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The experience of a tertiary level hospital in the 2023 Turkey double earthquake zone; management of 1,092 musculoskeletal injuries in the first week

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Abstract. – OBJECTIVE: The double earthquakes that occurred on February 6, 2023, are currently called the disaster of the century, in Turkey. This study is the first to report the experiences in the treatment of orthopedic emergency patients hospitalized in Adana City Training and Research Hospital (ACH), the largest tertiary hospital in the region.

PATIENTS AND METHODS: The study included the retrospective analysis of the files of the victims of the earthquakes admitted to the ACH between February 6, 2023, and February 13, 2023. The age, gender, time of admission, types and localization of injuries, treatment modalities of earthquake victims, and orthopedic surgical treatment data were recorded.

RESULTS: In the first week of the quakes, 3,699 patients were admitted to the ER with earthquake-related injuries. A total of 1,092 patients with musculoskeletal injuries were hospitalized, and 827 (75.7%) received orthopedic surgery. Surgical procedures included wound debridement under anesthesia (n=392, 47.4%), large bone fractures and/or pelvic ring fractures (n=224, 27.1%), fasciotomies (n=327, 69.1%), and amputations (n=121, 14.6%).

CONCLUSIONS: Although Orthopedics and Traumatology Clinic staff have the highest workload, all hospital personnel should be equipped with basic orthopedic approaches related to the disaster. We believe that taking a more active role in the follow-up of orthopedic patients will help improve the management of the chaotic processes and increase overall treatment success.

Key Words:
Earthquake, Bone fractures, Fasciotomy, Injuries, Crush injuries, Disaster medicine.

Introduction

An earthquake is a natural phenomenon whose strength and timing are generally unknown in advance, which can have a devastating effect on a wide geographical area and cause a large number of deaths. As a country in an earthquake zone with three big fault lines, earthquakes are one of Turkey's most frequent mass disasters. In the last 60 years, 61% of the damage caused by natural disasters in the country has been caused by earthquakes, most likely since more than 70% of the population lives in areas with high earthquake risk[1,2].

On 6 February 2023, the province of Kahramanmaraş, located in a high-risk earthquake zone in the Mediterranean region of Turkey, was struck by two major earthquakes. The first earthquake occurred at 04:17 local time in the Pazarcık district (37.288N-37.043E) and had a depth of 8.6 km and a magnitude of Mw 7.7. The second occurred at 13:24 local time in the Elbistan district (38.089N-37.239E) with a depth of 7 km and a magnitude of 7.6. Both earthquakes affected a total of 11 provinces, including Kahramanmaraş, Gaziantep, Malatya, Diyarbakır, Kilis, Osmaniye, Adana, Elazıg, Şanlıurfa, Adıyaman and Hatay, and were felt over a wide area in Turkey, covering Southeastern Anatolia, Eastern Anatolia, Central Anatolia, and the Mediterranean region. The Turkish Emergency Management Plan (TEMP) was activated, a level four alert was issued, and a state of emergency was declared for the region, where approximately 15 million people reside. According to official figures, more than 50,000 people have lost their lives.

In a devastating earthquake, the number of casualties can be significantly higher than the number of deaths directly related to the earthquake due to deficiencies in health services in the areas closest to the epicenter[3]. Many hospitals, roads, and transportation facilities in the affected area were damaged. Most of the injured were transferred to hospitals in neighboring provinces

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in the first 72 hours. Adana, one of the 11 cities in the disaster area, was relatively less affected, 7,450 were injured, and 408 lives were lost[4]. Adana City Training and Research Hospital (ACH) is the largest tertiary-level hospital in the region and is equipped with a helipad. The ACH exceeded its capacity and met the incoming referrals.

In this study, the orthopedic injuries encountered in the chaos of the immediate aftermath of the earthquake and the surgical treatments were analyzed. The difficulties experienced in the management of orthopedic injuries and the strategies to cope with the crisis environment were presented. The study aimed to contribute to providing a more efficient clinical response to possible earthquakes.

Patients and Methods

The study included the retrospective analysis of the files of the survivors of the earthquakes admitted to the Adana City Training and Research Hospital between February 06, 2023, and February 13, 2023. The data of the files with the diagnosis of X34: Victim of cataclysmic earth movements caused by earthquake and X39: Exposure to forces of nature were included. The age, gender, time of admission, types and localization of injuries, and treatment modalities of earthquake victims with musculoskeletal injuries who received orthopedic surgical treatment data were recorded.

The digital files of patients who were treated with orthopedic surgery were accessed through the statistical study module of ACH.

Patients treated by orthopedic surgery were categorized under four main categories. The surgical treatment of large bone and/or pelvic ring fractures, fasciotomies, large bone amputations or joint disarticulations, and wound debridements (WD) performed under anesthesia data were noted. The WDs performed under anesthesia were divided into three groups, once, twice, three times, and more.

