



The Impact of the COVID-19 Pandemic on Orthopedic Trauma Management; A Cross-sectional Study

COVID-19 Pandemisinin Ortopedik Travma Yönetimi Üzerindeki Etkisi; Kesitsel Bir Çalışma

 Vedat Öztürk¹,  Başar Burak Çakmur²,  Ali Can Koluman¹,  Malik Çelik¹,  Altuğ Duramaz¹

¹University of Health Sciences Türkiye, Bakırköy Dr. Sadi Konuk Training and Research Hospital, Clinic of Orthopedics and Traumatology, İstanbul, Türkiye

²University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of Orthopedics and Traumatology, İstanbul, Türkiye

ABSTRACT

Objective: The aim of this study was to compare emergency orthopedic trauma admissions between the pre- and pandemic periods and detect changes in orthopedic trauma epidemiology.

Methods: A total of 40,700 patients admitted within 1 year between March 2019 and March 2020 comprised the pre-pandemic group and 16,935 patients admitted between March 2020 and March 2021 comprised the pandemic group. Demographic characteristics of the patients, such as age and gender, were recorded. In addition, the injury mechanisms of the patients, diagnosis, injured extremity or anatomical region, broken bone, fracture classification, multitrauma rates, trauma-related complications, hospitalization days, and treatment modalities were examined.

Results: In the pre-pandemic period, the mean age of the patients was younger, and the distributions of pediatric/adolescent patients and female patients were higher compared with the pandemic period ($p=0.001$, $p=0.001$, and $p=0.001$; respectively). Fractures and dislocations were more frequent in the pandemic period, whereas soft tissue injuries were more common in the pre-pandemic period ($p=0.001$). Home accidents increased and occupational accidents decreased during the pandemic period ($p=0.001$). The rate of surgical treatment statistically increased during the pandemic period ($p=0.001$).

Conclusion: Considering the epidemiology of orthopedic trauma, estimating the trauma burden and optimizing resource use and allocation are very important for maintaining safe and effective treatment services for patients in extraordinary situations such as the coronavirus disease-2019 pandemic, which can cause serious disruptions in the healthcare system.

Keywords: Orthopedic trauma, COVID-19, pandemic, trauma epidemiology, resource use

ÖZ

Amaç: Çalışmanın amacı, pandemi öncesi dönem ile pandemi dönemi arasında acil ortopedik travma başvurularını karşılaştırmak ve ortopedik travma epidemiyolojisindeki değişiklikleri tespit etmektir.

Gereç ve Yöntem: Mart 2019 ile Mart 2020 arasında 1 yıl içinde başvuran 40.700 hasta pandemi öncesi grubu oluştururken, Mart 2020 ile Mart 2021 arasında başvuran 16.935 hasta pandemi grubunu oluşturmaktadır. Hastaların demografik özellikleri, yaş ve cinsiyet gibi kaydedilmiştir. Ayrıca, hastaların yaralanma mekanizmaları, tanı, yaralanan ekstremiteler veya anatomik bölge, kırılan kemik, kırık sınıflandırması, çoklu travma oranları, travma ile ilişkili komplikasyonlar, hastanede yatış günleri ve tedavi yöntemleri incelenmiştir.

Bulgular: Pandemi öncesi dönemde, hastaların ortalama yaşı daha gençti ve pediatrik/adölesan hastalar ile kadın hastaların dağılımları pandemi dönemine kıyasla daha yüksekti (sırasıyla $p=0,001$, $p=0,001$ ve $p=0,001$). Pandemi döneminde kırıklar ve çıkıklar daha sık görülürken, pandemi öncesi dönemde yumuşak doku yaralanmaları daha yaygındı ($p=0,001$). Ev kazaları pandemi döneminde artarken, iş kazaları azalmıştır ($p=0,001$). Cerrahi tedavi oranı istatistiksel olarak pandemi döneminde artmıştır ($p=0,001$).

