

What have we learnt as orthopaedic surgeons? Pandemic surveillance of surgically treated fracture patients

Ortopedik cerrahlar olarak ne öğrendik?
Cerrahi tedavi gören kırık hastalarının
pandemik sürveyansı

Abstract

Aim: To investigate the epidemiological and demographic data of the patients operated on during the first wave of the pandemic, and to analyze what the pandemic has taught orthopedic surgeons

Methods: In this retrospective analysis, 90 patients who were operated in our clinic were analyzed. Demographic data, injury mechanism, fracture site, anesthesia type, the number of consultations after admission, the comorbidities, average time between first admission to hospitalization, the length of stay in the intensive care unit (ICU), and neutrophil-lymphocyte ratio (NLR) were investigated.

Results: Higher incidence of hip fractures was observed in COVID-positive patients ($p<0.001$). The number of two or more consultations requested was significantly higher in COVID-positive patients ($p=0.034$). As the number of consultations requested increased, the mean time between the first admission and hospitalization also increased ($p=0.036$). Moreover, there was a significant association between COVID-positivity and the need for ICU follow-up ($p=0.001$). When the postoperative NLR was compared, it was found to be significantly different in COVID-positive patients compared to COVID-negative patients ($p=0.005$).

Conclusion: During the heart of disasters, patients with high comorbidity should not be made to wait for long periods in the emergency department. It is important to inform them and their relatives about the prognosis and possible ICU follow-up of these patients. It is important to consider that domestic injuries may increase. Additionally, it is important to note that parameters such as NLR, which are commonly used in routine follow-up, may be affected by infections.

Keywords: COVID-19; hip fracture; infection; intensive care unit

Öz

Amaç: Pandeminin ilk dalgası sırasında ameliyat edilen hastaların epidemiyolojik ve demografik verilerini araştırmak ve pandeminin ortopedik cerrahlara neler öğrettiğini analiz etmek

Yöntemler: Bu retrospektif analizde kliniğimizde ameliyat edilen 90 hasta incelendi. Demografik veriler, yaralanma mekanizması, kırık bölgesi, anestezi tipi, başvurudan sonraki konsültasyon sayısı, eşlik eden hastalıklar, ilk başvurudan hastaneye yatışa kadar geçen ortalama süre, yoğun bakım ünitesinde (YBÜ) kalış süresi ve nötrofil-lenfosit oranı (NLO) incelendi.

Bulgular: COVID-pozitif hastalarda daha yüksek kalça kırığı insidansı gözlenmiştir ($p<0,001$). İstene iki veya daha fazla konsültasyon sayısı COVID-pozitif hastalarda anlamlı olarak daha yüksekti ($p=0,034$). İstene konsültasyon sayısı arttıkça, ilk başvuru ile hastaneye yatış arasındaki ortalama süre de artmıştır ($p=0,036$). Ayrıca, COVID pozitifliği ile YBÜ takip ihtiyacı arasında anlamlı bir ilişki vardı ($p=0,001$). Ameliyat sonrası NLR karşılaştırıldığında, COVID-pozitif hastalarda COVID-negatif hastalara kıyasla anlamlı derecede farklı bulunmuştur ($p=0,005$).

Sonuç: Afetlerin merkezinde, yüksek komorbiditesi olan hastalar acil serviste uzun süre bekletilmemelidir. Bu hastaların prognozu ve olası YBÜ takibi hakkında kendilerini ve yakınlarını bilgilendirmek önemlidir. Ev içi yaralanmaların artabileceğini göz önünde bulundurmak önemlidir. Ayrıca rutin takipte sık kullanılan NLR gibi parametrelerin enfeksiyonlardan etkilenebileceği unutulmamalıdır.

Anahtar Sözcükler: COVID-19; enfeksiyon; kalça kırıkları; yoğun bakım ünitesi

Murat Tasci¹, Sedat Duman²,
İhsan Özdamar³

¹ Clinic of Orthopaedics and Traumatology, Ümraniye Training and Research Hospital, Health Sciences University

² Clinic of Orthopaedics and Traumatology, Ataşehir Medar Hospital

³ Department of Orthopaedics and Traumatology, Pendik Training and Research Hospital, Marmara University

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Corresponding author/Yazışma yazarı
İhsan Özdamar

Marmara Üniversitesi Pendik Eğitim ve Araştırma Hastanesi, Ortopedi ve Travmatoloji Anabilim Dalı, İstanbul, Türkiye.
E-mail: ozdmrihsan@hotmail.com