The number of erythrocyte suspensions (ES), fresh frozen plasma (FFP), and platelet suspensions (TS) used in the first week were recorded.

Mortality rates in the first week were recorded.

Statistical Analysis

All data were statistically analyzed using SPSS v. 23 software (Statistical Package for the Social Sciences, IBM Corp., Armonk, NY, USA). Continuous variables were shown as median (Min-Max). Mann-Whitney U Test and Chi-square statistical test were used to evaluate qualitative and quantitative variables, respectively. In this study, $p<0.05$ was regarded as statistically significant.

Results

Preparations and Initial Response

Before the quakes, the ACH, a tertiary class hospital consisting of 4 main blocks (A, B, C, and D) and a Physical Therapy and Rehabilitation wing, including over 7,000 employees, had a total capacity of 1,550 beds, 237 of which were allocated for intensive care units (ICU).

During the first week after the earthquake, the initial OT (Orthopedic and Traumatology) team consisted of eight lecturers, 15 specialist orthopedics physicians, and 24 resident doctors.

In the first stage, due to the apparent need for ICU beds, the number of ICU beds was increased from 237 beds to 380 beds within hours. The large single rooms were converted into double rooms. The staff was told to suspend all non-urgent elective surgical operations and outpatient clinics. Inpatients in the surgery queue and the ones possible to discharge were released from the hospital. Separate teams of orthopedists were assigned to inpatient wards in the main building blocks and physical therapy and rehabilitation wing, intensive care units in the main building, the emergency room (ER) and trauma arena, and the operating room. The teams consisted of lecturers, specialists, and residents of the OT clinic and were scheduled to work twelve-hour shifts.

Due to the expected increase in the workload of orthopedists, and to provide an optimal postoperative follow-up, the patients with orthopedic injuries who would be admitted to clinics other than the OT, were registered on behalf of the specialist physicians of the clinic, where the daily morning and evening rounds were planned to take place in-coordination of both the local team and the assigned separate orthopedics team. The number of rooms used by the OT clinic in the operating room was doubled and the number of operating room staff and nurses was increased. There were three C-arm fluoroscopy devices used by the OT clinic in our hospital. Initiatives were taken to procure new fluoroscopy devices to avoid inadequacy considering the patient density that was expected to happen.

Wound care teams were established and assigned for each block and the Physical Therapy and

Rehabilitation wing to ensure that the wound care following surgery was not interrupted. The teams consisted of two wound care staff, an orthopedic specialist, and a resident doctor.

Triage and Admissions in ER

Identity information could not be provided for most of the patients who were pulled out of the rubble, and their registration to the hospital was performed by using application protocol numbers. Adult patients with severe conditions disabling communication and children who had no relatives and could not express themselves were registered using protocol numbers starting with the prefixes "unidentified", "anonymous", "emergency patient", and "infant patient".

Following registration, problems arose in the hospital information management system in test requests, treatment, and procedure entries. Additional personnel were assigned to complete and verify missing or incorrect patient identification information and to update hospital records, and the technical problems gradually diminished. The records of patients who were identified during the hospitalization were corrected.

The triage of the patients was performed by the specialist and resident physicians of the ER. Orthopedic consultations of patients with musculoskeletal injuries were evaluated by a team of OT specialists and resident physicians assigned to the ER and trauma arena.

In the first week of the quakes, 6,506 patients were admitted to the ER, out of which 3,699 (56.9%) had X34 and X39 ICD diagnoses and presented with earthquake-related injuries. Among the earthquake victims, 393 (10.6%) were foreign nationals.

Almost all of the earthquake victims admitted in the first hours after the earthquake were patients residing in Adana province. Six hours after the first earthquake, there was a significant increase in the number of patients in the emergency room (ER) with the arrival of referrals from neighboring provinces. 1,975 earthquake victims were admitted within the first 48 hours. Triage and patient registration problems emerged suddenly and were experienced at a high level. The triage problem was overcome with the support of physicians and resident physicians from all departments, trauma-related and unrelated, to the ER.

The first earthquake victim was delivered to the hospital on February 6, 2023, at 05:05 and was a resident of Adana province. The first patient from the epicenter was brought by road ambulance at 07:39 the same day. Most of the patients conveyed to the ACH from Adana city center and 10 other affected provinces were carried by road ambulance. The helipad received 780 (21.1%) patients in 180 sorties. Earthquake victims delivered by helicopter or road ambulance had heat-insulated covers due to exposure to cold air for long periods under the rubble.

Among the earthquake victims, 1,877 (50.7%) were female and 1,822 (49.3%) were male. The mean age was 35 years. The number of pediatric patients was 1,037 (28%). The age distribution of the patients is presented in Figure 1.

