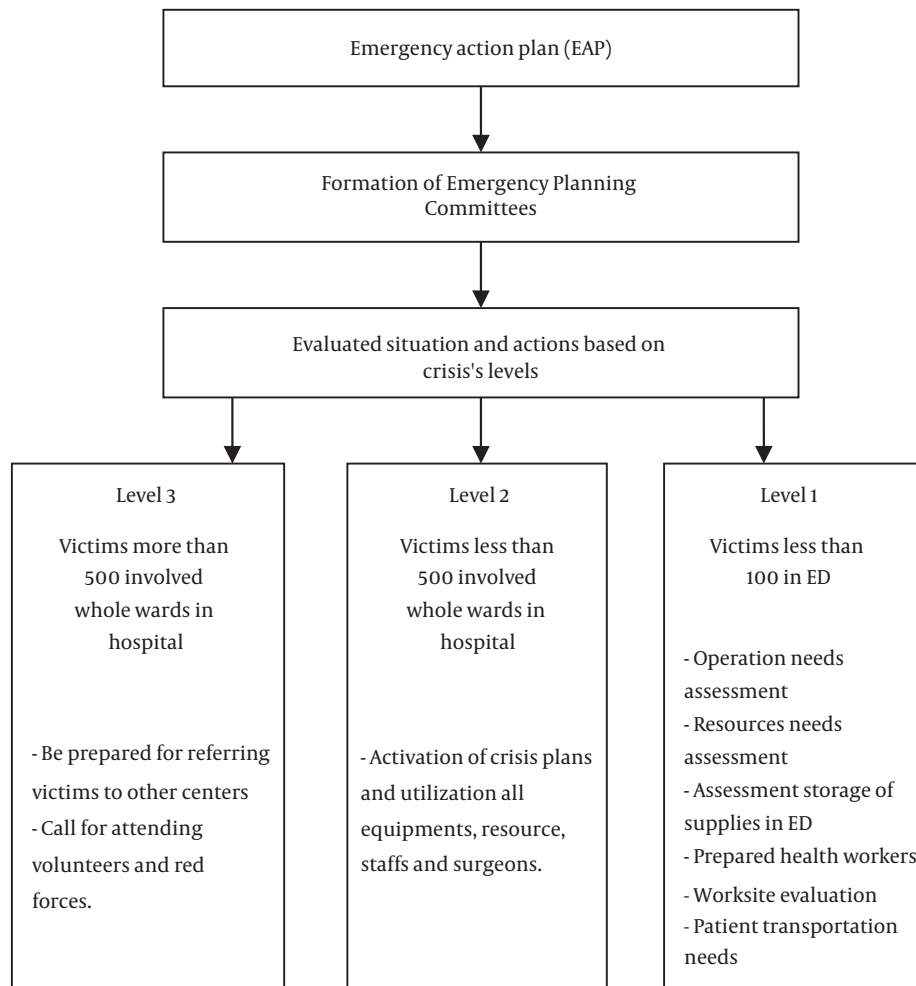


Figure 4. Crisis's response planning or emergency action plan (EAP) in casualties

The number of injured, who were referred to the hospital significantly declined 48 hours after the earthquake. Only 155 patients were treated from the second to fifth day after the earthquake since the specialists settled in earthquake-stricken areas, and the patients were distributed to other centers in the city. A challenging aspect in the management of the earthquake victims was the destruction of the patients' houses and their inability to access facilities after being discharged from hospitals. Therefore, a temporary accommodation was set up for the patients in the stadium of Imam Ali Hospital (Heart Center of Kermanshah province), and the injured were visited by the orthopedic residents daily and were examined for infection, compartment syndrome, and other complications in injured limbs

and soft tissue injuries. The patients with spinal cord injury were sent to equipped medical centers for rehabilitation.

4.1. Conclusions

During the first five days of the Ezgeleh earthquake, 855 injured people out of 9388 earthquake victims were admitted to the Taleghani Hospital of Kermanshah city (11). A crisis management team under the direction of the hospital management was formed within the first hours and based on hospital crisis' response planning or emergency action plan (EAP), all sections and wards in the hospital obtained their positions (Figure 4). Regarding the number of casualties in the Ezgeleh earthquake on 12th of November

2017 (in spite of the 7.3 Richter earthquake at the depth of 11 kilometers and the occurrence of a 4.3 Richter earthquake before the main earthquake and the lower number of casualties in comparison to Bam and Rudbar earthquakes (5)), it seems that in case of a similar incident, the management, strategies, health cares' preparedness and infrastructure of the medical centers of Kermanshah city could not meet the treatment needs and the other required procedures. Since earthquake is a natural disaster, the state of unpreparedness of the health care systems against natural disasters is unusual; therefore, due to the absence of a separate committee to take action against natural disasters, initial and timely preparedness of the health care system and the treatment of trauma patients requires preparing an efficient clinical guidance and setting up a subspecialty crisis committee under the supervision of an orthopedic team and participation of neurosurgeons, general surgeons, and other medical team to act against the incidents and reduce the number of related damages.

