ORIGINAL ARTICLE

First 10 days after the 6th of February 2023 earthquake disaster: experience of an orthopedic clinic on the border of the disaster zone

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ABSTRACT

BACKGROUND: The earthquake disaster that occurred on February 06, 2023, caused serious destruction and loss of life in the south of Türkiye. The purpose of this article consisting of two interconnected parts is to report the experience of our orthopedics clinic, which is located just on the border of the disaster area. The subject of the first part of the study is the characteristics of orthopedic traumas in earthquake victims and the treatment methods applied. The subject of the second part is the disaster work plan of the clinic and its consequences in practice.

METHODS: For the first step, descriptive information, diagnoses, and treatment methods of 204 earthquake victims who were treated by our clinic in the first 10 days after the disaster were compiled from the archives. In terms of the second phase of the study, an in-clinic work plan was created on the morning of the 1st day of the disaster. The teams and working hours in the emergency department, inpatient service, and operating room were determined. Hospital management and other clinics were contacted and hospital facilities were organized for orthopedic trauma victims.

RESULTS: The mean age of the patients was 42.3 years. Among the age groups, the smallest group was children under 10 years old (6.4% of all patients). 132 of the patients had at least one fracture in 135 extremities. Most of the injuries involved the lower extremity. 66 patients had crush injury with or without fracture. 181 orthopedic surgical procedures were performed in 144 patients. The most common operations were internal fracture fixation and debridement. The most used implant was the plate-screw combination. Thanks to the in-clinic work plan and the in-hospital assistance and allocation of facilities, we did not experience serious problems in the hospitalization, surgery, and post-operative follow-ups of the patients. Although we received numerous offers of assistance from external institutions, this was not possible due to bureaucratic obstacles. Among our most important problems were the shortage of sterilized powered surgical drills and the lack of a dynamic patient information database.

CONCLUSION: Orthopedic clinics should prepare their in-clinic work plans for earthquake disasters and develop their facilities. In order not to encounter bureaucratic obstacles in emergency assistance, orthopedic clinics in different risk regions should be formally matched beforehand. A patient database table that clinical staff can access and revise using their smartphones facilitates the follow-up of large numbers of simultaneously hospitalized patients.

Keywords: Earthquake; in-clinic disaster work plan; orthopedic trauma.

INTRODUCTION

Earthquakes are among the most destructive natural disasters. [1,2] One of them occurred recently on February 06, 2023. It was called the Türkiye-Syria earthquake in the world press. On the same day at 04:17 A.M. and at 01:24 P.M., two earthquakes of magnitude 7.7 and 7.6 occurred. It caused serious destruction in 11 provinces within the borders of Türkiye

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Figure 1. A view from Hatay after the earthquake. (With permission from Dr. Murat Ünal).

alone. Soon after the earthquakes, the country's government declared these provinces as disaster zones. Both of the earthquake centers were within the borders of Kahramanmaraş province. However, the most building destructions took place within the borders of Hatay province (Fig. 1). In the provinces directly affected by the disaster, the medical care system became insufficient due to hospital damages and high number of injured. In the 1st days after the earthquakes, there was an intense transfer of injured to the hospitals in the cities located on the border of the disaster zone.

Orthopedic surgeons have important roles in the treatment of earthquake injuries. Long bone fractures, soft-tissue damages, and crush injuries are among the most common earthquake injuries.[3,4] The documentation of epidemiological information and management experience regarding these earthquake injuries are critical for creating plans for future similar disasters.[5,6] In this two-part study, as a university clinic of orthopedics located on the edge of the disaster zone, we share our experience of the first 10 days after the earthquake. The subject of the first part is the characteristics of the earthquake victims and their treatment requirements. The second part is about the implemented disaster work plan.

MATERIALS AND METHODS

Data Collection and Classification

For the first part of the study, approval was obtained from the institutional clinical research ethics committee before starting the data collection (2023/161). From the hospital's digital archive, the information of those who were admitted with the earthquake victim code between February 6 and 16 were compiled. There was a total of 2045 patients meeting these criteria. Among them, 316 patients were consulted at the orthopedic clinic. Patients with missing clinical data and without an orthopedic injury were excluded. The study was conducted in 204 patients whose all intended information was available, consulted, and treated by the orthopedic clinic. Detailed information about these patients was compiled and classified retrospectively.

Statistical Analysis

The continuous variables were expressed as means ± standard deviation, and the categorical variables were expressed as numbers and percentages.

