



Staying home during “COVID-19” decreased fractures, but trauma did not quarantine in one hundred and twelve adults and twenty eight children and the “tsunami of recommendations” could not lockdown twelve elective operations

Jacques Hernigou¹ · Xavier Morel¹ · Antoine Callewier¹ · Olivier Bath¹ · Philippe Hernigou² 

Received: 4 May 2020 / Accepted: 11 May 2020 / Published online: 25 May 2020
© SICOT aisbl 2020

Abstract

Purpose The current pandemic caused by COVID-19 is the biggest challenge for national health systems for a century. While most medical resources are allocated to treat COVID-19 patients, fractures still need to be treated, as some patients with non-deferrable pathologies. The aim of this paper is to report the early experience of an integrated team of orthopaedic surgeons during this period.

Material and methods This is a mono-geographic, observational, retrospective, descriptive study. We collected data from the beginning of the epidemic (1 March 2020), during the pandemic lockdown period (declared in the country on March 16, 2020) until the end of our study period on April 15, 2020. All the 140 patients presented to the Emergency Department of the hospital during this period with a diagnosis of fracture, or trauma (sprains, dislocations, wounds) were included in the cohort. In addition, 12 patients needing hospitalization for planning a non-deferrable elective surgical treatment were included. A group of patients from the two same hospitals and treated during the same period (1st March 2018 to April 15, 2018) but previously was used as control.

Results Of these 152 patients (mean age 45.5 years; range 1 to 103), 100 underwent a surgical procedure and 52 were managed non-operatively. Twenty-eight were children and 124 were adults. The COVID-19 diagnosis was confirmed for four patients. The frequency of patients with confirmed COVID-19 diagnosis among this population treated in emergency was ten fold higher (2.6%; 4 among 152) than in the general population (0.30%) of the country. The mortality rate for patients with surgery was 2% (2 of 100 patients) and 50% (2 of 4) for those older than 60 years with COVID-19; it was null for patients who were managed non-operatively. As compared to the year 2018, the number of patients seen with trauma had decreased of 32% during the epidemic.

Conclusion Staying home during the COVID-19 pandemic decreased trauma frequency of 32%. The structural organization in our hospital allowed us to reduce the time to surgery and ultimately hospital stay, thereby maximizing the already stretched medical resources available to treat all the patients who needed orthopedic care during this period.

Keywords COVID-19 · Fracture · Dislocation · Sprain · Quarantine · Lockdown · Recommendation · Adult trauma · Children fractures · Paediatrics

In recent weeks, there has been an appropriate focus on the toll of the SARS-CoV-19 [1] with confirmed cases surpassing

three million worldwide at this moment. Different countries have responded to the epidemic in different ways but social distancing, lockdowns, curfews, and self-isolation are common across the world [2]. New policies have been drawn up for the management of conditions during the COVID-19 crisis. However, not necessarily because orthopaedic surgeons are on the frontline against COVID-19, but because of the very nature of our trauma practice [3], orthopaedic surgeons need to treat patients with or without COVID-19 infection during this period.

✉ Philippe Hernigou
philippe.hernigou@wanadoo.fr

¹ EpiCURA Hospital, Orthopedic Department, Baudour, Hornu, Belgium

² Hospital Henri Mondor, University of Paris-Est, Creteil, France

Table 1 Guidelines can be resumed to PARA as initials of four essential words

P	PPE	Personal Protective Equipment
A	Avoid	Avoid the wrong pathway, avoid contact, avoid transfer of patients, and so on
R	Restrict	Restrict visits, aerosols, visitors, access to COVID-19 pathways, and so on
A	Accelerate	Accelerate waiting times, surgery, discharge home, and so on

Since the beginning of the pandemic, there are around 50 articles (PubMed) published on trauma and COVID-19 on the end of April 2020. Each of these articles gives recommendations (sometimes more than 100) according to the possibilities of the countries and the Hospital. Even if some duplicates, and despite they may ultimately be limited to four letters with an acronym “PARA” (Table 1), it is a “tsunami of one thousand and one recommendations” which is present in the orthopaedic literature. In front of this tsunami of recommendations, if we exclude Chinese patients with 436 reported in a multicentric [4] and 10 in a monocentric study [5], the number of fractures treated in the rest of the world [6–9] during the same period (positive or negative to COVID-19) and reported in the orthopaedic literature (Table 2) does not exceed two hundred cases with both multicentric and monocentric studies!