Sonuç: Ortopedik travmanın epidemiyolojisini göz önünde bulundurarak, travma yükünü tahmin edebilmek ve kaynak kullanımını ve tahsisini optimize etmek, koronavirüs hastalığı-2019 pandemisi gibi olağanüstü durumlarda sağlık sisteminde ciddi aksamalara neden olabilecek hastalar için güvenli ve etkili tedavi hizmetlerini sürdürebilmek açısından oldukça önemlidir.

Anahtar Kelimeler: Ortopedik travma, COVID-19, pandemi, travma epidemiyolojisi, kaynak kullanımı

Address for Correspondence: Vedat Öztürk, University of Health Sciences Türkiye, Bakırköy Dr. Sadi Konuk Training and Research Hospital, Clinic of Orthopedics and Traumatology, İstanbul, Türkiye

Phone: +90 537 231 43 17 E-mail: dr.ozturkvedat@gmail.com ORCID ID: orcid.org/0000-0003-2412-9725

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INTRODUCTION

Although the coronavirus disease-2019 (COVID-19) pandemic seems to be under control, it continues to be a global problem for all world societies and our health systems because of the new forms (such as Erise variant) that have emerged and the fact that the disease has not yet been fully eradicated (1). Similar to many countries, our government has taken many measures to prevent the spread of the pandemic. Several rigid restrictions were taken to prevent possible blockages in the healthcare system and uncontrolled deaths, especially in the early stages of the pandemic when the vaccine was not yet widespread. Lockdown except for emergencies, closing schools and switching to online education, closing workplaces and developing remote working models, and banning social events and crowded activities were among the main precautions taken to reduce social contact and prevent the rapid spread of the pandemic (2,3). These precautions significantly affected social mobility. Especially during periods of strict isolation, traffic and human mobility decreased to a minimum level with lockdowns (4,5).

However, a large number of health institutions were privatized to combat infection, prevent the spread of the pandemic and ensure adequate resource allocation. Despite these regulations, there were serious resource problems in basic health services (6). Outpatient services, except for emergency health services, were either partially or completely stopped depending on the period of the pandemic (2,7). The precautions and the decrease in social mobility brought about by the precautions led to serious changes in the demand in the healthcare system. The healthcare system reaching saturation due to increasing COVID-19 cases and the filling of intensive care units and inpatient services with COVID-19 cases caused all health services except emergency procedures to be suspended (8). This study was conducted in a level 1 trauma referral center that also provided intensive COVID-19 services throughout the COVID-19 pandemic. The aim of this study was to compare emergency orthopedic trauma admissions between the pre- and pandemic periods and to detect changes in orthopedic trauma epidemiology. We hypothesized that restrictions during the pandemic period would change trauma exposure and injury mechanisms and differentiate orthopedic trauma epidemiology.

METHODS

Study Design and Level of Evidence

This study employed a retrospective cohort study design, classified as level 3 evidence according to established criteria.

This retrospective cross-sectional study was conducted between March 2019 and March 2021 after the approval of the University of Health Sciences Türkiye, Bakırköy Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (decision no: 2021-06-44, protocol code: 2021/168, date: 15.03.2021). The study was registered at clinicaltrials.gov (ID: NCT06237023).

The study was conducted with reference to the date of March 10, 2020, when the first case of COVID-19 was observed in our country. Admissions within the same cross-sectional time period were included in the study when creating the groups. A total of 40,700 patients admitted within 1 year between March 2019 and March 2020 constituted the pre-pandemic group and 16,935 patients admitted between March 2020 and March 2021 constituted the pandemic group. In the study, 57,635 patients who were admitted to the emergency department and the emergency orthopedics department within a 2-year period were examined. Demographic characteristics of the patients, such as age and gender, were recorded. In addition, the injury mechanisms of the patients, diagnosis, injured extremity or anatomical region, broken bone, fracture classification, multitrauma rates [injury severity score (ISS) score ≥ 15], trauma-related complications, hospitalization days, and treatment modalities were examined. The effects of the pandemic on these data were analyzed by comparing them with the pre-pandemic period.

