ORIGINAL ARTICLE

Which is more dangerous, earthquake, or the panic? Evaluation of the 24 January 2020 Elazig/Türkiye earthquake related musculoskeletal injuries

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ABSTRACT

BACKGROUND: The aim of this study is to evaluate the musculoskeletal injuries related with 24 January 2020 Elazig/Türkiye earthquake and their treatment protocols.

METHODS: Data of patients applied to İnönü University Medical Faculty Hospital, Elazığ Training and Research Hospital and Malatya Training and Research Hospital emergency departments within 48 h after the earthquake, were evaluated retrospectively. Age, gender, soft tissue injuries and sites, fracture sites and types, fracture etiology, and treatment methods were evaluated.

RESULTS: 247 patients were evaluated. 118 were women and 139 were men. There were 24 (9.7%) pediatric patients. Mean age was 37.3 (1–92) years. Waist majority of injuries were simple soft-tissue injuries. There were 103 fractures in 86 patients. Thirty-eight patients' fractures were treated surgically.

CONCLUSION: Every major disaster warrants retrospective studies so we can learn how to improve all levels of Emergency Medical Services. Great proportion of Elazıg earthquake victims had only simple soft tissue injuries such as sprain, laceration, or contusion. Many patients were injured due to reasons indirectly related to the destruction brought by the earthquake. Panic caused by the earthquake caused more injury than the destruction it brought.

Keywords: Earthquake; Elazig earthquake; musculoskeletal injuries.

INTRODUCTION

Compared to other natural disasters, earthquakes are the most devastating ones with a sudden onset.[1] Türkiye is one of the world's major earthquake zones, which is located on the Alpine-Himalayan belt and has many active faults due to its complex geological structure and geodynamic location.[2] On January 24, 2020, at 20.55 local time, there was an earthquake that lasted about 22 seconds, occurred in Cevrimtas Village of the Sivrice district of the Elazig Province. The most affected regions were the Elazıg and Malatya Provinces. According to the European-Mediterranean Seismological Centre, the earthquake had a magnitude of 6.8 on the Richter scale.[3] The disaster and emergency situations directorate reported that 44 people lost their lives in this earthquake.

Proper management of post-earthquake injuries is very important in terms of decreasing morbidity and mortality. Problems that may arise in the provision of health-care services due to infrastructural damage and lack of personnel after an

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earthquake may lead to an increase in the loss of life and injuries caused by the earthquake.[4,5]

Every major disaster warrants retrospective studies so we can learn how to improve all levels of Emergency Medical Services. A better understanding of the injuries that occur after natural disasters will provide data for a better medical management of the post-disaster period.[6] In this paper, we aimed to report the musculoskeletal injuries related to the Elazıg earthquake that took place on January 24, 2020.

MATERIALS AND METHODS

The study was approved by local ethical committee of corresponding author Institution (no: 2020/1354). The study was in accordance with ethical standard of Helsinki Declaration. Data of patients who applied to University Medical Faculty Hospital, Training and Research Hospital and Training and Research Hospital emergency departments within 48 h after the earthquake, were evaluated retrospectively. Patients with musculoskeletal injuries related with earthquake and who had complete medical records were included the study. Exclusion criteria were patients with other injuries and incomplete data, musculoskeletal injuries not related with earthquake.

Age, gender, soft tissue injuries and sites, fracture sites and types, fracture etiology, and treatment methods were evaluated from the patient records.

Statistical Analysis

The patients' age, sex, and the cause of injury were recorded. Lists for the number of patients with soft-tissue injuries, fractures, and compartment syndrome were created. The continuous variables were expressed as mean±standard deviation, while the categorical variables were expressed as number and percentage.

RESULTS

Of the two hundred and forty-seven patients who were admitted to the emergency wards, one hundred and ten were females (44.12%), and one hundred thirty-nine were males (55.88%). Twenty-four (9.7%) of the patients were children. The mean age of patients was 37.3 (1–92) years (Table 1). Simple soft-tissue injuries constituted the majority of the complaints (n=166). Five patients had compartment syndrome due to severe soft-tissue crush injury. Eighty-six patients had total 103 fractures and five shoulder dislocations. The distribution of the fractures by extremities is given in Table 1. Sixty of the fractures that occurred after the earthquake were in the lower extremity, and 36 in the upper extremity. Seven patients had spine fractures. The most affected bones were the tibia, the fibula, and the calcaneus.