State of the Orthopedic Clinic and its Disaster Work Plan

The orthopedic clinic subjected to the study is 300 km far from the earthquake epicenter. It is in one of the southern provinces where one of the largest commercial ports of the country is located. Before the disaster, the population of the geographical and administrative province was 1,500,000. After the disaster, there was a sudden and serious increase in the population due to migration. The clinic is a subunit of the only state university hospital in the province. The total num-

ber of operating rooms in the hospital is 21. Under normal conditions, the bed capacity of the orthopedic clinic is 24 (22 service beds and 2 intensive care beds), and two operating rooms are allocated to elective surgeries of the orthopedic clinic every day. A total of 23 doctors were working in the clinic at the time of the earthquake. The staff consisted of 7 lecturers, 2 hand surgery sub-specialization residents, and 13 orthopedic residents.

Due to the severity of the earthquake and the geographical proximity, all the staff of the clinic felt the earthquake shaking and fear. The familial origin of 10 of the staff was from the disaster zone. The first-degree families of 8 of them were living within the zone. Due to the interruption of cellular data services, it was not possible to contact family members in the disaster zone for hours. In the 1st h of the morning of the earthquake, clinic staff, like all the people in the region, left the buildings with their families. Due to the cold and rainy weather, they stayed in cars in the open area.

Staff who provided a relatively safe place to stay for their families met in the conference room of the orthopedic outpatient clinic on the ground floor of the hospital from 08:00 A.M. Those who could not find a safe place to stay were invited to the orthopedic outpatient clinic. Families of these staff were temporarily accommodated in examination rooms. Meanwhile, news began to be received from the media about the incredible level of the disaster. According to this news, it was understood that ours was the first province where there was no destruction on the western border of the earthquake zone. The most senior of the staff communicated with the hospital management and requested support for the orthopedic clinic.

Outpatient admissions and elective surgeries were stopped to get ready for massive emergent patient delivery. The hospital management announced that the routine patient admission will be stopped for at least 5 days so that the hospital facilities could be used for disaster victims. The management also asked clinics to discharge existing inpatients as soon as possible to allocate bed capacity to earthquake victims. In this context, bed capacities of ophthalmology, urology, cardiovascular surgery, otorhinolaryngology, plastic surgery, and surgical intensive care services were reserved for orthopedic trauma patients. These regulations were later extended to the 10th day after the disaster.

An orthopedics in-clinic emergency work plan was made for the expected intensive victim admission. The conference room in the polyclinic was designated as the commanding center. The facilities of the clinic were transferred to this area so that the internet, hospital digital archive system, and national TV stations could be accessed simultaneously. A work plan was made to prevent the staff from being insufficient due to fatigue. Lecturers were planned to work in 24-h periods. According to this plan, the orthopedic team would be led continuously by 2 lecturers, one senior and one junior. Two-hand surgery residents adopted a 12-h work and rest schedule. Orthopedic residents were divided into 3 groups. Each group was asked to work for 16 h and rest for 8 h. Thus, the orthopedic team would always consist of at least 11 doctors to admit the victims.

In terms of duty, the senior lecturer coordinated the work of the clinic, guided treatment indications, and communicated with the hospital management and the other clinics. The junior lecturer was mainly responsible for the processes in the operating rooms. Two of the residents were assigned to work in the emergency department (ED), one in the inpatient service, and the rest in the operating room. The consequences of this work plan that emerged in practice will be given in the results section.

RESULTS

Characteristics of Earthquake Victims and their Treatment Requirements

The first patient from the disaster zone entered the hospital at around 17:30 on the 1st day. Patient admission intensified

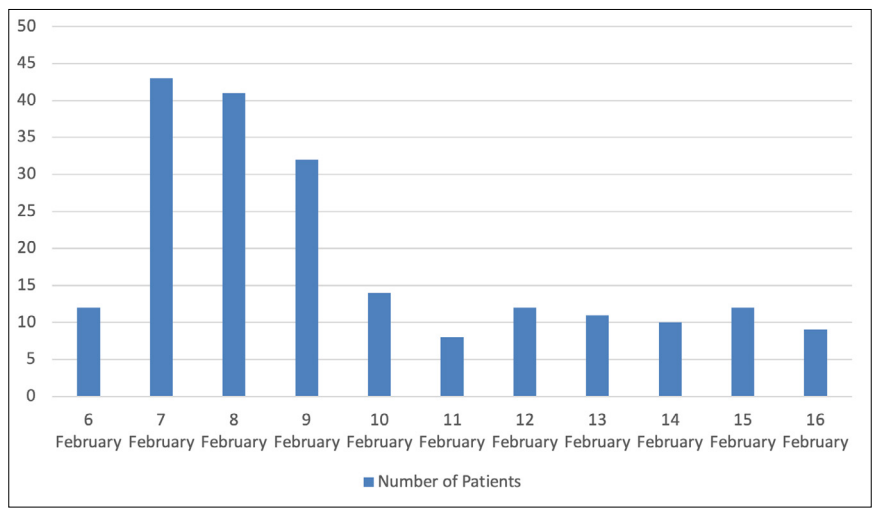

Figure 2. Distribution of the patients according to the day of their admission to the orthopedics clinic.

