

The impact of COVID-19 on orthopaedic trauma: A retrospective comparative study from a single university hospital in Italy

Valerio Andreozzi,¹ Fabio Marzilli,¹

Mario Muselli,² Leonardo Previ,¹

Matteo Romano Cantagalli,¹

Giorgio Princi,¹ Andrea Ferretti¹

¹Department of Trauma and Orthopaedics, Sant'Andrea Hospital, Sapienza University of Rome;

²Department of Life, Health and Environmental Sciences, University of L'Aquila, Italy

Abstract

The COVID-19 outbreak strongly affected Italy, putting a strain on the National healthcare system. Hospitals quickly reorganized the activity to cope with the emergency. This retrospective comparative study aimed to analyze the impact of the lockdown imposed in Italy during the COVID-19 outbreak on acute orthopedic trauma, in order to identify critical issues for improvement and future planning. We collected data on all the trauma admissions to a single University hospital DEA (Department of Emergency and Acceptance) in Rome during the COVID-19 pandemic lockdown in Italy, comparing them with the corresponding period in 2019. We reported demographic data; the characteristics of the injury, including the anatomical location, fracture, sprain, dislocation, contusion, laceration, whether the injury site was exposed or closed, where the injury occurred, and polytrauma. We also recorded the waiting time in the emergency room and mode of transportation. The study sample was composed of 1199 patients, 636 (53.04%) males and 563 (46.96%) females. The overall number of admissions in 2019 (pre-COVID-19 period) was 995; then it was 204 during COVID-19 outbreak in 2020. The average age of the 2020 group was 51.9 ± 24.8 years, significantly higher than that of the 2019 group (41.4 ± 25.7) ($p < 0.0001$). In particular, elderly patients (≥ 65 years) were the most commonly involved in the COVID-19 group, while in the pre-COVID-19 period they were middle-aged adults (15-44 years) ($p < 0.0001$). The injury occurred at home in 65.7% of cases in the 2020 group, and in 32.3% of patients in the 2019 group. Concerning the injury type, in

both groups, the most common injury was a fracture (45.1% in 2019; 62.7% in 2020) ($p < 0.0001$). The most injured anatomical location during COVID-19 lockdown was the hand (14.2%), while in the pre-COVID-19 group the most frequent injury type was polytrauma (22.8%). Despite the decrease of overall acute trauma referral rates during the COVID-19 outbreak in Italy, the incidence of fractures in elderly individuals remained stable, indicating that not all trauma presentations would necessarily decrease during such times.

Introduction

On January 30th, 2020, the World Health Organization (WHO) declared the outbreak of coronavirus disease (COVID-19) to be a public health emergency of international concern¹ and then characterized it as a pandemic on March 11th.²

Since the COVID-19 outbreak started, Italy has been among the first and most affected countries. The Italian Government responded by implementing social distancing measures in an attempt to reduce the transmission rate and therefore to reduce access to the Emergency Room (ER), unless strictly necessary.

To ensure social distancing and limit the movement of the population, public places, schools and all non-essential businesses were closed, and public transportation was restricted. As a result, due to the modifications of people's behavior secondary to the psychosocial impact of COVID-19 pandemic, significant changes have taken place in the demographics and epidemiology of traumatic injuries.³⁻⁷

Consequently, lockdown and quarantine measures led to a progressive reduction of trauma cases related to work and sports activities.⁸ Moreover, the reduction in elective surgeries has reduced the need for post-operative care, leaving rooms for COVID-19 patients and maximizing the available hospital resources.

Although several studies^{6,7,9-11} have examined the magnitude and prevalence of traumatic injuries during the so-called "Phase One" of lockdown, there is still a need for extensive and standardized traumatic injury related epidemiological investigation.

This study aimed to share and evaluate the impact of lockdown imposed in Italy during the COVID-19 outbreak on acute orthopedic trauma referral caseload in order to recognize areas for improvement and future planning, in order to be prepared for a possible second wave.

Correspondence: Fabio Marzilli, Department of Trauma and Orthopaedics, Sant'Andrea Hospital, Sapienza University of Rome, Rome, Italy.

Tel.: +39.3384581712.

E-mail: marzillifab@gmail.com

Key words: COVID-19; SARS-CoV-2; epidemiology; orthopedic; trauma, fracture.

Contributions: VA, FM: work design. FM, LP, MC: data acquisition. MM: data analysis. VA, FM, MM, GP: drafting the work. VA, GP, AF: critical revision for important intellectual content. AF: final approval of the version to be published.

Conflict of interests: The authors declare no conflict of interest.