The admissions to the ER in the first week showed that 1,894 (51.2%) patients were hospitalized and the remaining 1,805 (48.8%) were followed up in ER observation rooms. More than half (n=997, 55.2%) of the patients followed up in ER observation were referred to other hospitals due to overcapacity and 770 (77.2%) of the referrals were sent to other cities,

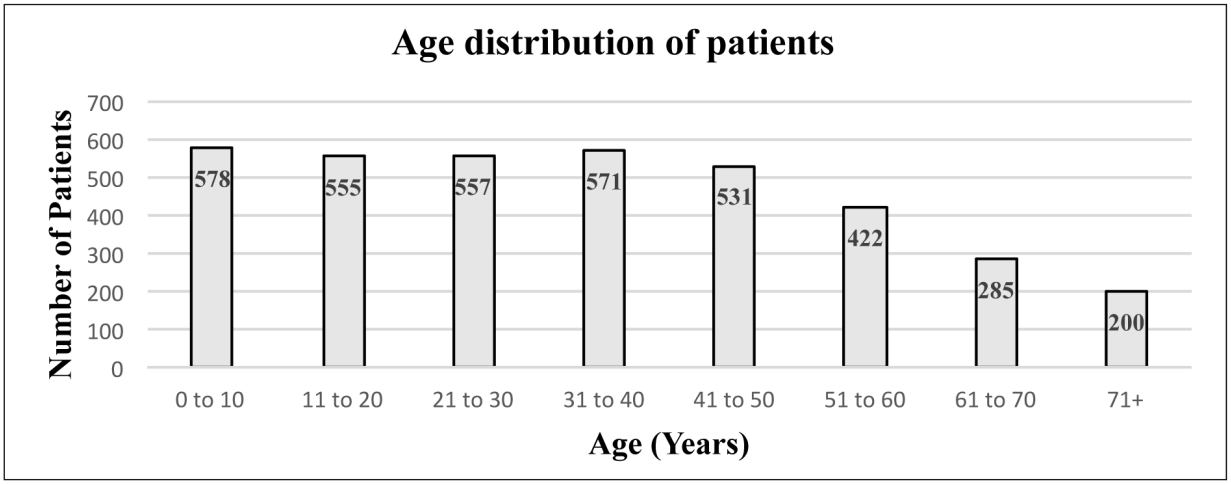

Figure 1. Age distribution of patients admitted to ACH.

227 (22.8%) to second-level hospitals within the province. The remaining 868 patients were treated and discharged after the relevant clinical evaluations.

The numbers of hospitalized patients in the first three days were 856, 317, and 256, respectively. The hospital bed occupancy rate reached a maximum at the end of the third day. The total number of Orthopedics and Traumatology consultations for the first week was 2,463 and mainly requested by ER staff (n=1,804, 73.2%). The suddenly increasing daily number of ER and other clinical consultation requests declined gradually towards the end of the first week. The daily number of earthquake victims admitted to the emergency department and the number of (OT) consultations are shown in Figure 2.

The hospitalization of the earthquake victims was spread out from the OT clinic almost throughout the hospital. Among the patients with musculoskeletal injuries, the clinical follow up of 337 were performed by the OT specialist physicians and the remaining 755 were by the specialist physicians of the clinic they were admitted to, based on the severity of accompanying disorders at the time of admission. The majority (n=852, 78%) were hospitalized within the first 72 hours.

Types of Musculoskeletal Injuries and Orthopedic Examination

The musculoskeletal injuries in the patients who underwent orthopedic surgical treatment included extremity crush injuries, large bone and/or pelvic ring fractures, traumatic large bone amputations or joint disarticulations, lacerations, and foreign body penetrations. The first intervention for all patients who underwent orthopedic surgical treatment was performed by the OT team assigned to the ER.

Emergency fasciotomy surgery was decided for all patients with extremity crush injuries and signs of compartment syndrome. Patients with compartment syndrome-like symptoms (paralysis, paresthesia, and pulselessness) without signs of extremity crush injury were hospitalized for observation. In particular, the lower extremities of these patients were cold on initial examination. The anamnesis showed that the time spent under debris was more than 24 hours and the patients were exposed to cold for a long time. It was seen that the neurovascular problems improved during the follow-up period as the temperature of the cold extremities gradually returned to normal values.

The first interventions for patients with large bone fractures had already been performed in the ER. Splints were applied to closed large bone fractures. Patients with open large bone fractures, and traumatic large bone amputations or joint disarticulations received tetanus vaccine and/or immunoglobulin, antibiotic prophylaxis, wound irrigation, or splinting in the initial intervention and were sent to the operating room for emergency orthopedic surgery.