with the start of the 2nd day after midnight. The distribution of patients according to the day of their admission in the first 10 days after the earthquake is shown in Figure 2. The overwhelming majority of the patients (n = 189, 92.6%) were from Hatay province and the rest (n=15, 7.7%) were from other earthquake provinces.

Of the patients included in the study, 106 (52%) were female and 98 (48%) male. The mean age was 42.3 (SD: 21.3; range: 0–92). In terms of age, the largest groups were patients aged between 18 and 40 years (n=52, 25.5% of patients) and patients over the age of 60 (n=50, 24.5% of patients). Only 6.4% of the patients (n=13) were children under 10 years of age.

One hundred and thirty-two of the patients had at least one fracture in 135 extremities. Of the fractured extremities, 56 were upper and 79 were lower extremities. Nineteen of the lower and 3 of the upper extremity fractures were open. A total of 66 patients had crush injury. Of these, 10 had lower extremity, 5 had upper extremity, and one had both lower and upper extremity fractures. Fifty of the crush injury patients had extremity injury without fracture. Of these patients, 36 had lower extremity injuries, 13 had upper extremity injuries, and one had both lower and upper extremity injuries. Nine patients had pelvis fractures. Categorized information regarding the orthopedic injuries of the patients is given in Table 1.

A total of 180 surgical procedures were performed in 144 of the patients in the first 10 days after the earthquake. The most common operations were fracture fixation (n=89), surgical debridement (n=38), amputation (n=27), and fasciotomy (n=13). Sixty patients were treated with non-operative methods. Categorized information on treatment methods is given in Table 2. The mostly used orthopedic implants were plate-screw combinations (n=39), Kirschner wires (n=30), intramedullary fixation devices (n=22), and external fixators (n=16). Hemiarthroplasty for hip fracture was performed in 9 patients. Categorized information regarding the used orthopedic implants is given in Table 3.

The mean duration of hospital stay was 5.14 (SD: 7.2; range: 1–40) days. This period was 6.5 (SD: 8.01) days for those who were operated on and 1.9 (SD: 3.43) days for those who were treated without surgery. During hospitalization, 3 out of 204 patients died (mortality rate 1.47%). The length of hospital stays and the mortality rate given in this paragraph may not be applicable to all of earthquake orthopedic trauma patients. Starting from the 7th day, some of the patients were transferred to hospitals in other cities by official referral. The referrals were made at the request of the patients or their relatives, and the aim was to reduce the burden on hospitals at the border of the disaster area.

Consequences of the Orthopedic Clinic Work Plan in Practice

ED processes

During the periods when many patients entered the ED at once, emergency medicine doctors and the two assigned orthopedic assistants could not evaluate the patients in a timely manner. To speed up the process, orthopedic lecturers joined the team. In addition, residents from internal medicine branches were called for their support. Although there were many offers from orthopedic clinics of other institutions dur-

Table 1. Classified information regarding the orthopedic injuries of the patients

	Surgical treatment (n=144)		Non-surgical treatment (n=60)		Total (n=204)	
Diagnosis	**n**	**%**	**n**	**%**	**n**	**%**
Upper limb fracture, closed	30	21	16	27	46	23
Upper limb fracture, open	2	1	0	0	2	1
Upper limb crush injury with fracture	5	3	0	0	5	2.5
Lower limb fracture, closed	44	31	13	21	57	28
Lower limb fracture, open	9	6	0	0	9	4
Lower limb crush injury with fracture	10	7	0	0	10	5
Upper and lower limb fracture, closed	1	1	0	0	1	0.5
Upper and lower limb fracture, open	1	1	0	0	1	0.5
Upper and lower limb crush injury with fracture	1	1	0	0	1	0.5
Upper limb crush injury without fracture	12	8	1	2	13	6.5
Lower limb crush injury without fracture	20	13	16	27	36	18
Upper and lower limb crush injury without fracture	1	1	0	0	1	0.5
Pelvic fracture	4	3	5	8	9	4
Extremity soft tissue injury without fracture	0	0	9	15	9	4
Hand tendon lacerations	4	3	0	0	4	2

