

The burden of proximal femur fractures and other skeletal injuries during the Covid-19 pandemic lockdown: a retrospective comparative study

Elena Manuela Samaila¹, Stefano Negri¹, Marco Corzani², Federico Zancan¹, Tommaso Maluta¹, Bruno Magnan¹

¹Department of Orthopaedics and Traumatology, University of Verona;

²Department of Orthopaedics and Traumatology, University of Perugia

Summary. Limiting people's movement is one of the main preventive measures deployed for the control of coronavirus 2019-nCoV pandemic. This study aims to assess the impact of COVID-19 lockdown on the incidence of the most common skeletal injuries and to provide a management algorithm specific for hospitalized fractured patients. We comparatively analysed the Emergency Department (ED) admissions between March 9th and May 4th 2020 with the same period in 2019. The frequency of the most common skeletal injuries has been derived. Data from the pre-hospitalization phase to discharge of all patients were considered. The impact on clinical orthopaedic consulting has been evaluated. All patients requiring orthopaedic care followed different pathways of hospitalization based on COVID positivity. Data of surgical activity has been analysed. During the 9 weeks of lockdown the access of patients to ED drastically decreased: 11726 accesses compared to 21501 in the same period of 2019. This trend was followed by the most common skeletal injuries but not by proximal femur fracture (PFF) that showed the same absolute numbers compare to the previous years (64 vs 63). If analysed in relation to the total ED access, PFF showed a relatively increase in their frequency. The data from this experience suggest that healthcare providers should strategically allocate resources for management and treatment of PFF during the COVID-19 pandemic. With the begin of the reopening phase, a "rebound effect" for orthopaedic care was observed leading to delayed treatments with a potential overall increased morbidity. (www.actabiomedica.it)

Key words: COVID-19; management algorithm; orthopaedics; trauma; surgery

Introduction

In early 2020, the World Health Organization declared the outbreak of the disease COVID-19, caused by the new variant of coronavirus 2019-nCoV; on March 11th COVID-19 became a global pandemic, with over 118,000 cases in over 110 countries (1). In response to this unprecedented event, on March 9th the Italian Government ordered a nationwide lockdown for 9 weeks, limiting people's movement as a preventive measure. This followed an earlier restriction announced on previous days which affected sixteen

million people including the whole region of Lombardy and fourteen provinces in Veneto, Piemonte and Emilia-Romagna.

No health care system was prepared for an event of this magnitude: hospitals and primary care providers optimized their strategic resources, increased the efficiency and safety of triage capacity, boost test availability and designed a proper logistic for Personal Protective Equipment (PPE) and ventilators distribution. Specific guidelines have been developed in different countries and regions (2,3). Despite this incredibly demanding situation for the health care system, several

medical and surgical conditions, like traumatic injuries and bone fragility fractures, still required immediate assessment and timely resolution (4).

In Italy the Emergency Departments (ED) tried to limit the access of patients without respiratory symptoms. Reducing the flow of patient through the ED has been demonstrated to ease testing and separation of COVID + patients. Clinical practice outside the hospital has also been scaled down to ensure the safety of patients and health personnel. In the outpatient setting, home delivery of refill prescriptions was promoted. Clinicians have also been encouraged to prolong the duration between non-urgent follow-ups to avoid patient overcrowding in hospitals (4).

Normally, about 40 percent of primary-care visits are related to the musculoskeletal system, and professionals involved in musculoskeletal medicine, surgery, and rehabilitation exert an essential role with high impact on social and working activities of the population (5).

We hypothesized that the incidence of different type of trauma had the same variation during the Italian lockdown compared with the same period in 2019. This study was designed and conducted during the lockdown period with the specific aim of evaluate orthopaedic trauma distribution and patient care in the level III Trauma Centre of a University Hospital, located in north-east Italy.

Methods

The data relative to the orthopaedic consult carried out in the ED of a University Hospital between March 9th 2020 and May 5th 2020 was obtained and compared to the same period in 2019. Accordingly, the 2020 cohort was further stratified based on the positivity for COVID 19.

The study employed FASTAT (Dedalus, Florence, Italy, Identifier AOUI_ve|14), a database management system used in our hospital to manage and process patient data in the ED. All patients admitted were prospectively registered in the FASTAT database. Demographic, clinical, biological and therapeutic data (from the prehospitalization phase to the discharge) for all recorded patients were anonymized.

The resulting cases of traumatic injuries has been divided in 4 categories: dislocation, fracture, sprain and wounds. The fractures cluster has been further stratified for the presence of proximal femur fractures. Fractures and dislocations diagnosis were confirmed by X-rays or 3- dimensional CT scan. Sprains and wounds diagnosis were based on clinical evaluation and the medical history.