Statistical Analysis

Descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum) were used for data evaluation. The conformity of the quantitative data to the normal distribution was tested using the Shapiro-Wilk test and graphical evaluations. Mann-Whitney U test was used to compare two independent and non-normal distributive variables. The Pearson chi-square test was used to compare qualitative data. Significance was evaluated at the $p < 0.05$ level. NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for statistical analysis.

RESULTS

The demographic characteristics of the patients are presented in Table 1. Adult patients, male gender, soft tissue injury, extremity trauma, simple fall, and conservative treatment showed proportional dominance. In the pre-pandemic period, the mean age of the patients was younger, and the distributions of pediatric/adolescent patients and female patients were higher compared with the pandemic period ($p=0.001$, $p=0.001$, and $p=0.001$;

Table 1. Demographic characteristics of the patients

		n	%	
Age (years)	Min-max (median)	0-102 (24)		
	Mean ± SD	28.15±19.49		
	Child/adolescent	17,586	30.5	
	Adult	40,049	69.5	
Gender	Male	32,524	56.4	
	Female	25,111	43.6	
Injury type	Soft tissue injury	34,828	60.4	
	Fracture	20,786	36.1	
	Dislocation	1977	3.4	
	Fracture dislocation	44	0.1	
Fractured bone (n=20,830)	Clavicula	452	2.2	
	Humerus	40	0.2	
	Radius/Ulna	1610	7.7	
	Carpal/Metacarpal	4581	22	
	Hand phalanx	2272	10.9	
	Vertebra	3326	16	
	Pelvic bones	53	0.3	
	Femur	117	0.6	
	Patella	903	4.3	
	Tibia/Fibula	115	0.6	
	Tarsal/Metatarsal	1893	9.1	
	Foot phalanx	2392	11.5	
	Scapula	2882	13.8	
	Multipl bone fractures	194	0.9	
	Gustilo Anderson Classification (n=20,830)	Closed	20,314	97.5
		Type 1 open	411	2
Type 2 open		47	0.2	
Type 3 open		58	0.3	
Injury location	Upper extremity	29,546	51.3	
	Lower extremity	27,844	48.3	
	Pelvis	122	0.2	
	Spine	81	0.1	
Trauma mechanism	Multipl location	42	0.1	
	Motor vehicle accident	927	1.6	
	Pedestrian accident	1348	2.3	
	Injury at home	3981	6.9	
	Occupational injury	2020	3.5	
	Fall from height	941	1.6	
	Gunshot injury	59	0.1	
	Sports/game injury	2268	3.9	
	Simple fall	43,181	74.9	
	Beating injury	721	1.3	
	Penetrating injury	83	0.1	
	Others (unknown cause)	2106	3.7	

Table 1. Continued

		n	%
Multitrauma	ISS score ≥15	439	0.7
Treatment	Conservative	55,389	96.1
	Surgery	2246	3.9
Surgical technique (n=2246)	CRIF	1142	50.8
	ORIF	953	42.5
	Soft tissue surgery	151	6.7
ASA score (n=2246)	I	554	24.7
	II	1001	44.5
	III	691	30.8
Hospitalization (days) (n=2246)	Min-max (median)	1-38 (4)	-
	Mean ± SD	5.10±4.08	-
Trauma related complications	No	57490	99.7
	Yes	145	0.3