Table 2. Classified information regarding the applied treatment methods

Type of surgery	n	%
Open reduction and internal fixation	42	23.2
Closed reduction and internal fixation	32	17.6
External fixation	16	8.8
Fasciotomy	13	7.2
Debridement	38	21
Amputation	27	15
Hemiarthroplasty	9	5
Reconstruction of hand tendon lacerations	4	2.2
Total	181	100

Table 3. Classified information regarding the used orthopedic implants

Used orthopedic implants	n	%
Kirschner wires	30	25.8
Titanium elastic nail	8	6.8
Intramedullary nail	14	12
External fixator	16	13.8
Plate-screw combination	39	33.7
Arthroplasty equipment	9	7.8
Total	116	100

ing the first few days, bureaucratic obstacles prevented receiving external help.

The clinical and radiographic images of the injured who were decided to be hospitalized were shared using the group messaging application of the clinic. Thus, it was ensured that all team members were informed.

Informed consent for orthopedic treatments was obtained in ED. In unconscious patients, informed consent was obtained from a companion, if present. In unconscious and unaccompanied patients, the situation was documented, and treatment was initiated as needed.

No major surgical procedures including fasciotomy were performed in the ED. However, procedures such as splinting, minor debridement, and skin closure were performed in the location.

Operating room processes

The number of operating rooms for simultaneous orthopedic surgeries increased up to 6 during periods of intense disaster victim entrance. This opportunity was made possible by the high efforts of anesthesiologists and operating room staff. However, during these periods, the number of surgeons in the orthopedic team remained insufficient. As a solution, a call was made through the hospital management and surgical assistance support was provided by the residents of other surgical branches.

To avoid a shortage of orthopedic surgical materials, suppliers were asked to keep all their stocks ready and sterilized. Except for elastic titanium nail no serious problem was observed in access to sterilized surgical fixation materials. Sterilizing and using the 30 surgical tool sets of the clinic was almost always sufficient. Surgical sets of other surgical clinics were used when there was a lag. However, the electric drills, which were limited to 10 in number, could not be sterilized fast enough. Due to this problem, we occasionally inserted sterilized drill bits and fixation pins onto disinfected powered drills during closed reduction and internal fixation (CRIF) or external fixation procedures.

Another problem experienced in the operating room was the delays in the emergency-radiology-emergency-operating room transfers of the injured. The problem was consulted with the radiology department, and it was decided not to perform thin section imaging in computed tomography requested for orthopedic trauma. In addition, the hospital management unit was asked to assign personnel from other parts of the hospital to transport the injured.

Inpatient service processes

Controls of inpatients were made by lecturers during daily visits starting at 09:00 every day. Due to the high number of patients with open wounds requiring control, the visits lasted 3–6 h. After the dressing was removed and checked, the necessary interventions were noted on the patient's bedside chart. Three nurses were assigned to close the dressings.

With the increase in victim density on the 3rd day after the disaster, the orthopedics team was insufficient in-patient follow-up in inpatient services. Thereupon, the hospital management and related branches were contacted, and routine follow-ups were started to be done by the relevant surgical clinic residents. At the same time, it was decided to categorize the patients according to the service they will be admitted to. With this decision, preoperative patients were admitted to the orthopedic service to facilitate their preoperative preparations. Pediatric patients were admitted to the urology service to facilitate their follow-up by pediatricians. Patients who underwent fasciotomy were admitted to the plastic surgery clinic and their follow-up and transfer to that clinic were accelerated.

On the 5th day after the disaster, when the number of hospitalized patients was the highest, we created a cloud-based database to reduce the possibility of patient overlook. The database contained information about patients' diagnoses, treatment, and follow-up plans, and when and where they were hospitalized. Orthopedic doctors were able to access this information through their smartphones and make instant updates. In practice, it was too late for this process. It was difficult and took a long time to retrospectively record the

accumulated patient information in the database. Therefore, it could not be used effectively.

DISCUSSION

Between 1998 and 2017, earthquakes caused about 750.000 deaths worldwide, more than half of all natural disaster-related deaths.[7] Especially in densely populated regions, earthquakes of high magnitude can lead to a significant number of orthopedic-related injuries with a wide variety.[8] The 6th of February earthquakes affected a very large and populated region. According to official reports, it caused more than 50,000 deaths and many more injuries within the borders of Türkiye alone. Since the disaster area was heavily damaged in terms of infrastructure and human resources, the injured were primarily transferred to the surrounding provinces. Due to its location, our province experienced intense migration of disaster victims. Its hospitals were among the first addresses where the wounded were admitted.