Ethics approval and consent to participate: The hospitals' Ethical Review Board approved the study.

Availability of data and materials: The dataset used and analyzed is available from the corresponding author upon request.

Received for publication: 19 September 2020.
Accepted for publication: 22 October 2020.

This work is licensed under a Creative Commons Attribution NonCommercial 4.0 License (CC BY-NC 4.0).

©Copyright: the Author(s), 2020

Licensee PAGEPress, Italy

Orthopedic Reviews 2020;12:8941

doi:10.4081/or.2020.8941

Materials and Methods

This observational epidemiological study was performed at a first level DEA, one of the referral trauma centers located in the city of Rome, within the Italian National Health System. The hospitals' Ethical Review Board approved the study protocol, and it was conducted following the principles of the Declaration of Helsinki and its amendments.

The study period was from the COVID-19 pandemic lockdown in Italy (March 9th, 2020), to May 4th, 2020, and was compared with the same period in 2019. All the trauma admissions to the DEA, the triage notes, the inpatient medical records, and the discharge summaries were collected using the hospital's electronic medical system.

The patient's search was performed by the information and communication technology unit, using the search terms "trauma" and "fracture" within the database of our emergency department during the analyzed period.

All orthopedic trauma cases seen at the hospital DEA were included in the study. Any case of pathological fracture and all surgical site infections were excluded from the study to avoid inaccurate assessment of the impact of lockdown measures on the emergency department's trauma workloads.

Demographic data, including age and gender, were recorded. Characteristics of the injury, including the anatomical location, fracture, sprain, dislocation, contusion, laceration, whether the injury site was exposed or closed, and where the injury occurred were recorded and classified for all patients. Patients with more than one injury on multiple anatomical locations were assessed as polytrauma; instead, those who had more than one injury on the same anatomical location were counted as a single injury.

Other recorded data included the waiting time in the emergency room and mode of transportation.

Statistical analysis

Statistical analyses were performed using SataMP 15 Software. After ascertaining the skewed distribution of all data with the Shapiro-Wilk test, the Wilcoxon rank-sum test was used to compare continuous variables, while proportional differences were assessed using the chi-square test. A p-value of <0.05 was considered significant.

Results

During the considered period, there were a total of 1199 admissions; the average age was 43.2 ± 25.9 years (range, 1 to 97). The study sample was composed of 640 (53.4%) males and 559 (46.6%) females. The mean age of males was 38.6 ± 24.4 years, significantly lower than that of females (48.4 ± 26.5 years) ($p < 0.0001$). Comparing the two timeframes considered, the overall number of admissions decreased from 995 in 2019 to 204 during the 2020 lockdown (-79.4%) (Figure 1). Consequently, also the mean value of total admissions per week in the eight observed weeks decreased in 2020 compared to 2019, as shown in Figure 2. The gender distribution did not change significantly in the considered period ($p = 0.212$): in 2019, there were 523 (52.7%) males and 472 (47.4%) females; in 2020, there were 117 (57.4%) males and 87 (42.6%). The average age of the 2020 group was 51.9 ± 24.8 years, significantly higher than that of the 2019 group (41.4 ± 25.7 years) ($p < 0.0001$). In particular, the age distribution showed that the most involved age group during the lockdown

was elderly patients (≥ 65 years), while it was middle-aged adults (15-44 years) for the pre-COVID-19 group (Table 1), with a statistically significant difference

($p < 0.0001$). There was a significant difference regarding the place where the injury occurred ($p < 0.0001$); in both groups, the majority of patients suffered a domestic