ISS: Injury severity score, ASA: American Society of Anesthesiologists, SD: Standard deviation, min-max: Minimum-maximum, CRIF: Close reduction and internal fixation, ORIF: Open reduction and internal fixation

respectively) (Table 2). Fractures and dislocations were more frequent in the pandemic period, whereas soft tissue injuries were more common in the pre-pandemic period (p=0.001). A statistically significant difference was found between the pre-pandemic and pandemic periods in terms of injury characteristics such as fractured bone, fracture classification, injury location, trauma mechanism, and multitrauma rates (p=0.001). It is noteworthy that accidents at home increased and occupational accidents decreased during the pandemic period (p=0.001). The rate of surgical treatment statistically increased during the pandemic period (p=0.001). However, the surgical technique did not differ (p=0.508). The incidence of trauma-related complications increased by two times compared with the pre-pandemic period (0.2% vs. 0.4%), whereas hospitalization was relatively reduced during the pandemic period (p=0.001 and p=0.023; respectively).

DISCUSSION

The most important aspect of the present study is to show the impact of the COVID-19 pandemic on the demographic, diagnosis, and treatment processes in orthopedic trauma admission and daily orthopedic management. Our study showed that all emergency orthopedic admissions decreased by 58.3% during the pandemic period compared with the 1-year period before the pandemic. Previous studies comparing the pandemic period with the pre-pandemic period showed a similar decrease in emergency orthopedic admissions (2,9-11). The reduced admissions can be explained by a decrease in social mobility caused by strict lockdown precautions taken by governments. It is also

Table 2. Comparison of the demographics, trauma features and the treatment modality of the patients in the pre-pandemic period and the pandemic period

		Pre-pandemic (n=40700)	Pandemic (n=16935)	p-value
		n (%)	n (%)	
Age (years)	Min-max (median)	0-102 (23)	0-101 (26)	^a 0.001**
	Mean ± SD	27.72±19.36	29.18±19.78	
	Child/adolescent	12,871 (31.6)	4715 (27.8)	^b 0.001**
	Adult	27,829 (68.4)	12,220 (72.2)	
Gender	Male	22,705 (55.8)	9819 (58.0)	^b 0.001**
	Female	17,995 (44.2)	7116 (42.0)	
Injury type	Soft tissue injury	26,085 (64.0)	8743 (51.6)	^b 0.001**
	Fracture	13,342 (32.8)	7444 (44.0)	
	Dislocation	1245 (3.1)	732 (4.3)	
	Fracture dislocation	28 (0.1)	16 (0.1)	
Fractured bone (n=20,830)	Clavícula	268 (2.0)	184 (2.5)	^b 0.001**
	Humerus	1028 (7.7)	582 (7.8)	
	Radius/Ulna	2763 (20.7)	1818 (24.4)	
	Carpal/Metacarpal	1459 (10.9)	813 (10.9)	
	Hand phalanx	2367 (17.7)	959 (12.9)	
	Vertebra	31 (0.2)	22 (0.3)	
	Pelvic bones	97 (0.7)	20 (0.3)	
	Femur	500 (3.7)	403 (5.4)	
	Patella	84 (0.6)	31 (0.4)	
	Tibia/Fibula	1182 (8.8)	711 (9.5)	
	Tarsal/Metatarsal	1548 (11.6)	844 (11.3)	
	Foot phalanx	1903 (14.2)	979 (13.1)	
	Scapula	23 (0.2)	17 (0.2)	
	Multipl bone fractures	117 (0.9)	77 (1.0)	
Gustilo Anderson Classification (n=20,830)	Closed	13,077 (97.8)	7237 (97.0)	^b 0.001**
	Type 1 open	223 (1.7)	188 (2.5)	
	Type 2 open	34 (0.3)	13 (0.2)	
	Type 3 open	36 (0.3)	22 (0.3)	
Injury location	Upper extremity	20,637 (50.7)	8909 (52.6)	^b 0.001**
	Lower extremity	19,898 (48.9)	7946 (46.9)	
	Pelvis	100 (0.2)	22 (0.1)	
	Spine	37 (0.1)	44 (0.3)	
	Multipl location	28 (0.1)	14 (0.1)	
Trauma mechanism	Motor vehicle accident	595 (1.5)	332 (2.0)	^b 0.001**
	Pedestrian accident	900 (2.2)	448 (2.6)	
	Injury at home	2492 (6.1)	1489 (8.8)	
	Occupational injury	1612 (4.0)	408 (2.4)	
	Fall from height	647 (1.6)	294 (1.7)	
	Gunshot injury	34 (0.1)	25 (0.1)	
	Sports/game injury	1599 (3.9)	669 (4.0)	
	Simple fall	30,463 (74.8)	12,718 (75.1)	
	Beating injury	517 (1.3)	204 (1.2)	
	Penetrating injury	32 (0.1)	51 (0.3)	
	Others (unknown cause)	1809 (4.4)	297 (1.8)	