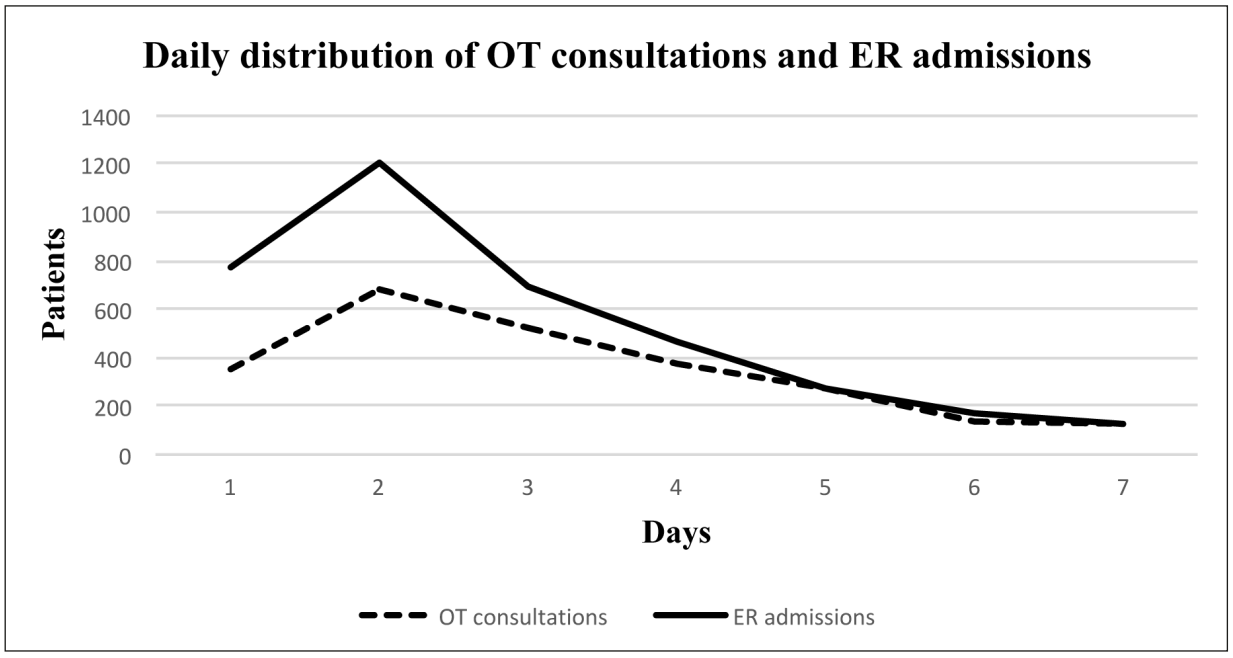

Figure 2. Daily distribution of OT consultations and ER admissions.

Patients with traumatic large bone amputations or joint disarticulations were sent to the operating room immediately after initial evaluation by the orthopedic team in charge of the emergency department.

Surgical Treatment of Musculoskeletal Injuries

In the first week, the number of patients hospitalized with earthquake-related musculoskeletal injuries was 1,092, and 827 (75.7%) cases received orthopedic surgery. Among the 827, 421 (50.9%) were males and 406 (49.1%) were females, with a median age of 32 years (0-93). The daily distribution of the number of patients who underwent surgical treatment during the first seven days is shown in Figure 3.

The most common surgical procedure was WD, and nearly half (n=392, 47.4%) received the debridement under sedation/anesthesia. The high median age of WD patients was 32 years (0-93), which was significantly higher than the patients who received other surgical treatments (p=0.015). The majority of the WD cases were adults (n=251, 69.1%), and the number of WD frequencies for once, twice, and three or more times were as follows: 308, 32, and 21, respectively.

A total of 473 patients with signs of crush injury in the extremities were clinically evaluated for compartment syndrome, and fasciotomy surgery was performed on 327 (69.1%) victims demonstrating compartment syndrome findings, 192 of whom (60.2%) were adults. The median age of the patients who received fasciotomy surgery was 22 years (0-73) and was significantly lower than the patients who underwent other surgical treatments (p<0.001).

In the first eight hours after the first quake, four patients with crush injuries and compartment syndrome findings underwent fasciotomy procedures. The number of fasciotomies performed in the first 24 hours after the quakes was 92. In the following days, the numbers were 191, 32, five, three, two, and two, respectively. The distribution of the extremities and anatomical localizations of the patients who underwent fasciotomy surgery is given in Table I.

The number of patients with large bone fractures and/or pelvic ring fractures who underwent surgery was 224 (27.1%), and the majority were adults (n=165, 73.7%). The median age of patients with fractures was 35 years (1-87), which was significantly higher than those without fractures (p<0.001). The daily number of operations for large bone and/or pelvic ring fractures for the first week were 35, 46, 31, 23, 39, 22, and 28, respectively. The distribution of surgically treated fractures in one week according to the anatomical site is shown in Table II.