Statistical analysis was performed using the Chi-square test. The statistical software, GraphPad Prism 8.1 Version (GraphPad Software, San Diego, CA) was used for all statistical analyses and a $P < 0.01$ were considered significant.

Emergency Department evaluation

The trauma patients were admitted in Orthopaedic ED with 2 modalities: fast-track for non-urgent codes with direct access to the orthopaedic evaluation or as a secondary consult, requested by ED physician, for urgent codes.

During the COVID-19 pandemic, every emergency case in the ED are assumed to be positive until proven otherwise. The orthopaedic surgeon as all the health professional involved in the care of these patients are required to follow the guideline for personal protection proper of this situation (6). We tested for COVID-19 using clinical and epidemiological criteria (Table 1). The physician that first evaluate the patient in the ED evaluate the presence of any clinical criteria; if there is a risk of COVID infection a fast Swab coupled with radiological diagnostic exams (chest X-rays or CT scan) are performed. In the meantime, patient must wait the results in an isolated and dedicated area. If patient results positive for COVID-19, the orthopaedic evaluation will be performed in the isolated COVID+ area in the ED.

Orthopaedic management

If the condition requires a surgical treatment, the patient will be admitted to COVID+ department and the surgery performed in a specific dedicated surgical theatre for COVID+ patients. If the patient doesn't need hospitalization, the conservative treatment will be continued at home in quarantine isolation (Fig 1).

Table1. Patient questionnaire: clinical and epidemiological criteria

PATIENT

Name Surname.....

Birth date Birth Place

Candidate for intervention by

Candidate for pain therapy visit YES NO

1) Did you have had in the last few days sudden onset of at least one of the following signs and symptoms? (tick the answer):

- fever (38 ° C) YES NO

- cough YES NO

- sore throat YES NO

- rhinorrhea (cold) YES NO

- breathing difficulty YES NO

- flu-like symptoms YES NO

2) Did you have returned from China in the past 14 days YES NO

3) Do you come from a region/province/ municipality affected by the contagion containment measures YES NO

4) Did you have had close contact * with probable or confirmed case of COVID-19? YES NO

5) Did you worked/attended at a health facility where patients with Coronavirus infection were hospitalized? YES NO

* close contact means having been in close contact (face to face) or in the same closed place or living in the same house or having travelled by plane in near row or in the two previous or subsequent rows with a suspected or confirmed positive case of COVID-19 person.

DATE

SIGNATURE

In contrast, if the patient needs to be admitted, a supplementary diagnostic swab is performed and the patient will wait the result in a dedicated room in general ED. This approach is justified by the important rate of a false-negative – up to 30% - that has been recorded in several experience (7). If the diagnostic test for COVID-19 is negative, the patients can be admitted to the orthopaedic department. In case of positive swab, the patient follows a designated COVID path, with dedicated elevators, to the COVID+ department. For these patients, the surgery will be performed in a dedicated surgical theatre. If the swab results negative the patient is transferred to the COVID free orthopaedic department, and the following surgery will be carried out in a COVID-negative surgical room.

Results

During the 9 weeks lockdown period for COVID-19 pandemic we found an impressive decrease in the numbers of admissions to the ED as well as in the numbers of orthopaedic consult in the Verona city University Hospital (Verona, Italy). The total number of access in the period between March 9th to May 4th decreased from 21,501 in 2019 to of 11,726 (- 45.5%) in 2020. The trauma related activities showed a dramatic reduction (Table 2): total numbers of orthopaedic consulting decreased of 62.3%, fractures diagnosis of about two times, dislocations of 63.8% and sprains of 79.9%. Interestingly, the number of proximal femur fractures in elderly remained stable: 64 in the index period of 2019 and 63 during the 2020 lockdown (-