Therefore, we describe and report our early monocentric experience of 152 patients. The aim of this study was to report the epidemiologic characteristics and outcome of our patients, both adults and children; to evaluate the safety of treatments during this period; to compare the frequency of admission in patients with COVID-19 as compared with the general population; and to compare and describe the variation in volumes and types of injuries admitted with a previous identical period.

Methods

A prospective cohort study with a retrospective control group was undertaken. Data on each patient admitted to our hospital with an admission diagnosis of fracture, trauma, sprains,

Table 2 Series of patients with trauma reported during COVID 19 pandemic (except China)

Authors	Multicentric study	Monocentric study	Number of patients
Vives [6]	+		136
Samsami [7]		+	8
Catellani [8]		+	16
Giorgi [9]		+	19
Hernigou		+	152

dislocation, and wounds between 1 March and 15 April 2020 were collected prospectively. These included demographics, diagnosis, type of anaesthesiology and surgery, and time interval between admission and surgery. This cohort was compared to a retrospective cohort of patients admitted for the same reasons in the same period two previous years before (1 March to 15 April 2018).

Previous period (2018) for fractures with surgical treatment

We selected only traumatology patients for the 2018 period (Table 3). This year 2018 was taken as comparison for two reasons: (1) data of 2019 were not yet published and not available during the lockdown period. (2) There was no epidemic in 2018, and particularly, the 2017–2018 seasonal (influenza virus) flu-epidemic ended in early March 2018 in Belgium, as the 2019–2020 seasonal (influenza virus) flu-epidemic which ended in early March 2020, which allows comparison for the periods. At contrary, the 2018–2019 seasonal (influenza virus) flu-epidemic ended only end of April 2019 in Belgium which makes the comparison non-appropriate.

In the same period of the year 2018, we had 129 admissions for adult fractures surgery (78 females) with a mean age of 61 years (range 18 to 98) and three admissions for child surgery in emergency. Anaesthesiology was not different and the time between admission and treatment the same. Indications and treatments were similar. Prophylaxis with low-molecular weight heparin (LMWH), standard hydration, was administered according to our hospital’s protocol for patients who needed.

Study population (outbreak period 2020)

The regional health system of Belgium was reorganized after the 15 March 2020 to maximize the number of beds needed for COVID-19 patients and to rationalize the care of patients with unrelated conditions. Under this new system, our two sites hospital (CH EpiCURA sites Baudour and Hornu, Belgium) were chosen to treat orthopaedic and trauma patients with non-deferrable conditions.

Table 3 Patients with surgery performed (conservative treatment excluded). Comparison between 2018 and 2020 (same period)

Category	2018 Patients (Nb)	2020 Patients (Nb)
Proximal femoral fractures	34	23
Adult lower limb fractures	37	20
Femoral fractures	3	3
Tibial	4	3
Ankle	15	9
Others	15	5
Adult upper limb fractures	58	36
Humeral fractures	12	12
Wrist	19	13
Elbow	7	4
Hand wounds	20	7
Total adult fractures	129	80
Child fractures	3	8

This prospective study concern 152 patients included in from the 1 March 2020 to the 15 April 2020. Twenty-eight were children and 124 were adults. Fifty-two patients (35 females) with an average age of 33 years (range, 4 to 85 years) were managed non-operatively. Eighty adults (50 females) with an average age of 61 years (range, 18 to 103 years) and eight children (5 females) with an average age of seven years (range, 1 to 17 years) underwent a surgical trauma procedure. Twelve patients (7 females) with an average age of 56 years (range, 35 to 70 years) had a non-deferrable elective surgical treatment. Comorbidities are indicated in Table 4. Prophylaxis with low-molecular weight heparin (LMWH), standard hydration, was administered according to our hospital's protocol for patients, and not changed during this period.