The arrival time of disaster victims to the hospital varies according to the distance of the hospital to the earthquake center and the level of destruction of the transportation roads. Elmi et al.[9] reported that patient admissions began within the 1st h following the earthquake. Moitinho de Almeida et al.[10] reported that the number of admitted patients after the earthquake peaked on the 5th day. Guner et al.[11] reported that 70% of the patients were admitted to the hospital over the first 3 days. In our experience, the most intense entry of the patients occurred between the 2nd and 4th days. Another point we have experienced about patient admission is that there can be very intense patient admissions to the ED simultaneously. The transportation of the disaster victims to our city was mostly done by ships from the province of Hatay, where roads and runways were damaged. For this reason, many victims were brought to the ED at once each time a ship arrived at the port. A work plan should be prepared in advance for similar situations where the patient admission workload suddenly increases. The solution we found was to call the residents of the internal medicine branches for assistance in the ED.

There are different reports regarding the age distribution of patients in earthquake injuries.[11-13] It seems that it depends on the socio-demographic characteristics of the affected area. In addition, based on our results, we think that children might be less affected under wreckages due to their smaller body size than adults.

The lower extremities are the most injured anatomical body region in earthquake-related orthopedic traumas.[5,9,11,14] Our results are also compatible with the literature in this respect. According to our results, the incidence of crush injury due to lower extremity involvement with or without fracture was also a remarkable finding. Possible reasons for these determinations may be that the lower extremities are bulkier and contain more muscle mass than the upper extremities. On the other hand, due to the frequency of crush syndrome, it is important for orthopedic specialists to keep their knowledge up to date on the mechanism of injury, treatment, and follow-up of this syndrome.

External fixation, amputation, debridement, open reduction, internal fixation (ORIF), and CRIF are the most commonly performed orthopedic procedures in the acute period after the earthquake.[5,9,10,14] The relative frequency of the various types of treatment varies among studies. For example, Bar-On et al.[15] reported that external fixation was used in 31% of the patients, while Phalkey et al.[16] reported this rate as less than 2%. The most common surgeries in our series were ORIF, debridement, CRIF, amputation, external fixation, and fasciotomy. Our preference to perform the definitive surgery as soon as possible has been effective in the formation of this distribution.

In parallel with the types of surgeries we performed, the most frequently used orthopedic implants were plate-screw combinations and Kirschner wires. Although we did not have any major problems in terms of the supply of orthopedic implants and sterilization of the surgical sets, the shortage of sterile electric drills was an important problem. According to our calculation, our powered drill number should have been 80% more (18 pieces) to avoid this problem.

In modern societies, disaster management plans are made at different layers, and practices are made from time to time to maintain preparedness. However, plans made by national, regional, or hospital administrations may not adequately regulate the work of sub-units such as clinics.[17,18] According to Born et al.[17] the purpose of a specific orthopedic disaster plan is to provide a response template for both internal (i.e., the hospital is a disaster area) and external (i.e., the hospital is the primary reception center) situations. The province where our clinic is located does not carry a high risk for earthquakes, and before February 6, our clinic did not have an earthquake disaster work plan. The clinic-specific work plan detailed in this study was quickly created on the day of the disaster and revised according to the requirements in the process. We think that the experiences we gained from this work plan can be a guide to preparation for future disaster periods.

CONCLUSION

Based on our experience, we recommend the following points in terms of preparedness for future disasters:

• Orthopedic clinics should prepare disaster situation work plans in advance. In this framework, in-clinic tasks should be determined. The teams that will work in the emergency room, operating room, and inpatient services and their working hours should be determined. In case of a disaster, orthopedic team members tend to work with maximum effort and without interruption. This tendency can lead to fatigue failures. The work plan should address this possibility.

• To be prepared for situations where the workforce capacity of the orthopedic clinic is exceeded, other units that will receive in-hospital assistance should be determined. For adjustment of the level and timing of this assistance, communication and coordination with the hospital management unit and related units should be ensured.

• Official correspondence should be made in advance to arrange the support to be received from orthopedic clinics of other institutions. In this context, our recommendation is to match the clinics for cooperation according to their location and risk levels. For each clinic, primary and secondary matching clinics can be determined. In this case, whenever necessary, quick delivery of help would be possible bypassing the bureaucratic obstacles.