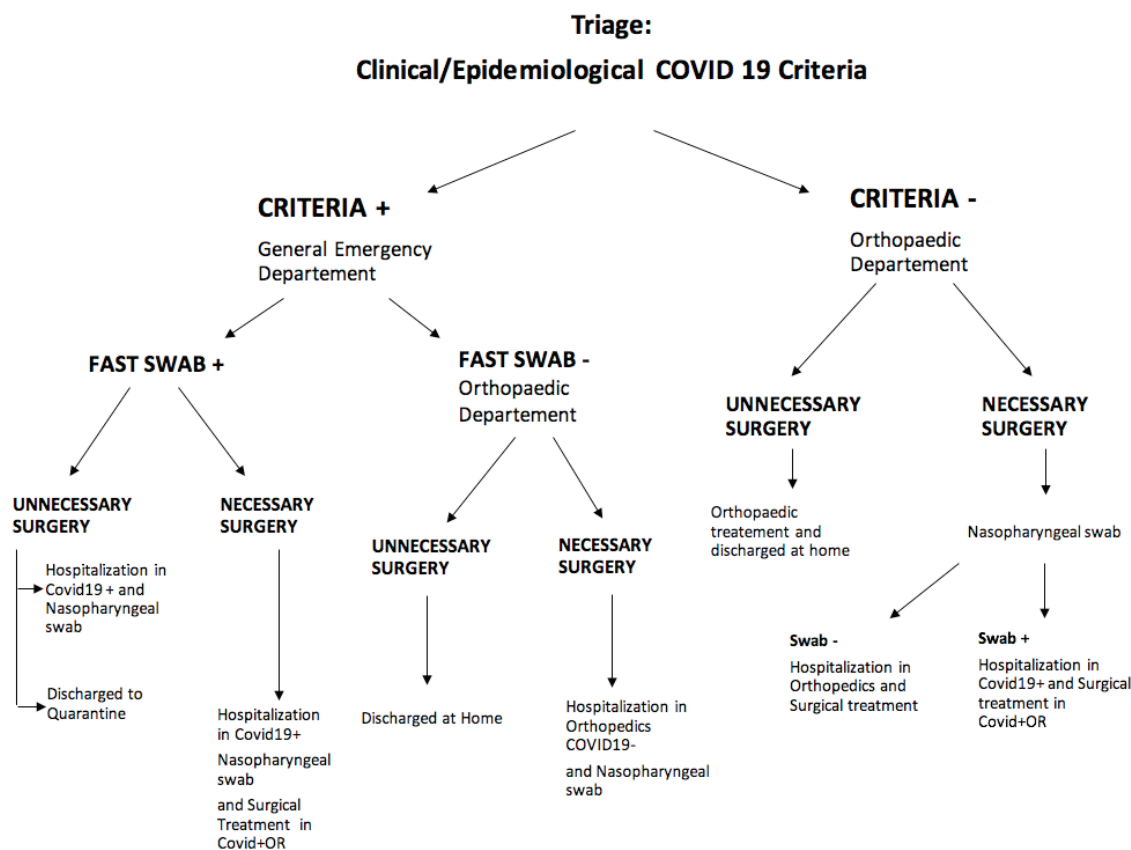


Fig. 1. Decisional flowchart of the management of Orthopaedic trauma patient in the Emergency Department. (O R, operating room).

1,2 %). The analysis of frequencies in relation to the total ED access showed that proximal femur fractures increased from 0.3 % to 0.5 % ($P < 0.01$).

Surgical management of COVID-19 positive patient

Three operating theatres with negative-pressure air flow and a high frequency air exchange (≥ 40 cycles/hour) have been set up for COVID+ patients. Doors of the operating room were always kept closed to maintain the correct air flow. All patients arrived in the operating room wearing a surgical mask. Anaesthesia carts and all essential equipment were limited for the use in the designated COVID-19 room and followed the hospital guidelines for sanitation. The access to the surgery room was limited to the essential

(one entrance and one exit). Surgical team staff was minimized, and their preparation following the hospital's guideline required an extra scheduling operating time. A careful preparation is required since many orthopaedic procedures generate aerosol particles due to the mechanical disruption of blood or other body fluids (8). Is this the case of intramedullary reaming, the use of powered instruments (a drill, saw or burr) and pulsed lavage.

Alternative management

Conservative treatment of fractures must not be seen as 'out of fashion' and should be adopted wherever feasible. Importantly, elective patients may also have asymptomatic COVID-19 infection, which po-

Table 2. Trauma cases recorded at the Emergency Department of the Verona University Hospital (Verona, Italy) during the 9 weeks period of lockdown in comparison to the same interval in 2019. Numbers and frequencies of cases are reported. The potential association of results has been assessed with Chi-square test. A P value less than 0.05 has been considered for statistical significance of results. ED Emergency department.

	March, 9th – May, 4th 2019	March, 9th – May, 4th 2020	χ^2 value	P
Total ED access	21501	11726	-	-
Orthopaedic consults	800 (3.7%)	302 (2.6%)	21.956	< 0.01
Fractures	264 (1.2%)	122 (1.0%)	1.142	= 0.03
Proximal femur fractures	64 (0.3%)	63 (0.5%)	13.329	< 0.01
Dislocations	105 (0.5%)	38 (0.3%)	3.683	> 0.05
Sprains	220 (1.0%)	46 (0.4%)	33.584	< 0.01
Wounds	849 (3.9%)	580 (4.9%)	24.722	< 0.01

tentially increases their mortality. Similarly, emergency patients may also have synchronous COVID-19 infection, which will increase their mortality risk associated with general anaesthesia. Hence, a non-operative management should always be favoured over surgical intervention (9).