Patients were classified in different categories corresponding to dedicated pathways. Our orthopaedic and traumatology unit has suspended elective surgery. Even before the COVID-19 pandemic, emergencies were managed in our hospital by an integrated surgery team, including both orthopaedic and other specialties, with a prescribed care pathway for diagnosis

and treatment. After reorganization due to the pandemic, this was maintained and used to provide effective intervention and to limit the patient's stay in the hospital as far as possible. In accordance with the anesthesiology team, we created two management pathways for trauma cases: one pathway for those who test negative, one pathway for those with COVID.

Patients needing immediate surgical treatment

Forty-one patients were referred to the emergency department with severe condition (open fractures, dislocations, and so on) requiring immediate surgery. After body temperature screening, flu-like symptoms were evaluated. Using FFP2 mask, protective disposable gown, gloves, and protective glasses, an oropharyngeal swab was performed when clinical doubt and the diagnosis of COVID-19 was determined by a polymerase chain reaction (PCR) test when there was a clinical suspicion. At the end of the surgical procedure, the patients were moved in a single room of the dedicated ward, waiting for the result of the PCR test. When the result is negative, the patients were directed to the usual ward. When the result is positive, the patient was moved to the dedicated COVID-19 ward. All involved surgeons and operative room personnel respected the specific protocol for dressing and undressing.

Patients needing hospitalization for planning a surgical treatment

Fifty-nine patients required treatment in the subsequent days. Many patients were hip fractures, particularly those with previous anticoagulation or thrombin inhibitors. Previously, the patient was screened and then admitted to a dedicated ward. Patients who had a positive result were admitted to the COVID-19 ward, following the dedicated pathway. Patients with negative tests were then admitted to the usual ward, choosing single rooms when available.

Patients treated conservatively

This group included 52 patients with a large number of traumatic diseases treated conservatively (plaster), without the

Table 4 Comorbidities according to the site of fractures

Category	Hypertension	Diabetes	Pulmonary diseases*	Auricular fibrillation	Alcohol	Tobacco
Percentage of patients with the disease						
Femoral neck fractures	88%	0%	33%	11%	11%	11%
Trochanteric fractures	91%	27%	9%	9%	0%	0%
Humeral fractures	80%	40%	0%	10%	10%	0%
Wrist fractures	23%	8%	8%	8%	8%	8%

*Asthma and chronic obstructive pulmonary disease

need for hospitalization. The clinical pathway started with evaluation of flu-like symptoms and body temperature control. Patients were asked to wear surgical masks during the stay and healthcare workers used protection when treating patients. Patients were treated as usual and discharged home. Specific recommendations were given for trauma and for the Epidemic.

Statistical analysis

Continuous variables were presented as the mean and the standard deviation, and categorical variables were presented as the number and percentage. We used the Mann-Whitney *U* test, chi-square test, or Fisher exact test to compare differences between groups.

Demographic variables were sex, age, residence (nursing home or family home). The diagnosis of COVID-19 was determined by a polymerase chain reaction (PCR) test from throat swab samples when there was a clinical suspicion. The variables related to treatment included the type of surgical procedure performed (as fracture fixation, plate and screws, nails, hip replacement) or non-operative treatment (plaster) and surgical procedure delay in days since presentation to the emergency department.

The pandemic state has been a dynamic process, and, thus, it has been difficult to compare patients at specific time point. The virus has put pressure not only on hospitals' infrastructures, but also on their staff, both physically and psychologically. According to this dynamic process, two different periods exist: from 1st to 15 March before the institutional changes due to government lockdown; from 16 March to 15 April when PCR and chest CT scan could be used but not for all patients.

Results

COVID-19 patients

During the study period 2020 (Fig. 1), the confirmed (by Ministry of Health) number of COVID-19 patients was 3000 per million (0.30%) habitants for a population of 11.5 million in Belgium, country with a high density of population and an homogeneous repartition of the pandemic in the country. With these data, the expected confirmed number of COVID-19 patients should have been less than one (0.45) for our 152 patients.

