

## Original Research Article

# Experiences from a non-COVID hub referral orthopedic trauma hospital during the COVID-19 pandemic in Turkey

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## ABSTRACT

**Background:** During the COVID-19 pandemic period, resources should be reorganized to treat the increased burden of COVID-positive patients under the best conditions while simultaneously providing non-deferrable treatment to patients with no suspicion of COVID-19. In this study, we aimed to analyse the trauma patient profile and treatment strategies that emerged in the regional orthopaedic and traumatology hospital during the pandemic period after the implementation of “hub and spoke” organization among the orthopaedic and traumatology clinics.

**Methods:** This cross-observational study was conducted in a training and research hospital in the field of orthopaedics and traumatology that was converted to a non-COVID referral orthopaedic trauma center during the pandemic. Gender, age, length of hospitalization, duration of trauma, place of trauma, severity of trauma, type of admission, type of anaesthesia and site of trauma were evaluated in the patients that presented between March 16 and May 16, 2020.

**Results:** Of the orthopaedic trauma patients requiring surgery, 169 (62.6%) were men and 101 (37.4%) were women. In comparison of the data with that of the last year, significant increases were observed in the number of home traumas (241.5%), low-energy traumas (87.4%), patients referred from other institutions (328.9%), regional anaesthesia patients (124.2%) and patients with hip traumas (226.7%). The length of hospitalization decreased significantly ( $p < 0.05$ ).

**Conclusions:** The creation of hub and spoke organization through the cooperation of orthopaedics and traumatology clinics in the region can reduce the burden on pandemic hospitals by isolating trauma patients requiring orthopaedic surgery who were not suspected of COVID-19 and directing them to dedicated orthopaedics and traumatology hospital.

**Keywords:** Coronavirus, Pandemic, Hospital reorganization, Orthopedic procedures, Traumatology

## INTRODUCTION

The novel coronavirus (COVID-19) was declared a pandemic by the World Health Organization on March 11, 2020 following a worldwide outbreak.<sup>1</sup> In order to meet the resultant rapidly increasing patient burden, health systems required immediate reorganization. In line with Turkey's National Preparedness Plan for Pandemic Influenza, pandemic hospitals in the provinces were assigned and the diagnosis and treatment of the patients

infected with the virus were handled without exceeding hospital capacity.<sup>2</sup> Deferral of non-urgent elective surgical procedures was mandated during pandemic period.<sup>3,4</sup>

Numerous measures such as the restriction of travel taken to control the COVID-19 outbreak,<sup>2</sup> also served to significantly reduce the number of patients with fractures caused by high-energy traumas. Meanwhile, fractures due to low-energy traumas such as accidental falls at home are expected to be seen more frequently.<sup>5</sup>

During the pandemic, different diagnosis and treatment pathways must be created for COVID-19-positive and negative orthopedic trauma patients.<sup>6</sup> The “hub and spoke” system, created by performing specified medical services through secondary units (spokes) at a center (hub), maximizes efficiency without consuming valuable resources.<sup>7</sup> Creation of adequate central hospitals in terms of infrastructure and personnel for non-COVID orthopedics and traumatology surgery emergency cases is one of the recommended practices.<sup>8</sup> Such orthopedics and traumatology centers, which cooperate with surrounding pandemic hospitals, can improve the treatment quality of non-COVID orthopedics and traumatology patients and reduce the risk of overload in pandemic hospitals.<sup>9</sup>

The training and research hospital in the field of orthopedics and traumatology where this study was conducted served as a non-COVID orthopedics and traumatology center (hub). In order to decrease the orthopedic trauma burden of the pandemic hospitals declared in the region, the transfer and acceptance of isolated orthopedic trauma patients without a suspicion of COVID-19 to the hospital were achieved thanks to the information exchange between the orthopedic and traumatology clinics (spokes) of the pandemic hospitals. Thus, the hospital became a non-COVID orthopedic trauma reference hospital, operating as a hub and spoke organization for orthopedics and traumatology patients during the pandemic process.

Our aim in this study was to analyze the trauma patient profile and treatment strategies of regional orthopedic and traumatology clinics during the pandemic period after the implementation of the hub and spoke organization for orthopedic and traumatology clinics. This study will contribute to the orthopedics and traumatology, ongoing COVID-19 pandemic and future pandemic literature.