Surgical data

Elective surgery during the lockdown was cancelled except for tumours and infections. The pre-operative preparation of patients for elective surgeries during COVID-19 pandemic involves a routine blood tests, chest X-ray, nasopharyngeal swab and an anaesthesiologic evaluation.

The limitation of most common elective orthopaedic procedures was clearly effective: only 41 patients had elective procedures during the 9 weeks lockdown of 2020 compare to 166 patients in the same period of 2019. This correspond to a decrease of 75.3 %.

On the opposite, our data showed a relatively low decrease in trauma-related surgical activity: from 165 procedures performed in 2019, to 116 during the abovementioned lockdown, that correspond to a decrease of 29.7%.

Of the patients admitted with surgical indication for fracture, 4 resulted positive to the naso and oropharyngeal swab for COVID-19 and needed hospitalization in the dedicated COVID+ department.

Patients characteristics are summarized in Table 3. The first patient, the youngest of the surgical treated, had a left tibial plateau fracture. She was treated 3 days

after trauma with open reduction and internal fixation (ORIF). Three weeks after surgery the patient was transferred for rehabilitation in a COVID+ Hospital. An additional test confirmed the positivity for COVID-19 before the discharge.

The three COVID-19 infected elderly patients affected by hip fractures were due to low energy injury.

The second patient, a 100 years-old woman, was admitted with a right pertrochanteric fracture. She was treated conservatively for the high anaesthesiologic risk. The swab resulted negative 27 days after trauma and the patient was discharged at home painless in wheelchair (Fig 2 a, b).

Patient 3, admitted for a right femoral neck fracture, died for the important comorbidities before any surgical treatment was carried out, 5 days after trauma.

Patient 4 affected by left femoral neck fracture was treated with hip hemiarthroplasty 14 days after the trauma at the resolution of lung complications. The swab resulted negative 21 days after trauma and patient now is in rehabilitation.

Our data showed that COVID-19 positive patients had an increased American Society of Anaesthesiologists (ASA) risk for the severe pneumonia and respiratory insufficiency. This is in accordance to what already reported in literature

Discussion

COVID-19 pandemic represents an unprecedented challenge for the health care systems. The

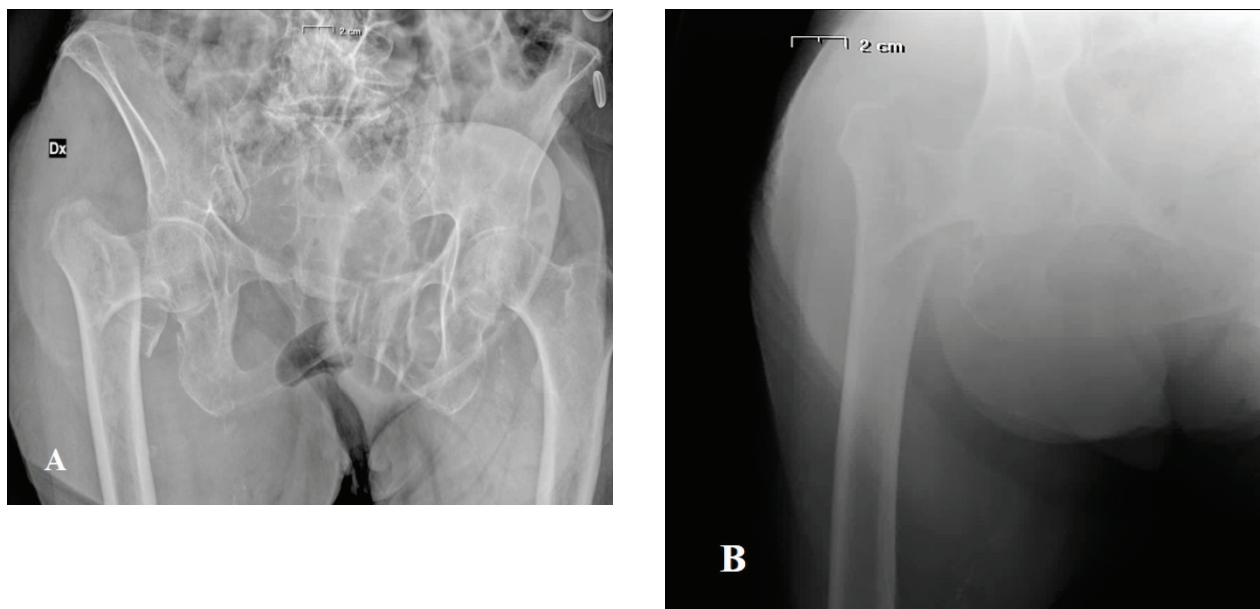


Fig. 2. Clinical case of a 100 years old woman affected by a perthrochanteric fracture (type 31-A); a: pre-operative X-ray; b: 1-month follow-up X-ray after a conservative treatment.