ORCID

Murat Taşçı: 0000-0001-5391-7662

Sedat Duman: 0000-0003-4734-9958

İhsan Özdamar: 0000-0002-0685-9284

INTRODUCTION

About four years ago, our country and the whole world fought against the Coronavirus infection (COVID-19), which has been called “the pandemic of our time”. While fever, cough, shortness of breath were the main symptoms, non-specific findings such as impairment of smell-taste, headache, weakness, and muscle aches could also be seen in COVID-19 infection. Although we recognize the pandemic of our time today, the fact that the treatment was not fully clarified at the time of its emergence and that the infection spread rapidly even without symptoms were the main problems in the management of this respiratory disease (1,2).

The rapid and uncontrolled spread of the infection has made it necessary to take urgent measures in our country, as in many other countries. One of the first moves made for this purpose was the concept of the “new normal”, which included curfews, especially for risk groups, and the regulation of social rules (3). As orthopaedic surgeons, our main objective during this period was to determine the most appropriate management strategy in cases with fractures that need hospitalization. The importance of isolation of COVID-19-infected and COVID-suspected patients, proper management of hospital resources, and measures to prevent transmission were of maximum importance during this period (4-7). Therefore, considering the hospitals as the riskiest contamination places, elective surgeries were postponed to protect both patients and healthcare professionals, as many centers around the world (8-10). Moreover, all necessary measures were taken to prepare and perform trauma surgeries as quickly as possible and to ensure the early discharge of patients (11).

Today, we recognize, know, and manage COVID-19 infection. With precautions, proper treatments, and vaccines, we have brought the pandemic of our age under control and normalcy has returned. However, it should not be forgotten that COVID-variants continue to emerge and that coronavirus is not the only virus that carries the risk of a pandemic. Moreover, pandemics are not the only disasters that we need to manage as orthopedic surgeons, we must fulfill the responsibilities of our profession in all-natural disasters such as earthquakes and floods. Therefore, we must learn from the pandemic of our age. Our aim in

this study, in which we investigated the epidemiological and demographic data of the patients we operated in our clinic during the first wave of the pandemic, was to analyze what the pandemic has taught orthopedic surgeons and how we should act in possible future pandemics.

MATERIAL AND METHODS

Patient Selection

Following the local ethical board approval (Ümraniye Education and Research Hospital Clinical Research Ethics Committee, date: 12/05/2020, decision no: 160) and Turkish Ministry of Health Approval (02/05/2020), this study was conducted in a tertiary training and research hospital. Between the dates of March-May 2020, which is also called the first wave of the pandemic all orthopaedic trauma patients who applied to the emergency department and required surgical intervention were included in the study, regardless of the age (10). Patients who did not need surgery, patients who refused surgery and patients who followed up conservatively were excluded from the study. Considering these criteria, 90 patients were retrospectively analyzed.

Patient Management

In line with the recommendations of the Turkish Ministry of Health and the World Health Organization, all patients who were evaluated in the emergency room and planned to be hospitalized and surgically treated were evaluated for COVID-19 infection (12). Radiological and laboratory examination was performed on all the patients, and the diagnosis was made mainly based on performing thoracic computed tomography (CT) without waiting for PCR test results (Fig. 1) (13) and treatment strategy was planned accordingly (Fig.2). Suspicious or positive cases were quickly taken to the isolation areas. The patients were hospitalized as soon as possible, after their emergency interventions and consultations were completed. After hospitalization, patients with suspected or positive COVID-19 diagnosis were asked for a consultation from the Infectious Diseases Department and their treatment was arranged. To keep the duration of hospitalization shorter by speeding up the preoperative preparation period, as

suggested in the literature (4), preoperative preparation was completed as soon as possible under the supervision and management of the anesthesiologist.

Surgeries were performed in a separate operating room with negative pressure and HEPA filters. In an infected case, regional anesthesia techniques were preferred as much as possible due to the high risk of transmission with droplets and aerosols during intubation. In addition, regional anesthesia application is less likely to develop secondary pneumonia compared to general anesthesia (14). In patients undergoing general anesthesia, laryngeal mask airway was preferred to endotracheal intubation (15). During the anesthesia procedure, minimum healthcare professionals were kept in the operating room and after the anesthesia procedures were completed, surgeons and surgical nurses were taken into the operating room. All healthcare professionals were provided to use personnel protective equipment appropriately (1). Moreover, to achieve lesser exposure by shortening the operation time, two orthopaedic surgeons were enabled to work on the same case in the operating room. In terms of surgical technique, minimally invasive-closed techniques such as intramedullary nail applications were prioritized in order to reduce aerosol formation as much as possible and to provide less contact with the patient and shorter hospitalization time (15). The use of power tools such as electrocautery, drill, reamer, saw, and jet lavage, which has been shown to form aerosols, was tried to be reduced. In order to reduce the need for transfusion of patients, reduce hematoma formation and extra bleeding, diligent efforts were made to provide good intraoperative hemostasis (16)