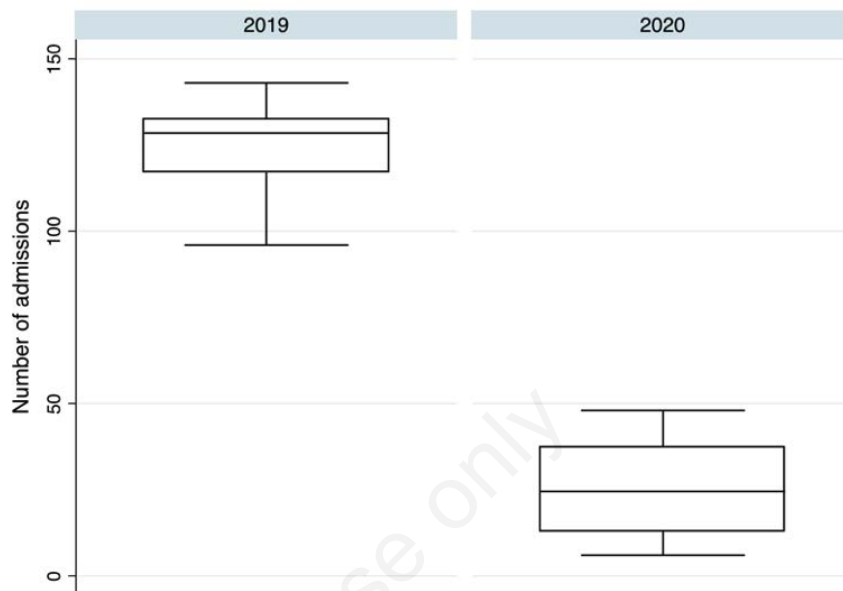


Figure 1. Mean value of admissions 2020 vs 2019.

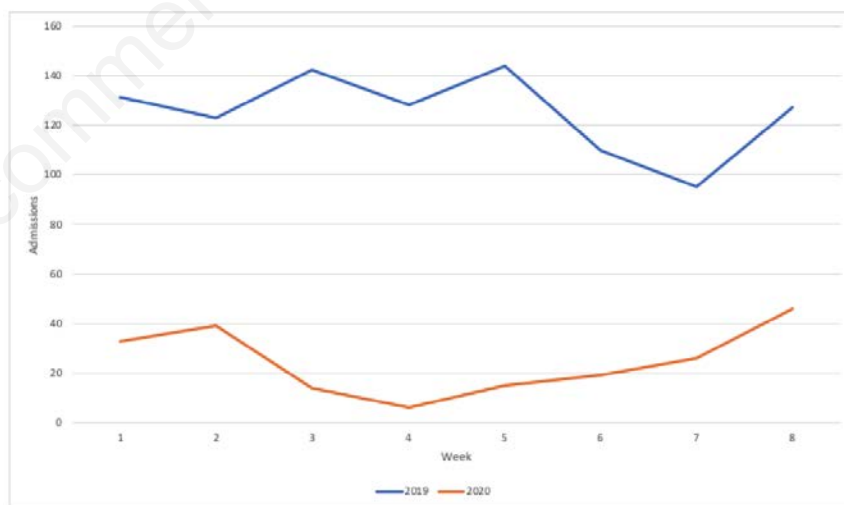


Figure 2. Overall admissions from March 9th to May 4th, 2020 compared with the same period in 2019.

Table 1. Frequency distribution of age groups of patients in two groups.

Age group	2019	2020	p
<15	202	18	<0.001
15-44	349	52	0.008
45-64	224	63	0.011
≥ 65	220	71	<0.001
Total	995	204	

injury (2019 group: 32.3%; 2020 group: 65.7%) (Table 2). Concerning the distribution of the injury characteristics, in both groups the most frequent injury was the fracture: 128 (62.7%) in the 2020 group; 449 (45.1%) in the 2019 group ($p<0.0001$). Other injury types were represented in Table 3. Among 204 injuries in the 2020 group, the top-three of the most frequent injury sites were hand (29; 14.2%); head-neck (26; 12.8%); and hip (22; 10.8%). In the 2019 group, among 995 injuries, the top-three were: 227 (22.8%) polytrauma; 155 (15.6%) vertebral injuries; and 95 leg injuries (9.6%). There was a significant difference in the anatomical location of the injuries between the two groups ($p<0.0001$). Anatomical location data are summarized in Table 4.

Regarding the time spent in the emergency room, no statistically significance emerged between 2019 and 2020 (8.6 vs 7.5 hours, $p=0.1675$). Instead, regarding the mode of transport, in 2020 we observed 54 ambulance admissions (26.5%) compared to 123 (12.4%) during 2019, and this difference was statistically significant ($p<0.0001$).

Discussion

Whereas a shift has been observed in the orthopedic departments' capacity in the COVID-19 scenario, orthopedic surgeons continued to serve patients requiring acute and urgent care.

Among the most important findings identified in the present study is the reduction of acute trauma cases registered in the ER, between the time intervals one year apart pre- and during-COVID-19 in the first level DEA of a University Hospital in Rome. Moreover, the most frequently involved age group was elderly patients (>65 years) in the epidemic period, while it was patients aged 15-44 years in the non-epidemic period. The age distribution difference between the pre-COVID-19 and COVID-19 group is probably related to the change in lifestyle and in daily activities, with restrictions in sports and the introduction of smart working that reduced injuries on the way.