Table 3. Demographics, clinics, diagnosis and treatment of the Covid19+ fractured patients. Abbreviations: F, female; M, male; fx, fracture; ORIF, open reduction internal fixation; AF, atrial fibrillation; BHP, Benign prostatic hyperplasia; CKD, chronic kidney disease.

Case N.	Sex, Age (yr)	Type of fracture, A.O. classification	Type of Surgery	Comorbidities	COVID-19 Therapy	pO ₂ Saturation, Ventilation
1.	F, 67	Tibial plateau fx 41-C1	ORIF	Hypertension	Cefazolin Enoxaparine	96% Ambient Air
2.	F, 100	perthrochanteric fx 31-A	Conservative management	Dementia	Ceftriaxone (bacterial lung superinfection)	93% Ambient Air
3.	M, 91	femoral neck fx 31-B	Deceased before surgery	Hypertension, DM2, AF, Chronic heart failure, Aortic stenosis, BHP, CKD	Hydroxichloroquine Piperacillin/Tazobactam Calcic Heparin Diuretic therapy Albumine	93-94% in Venturi mask. 35% (6 L)
4.	F, 89	femoral neck fx 31-B	Hip hemiarthroplasty	Depressive anxiety Syndrome	Hidroxychloroquine Ceftriaxone Enoxaparine	97% in MV 28% (4LO2)

orthopaedic activity has been drastically revised worldwide in order to reduce the chain of infection and face the needs for urgent care.

In our institution a joint effort of many health professionals, from the ED to the inpatient and surgi-

cal facilities and the Intensive Care Unit (ICU) have been deployed in order to develop operative guidelines for orthopaedic and trauma cases. During the lockdown period, elective surgery was performed only for oncological cases and musculoskeletal infections.

Online training resources made possible additional training for the involved health care professional in an efficient way (11).

A big effort in terms of communications has been made to educate the general population for a better use of urgent care. The inappropriate access to the ED has been demonstrated to negatively affect the infection spreading with an unfavourable impact on fragile patients (12). Internet resources have been demonstrated to play a key role in patients' education about health-related topics (13,14).

Our data showed a drastic decrease of 62.3% of orthopaedic consults during the Italian lockdown period from March 9th to May 5th, 2020. The elective surgical activity decreased of 75.3% while trauma related of only 29.7%. We found that the total numbers of proximal femur fractures remain stable, with an increase of their relative frequency on total ED access. Since the other common skeletal injuries assessed in this study showed an important decrease in their numbers and relative frequencies, additional resources should be allocated for patients' with PFF. In addition, these patients are more fragile and susceptible to COVID-19. A sub-optimal management in all the critical steps, from the ED to the inpatient and surgical facilities can have catastrophic consequences on mortality and disease spreading.

We think that the experience of our institution can help not only for the management of orthopaedic activities during the COVID-19 pandemic, but also to better allocate the available resources. With the end of lockdown and the begin of the reopening phase we expected a surge of trauma related cases and an increase of elective surgery that has been postponed. In this scenario we observed an overload on orthopaedic care provider that lead to delayed treatments with a potential overall increased morbidity and this data is now under revision. The resumption of elective surgery was slow and is still influenced by the incidence of trauma. The algorithm of management of the patient in the E.D. was very useful and is still applied.

Conclusions

Orthopaedic surgeons continue to play an important role in this COVID-19 crisis especially in regards

of old and fragile patients. In our experience, the lockdown did not reduce the incidence of proximal femur fractures. Furthermore, it was confirmed the risk of a "rebound effect" for orthopaedic care during the reopening phase and some difficulty to recover the elective surgery. The adoption of new technologies, such as digital tracking system, could help to contain and contrast the Covid-19 global emergency.

Conflict of Interest

Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

Informed Consent

Informed consent was obtained from all individual participants included in the study. The study was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Correspondence:

Elena Manuela Samaila

ORCID iD: 0000-0003-0506-2668

AZIENDA Ospedaliera Universitaria Integrata Di Verona

Piazzale Aristide Stefani, 1, 37126 Verona VR

Phone: 045 8123542

FAX: 045 8123578

E-mail: elenamanuela.samaila@univr.it