Data Analysis

While analyzing data, demographic data such as age and gender, injury mechanism, fracture site, anesthesia type, the number of consultations after admission to the emergency department, the comorbidities, average time between first admission to hospitalization, and the length of stay (LOS) in the intensive care unit (ICU) were investigated. Also, considering the fact that in the majority of COVID-19 patients, neutrophil count increases, while the lymphocyte count decreases, and as a result, neutrophil-lymphocyte ratio (NLR) increases, patients preoperative and postoperative

NLR were also investigated (4). All data were analyzed retrospectively, using the hospital information system and HSYS (Public Health Management System).

Statistical analyses

The database was created using Microsoft Excel and statistical analysis and visualizations were done using SciPy 1.4 software and Statistical Package for the Social Sciences package program version 23.0 (SPSS Inc., Chicago, IL, USA). Frequency and percentage were used as descriptive statistics in categorical data and mean and minimum-maximum range values were used to have an overview of the distribution of the variables. Since our data were found to be skewed distributed, the Mann-Whitney U test was used to compare the means of two groups of the variables age, NLR, and length of stay in ICU. The Spearman Correlation Analysis was used to investigate the association between the number of comorbidities and length of stay in the ICU and between the number of consultations and the average time of admission to hospitalization. For categorical data (gender, fracture site, injury energy, anesthesia type, number of consultations, number of comorbidities, and ICU follow-up requirement), the Chi-square test was used and in cases where the Chi-square assumption was not met, Fischer's exact test was used. For all the tests, significance was set at 0.05.

RESULTS

Among 90 patients who were treated surgically during the COVID-19 period, 16 (17.8%) patients had computed tomography findings compatible with pandemics. The mean age of all the patients was 42.5 (Range:4-95) years whereas the mean age of those with positive radiological findings compatible with pandemics was 70 (Range:24-95) years ($p=0.032$). In terms of fracture sites, a higher incidence of hip fractures was observed in COVID-positive patients ($p<0.001$). Detailed follow-up characteristics of surgically treated fracture patients in our clinic during the pandemic can be observed in Table 1.

When the number of consultations requested during the first emergency department admissions of the patients was analyzed, it was found that the number of two or more consultations requested was significantly

Table 1: Demographics and follow-up characteristics of surgically treated fracture patients during the COVID-19 pandemics

		COVID-positive (n=16)	COVID-negative (n=74)	Total (n=90)	P
Age (years)		70 years (24-95)	36.5 years (4-95)	42.5 years (4-95)	0.032
Gender	Female	10 (62.5%)	22 (29.7%)	32 (35.6%)	0.013
	Male	6 (37.5%)	52 (70.3%)	58 (64.4%)	
Fracture site	Upper limb	0	18 (24.3%)	18 (20%)	<0.001
	Lower limb other than hip	2 (12.5%)	42 (56.8%)	44 (48.9%)	
	Hip fracture	14 (87.5%)	14 (18.9%)	28 (31.1%)	
Injury energy	High-energy	2 (12.5%)	10 (13.5%)	12 (13.3%)	0.914
	Low-energy	14 (87.5%)	64 (86.5%)	78 (86.7%)	
Anesthesia type	General	5 (31.3%)	41(55.4%)	46 (51.1%)	0.080
	Regional	11 (68.7%)	33 (44.6%)	44 (48.9%)	
Number of consultations sent	<2	10 (62.5%)	64 (86.5%)	74 (82.2%)	0.034
	≥2	6 (37.5%)	10 (13.5%)	16 (17.8%)	
Comorbidity	<2	4 (25%)	52 (70.3%)	56 (62.2%)	0.001
	≥2	12 (75%)	22 (29.7%)	34 (37.8%)	
ICU Follow-up	No	6 (37.5%)	60 (81.1%)	66 (73.3%)	0.001
	Yes	10 (62.5%)	14 (18.9%)	24 (26.7%)	

n: number of patients; p: statistical significance value; Number of consultations sent: Number of consultations required at the first emergency admission; ICU: Intensive Care Unit.

higher in COVID-positive patients ($p=0.034$) (Table 1). There was also a significant correlation between the number of consultations requested and the average time between the first admission and hospitalization. It was observed that as the number of consultations requested increased, the mean time between the first admission and hospitalization also increased ($p=0.036$) (Fig 3).