After clinical screening, 23 patients were tested with chest CT scan and/or PCR (17 patients had both CT scan and PCR). With four cases (2.6%) of confirmed COVID-19 patients among the 152 patients treated during the outbreak, this number is nine fold higher ($p < 0.0001$) than in the general population (OR 8.77; CI 95%, 3.85–19.95). Among these four

patients, two died after surgery, and the two other recovered from COVID-19 infection and from surgery. Discharge criteria for these two patients in this situation were the absence of fever for 72 hours, oxygen saturation $> 96\%$ (94% in case of chronic obstructive pulmonary disease, COPD), respiratory rate < 22 breaths for a minute and a final negative chest X-ray. Patients with adequate assistance could be discharged home, formal communication was made with the local health organization, using a specific form describing the clinical situation and the indication for obligatory quarantine.

Despite management and organization of pathways, six negative patients had exposure or contact with positive patients during the hospital stay. They had physical contact or direct physical contact with droplet exposure of positive COVID-19, staying in the same room for more than 15 minutes, or contact with a healthcare professional that had contact with positive COVID-19 patient without the protection of correct PPE. This group of patients was discharged home, after formal communication with the local health organization using a specific form describing the clinical situation and indication for obligatory quarantine. At this moment (after 15 days follow-up), one is COVID-19, and of course, it is impossible to know whether it is related to an inside hospital contact or and outside contact (before or after surgery).

Treatments performed among the 152 patients during the pandemic period

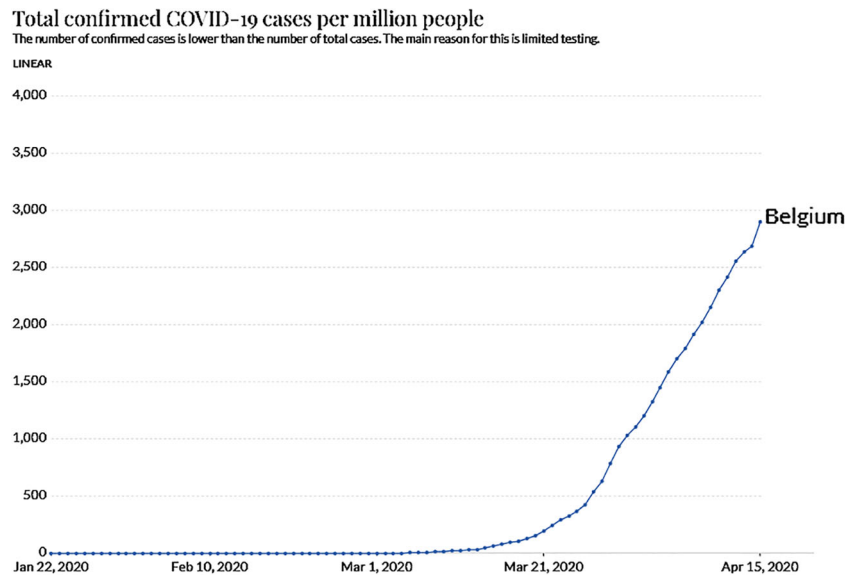
Twenty-three proximal femur fractures in elderly patients

Twenty-three patients (Table 3) with an average age of 85 years (range 60 to 103 years) were admitted to the emergency orthopaedic room for the treatment of a proximal femoral fracture; 11 fractures were intertrochanteric, and 12 were femoral neck fractures. There were 22 patients who underwent a surgical procedure and one patient who did not, because he died before he underwent an operation. Patients had accidentally fallen at home with no signs of head injury. Three patients presented with oxygen desaturation on ambient air but without fever; these three needed respiratory support before surgery.

Three (13%) of these 23 patients were positive for COVID-19. As per the recommendations of the anaesthesiologists and trauma team, and the comorbidities (Table 4), the criteria for surgery were a peripheral oxygen saturation (pO₂) of $> 90\%$ and a body temperature of < 38 °C. Twelve patients were operatively treated on the first day, 12 to 24 hours after admission. Ten patients had suspended their use of direct thrombin inhibitors and needed surgery to be delayed until the third day after recovery.

According to our usual clinical practice, 14 patients received regional anaesthesia and eight general anaesthesia. We performed reduction and osteosynthesis with an

Fig. 1 Aspect of the epidemic curve in Belgium



intramedullary nail (Gamma3; Stryker) for trochanteric fractures and arthroplasty (cementless exelR Group Lepine, and cementless Mobility Xnov) for femoral neck fractures, with an average operative time of 45 and 60 minutes, respectively. Postoperative pain management was based on a non-opioid multimodal strategy, and patients who had haemoglobin values of ≤ 9 g/dL received concentrated red blood-cell transfusion.