Table 2. Continued

		Pre-pandemic (n=40700)	Pandemic (n=16935)	p-value
		n (%)	n (%)	
Multitrauma	ISS score ≥ 15	196 (0.4%)	243 (%1.4)	^b 0.001**
Treatment	Conservative	39,367 (96.7)	16,022 (94.6)	^b 0.001**
	Surgery	1333 (3.3)	913 (5.4)	
Surgical technique (n=2246)	CRIF	679 (50.9)	463 (50.7)	^b 0.508
	ORIF	558 (41.9)	395 (43.3)	
	Soft tissue surgery	96 (7.2)	55 (6.0)	
ASA score (n=2246)	I	323 (24.2)	231 (25.3)	^b 0.440
	II	609 (45.7)	392 (42.9)	
	III	401 (30.1)	290 (31.8)	
Hospitalization (days) (n=2246)	Min-max (median)	1-22 (4)	1-38 (3)	^a 0.023*
	Mean \pm SD	5.23 \pm 4.00	4.91 \pm 4.19	
Trauma related complication	No	40,631 (99.8)	16,859 (99.6)	^b 0.001**
	Yes	69 (0.2)	76 (0.4)	

ISS: Injury severity score, ASA: American Society of Anesthesiologists, SD: Standard deviation, min-max: Minimum-maximum, CRIF: Close reduction and internal fixation, ORIF: Open reduction and internal fixation

^aMann-Whitney U Test, ^bPearson chi-square test, *p<0.05, **p<0.01

a fact that people's fear of being affected by the pandemic and being infected with COVID-19 is effective in reducing hospital admissions, except for emergencies (12).

In the comparison of the number of child/adolescent and adult admissions, there was a significant decrease in the total number of admissions in both groups during the pandemic period compared with the previous year. On the other hand, an increased rate of adult admission and a decreased rate of child/adolescent admission were noteworthy in this study. Several studies have similarly shown that the average age of fractures was higher during the pandemic period compared with previous periods and that there was a decrease in pediatric trauma admissions (13,14). The closure of nurseries and schools during the isolation period, the adoption of distance education, and the partial continuation of workplaces with distance rules may explain why child/adolescent emergency admissions decreased more than adults. In addition, the fact that fragility fractures, which concern the adult age group and especially occur at home, are not affected by social mobility may have contributed to the increased emergency admission rates in adults (15). Some authors have reported that the pandemic had no effect on the male-female patient ratio (16,17) while others have reported an increase in the rate of female admissions compared with males (18). The present study reported a 2.2% decrease in female patients during the pandemic period compared with the pre-pandemic period and an increase in the ratio of male to female patients. Similar to our study, several studies have

reported a decrease in the rate of female patient admissions and an increase in the ratio of male to female patients (9,19-22). Due to the closure of nurseries in our country, official permission was given to women with young children and pregnant women who are sensitive to COVID-19, especially to take care of their children. These precautions explain the decrease in trauma exposure and the number of emergency admissions among females.