Acknowledgments

The authors would like to thank the Clinical Research Development Center of Taleqani and Imam Ali Hospital, University of Medical Sciences, Kermanshah, Iran, for the support, cooperation and assistance throughout the period study.

Footnotes

Conflict of Interests: It is not declared by the authors.

Funding/Support: This paper was supported by the Kermanshah University of Medical Sciences.

References

1. Iranian Seismological Center Institute of Geophysics University of Tehran. *Latest earthquakes in Iran and adjacent areas*. 2019. Available from: http://irsc.ut.ac.ir/newsview_-fa.php?eventid=125729&network=earth_ismc.
2. Iranian Seismological Center Institute of Geophysics University of Tehran. *Kermanshah earthquakes*. 2019. Available from: http://irsc.ut.ac.ir/Kermanshah_M7.3.pdf.
3. *Kermanshah University of Medical Sciences*. 2019. Available from: <http://taleghani.kums.ac.ir/fa/introductionhospital/history>.
4. Bortolin M, Morelli I, Voskanyan A, Joyce NR, Ciottoni GR. Earthquake-related orthopedic injuries in adult population: A systematic review. *Prehosp Disaster Med*. 2017;**32**(2):201-8. doi: [10.1017/S1049023X16001515](https://doi.org/10.1017/S1049023X16001515). [PubMed: [28134070](https://pubmed.ncbi.nlm.nih.gov/28134070/)].
5. Ho JW, Vanderpool DM, Bush RL. Lessons learned in delivery of post-earthquake orthopedic surgical care in Haiti. *J Dis Global Health*. 2016;**8**(2):90-7.
6. Roy N, Shah H, Patel V, Coughlin RR. The Gujarat earthquake (2001) experience in a seismically unprepared area: Community hospital medical response. *Prehosp Disaster Med*. 2002;**17**(4):186-95. [PubMed: [12929949](https://pubmed.ncbi.nlm.nih.gov/12929949/)].
7. Elmi A, Ganjpour Sales J, Tabrizi A, Soleimanpour J, Mohseni MA. Orthopedic injuries following the East Azerbaijan earthquake. *Trauma Mon*. 2013;**18**(1):3-7. doi: [10.5812/traumamon.8322](https://doi.org/10.5812/traumamon.8322). [PubMed: [24350141](https://pubmed.ncbi.nlm.nih.gov/24350141/)]. [PubMed Central: [PMC3860649](https://pubmed.ncbi.nlm.nih.gov/PMC3860649/)].
8. Li T, Jiang X, Chen H, Yang Z, Wang X, Wang M. Orthopaedic injury analysis in the 2010 Yushu, China earthquake. *Injury*. 2012;**43**(6):886-90. doi: [10.1016/j.injury.2011.11.020](https://doi.org/10.1016/j.injury.2011.11.020). [PubMed: [22177459](https://pubmed.ncbi.nlm.nih.gov/22177459/)].
9. Ardagh MW, Richardson SK, Robinson V, Than M, Gee P, Henderson S, et al. The initial health-system response to the earthquake in Christchurch, New Zealand, in February, 2011. *Lancet*. 2012;**379**(9831):2109-15. doi: [10.1016/S0140-6736\(12\)60313-4](https://doi.org/10.1016/S0140-6736(12)60313-4). [PubMed: [22510397](https://pubmed.ncbi.nlm.nih.gov/22510397/)].
10. Bar-On E, Lebel E, Kreiss Y, Merin O, Benedict S, Gill A, et al. Orthopaedic management in a mega mass casualty situation. The Israel defence forces field hospital in Haiti following the January 2010 earthquake. *Injury*. 2011;**42**(10):1053-9. doi: [10.1016/j.injury.2011.03.054](https://doi.org/10.1016/j.injury.2011.03.054). [PubMed: [21507401](https://pubmed.ncbi.nlm.nih.gov/21507401/)].
11. Mehrnews. *Earthquake news in the west country*. 2019. Available from: <https://www.mehrnews.com/news/4142365>.