The etiologies of the fractures were fall at ground level in 53 patients, fall, or jump from height or in 21 patients, being caught under rubble in eight patients, and being crushed under a falling cabinet in one patient. The classification of the

Table 1. Distribution of fractures based on anatomical site

Fracture location	Frequency	Percent
Upper limb	36	33.64
Humerus	14	13.08
Forearm (radius and ulna)	10	9.34
Hand (metacarpals and phalanges)	5	4.67
Scapula and clavicle	2	1.86
Shoulder dislocation	5	4.67
Lower limb	60	56.07
Femur	9	8.41
Tibia-fibula	20	18.68
Talus-calcaneus	18	16.82
Metatarsals, phalanges	9	8.41
Spine	7	6.54
Pelvis-acetabulum	4	3.73

Table 2. Table showing the distribution of fractures according to etiology

Etiology	Frequency
Fall (53 patients)	
Humerus	13
Tibia-fibula	12
Forearm	7
Shoulder dislocation	4
Hand (metacarpals phalanges)	5
Foot (metatarsals, phalanges)	8
Femur	6
Spine	5
Jump (25 patients)	
Calcaneus-talus	18
Tibia-Fibula	6
Forearm	3
Pelvis-acetabulum	3
Spine	3
Humerus	1
Patella	1
Shoulder dislocation	1
Being under rubble (8 patients)	
Spine	3
Femur- tibia	3
Pelvis	1
Scapula	1
Metatarsals	1

fractures according to etiology is given in Table 2.

Triage algorithm of patients is shown in Figure 1. Conservative treatment with splinting or casting, open reduction internal fixation, closed reduction internal fixation, and external fixation after fasciotomy were performed on the earthquake victim patients.

Five patients developed compartment syndrome, four in the leg, one in the hand, due to getting caught under rubball of them treated with immediate fasciotomy. Fortunately, we did not encounter crush syndrome or acute renal failure in any of the patients. Thirty-eight patients' fractures treated surgically. Most common surgical procedure was open reduction internal fixation and close reduction internal fixation, respectively. External fixation performed for one femur, one tibia open fracture, and two pelvic injuries. Posterior vertebral stabilization performed for two patients.

There were only three open fractures. Open fractures were managed with tetanus prophylaxis and intravenous antibiotics. Patients who did not have open fractures or compartment syndrome but required surgical treatment were hospitalized with a splint or skeletal traction. After the acute phase of the earthquake had passed and the injury profiles were understood more clearly, patients who required surgical treatment were operated.

DISCUSSION

Most earthquake injuries involve the musculoskeletal system. As stated by Missair et al.,[7] survivable traumatic injuries include bone fractures, soft-tissue lacerations, and crush injury to various parts of the body.[8] This group of earthquake victims presents for medical care in the acute phase of medical relief. Orthopedic surgeons and other surgical divisions are mostly needed in the treatment of post-earthquake injuries.[9,10]

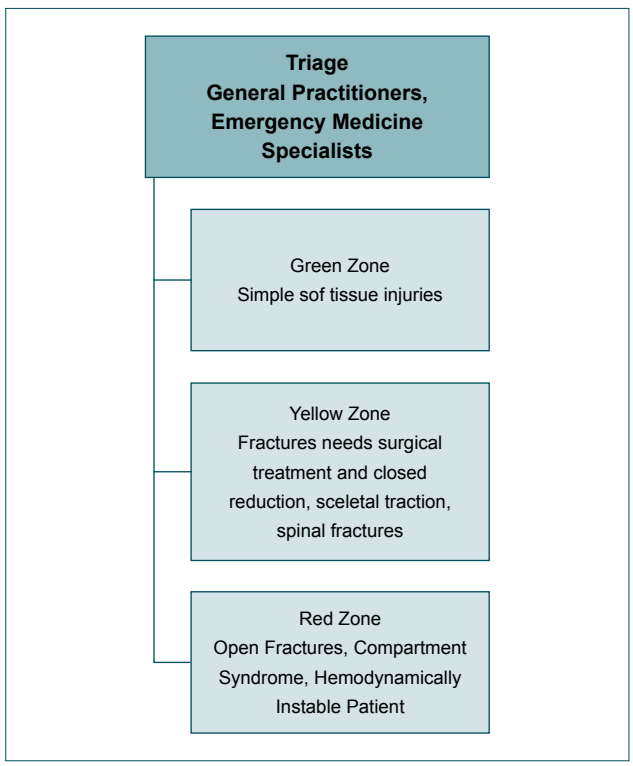


Figure 1. Triage of patients applied to emergency department.