Kalem et al. (19) reported that soft tissue traumas decreased and the percentage of fractures increased during the pandemic period. In our study, admissions due to fractures increased by 11.2% and soft tissue lesions decreased during the pandemic period. There was no significant change in the dislocation and fracture-dislocation rates. The decrease in soft tissue trauma rates can be explained by the efforts of patients with simple trauma to cope with their problems themselves and perhaps by applying to private hospitals, which are relatively less busy. Vatsya et al. (23) reported that forearm and wrist fractures were the most common during the pandemic period. The largest proportion of admissions during both the pre-pandemic and pandemic periods were for radius/ulna fractures in this study. Radius/ulna fractures were followed by hand phalanx, tarsal/metatarsal, and foot phalanx fractures. An increase in femur and tibia/fibula fractures was detected in the lower extremities (0.7% and 1.7% respectively). The trauma area and broken bone consisted of upper extremity and radius/ulna fractures in both pre-pandemic and pandemic periods, similar to the literature (19).

In this study, the most common trauma mechanism was simple falls. It was observed that strict isolation measures increased domestic injury rates and flexible working hours reduced work accidents. Our data regarding the mechanism of trauma are similar to the literature (3,9,14). Several authors mentioned that traffic accidents and related multitrauma rates have decreased (1,3,9,19,23). Reduced social mobility will generally ensure a decrease in traffic accidents, multitrauma rates, trauma-related complication rates, and open fracture rates. Interestingly, there was a statistically significant increase in the application rates for pedestrian and motor vehicle accidents in the present study. Similarly, we found a statistically significant increase in trauma-related complication rates, multitrauma (ISS score ≥ 15), and open fracture rates. Previous studies investigating treatment methods have shown that the tendency toward conservative treatment increased during the pandemic period (24). However, trauma-related complication rates were twice as high as those in the pre-pandemic period, and a significant increase in surgical treatment rates was found in our study. Considering that these parameters (multitrauma, trauma-related complications, open fractures and the need for surgical treatment) are directly related to the severity of trauma, the main reason for the increase in these parameters is that our hospital not only provided COVID-19 healthcare services but also actively accepted trauma. It is noteworthy that similar outcomes have been reported in the literature in such studies conducted in primary trauma referral centers (20,25-28). In addition, we examined the changes in the length of stay of inpatients and found that our findings were in line with the literature and there was no significant difference (29,30).

This study has limitations, such as being a single-center and retrospective design. In addition, our study shows the epidemiology of the data, and we did not present any data on patient follow-up or outcomes. Studies in the literature generally investigate the effects of the pandemic on trauma epidemiology by comparing short periods. In our study, comparing the pandemic period with the 1-year period before the pandemic minimized the effect of seasonal changes on trauma admissions. This provides more reliable data on the isolated impact of the pandemic on the etiology of orthopedic trauma. However, because the center where our study was conducted is a primary trauma referral center hospital in the most populous city of the country, the high number of patients included in the study and the high number of trauma admissions make our study strong. However, studies involving more centers and perhaps longer-term analyses are needed to fully

understand the impact of the pandemic on orthopedic trauma epidemiology.

CONCLUSION

In conclusion, considering the epidemiology of orthopedic trauma, being able to estimate the trauma burden and optimizing resource use and allocation are essential for maintaining safe and effective treatment services for patients in extraordinary situations such as the COVID-19 pandemic, which can cause serious disruptions in the healthcare system. The present study will guide clinicians to better understand the burden of orthopedic trauma and to be prepared for extraordinary situations such as the COVID-19 pandemic that need to be managed and to optimize resource allocation and use.

ETHICS

Ethics Committee Approval: University of Health Sciences Türkiye, Bakırköy Dr. Sadi Konuk Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee approval was received from (decision no: 2021-06-44, protocol code: 2021/168, date: 15.03.2021).

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Authorship Contributions

Concept: V.Ö., A.D., Design: V.Ö., A.D., Data Collection or Processing: B.B.Ç., A.C.K., Analysis or Interpretation: V.Ö., B.B.Ç., A.C.K., Literature Search: V.Ö., B.B.Ç., M.Ç., Writing: V.Ö., M.Ç., A.D.

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