When the relationship between the number of comorbidities and COVID diagnosis was examined, a significant association was found between COVID-positive patients and the presence of two or more comorbidities ($p=0.001$) (Table 1). Moreover, there was a significant association between COVID-positivity and the need for ICU follow-up ($p=0.001$). In the intensive care unit, the mean follow-up time was 1.62 (Range:0-6) days in COVID-positive patients, while it was 0.45 days (Range:0-2) in COVID-negative patients ($p=0.007$). The length of stay in the ICU of the COVID-positive patients with three or more comorbidities increased significantly compared to other patients ($p=0.023$) (Fig 4).

The preoperative mean NLR of all patients was 5.59 (Range:1.07-21.34), whereas postoperative NLR

was 7.69 (Range:1.05-27.12). When the patients with COVID-19 were examined, the preoperative mean NLR was 9.2 (Range:1.66-21.34), whereas the postoperative NLR was 17.65 (Range:5.89-27.2). When the postoperative NLR was compared, it was found to be significantly different in COVID-positive patients compared to COVID-negative patients ($p=0.005$). The postoperative NLR of COVID-negative patients increased by an average of 43.5%, whereas an average of 178.3% increase was observed postoperatively among the COVID-positive patients ($p=0.008$)

DISCUSSION AND CONCLUSION

Orthopaedics and Traumatology is a branch that can be heavily impacted by natural disasters. Orthopaedic surgeons often play an active role in responding to disasters such as earthquakes, floods, and war situations (17). Additionally, the COVID-19 pandemic has highlighted the importance of orthopaedic surgeons during infectious pandemics (3,6,7). It is crucial to postpone elective cases and prioritize emergency cases based on infection status (7,9,10). Therefore, we must learn the necessary lessons from the pan-

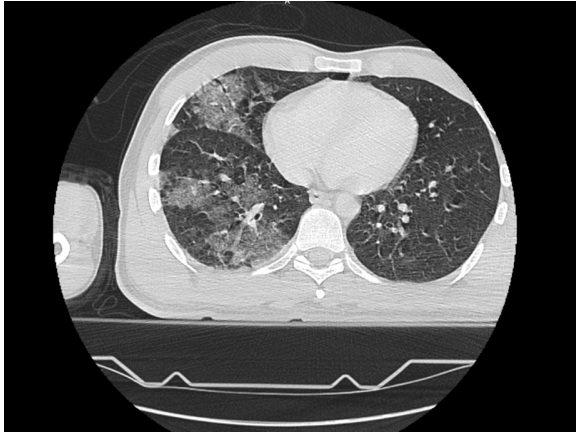


Figure 1: Computed tomography image of a COVID-positive patient

demic of our age and prepare for potential disasters. The study found that COVID-positive fractures were more common in women and the elderly, which is consistent with existing literature (2-6). The study also found a higher incidence of lower extremity fractures, particularly hip fractures, which is a common injury resulting from domestic accidents. Our study found that COVID-positive patients had significantly higher numbers of comorbidities, number of emergency consultations, duration between admission to hospitaliza-

tion, and longer length of stay in ICU compared to COVID-negative fracture patients. Additionally, our study shows the preoperative and postoperative variation of NLR in COVID-positive and COVID-negative patients.

We spent most of our time in our homes due to the measures taken during the global COVID-19 pandemic. This can be interpreted as an increase in domestic accidents and related injuries, which is consistent with the literature (3,18). According to our data, fractures occur mainly in elderly patients with domestic falls, most often with falls from standing. 80% of the operated patients were lower extremity fractures and 31.1% of them were hip fractures. Gencer and Doğan conducted an epidemiological analysis of COVID-19 fracture patients in 2022 and reported a hip fracture incidence of 12.6%. The variation in rates may be related to regional differences, especially to the density of the elderly population. However, it is evident that increased time spent indoors results in a decrease in high-energy injuries and an increase in domestic injuries. In a study by Yanbin et al., it was stated that 72.7% of the fractures occurred especially in elderly patients with domestic falls, 89.4% of them were caused by falls from standing. They sug-