Earthquake is a natural disaster with the possibility of mass injuries and deaths. Number of injuries and deaths may vary depending on the magnitude of the earthquake, the strength of the buildings and the population factors (human behavior and demographics) of the affected area.[11] As with any natural disaster, human behavior can affect the variety of injuries. In our patient group, the number of patients admitted due to being caught under rubble was only 17 and eight of them required surgical intervention. Five of them, except one, had isolated compartment syndrome (four in the leg, one in the hand) and four of them experienced high-energy fractures to the axial skeleton and lower extremities.

In our study, a great proportion of patients had only simple soft tissue injuries such as sprain, laceration, or contusion. In a recent study, the lower extremity trauma without fracture has been reported as the most common injury in 2017 Mexico City earthquake, similar to our results.[12] Vaishya et al.[13] reported of four amputations in 80 orthopedic patients due to severely mangled extremities. Fasciotomy was performed in five of our patients fortunately; we have not performed any amputation. Due to the inclusion of patients who presented within 48 h after the earthquake, we may have not evaluated patients with delayed compartment syndrome with vascular damage. Some authors observed a positive correlation between the time passed under rubble and the number of amputations.[14,15] In addition, Tahmasebi et al.[16] stated that there was a significant relationship between the time passed under rubble and the incidence of compartment syndrome. Also he added that each hour passed under rubble increases compartment syndrome and acute renal failure risks by 15% and 5%, respectively. Unfortunately, there was no data in our study group regarding the time that patients who underwent fasciotomy due to compartment syndrome remained under rubble. However, there was no patient with crush syndrome or acute renal failure in our patient group. Furthermore, early intensive fluid therapy may keep from acute renal failure or crush syndrome.

In a study conducted by Guner et al.,[4] the musculoskeletal injury profile of the 2011 Van earthquake in Türkiye was reported, the authors excluded patients who jumped or accidentally fell from height. However, we have seen that the waist majority of patients who were treated for orthopedic injuries after the Elazig earthquake had indirect injuries caused by reasons such as falling at ground level or jumping. Although the injuries have an indirect connection with the quake, we think that it should be revealed that they occur due to the panic and fear created by the earthquake.

After earthquakes, vast majority of orthopedic injuries includes extremities.[8,17] Görmeli et al.[10] and Naghi et al.[16] concluded that there was a connection between the time of the earthquake and the fractures that could be seen. They conclude that if the earthquake occurs in afternoon or early night when most victims are awake and distal bones are more commonly involved. In our study, the lower extremity fractures were more common than upper extremity in the patients in our study. Fractures involving the upper extremity ranked second in frequency. Pelvis and vertebral fractures were very rare. Calcaneus and distal tibial fractures were most common fracture types. Our fracture distribution rates were similar with 9th November 2011 Van earthquake that was hitted at 21:13 p.m.[4]

The most common surgical procedure was open reduction and internal fixation in our patient group, a finding similar to many other post-earthquake epidemiological studies.[8,12,16,17] Some studies reported that the debridement of soft-tissue injuries is the most commonly performed surgery after an earthquake.[10,18] We believe that the low number of patients with compartment syndrome and severe soft tissue injury brought this result. We had only two open fracture that required aggressive debridement and external fixation. We did not perform primary closure due to risk of infection as previously recommended.[19]

Triage of patients is especially important in times of disasters for a better deployment of medical teams and providing better healthcare to the victims.[12] In the hospitals included the current study, general practitioners experienced in emergency department and emergency medicine specialists performed the initial triage. The patients who required orthopedic care but were not under critical condition were directed to yellow zone, where their care was given by orthopedic team. The severely injured patients (with multiple fractures, hemodynamically instable, etc.) had been directed to red zone to early resuscitation.