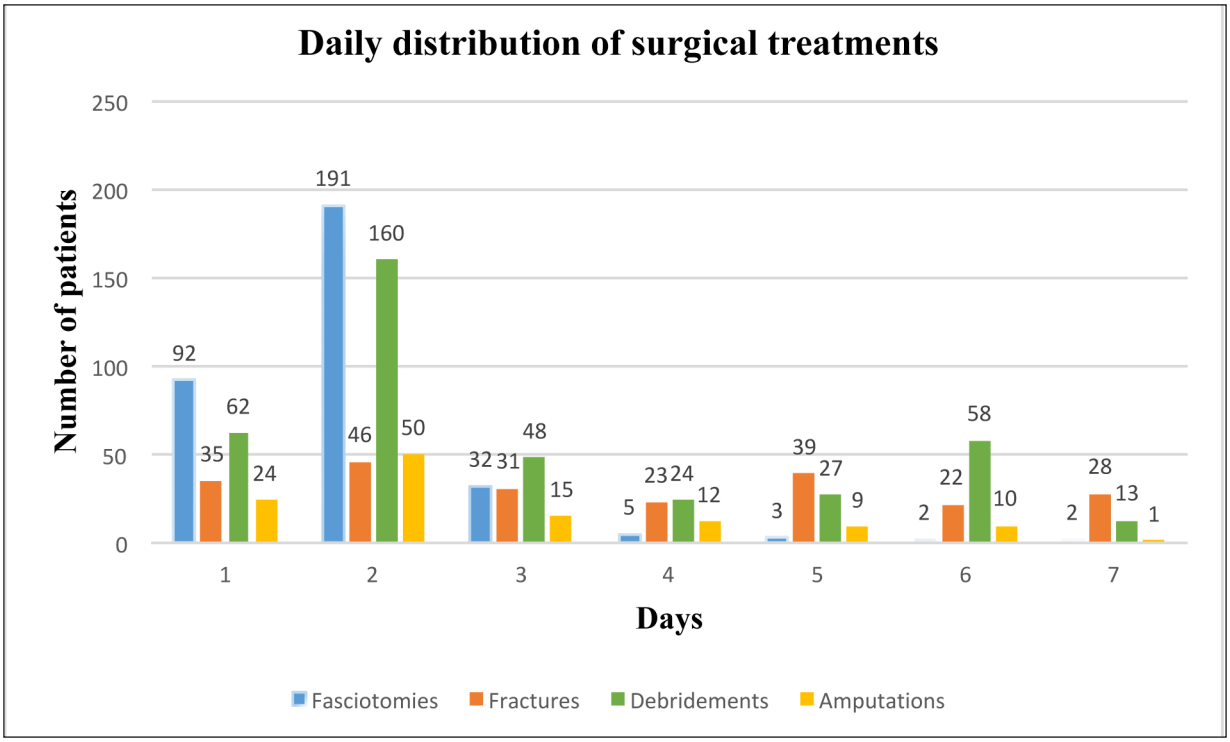

Figure 3. Daily distribution of the number of patients who received orthopedic surgical treatments.

In the first three days, 50% of the patients were operated on for large bone and/or pelvic ring fractures. The high number of cases needing fracture surgery built up in the operating room and C-arm fluoroscopy devices became insufficient because the hospital had three C-arm fluoroscopy devices allocated for the use of the Orthopedics and Traumatology clinic. Patients were queued according to urgency and open fractures, lower extremity fractures, and injuries accompanied by crush injuries with compartment syndrome were prioritized. Temporary fracture fixation with splint application was applied to fracture patients waiting in the queue who had closed fractures and upper extremity fractures. On the 2nd day, with the arrival of three other fluoroscopy devices from hospitals located in nearby cities, the number of operations increased, and the density of fracture patients decreased. In the first two days, the ACH managed the human resources problem internally. On the third day, five volunteer orthopedic specialists approved by the Ministry of Health arrived and joined the ACH OT clinic, which increased the efficacy of the operating room usage.

Among the patients who underwent fracture surgery, in 38 cases, the fracture location was in the pelvis. The number of patients operated on for two or more large bone and/or pelvic ring fractures was 30.

There were 224 surgically treated large bone fractures and/or pelvic ring fractures patients, and 128 (57.1%) were internally fixated by closed and/or open reduction methods using locking plates and intramedullary fixation materials. External fixators and/or Kirschner wires were used on 73 (32.6%) patients. Hemiarthroplasty and total hip arthroplasty were performed on 13 (5.8%) patients (12 hemiarthroplasties, one total arthroplasty). The number of patients receiving external fixators on the tibia, femur, humerus, radius or ulna, and pelvic ring were as follows: 41, 13, seven, seven, and five, respectively. There were 10 (4.5%) patients fixated with both external and internal fixators.

Among all patients who underwent fasciotomy (n=327), 34 (10.3%) were surgically treated for large bone fractures. The number of cases with the tibia, femur, humerus, and radius or ulna was 15, nine, five, and five, respectively.