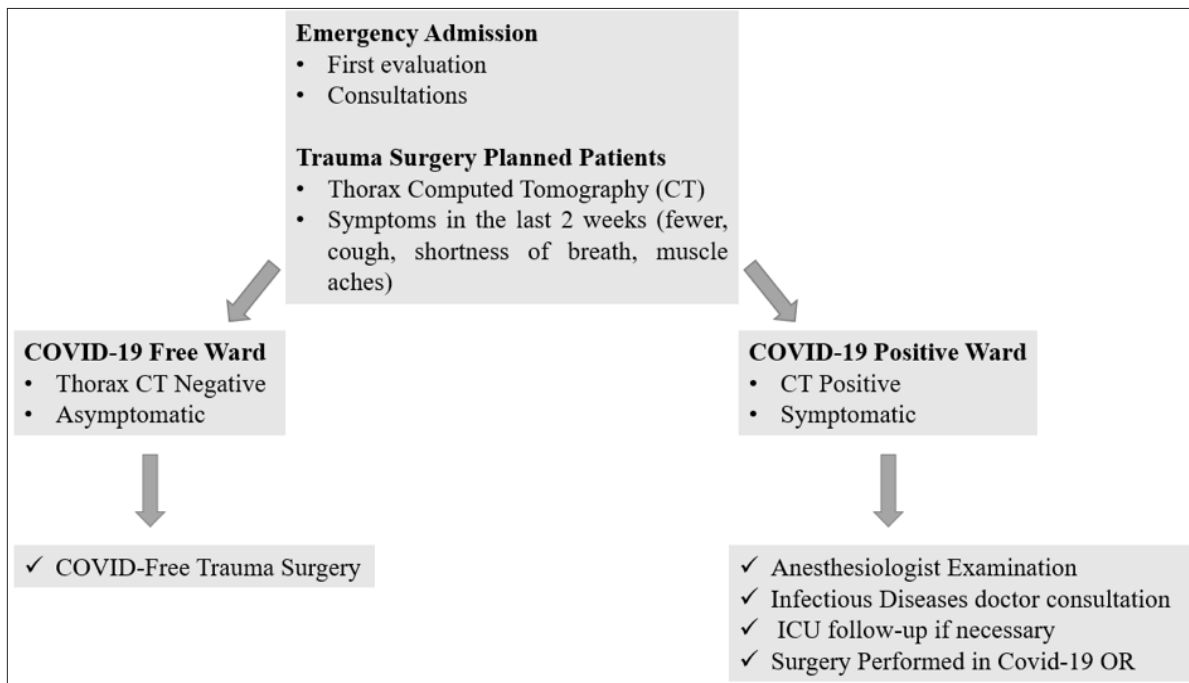


Figure 2: Treatment strategy in fracture patients admitted to our hospital during the pandemic
CT: computed tomography; OR: operations room

gest that the elderly must get up by 'holding on' after sitting or lying down for a long time (9). It is also important to investigate the causes of the higher incidence of COVID-19 positivity in hip fractures. Considering that COVID-19 infection is more common in people with weakened immune systems and in those who do not take adequate measures to prevent the risk of transmission, the susceptibility of the geriatric patient population to this infection due to both weakened immunity and inadequate precautions can be understood. The predisposition of the same population to hip fractures with domestic injuries may be the reason for the increased COVID-19 positivity in hip fractures.

According to our data, the average duration between admission to hospitalization is 339 minutes in cases where two or more consultations are requested in the emergency room and 109 minutes in cases where one consultation is requested ($p=0.037$). Keeping the patient in the emergency room for a long time will increase the probability of infection of the traumatized patient. In another possibility, if the patient is infected, it increases the likelihood of spreading to other people. The rational solution is to minimize the duration that the patient spends in crowded departments such as the emergency room (11). However, it is essential that a patient with both a trauma-related fracture and COVID-19 infection must be evaluated by the relevant clinics at the first admission, and it is urgent in terms of planning the treatment correctly and affecting the hospitalization of the patient. As a matter of fact, in our study, it was determined that the number of emergency consultations requested in COVID-positive patients was significantly higher. Undoubtedly, among the factors affecting this situation, the fact that COVID-positive patients are older and have more comorbidities is also important. Another important point to emphasize is that, during the pandemic, high-energy injuries decreased due to curfew restrictions, closure of some workplaces, and reduced traffic density. This situation can be considered as an advantage. Namely; the reduced patient load allowing the physician to perform consultations after hospitalization may reduce the need for additional consultations during pre-hospitalization process in traumatic patients. In any case, emergency department management becomes very important in emergencies such as