All patients were encouraged to assume the sitting position on a wheelchair or armchair on the first day post-operatively, and they were assisted by physiotherapists to improve physiological ventilation. Prophylaxis with low-molecular weight heparin (LMWH), standard hydration, was administered according to our hospital's protocol for patients.

The observed mortality rate at a mean follow-up of 14 days was 5% (1 case) for those 20 patients negative to disease, so not higher than other national registries in Europe [10]; the rate was 33% (1 case) for those three patients positive to COVID-19.

Thirty-two lower limb fractures in adult patients

Twenty fractures (among 32) were treated with surgery (osteosynthesis or nailing); there were nine ankle fractures (45%), three tibial fractures, three femoral shaft fractures, and five various sites (Table 3). Open reduction and internal fixation was the most used surgical, with nailing as second method; among the two open fractures, one external fixation was used. One (5%) of these 20 patients was COVID-19 positive and died after surgery from respiratory distress. There were eight cases of closed fractures treated conservatively, taking a proportion of 25% among the 32 lower limb fractures of adults. Four patients needing hospitalization for planning a non-deferrable elective surgical treatment were included in this group.

Sixty-nine upper limb trauma in adult patients

Thirty-six fractures (among 69) were treated with surgery (Table 3); surgeons did not modify the indications for surgery; upper limb surgery (12 proximal humerus with 2 shoulder arthroplasty and 8 nails; 13 distal radius; 4 elbows and 7 hands) was performed in the same operating room as lower limb surgery. Twenty-five fractures were treated by plaster fixation. No patient was positive for disease in this group. Eight patients with a non-deferrable elective surgical treatment were included in this group.

Twenty-eight children:

Eight fractures in eight patients of mean seven (range 1 to 17) years old were treated surgically (Table 3), and 20 (mean age 11 years; range 2 to 17) were treated by plaster fixation.

Comparison with the previous period (2018) for fractures with surgical treatment

In the same period of the year 2018, we had 129 admissions for adult fractures surgery (78 females) with a mean age of 61 years (range 18 to 98) and three admissions for child emergency surgery (mean age 11 years; 1 to 17 years). The diagnosis, type, and treatment of fractures were not significantly different. Anaesthesiology was not different and the time between admission and treatment the same. Indications and treatments were similar.

This number of patients during the pandemic 2020 (Table 3) was significantly lower for adults (88 versus 129 cases) and significantly higher for children (8 cases versus 3 cases). Overall there was a reduction of 32% in all injury-related admissions for surgery with same significant

reductions seen in proximal femoral fractures (33% reduction; 23 versus 34 cases); the same reduction (32% reduction) was observed for lower limb fractures, and upper limb fractures.

As a result, compared with the previous period, and despite a decreased absolute number of hip fractures, the pandemic study revealed among the 80 adults patients who had surgery a higher 29% (23 among 80 patients) prevalence of hip fracture as compared with 26.3% (34 among 129 patients); this was associated with a disproportionally increase ($p = 0.003$) fractures in children from 2.3 (3 among 132) to 9% (8 among 88).

Discussion

While most of the literature about COVID-19 understandably concentrates on the disease itself, there have been few papers about the management of both COVID-19 and non-COVID-19 conditions with fractures during the pandemic, the last one being the more frequent situation. Our series allow to answer to some questions.

Elderly patients

Our objective was to define the mortality rate of elderly patients with proximal femoral fractures in Belgium during this worldwide COVID-19 pandemic. For patients without COVID-19, the observed mortality rate (5%) at a mean follow-up of 14 days was not higher than other national registries in Europe [10]. According to these results, it seems that patients without COVID-19 infection, despite their usual mortality rates, could benefit from an early surgical procedure and, therefore, they should continue to undergo surgical treatment if they are clinically fit. For patients with COVID-19, and older than 90 years, the mortality rate for proximal femoral fractures with surgery was 33% (1 of 3). The mortality rate is similar to those 23 patients from Spain [6] with a 30.4% (7 of 23 patients) mortality at a mean follow-up of 14 days. As the 12 patients with COVID-19 managed non-operatively [6] had higher (67%) mortality (8 of 12), patients with hip fractures should continue to be operated even with COVID-19.