The large bone and joint amputation or disarticulation surgery ratio compared to all surgical treatments was 121 (14.6%) and 33 (3.9%) cases were children. There were eight (6.6%) patients with traumatic large bone or joint amputation. The number of traumatic amputations at the shoulder, forearm, transhumeral, below the knee, and above knee levels was one with disarticulation, three, one, two, and one, respectively.

Table I. Distribution of fasciotomies based on limb and anatomic localizations.

Localization	n	Percentage
Upper limb	103	31.5%
Bilateral	9	2.8%
Forearm	64	19.6%
Upper Arm	51	15.6%
Forearm and Upper Arm	12	3.7%
Lower limb	224	68.5%
Bilateral	47	14.4%
Cruris	201	61.5%
Thigh	58	17.7%
Cruris and Thigh	35	10.7%
Upper and Lower limb	20	6.1%

Table II. Distribution of fractures based on anatomical site.

Localization	n	Percentage
Upper limb fractures	34	15.2%
Humerus	19	8.5%
Radius/Ulna	15	6.7%
Lower limb fractures	152	67.8%
Femur	70	31.6%
Tibia/Fibula	82	36.6%
Pelvis	38	17%

The distribution of amputation levels of patients who underwent large bone and joint amputation or joint disarticulation surgery is detailed in Table III.

Follow-up, Discharge, and Mortality

The high number of patients undergoing fasciotomy surgery caused an increase in the workload in wound care. Daily fasciotomy dressings were performed using a paraffin antiseptic gauze wound care dressing. Despite broad-spectrum antibiotherapy, frequent debridement, and careful attention to sterility in wound care, infection or muscle necrosis occurred in several fasciotomy

Table III. Distribution of amputation levels.

Localization	n	Percentage
Forearm	11	9%
Transhumeral	16	13.2%
Shoulder disarticulation	4	3.3%
Elbow disarticulation	2 (1 of bilateral)	1.7%
Below knee	43 (6 of bilateral)	35.5%
Above knee	39 (1 of bilateral)	32.3%
Knee disarticulation	4 (1 of bilateral)	3.3%
Hip disarticulation	2	1.7%

cases, but deep tissue culture samples were taken from the fasciotomy sites, antibiotic treatment was revised, and hyperbaric oxygen treatment was planned to follow the recommendations of infectious diseases physicians.

Dressings of fasciotomy sites were applied in the operating rooms under anesthesia in pediatric patients, whereas bedside sedation was used in adult patients.

Vacuum Assisted Closure (VAC) treatment was given where applicable. Hypochlorous acid was applied to the fasciotomy sites before the application. The number of VAC devices was insufficient, and the bedside aspirator systems were utilized.

On the second day after the earthquake, additional operating rooms were assigned for fasciotomy site dressings and wound debridement to provide continuity of the wound care processes.

A total of 241 patients who underwent emergency orthopedic surgery, with stable conditions on follow-up visits and suitable for air ambulance transfer, were transferred to tertiary hospitals in Istanbul and Ankara by the end of the first week, and 90 (37.3%) of them were fasciotomy patients. Patient referrals by day are presented in Figure 4.

The majority of the patients, having lost their homes in the earthquake, showed resistance during the discharge phase. Thus a timely discharge process did not occur. In particular, following large bone fractures or amputation surgery, patients whose treatment process was completed but could not be discharged were transferred to the physical therapy and rehabilitation wing, where orthopedic rehabilitation and post-op wound care were carried out with the collaboration of orthopedics and physical therapy and rehabilitation specialist doctors and physiotherapists.

Several patients did not have a place to stay or a companion after discharge. The social services unit was contacted for these patients.

A total of 2,541 units of blood products were used, including 1,789 (70.4%) erythrocyte suspensions (ES), 612 (24.1%) fresh frozen plasma (FFP), and 140 (25.5%) platelet suspensions.

During the first seven days, 100 (2.7%) of the earthquake victims died.

Hospital Staff and Burnout

On the first day of the earthquake, all hospital staff was called to their clinics, including the ones on leave. A significant part of the hospital staff did not leave the hospital in the first week due to the damaged homes and the fear of the quakes. Some brought their families with them. The staff spent their resting time in cars and tents. At the end of the third day, burnout syndrome started in the emergency service and operating room staff.

Discussion

The Kahramanmaraş double earthquakes disaster ranks fifth among all earthquakes in the 21st century in terms of the number of fatalities[5].