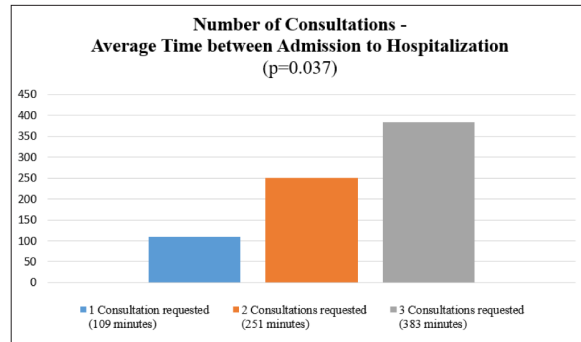


Figure 3: Association between the number of consultations requested in the emergency department and the average time between admission to hospitalization

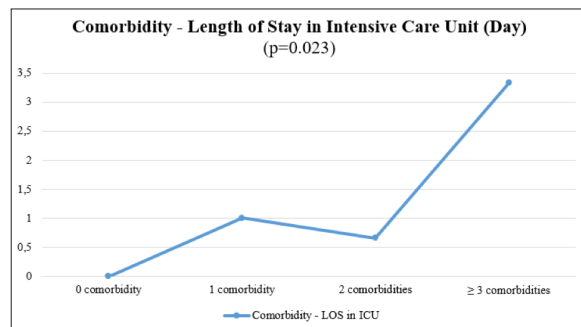


Figure 4: Association between the number of comorbidities and the length of stay in intensive care units

pandemics, and it is of utmost importance to manage the workforce correctly, to complete the absolute emergency procedures of the patients quickly and then to hospitalize them and to prevent overcrowding in emergency departments.

In our study, postoperative ICU requirement increases significantly in COVID-positive patients. Here, it is the factor that the infection disrupts respiratory functions and is more severe in patients with high comorbidities. In addition, we think that the surgery applied to the patient negatively affects the patient clinic by creating a second hit effect on the already traumatized patient. According to our data, 75% of infected patients have two or more comorbid diseases. In addition, in our study, COVID-positive patients with three or more comorbidities required longer follow-up in the ICU ($p=0.023$). Acknowledging the effect of comorbidity on fracture patients and especially the necessity of ICU follow-up is crucial for the optimal management of these patients and to correctly inform their relatives.

As stated in the current literature, COVID-19 infection decreases lymphocyte count, increases neutrophil count and increases NLR (14). The amount of this increase was found to be correlated with the severity of the disease and mortality rates (2, 15). In our patient group, we observed that the NLR in COVID-positive cases was higher than in COVID-negative patients. When we compare the preoperative and postoperative NLR; in COVID-positive cases, the mean NLR increased significantly higher whereas in COVID-negative patients the increase was relatively lower. It is important to know that the range of change of NLR is much wider in COVID-positive patients and that it increases both with infection and with trauma, fracture and surgery. When using this parameter in patient follow-up, it should be remembered that the patient's additional injuries and previous surgeries should be taken into consideration.

Our study has some limitations. Firstly, it was conducted in a single center and had a relatively low number of patients. Additionally, it was retrospective in nature. Another limitation is that the evaluation did not include asymptomatic cases that may have been overlooked, or cases in which conservative treatment was started but surgical treatment was required due to loss of reduction during outpatient follow-up. Furthermore, the process of the pandemic, injury, emergency admission, and operation is limited by several confounding factors and it is not possible to evaluate all. Despite its limitations, this single-center study examines variables related to patients operated on for fractures during the most active period of the pandemic. We believe that this study will contribute to the literature and that it is important to take action based on the findings. This will help us prepare for future disasters that may occur.

As orthopaedic surgeons, it is part of our job to work in the heart of disasters. During such times, it is important to make correct plans and ensure emergency admissions are met promptly. Patients with high comorbidity should not be made to wait for long periods in the emergency department. It is important to inform them and their relatives about the prognosis and possible ICU follow-up of these patients. It is important to consider that domestic injuries may increase. Additionally, it is important to note that parameters such

as NLR, which are commonly used in routine follow-up, may be affected by infections. In conclusion, while planning the surgery during the pandemic, following the isolation rules, shortening the admission process, and striving to reduce mortality by closely monitoring patients with additional comorbidities is of utmost importance.

Conflict-of-interest and financial disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

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