The overall reduction in acute caseload was mainly due to lockdown and travel restrictions imposed by the Italian Government and the fear of the general population to get infected by COVID-19. Since industries not related to food, medicines and strategic needs stopped production, sport and outdoor activities and inessential transportation were suspended, the risk of frac-

ture for the younger population decreased considerably. Overall admissions decreased as well (Figures 1 and 2), as procedures were performed on an outpatient basis whenever possible. Compared with the non-epidemic period, epidemiological characteristics and injury mechanisms of traumatic fractures have changed significantly in Italy;^{7,9,10,12} which is consistent with the profound changes described in other coun-

tries.^{3,5,6,11} Italy, Spain, and France have been among the most affected European countries by COVID-19.¹³ Hence, the great concern of European countries about the healthcare system capacity to respond to the COVID-19 epidemic.

Public authorities shared measures to react more effectively to the epidemic crisis encouraging only essential work being performed on site and the majority of the work

Table 2. Characteristics of patients between two groups. Mann-Whitney U Test for continuous variables, Pearson chi-squared test for categorical variables.

	2019	2020	p
Age in years (mean±SD)	41.4±25.7	51.9±24.8	<0.0001
Gender, male (%)	523 (52.6)	117 (57.4)	0.212
Type of access, ambulance (%)	123 (12.4)	54 (26.5)	<0.0001
Length of stay (mean ±SD)	514.5±1105.3	448.8±676.2	0.1675
Setting, n (%)			<0.0001
Domestic	361 (32.3)	134 (65.7)	
Drive	315 (31.7)	46 (22.6)	
Sport	227 (22.8)	9 (4.4)	
Work	92 (9.2)	15 (7.3)	

Table 3. The distribution of characteristics of injuries in 2019 and 2020.

	2019 (%)	2020 (%)	Δ (%)	p
Fracture	449 (45.1)	128 (62.7)	-71.5	<0.0001
Dislocation	118 (11.9)	15 (7.4)	-87.3	0.062
Laceration	66 (6.6)	12 (5.8)	-81.8	0.692
Sprain	20 (2)	15 (7.4)	-25	<0.0001
Contusion	342 (34.4)	34 (16.6)	-90.1	<0.0001

Table 4. The distribution of injury sites in each group.

	2019 (%)	2020 (%)	Δ (%)	p
Polytrauma	227 (22.8)	17 (8.3)	-92.5	<0.001
Head-neck	23 (2.3)	26 (12.8)	+13.1	<0.001
Clavicle	20 (2)	1 (0.5)	-95	0.235
Shoulder	18 (1.8)	9 (4.4)	-67.9	0.034
Humerus	13 (1.3)	7 (3.4)	-46.2	0.063
Elbow	5 (0.5)	21 (10.3)	+76.2	<0.001
Forearm	32 (3.2)	8 (3.9)	-75	0.609
Wrist	94 (9.5)	13 (6.4)	-87.1	0.161
Hand	78 (7.8)	29 (14.2)	-62	0.004
Pelvis	4 (0.4)	2 (1)	-50	0.271
Hip	49 (4.9)	22 (10.8)	-55.1	0.001
Rotula	35 (3.4)	5 (2.5)	-85.7	0.440
Knee	11 (1.1)	12 (5.9)	+9.1	<0.001
Leg	95 (9.6)	3 (1.5)	-96.8	<0.001
Ankle	33 (3.3)	11 (5.4)	-66.7	0.151
Foot	66 (6.6)	10 (4.9)	-84.8	0.355
Vertebrae	155 (15.6)	3 (1.5)	-98.1	<0.001
Other	37 (3.7)	5 (2.5%)	-86.5	0.370

being performed remotely, consequently lowering the risk of traffic and workplace accidents.

Benazzo *et al.*⁷ described a progressive reduction of vehicle accidents (up to a reduction of 94%); in light of this, we observed that polytrauma caseload nearly disappeared (-92.5%) (Table 3). Other recent observational studies^{5,11,14,15} found, as well, significant reductions in visits to the ER, workplace accidents, traffic accidents and hospital admissions. Nonetheless, geriatric patients continued to suffer from low-energy falls, despite the social isolation, within their homes.⁶

During the epidemic period, fractures occurring at home accounted for 66.2%, compared to 36.3% during the non-epidemic period. These findings are consistent with the rigorous anti-epidemic measures imposed by the Italian Government, which led to a significant reduction in acute referrals due to sporting and "on the way" injuries.

Proportions of different fractured areas were not significantly influenced by the state of emergency, except for elbow fractures (+76.2%), head and neck trauma (+13.1%) and knee injury (+9.1%) which had occurred more often during this state in comparison to other areas. This is in line with the findings of a recent study¹⁶ in which elderly individuals continued to be exposed to shoulder and elbow trauma due to domestic falls. Gender distribution in patients was comparable during the two different periods.