• A social media communication group including all team members should be established. Clinical and radiographic images of each injured person should be shared in this group. In addition, a patient database should be created. This database should contain descriptive information, time of hospitalization, hospitalization unit, and treatment and follow-up plans. Team members should be able to access and make changes to this table from their smartphones. Thus, patients should be saved from being overlooked.

• Classification of earthquake trauma patients according to their needs and hospitalization in separate hospital units according to this classification facilitates their management procedures. For this purpose, the distinction between child/adult and closed/open fractures and having fasciotomy or crush syndrome are reasonable criteria.

• Orthopedic clinics in earthquake-risk areas or on the border of risky areas should strengthen their inventory of surgical sets, powered drills, and wide wound dressing materials and keep them up-to-date and sterile. Regional storage of orthopedic trauma implants may be considered for simultaneous use in large numbers of patients.

Ethics Committee Approval: This study was approved by the University of Health Sciences Mersin University Ethics Committee (Date: 15.03.2023, Decision No: 2023/161).

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ORİJİNAL ÇALIŞMA - *ÖZ*

6 Şubat 2023 Depremi sonrasındaki ilk 10 gün: Afet bölgesi sınırındaki bir ortopedi kliniğinin deneyimi

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AMAÇ: 06 Şubat 2023 tarihinde meydana gelen deprem felaketi, Türkiye'nin güneyinde ciddi yıkım ve can kaybına neden oldu. Birbiriyle ilişkili iki bölümden oluşan bu makalenin amacı, afet bölgesinin hemen sınırında yer alan ortopedi kliniğimizin deneyimini aktarmaktır. Çalışmanın ilk bölümünün konusu depremzedelerde saptanan ortopedik travmaların özellikleri ve uygulanan tedavi yöntemleridir. İkinci bölümün konusu kliniğin afet iş planı ve uygulamadaki sonuçlarıdır.

GEREÇ VE YÖNTEM: Çalışmanın birinci bölümü için deprem felaketinden sonraki ilk 10 günde kliniğimizce tedavi edilen 204 depremzedenin açıklayıcı bilgileri, tanıları ve uygulanan tedavi yöntemleri arşivden derlendi. Çalışmanın ikinci bölümü açısından afetin ilk günü sabahı klinik içi çalışma planı oluşturuldu. Acil servis, yataklı servis ve ameliyathanede çalışacak ekipler ve çalışma saatleri belirlendi. Hastane yönetim birimi ve diğer kliniklerle iletişim kuruldu ve ortopedik travmalı hastalar için hastane olanaklarının tahsis edilmesi sağlandı.

BULGULAR: Hastaların yaş ortalaması 42.3 yıldı. Yaş grupları arasında en küçük grup 10 yaş altı çocuklardı (tüm hastaların %6.4'ü). Hastaların 132'sinin 135 ekstremitesinde en az bir kırık bulunuyordu. Yaralanmaların çoğu alt ekstremiteyi tutmuştu. 66 hastada kırıkla birlikte veya kırıksız ezilme yaralanması vardı. 144 hastada 181ortopedik cerrahi prosedür uygulandı. En sık yapılan ameliyatlar kırık içten tespiti ve debridman idi. En sık kullanılan implant plak-vida kombinasyou idi. Klinik içi çalışma planı ve hastane içi yardımlaşma ve olanakların tahsisi sayesinde hastaların yatırılması, ameliyat ve ameliyat sonrası takiplerinde ciddi bir sorun yaşamadık. Dış enstitülerden çok sayıda yardım teklifi almamıza rağmen bürokratik engeller nedeniyle bu mümkün olmadı. En önemli sorunlarımız arasında steril elektrikli cerrahi matkap eksikliği ve dinamik hasta bilgileri veritabanının bulunmaması yer aldı.

SONUÇ: Ortopedi klinikleri deprem felaketi için klinik içi çalışma planlarını önceden hazırlamalılar ve olanaklarını geliştirmeliler. Acil yardımlaşmada bürokratik engellerle karşılaşmamak için önceden resmi olarak farklı risk bölgelerindeki ortopedi klinikleri eşleştirilmelidir. Klinik çalışanlarının akıllı cep telefonundan ulaşıp revize edebildiği bir hasta veri taban tablosu eşzamanlı yatan çok sayıda hastanın takibini kolaylaştırır.

Anahtar sözcükler: Deprem; ortopedik travma; klinik-içi afet çalışma planı.

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