## METHODS

The cross-observational study was carried out in a training and research hospital in the field of orthopedics and traumatology. This research has been approved by the IRB of the authors affiliated institution. Hospital was established in 1944 for the diagnosis and treatment of bone diseases and today is a center of excellence in the treatment of musculoskeletal system diseases, covering all aspects of orthopedics and traumatology. The hospital has 38 experts and 33 specialist students in the field of orthopedics and traumatology. The hospital has seven operating rooms, and the average number of patients undergoing orthopedic surgery annually is 7,100, and the average number of interventions is 13,900.

In line with the decisions and announcements of the ministry of health of the Republic of Turkey and the recommendations of the Turkish society of orthopedics and traumatology, hospital was reorganized quickly according to pandemic. In addition to new arrangements that suited the pandemic process, services in the outpatient

clinics and conservative treatments, and surgeries for orthopedic traumas and infections, hand surgery and orthopedic tumor cases continued to be provided.

Some of the measures taken for the management of trauma patients were as follows:

Personal protective equipment (face masks, waterproof shields, goggles, hair caps and gloves) were provided to every healthcare worker in the emergency room, orthopedics and traumatology service and operating room.

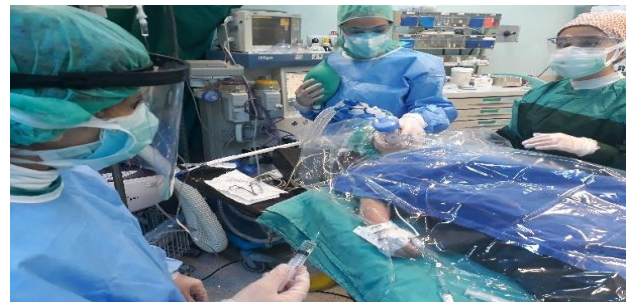
A surgical mask was distributed to each patient and their temperature was measured at presentation.

Each patient with fever or respiratory symptoms at presentation or in the wards was isolated and referred to the determined pandemic hospitals.

Patients who needed to be hospitalized were admitted to the normal ward. They were strongly recommended to take protective measures and pay attention to hand hygiene. Patients were repeatedly reminded about these measures and were checked for compliance.

Four surgery rooms and related equipment were arranged in accordance with recommendations for trauma cases or non-deferrable orthopedic surgeries. Surgical preparations and operating room services continued on weekends.

Anesthesia and surgical procedures were performed using personal protective equipment (PPE) (Figures 1 and 2).



**Figure 1: General anesthesia application to orthopedic trauma patient during the pandemic period.**



**Figure 2: Retrograde femur nail application in a distal femur fracture case, using PPE.**

Isolated orthopedic trauma patients who underwent surgery in the hospital between March 16 and May 16, 2020 were included in this study. The time period was chosen as it represented the period during which the number of COVID-19 cases in Turkey began to increase and elective cases were deferred to a later period. Patients who underwent orthopedic trauma surgery between March 16 and May 16, 2019, a non-pandemic period, were included and evaluated as a control group. Orthopedic tumor, orthopedic infection and hand/microsurgery cases that were operated in the hospital were excluded from the study.

The gender, age, length of hospitalization, place of trauma, severity of trauma, type of admission, type of anesthesia and the site of trauma of the patients were evaluated.

Descriptive statistical methods (mean, standard deviation) as well as the independent samples t-test and chi-square test were used to evaluate the data with the SPSS v.20 software. The results were evaluated at a significance level of  $p < 0.05$ .

**RESULTS**

A total of 1,196 surgical and 307 trauma surgical procedures were performed between March 16 and May 16, 2020. In the same period in 2019, the numbers were

2,267 and 175, respectively. As elective procedures were not performed during the pandemic period in 2020, the number of surgical procedures decreased by 47.2% and the number of trauma surgery procedures increased by 75.4%.

Of the patients that presented during the pandemic period, 169 (62.6%) were men and 101 (37.4%) were women. There was no significant difference in terms of gender distribution when compared to that in 2019. The average age of patients admitted during the pandemic period increased significantly ( $p < 0.05$ ), while the length of hospitalization decreased significantly ( $p < 0.05$ ) in comparison to 2019 (Table 1).

When the patients who applied during the pandemic period in 2020 were analyzed in comparison to 2019, significant increases were observed in the number of home traumas (241.5%), low-energy traumas (87.4%), patients referred from other institutions (328.9%), regional anesthesia patients (124.2%) and patients with hip traumas (226.7%) ( $p < 0.05$ ). Figures are shown in Tables 1 and 2.