Approximately 10.5% of the earthquake victims admitted in the first week were foreign patients, composed of almost all Syrian nationals. Two earthquakes with Richter magnitude scales of 7.7 and

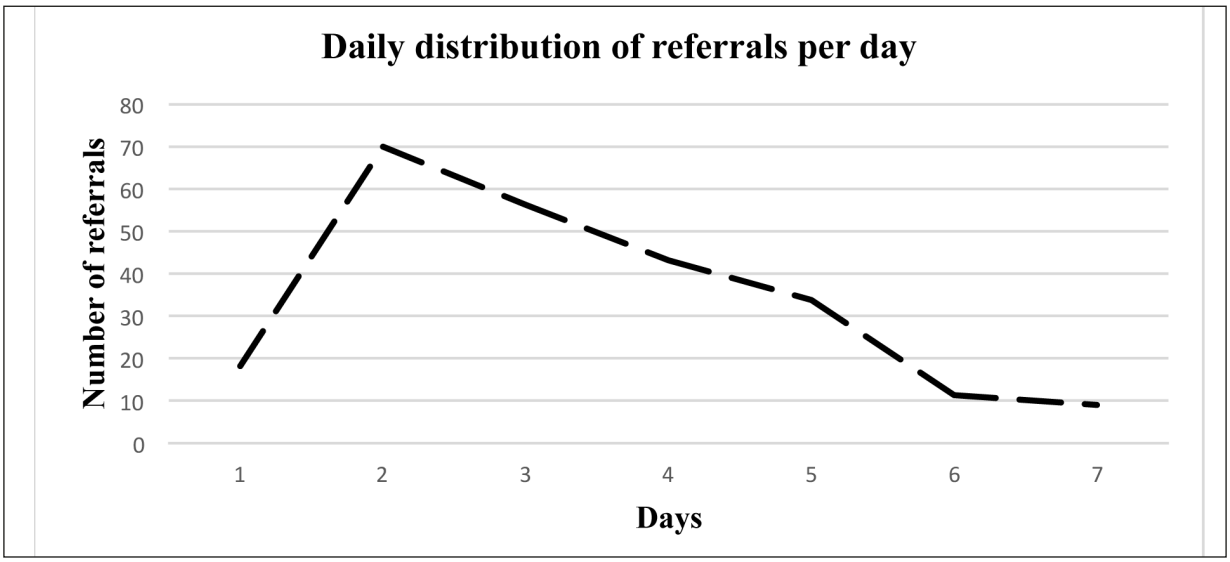

Figure 4. Distribution of the number of referrals of inpatients who underwent orthopedic surgery.

7.6, which occurred several hours apart, affected 11 cities in the country as well as the north of Syria, one of the southern neighbors. In addition, the earthquakes also covered the regions where Syrian refugees were concentrated. The impact area of the quake extending to Syria and the zones where the refugees were dense might explain the high rate of foreign earthquake victims admitted to the hospital.

The first earthquake occurred at 04:17 in the morning and almost all earthquake victims were caught while sleeping in their homes during the winter season, which increased the number of people directly affected by the earthquake[6]. Many studies[6,7] have also indicated the role of the timing of a quake in the type of injuries and number of deaths. Mortality increases parallel to the duration of time trapped in the rubble, so the first 48 are golden hours. The study findings showed that the majority of the survivors (n=1,975, 53.4%) delivered to the ACH were extricated in the golden hours, the first 48 hours.

The increase in the number of admissions of patients with complaints unrelated to earthquake trauma to the ER was another issue to be noted. The rapid augmentation of patients in the ER decreased the time and physical space for care. Similar conditions were experienced after the 1999 Marmara and 2011 Van earthquakes[9,10].

Chen et al[11] reported that 66.2% of patients were admitted to the hospital on the first day after the 1999 Taiwan earthquake. Similar to our findings of 45.2%, in a study conducted focusing on the 1999 Marmara earthquake, which occurred in Turkey, the rate was 42%[12]. This indicates that a larger proportion of the hospitalized earthquake victims were hospitalized on the second and third days.

In the first week, the number of earthquake victims admitted to the ER was well above the bed capacity of our hospital, and 55.2% were referred after initial care. Mulvey et al[8] reported that in the 2005 Kashmir earthquake, the number of applications in the first 72 hours was far above the capacity. A report[13] about the Taiwan earthquake stated that all the injured victims were extricated and delivered to the ER within the first three days following the earthquake. Almost all (92.9%) of the earthquake victims admitted to the ACH emergency department were hospitalized within the first 72 hours. The high rate can be attributed to three main reasons: the hospital's proximity to all provinces in the earthquake zone, offering opportunities for advanced medical or surgical treatments, and finally, the fast delivery of referrals by air ambulances due to the existence of the helipad.

Musculoskeletal injuries are quite common in the majority of patients, often including complicated injuries such as fractures, crush injuries, limb loss, burns, and frostbite[14,15]. Hypothermia emerged as an additional threat for earthquake victims since the disaster occurred in winter. Oshiro et al[16] stated that earthquakes and natural disasters are frequently associated with hypothermia.

Mackenzie et al[17] reported that 65% of orthopedic injuries in earthquakes were fractures, and the most common site was tibia. Similar to the study by Mackenzie et al[17], the most common fractured bone in this study was the tibia (36.6%). In the 2005 Pakistan-Barakott earthquake, the total fracture rate among all injured patients was reported to be 18%[18]. In this study, the proportion of patients who received orthopedic surgical treatment for fractures was 27.1%.