Furthermore, the reorganization of the hospital (including the creation of a selected COVID-19 track with separated ER) led to a natural decrease in the time spent in the ER. This confirms that in such a pandemic, a comprehensive strategy is vital, as well as a well-functioning local network able to deliver better primary healthcare services.

The main limit of this observational study is its single-centered nature, which may not be representative of the national profile. As well as its retrospective nature, but it would not have been possible to expect such an unpredictable emergency. It also provides a picture of a limited timeframe. However, it reports on the entire so-called "Phase One" of lockdown in Italy, comparing the same period of the year in two completely different situations (pre-COVID-19 vs COVID-19). Further studies are needed to analyze the different trends in acute orthopedic referrals and orthopedic trauma case-

load as a consequence of the structural changes due to COVID-19. Finally, more attention should be paid to the changes linked to the evolving pandemic in order to be prepared for unpredictable second waves.

Conclusions

This investigation provides data on the unique impact of COVID-19 on an Orthopaedic and Trauma Department in a University teaching hospital in Italy.

Overall acute trauma referral rates have fallen; however, fractures in elderly individuals may remain stable in incidence during such times; indicating that not all trauma presentations would necessarily decrease. While this experience posed challenges, important lessons were learned, including the need for elasticity and coordination by healthcare professionals in their tasks in an emergency at a national level.

References

1. World Health Organization. Statement on the second meeting of the International Health Regulations (2005). Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). 2020. Available from: [https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)).
2. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. 2020. Available from: <https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020>.
3. Lv H, Zhang Q, Yin Y, et al. Epidemiologic characteristics of traumatic fractures during the outbreak of coronavirus disease 2019 (COVID-19) in China: A retrospective & comparative multi-center study. *Injury* 2020;51:1698-704.
4. Yan Y, Zhu Y, Lian X, et al. A comparative epidemiologic study of fractures among people in rural and urban areas. *Injury* 2020;51:1784-90.
5. Nuñez JH, Sallent A, Lakhani K, et al. Impact of the COVID-19 pandemic on an emergency traumatology service: experience at a tertiary trauma centre in Spain. *Injury* 2020;51:1414-8.
6. Park C, Sugand K, Nathwani D, et al. Impact of the COVID-19 pandemic on orthopedic trauma workload in a London level 1 trauma center: the "golden month". *Acta Orthop* 2020;91:556-61.
7. Benazzo F, Rossi SMP, Maniscalco P, et al. The orthopaedic and traumatology scenario during Covid-19 outbreak in Italy: chronicles of a silent war. *Int Orthop* 2020;44:1453-9.
8. Gilat R, Cole BJ. COVID-19, medicine, and sports. *Arthrosc Sports Med Rehabil* 2020;2:e175-6.
9. Bellan M, Gavelli F, Hayden E, et al. Pattern of emergency department referral during the Covid-19 outbreak in Italy. *Panminerva Med* 2020. doi: 10.23736/S0031-0808.20.04000-8.
10. Maniscalco P, Poggiali E, Quattrini F, et al. The deep impact of novel CoVID-19 infection in an Orthopedics and Traumatology Department: the experience of the Piacenza Hospital. *Acta Biomed* 2020;91:97-105.
11. Pichard R, Kopel L, Lejeune Q, et al. Impact of the CORonaVirus Disease 2019 lockdown on hand and upper limb emergencies: experience of a referred university trauma hand centre in Paris, France. *Int Orthop* 2020;44:1497-501.
12. Zagra L, Faraldi M, Pregliasco F, et al. Changes of clinical activities in an orthopaedic institute in North Italy during the spread of COVID-19 pandemic: a seven-week observational analysis. *Int Orthop* 2020;44:1591-8.
13. Ceylan Z. Estimation of COVID-19 prevalence in Italy, Spain, and France. *Sci Total Environ* 2020;729:138817.
14. Kamine TH, Rembisz A, Barron RJ, et al. Decrease in trauma admissions with COVID-19 pandemic. *West J Emerg Med* 2020;21:819-22.
15. Christey G, Amey J, Campbell A, Smith A. Variation in volumes and characteristics of trauma patients admitted to a level one trauma centre during national level 4 lockdown for COVID-19 in New Zealand. *N Z Med J* 2020;133:81-8.
16. Gumina S, Proietti R, Polizzotti G, et al. The impact of COVID-19 on shoulder and elbow trauma: an Italian survey. *J Shoulder Elbow Surg* 2020;29:1737-42.