Until the end of the 1st day after the earthquake, as an orthopedic team, we did not perform any surgical intervention in any patient except those with compartment syndrome and open fractures. The earthquake had happened in a rural area and we did not know the extent of the damage. To preserve the operating room and the surgical team for the most urgent patients, we hospitalized the patients who did not need urgent surgical treatment by applying splint or skeletal traction. Damage-controlled orthopedic procedures can be applied before definitive internal fixation in earthquakes where the infrastructure is damaged and the patient load is very high.[17] The focus should be on hemorrhage management, wound debridement, infection control, and soft-tissue stabilization. External fixators are valuable damage-control tools in natural disasters and warfare injuries.[20]

The number of dead and injured victims may have been lower since the earthquake affected a rural area with a low population. The previous studies reported that medical help from other cities or even from other countries could be necessary according to the damage caused by earthquakes or other natural disasters.[13,19]

Many patients evaluated in our study were injured due to reasons indirectly related to the destruction brought by the earthquake. Surgical treatment was performed on the majority of the patients for fractures caused by falling or jumping. We did not find a similar result in any of the studies reporting earthquake epidemiology in the literature. In the Elazig earthquake, the panic caused by the earthquake caused more injury than the destruction the quake itself created. Based on this finding, we believe that training people for preparedness and response to an earthquake may be useful in regions with high earthquake risk.

One of the main limitations of our study was that the patient group examined in our study consisted of only patients who presented to three main hospitals in Elazig and Malatya provinces. The retrospective design of the study may be another limitation.

Even with today's technology, preventing an earthquake or knowing in advance where, when and at what intensity an earthquake will strike is not possible. The only thing we can do as orthopedic surgeons is to anticipate possible injuries and be prepared appropriate interventions for future earthquakes. In orthopedic terms, the fast supply of the most likely implants such as external fixators and plate-screws after an earthquake can facilitate patient management logistically.

Conclusion

Indirect musculoskeletal injuries related with earthquake were more common after Elazig earthquake. Lower limbs were the most common affected body part and tibia and calcaneus were the most affected bones. Open reduction internal fixation and close reduction internal fixation were the most common surgical procedures.

Ethics Committee Approval: This study was approved by the İnönü University Non-interventional Clinical Research Ethics Committee (Date: 22.12.2020, Decision No: 2020/1354).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: E.E., O.K., Ö.Y., O.C.B.; Design: E.E., O.A., M.K., İ.G.; Supervision: O.A., M.K., İ.G., S.K.; Data: E.E., O.K., Ö.Y., H.U.Ö., O.C.B.; Analysis: O.K., Ö.Y., H.U.Ö., İ.G.; Literature search: E.E., H.U.Ö., O.C.B., S.K.; Writing: E.E., O.A.; Critical revision: O.A., S.K., M.K.

Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Hangisi daha tehlikeli, deprem mi yoksa panik mi? 24 Ocak 2020 Elazığ/Türkiye depremiyle ilişkili kas iskelet yaralanmalarının değerlendirilmesi

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AMAÇ: Bu çalışmanın amacı, 24 Ocak 2020 Elazığ/Türkiye depremine bağlı kas-iskelet yaralanmaları ve tedavi protokollerini değerlendirmektir.
GEREÇ VE YÖNTEM: İnönü Üniversitesi Tıp Fakültesi Hastanesi, Elazığ Eğitim ve Araştırma Hastanesi ve Malatya Eğitim ve Araştırma Hastanesi acil servislerine depremden sonraki ilk 48 saat içerisinde başvuran hastaların verileri geriye dönük olarak değerlendirildi. Yaş, cinsiyet, yumuşak doku yaralanmaları ve bölgeleri, kırık bölgeleri ve tipleri, kırık etiyolojisi ve tedavi yöntemleri değerlendirildi.
BULGULAR: İki yüz kırk yedi hasta değerlendirildi. Yüz on sekizi kadın, 139'u erkekti. Yirmi dört (%9.7) pediatrik hasta vardı. Ortalama yaş 37.3 (1–92) yıldı. Yaralanmaların çoğu basit yumuşak doku yaralanmalarıydı. Seksen altı hastada 103 kırık vardı. Otuz sekiz hastanın kırığı cerrahi olarak tedavi edildi.
TARTIŞMA: Her büyük afet, geçmişe dönük çalışmaları hakeder, böylece acil sağlık hizmetlerinin tüm seviyelerini nasıl iyileştireceğimizi öğrenebiliriz. Depremzedelerin büyük bir kısmında burkulma, yırtılma veya kontüzyon gibi sadece basit yumuşak doku yaralanmaları vardı. Depremin getirdiği yıkımla dolaylı olarak ilgili nedenlerle birçok hasta yaralandı. Depremin neden olduğu panik, getirdiği yıkımdan daha fazla yaralanmaya neden oldu.

Anahtar sözcükler: Deprem; Elazığ depremi; kas-iskelet yaralanmaları.

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