There are reports[19] highlighting the difficulty in the surgical processes due to inaccessibility to fluoroscopy parallel to the findings in the study. The need for additional fluoroscopy devised in times of such disasters is apparent and requires foreplanning. Three new fluoroscopy devices were provided on the second day and with the help of volunteer orthopedic specialists who arrived on the third day, we were able to overcome this challenge in the management of fracture patients.

In the literature[20], it is recommended to start rehabilitation promptly after the acute period of trauma to maintain functionality. The aim was to reduce the risk of mobility and mortality in patients with postoperative fractures who were transferred to the physiotherapy and rehabilitation unit by starting rehabilitation with physiotherapists as soon as possible, but the results were not reported because conducting a thorough evaluation in the early period was not viable, particularly in children.

Compartment syndrome is a permanent dysfunction that develops by the inhibition of blood flow in vascular structures of the muscle and nerve tissues due to increased tissue pressure in a closed osteofascial compartment, resulting in ischemia of the tissue[21]. Compartment syndrome is very common with crush injuries and the process may become irreversible after six to eight hours. The emergency fasciotomy procedure aims to reduce compartment pressure and protect neuromuscular structures[22]. In the study, almost all of the patients who underwent fasciotomy surgery had acute compartment syndrome, and a considerable percentage of the fasciotomy surgery operations were performed in the first 48 hours after the earthquake (86.5%).

In the Guideline for the Management of Limb Injuries in disasters, in the first eight hours after injury, following a careful assessment of the vitality of the extremity, if the patient has clinical signs of compartment syndrome, urgent fasciotomy is recommended. However, the benefit of fasciotomy in the following 24-48 hours is controversial[23]. As shown in this study, a large number of fasciotomies were performed in the first 24-48 hours. The most important factor is likely to be the fact that the hospitals at the epicenter of the earthquake were heavily damaged, and the patients with crush injuries and extremity fractures extracted from the rubble might not have reached the emergency health services adequately or on time.

The reports[24-26] indicate that, after the Wenchuan and Bam earthquakes, 15 out of 32 (47%) and 70 out of 200 patients (35%) with crush injuries underwent fasciotomy surgery. Following the Van earthquake in Turkey, the number of patients with crush injuries exclusively underwent fasciotomy surgery was 21 (45%) of 46. In the 2003 Bingol, Turkey earthquake, routine fasciotomies were performed in almost 70% of the patients with acute muscle crush compartment syndrome[27]. In this study, fasciotomy surgery was performed in 327 (69.1%) of 473 patients with crush injuries, presenting a significantly higher rate compared to other studies but similar to the 2003 Bingol, Turkey earthquake.

Successful results of hyperbaric oxygen administration have been reported[28] in soft tissue injuries, open fractures, and crush injuries. Therefore, we utilized hyperbaric oxygen therapy during the follow-up period, especially in patients who underwent fasciotomy surgery.

In the 2005 Pakistan earthquake, unlike the difficulties encountered in the supply of blood products due to damage to blood banks, there was no shortage due to undamaged blood banks and an increase in donations of blood products throughout the province[29].

Limitations

There are some limitations in this study. First, this is a retrospective study based on medical records. Although many were double-checked, the accuracy of the patients' files might have been compromised under chaotic conditions. Moreover, the study focused on musculoskeletal injuries in the survivors of the earthquakes admitted to the ACH. The details of major organ injuries and additional situations were not reported in this study.

Conclusions

Severe earthquakes are inevitable in the countries located in the earthquake zones. The most important task in uneventful times should be improving the emergency action plans for a possible earthquake in the light of scientific studies and staying alert.

Almost all studies show that there are great difficulties in health care in the first 72 hours after a severe earthquake. Although Orthopedics and Traumatology Clinic staff have the highest workload, all hospital personnel should be equipped with basic orthopedic approaches related to the disaster. We believe that taking a more active role in the follow-up of orthopedic patients will help improve the management of the chaotic processes and increase overall treatment success.

Authors' Contributions

Both authors, M.Y. Gokmen and M. Uluoz have contributed to the conceptualization, design, data collection, analysis, interpretation, manuscript preparation, and editing. Both authors have read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Ethics Approval

The ethical approval of the study was obtained by the Clinical Research Ethics Committee of the Adana City Training and Research Hospital on April 6, 2023, with decision number 2449.

Informed Consent

Not applicable.

Funding

This study received no funding.

Data Availability

The data that found the analysis results of this study are de-identified patient records available from the ACH, which Turkish regulations restrict open access. The data was used by permission for this research and thus may not be offered to the public. Nevertheless, might be available upon plausible request, given that ACH Ethical Committee is open to discussion.

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