During the pandemic period, no problems were encountered in the supply of orthopedic consumables and implants. Fifteen patients who were diagnosed of COVID-19 at presentation or during their stay at inpatient clinics were isolated and transferred to pandemic hospitals.

**Table 1: Demographic and clinical characteristics of the groups in the study.**

Characteristics	2019 (Mar 16-May 16)	2020 (Mar 16-May 16)	Difference between 2019 and 2020 (%)	P value
<b>Number of patients operated on/number of interventions</b>	1,276/2,267	712/1,196	-44.2/-47.2	
<b>No. of patients operated on due to trauma/number of interventions</b>	158/175	270/307	+70.9/+75.4	
<b>Gender (men/women)</b>	99/59	169/101	+70.7/+71.2	0.693
<b>Age (years), mean±SD</b>	36.1±18.6	41.5±23	+15.0	0.006
<b>Duration of hospitalization (days), mean±SD</b>	4.9±3.4	3.7±2.7	-24.5	0.000
<b>Place of trauma, N (%)</b>				
At home	41 (23.4)	140 (45.6)	+241.5	0.000
Outside home	134 (76.6)	167 (54.4)	+24.6	
<b>ASA score, N (%)</b>				
1	126 (72.0)	260 (84.7)	+106.3	0.007
2	46 (26.3)	42 (13.7)	-8.7	
3	2 (1.1)	3 (1.0)	+50.0	
4	1 (0.6)	2 (0.7)	+100.0	
<b>Severity of trauma, N (%)</b>				
Low-energy trauma	119 (75.3)	223 (82.6)	+87.4	0.027
High-energy trauma	39 (24.7)	47 (17.4)	+20.1	
<b>Type of admission, N (%)</b>				
Primary admission	120 (75.9)	107 (39.6)	-10.8	0.000
Referrals	38 (24.1)	163 (60.4)	+328.9	
<b>Type of anesthesia, N (%)</b>				
Regional anesthesia	91 (57.6)	204 (75.6)	+124.2	0.000
General anesthesia	67 (42.4)	66 (24.4)	-1.5	

Continued.

Characteristics	2019 (Mar 16-May 16)	2020 (Mar 16-May 16)	Difference between 2019 and 2020 (%)	P
<b>Site of trauma, N (%)</b>				
Shoulder	8 (4.6)	14 (4.6)	+75.0	1.000
Upper arm	2 (1.1)	1 (0.3)	-50.0	0.299
Elbow	18 (10.3)	42 (13.7)	+133.3	0.317
Forearm	13 (7.4)	18 (5.9)	+38.5	0.563
Wrist	12 (6.9)	19 (6.2)	+58.3	0.847
Hip	15 (8.6)	49 (16.0)	+226.7	0.025
Thigh	7 (4.0)	11 (3.6)	+57.1	0.807
Knee	12 (6.9)	21 (6.8)	+75.0	1.000
Leg	8 (4.6)	15 (4.9)	+87.5	1.000
Foot-ankle	80 (45.7)	114 (37.1)	+42.5	0.067
Vertebra	0 (0.0)	3 (1.0)		0.557

SD: standard deviation. Significant p values are written in bold.

**Table 2: Analysis of the hip trauma patients.**

Analysis	2019 (Mar 16- May 16)	2020 (Mar 16- May 16)	P
<b>Hip trauma encountered inside at home, N (%)</b>	5 (33.3)	36 (73.5)	0.012
<b>Hip trauma encountered outside home, N (%)</b>	10 (66.7)	13 (26.5)	
<b>Age (years), mean±SD</b>	52.8±25.6	60.6±23.9	0.284
<b>Age (years), min-max</b>	14-91	14-92	

SD: standard deviation. Significant p values are written in bold.

## DISCUSSION

Reorganization of the health system was required to treat the increased COVID-positive patient load during the pandemic period under the best conditions.<sup>2</sup> At the same time, the continuation of non-deferrable treatments of COVID-negative patients during this pandemic period was a necessity.

Treatment of trauma patients who were not suspected of COVID-19 in pandemic hospitals increases the burden of the hospital. The creation of hub and spoke model organizations for a more efficient performance of the pandemic hospitals and enabling trauma patients with no suspicion of COVID-19 to go to these hospitals without fear of infection has been recommended.<sup>8,9</sup> The hub and spoke system is created by the referral of patients by secondary units (spokes, or orthopedics and traumatology clinics of pandemic hospitals) in a center (hub, bone diseases hospital) designated for providing medical services (orthopedic trauma requiring surgery) to patients without suspicion of COVID-19 during the pandemic period. An analysis of this system found that 39.6% of the

presentations to the orthopedic trauma center (hub) that required surgery was primary applications, while 60.4% of the patients were referred by the orthopedics and traumatology clinics of pandemic hospitals (spokes). The fact that 15 orthopedic surgical trauma patients admitted primarily to the hospital were isolated due to diagnosis of COVID-19 and were referred to pandemic hospitals shows that separate pathways were followed for COVID-negative and COVID-positive patients.

The number of trauma patients is expected to decrease due to the partial and complete quarantine practices and “stay home” and “life fits home” campaigns implemented to prevent the spread of infection during the pandemic period.<sup>10</sup> In addition, we believe that trauma patients who may require surgical treatment do not go to the hospital due to the risk of infection with COVID-19, which in turn will decrease hospital admissions.<sup>11</sup> It has been shown that the number of trauma patients decreased during the COVID-19 pandemic period.<sup>12</sup> In our study, we observed that the number of orthopedic trauma patients requiring surgery, which “primarily” presented to the hospital, decreased by 10.8% when compared to the same period a year earlier. However, due to the 328.9% increase in the number of patients referred from the spoke units in the hub and spoke organizations, the number of orthopedic trauma patients that required surgery increased by 70.9% in comparison to the non-pandemic period. During the COVID-19 pandemic, trauma cases were mostly low-energy traumas and home injuries.<sup>5</sup> We also observed that 82.6% of the patients that required surgery were subjected to a low-energy trauma, an increase of 87.4% from the same period the year before. Similarly, 45.6% of orthopedic trauma patients requiring surgery had home injuries and their number increased by 241.5% when compared to the non-pandemic period.

Analysis according to the site of injury found that the majority (37.1%) of patients had injuries in the foot-ankle region, followed by hip (16%) and elbow regions (13.7%). It was noteworthy that hip traumas were significantly



increased by 226.7% compared to the non-pandemic period.

It is known that asymptomatic patients may be COVID-19 carriers.<sup>13</sup> In this case, the possibility of transmitting the infection to the operating room environment and the people who work there is likely. For this reason, taking protective measures by treating each patient undergoing surgery with the assumption of COVID-positive status is recommended.<sup>14,15</sup> In addition to personal protective measures, there are also considerations for the way anesthesia will be administered. Compared to regional anesthesia, there is a possibility that general anesthesia application may cause COVID-19 through inhalation aerosols. For this reason, regional anesthesia, and in cases where general anesthesia is mandatory, taking additional protective measures is recommended.<sup>16</sup> In our study, regional anesthesia was performed in 75.6% of orthopedic trauma surgeries and the number of regional anesthesia interventions increased significantly by 124.2% compared to the non-pandemic period.

Thanks to the regulation of the management protocols of inpatients in the hub and spoke organization, the duration of surgery and length of hospital stay were shortened.<sup>17</sup> In the orthopedics and traumatology hospital (hub) where our study was conducted, four surgery rooms were reserved for trauma and non-deferrable orthopedic surgeries, and surgical preparations such as consultation and surgeries were also carried out on weekends. While the average length of hospitalization of orthopedic trauma patients requiring surgery was 4.9 days in the non-pandemic period, it decreased significantly to 3.7 days during the pandemic period.

## CONCLUSION

In conclusion, thanks to the announcements of the ministry of health of the Republic of Turkey and the cooperation between orthopedics and traumatology clinics in the region, the hospital where the study was conducted was reorganized quickly according to the pandemic. Following the hub and spoke organization created with the cooperation of orthopedics and traumatology clinics in the region, isolated trauma patients requiring orthopedic surgery who were not suspected of COVID-19 were directed to orthopedics and traumatology hospital, and the burden on the pandemic hospitals was reduced. In orthopedic trauma applications requiring surgery during the pandemic period, the number of surgeries required due to home injuries and low-energy traumas were increased compared to the non-pandemic period. Thanks to the creation of separate pathways for COVID-19 negative orthopedic trauma patients, the capacity of the hospitals was used effectively and efficiently.

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