Frequency of COVID-19 patients among trauma

The frequency of COVID-19 in the general population is not well known. Currently, there is only antigen testing for COVID-19. This tests for active infection and has a reported false negative rate of between 10 and 30%. However, testing was currently restricted to patients who require hospital admission, and the majority of the population has not been tested. During this period, the confirmed number of COVID 19 was 3000 per million habitants (0.30%) in Belgium. With a number of 152 patients hospitalized during this period, as compared to the frequency observed in a previous period,

the risk of trauma was reduced of 30% with lockdown. However, the expected number of COVID-19 patients should have been less than one (0.45); we observed four confirmed patients with COVID-19, which appears nine fold higher than in the general population. The basis for this uptick is unclear. It is hard to say at this point whether this phenomenon represents a real significant increase ($p < 0.0001$) as we observed in our small series or a just random variation; only time and larger series will tell. But “orders to stay at home” may reduce the totality of trauma in the general population, without reducing the risk in a particular population as those with COVID-19. The inability of society’s most disadvantaged groups to abide by a “stay at home” order, combined with the heightened stress of the pandemic, and the chronic fatigue in COVID-19 patients may in part explain the increase of trauma in a subgroup with COVID-19.

Which is the best treatment for trauma in the outbreak period

When possible, to minimize surgical times, we should consider surgical approaches and strategies in which we are most confident and with which we are familiar. Surgery should allow for immediate weight-bearing post-operatively to facilitate rehabilitation and minimize prolonged bed rest in patients with COVID-19. Uncemented implants and un-reamed nails should be considered given their shorter surgical timings and potential advantage in reducing respiratory complications in patients who are infected with COVID-19.

Simplifying treatments, the use of braces and boots rather than plaster casts may reduce number of visits to the hospital and exposure to densely packed waiting rooms which are a breeding ground for the disease. When discussion with the patient, the fact that it might be better now to accept a sub-optimal outcome and avoid hospital inpatient stays can be an approach for discussion.

Relative safety of screening and of two management pathways

The management of non-COVID-19 conditions during the pandemic, which is the more frequent situation, appears as difficult the management of COVID-19 condition, but for other reasons. One concern was to create pathways, ensuring “COVID-free” paths for elderly patients in need of orthopaedic surgery. In accordance with the anaesthesiology team, we created two management pathways for trauma cases: one pathway for those who test negative, one pathway for those with COVID. There are no reports of contamination of patients in hospital stays in the literature, since this would be difficult to prove in a pandemic situation. However, there is a high probability that some patients with COVID-19 had surgery without diagnosis of the disease and were moved in

the COVID-negative pathway. Because of the sudden impact of the pandemic in Belgium, there was an initial lack of tests for COVID-19 and protocols for testing patients. In general, patients who presented in the emergency department with any respiratory symptoms (cough, fever, shortness of breath) were tested. However, patients who presented for any other cause and did not show symptoms on presentation were not systematically tested during the first period. The problem is coming from the fact that the confirmed number (0.30%) of patients in the general population is lower than the reality, since many cases are non-symptomatic, and the reality could be as high as 8% which is the number of patients estimated to have been in contact with the virus in France which has the same epidemic curve. We observed four patients confirmed with COVID-19 in our series; however, the number of patients having contact with the virus could be as high as 12 patients, with eight missed diagnoses. According to contagiousness that seems to start with the appearance of symptoms, even a few days before for some people, and a period of 15 days of contagiousness in asymptomatic people, we are certain that a part of our patients (negative for COVID-19) was directed in the wrong pathway (pathway COVID-19). Furthermore we know that six negative patients had exposure or contact with positive patients during the hospital stay. This means that despite two different management pathways, some patients were in the wrong pathway. Therefore, even with organization and recommendations, the “safest place for patients during the COVID-19 crisis is not in the hospital.”

Children fractures and the disease

The frequency of trauma among children was increased. The pressure cooker of family life is a standing joke, but it hangs on the truth that for some families staying at home together increases the chances of child neglect and fractures. Then, there is the absence of any outside oversight which may increase the risk of fractures in children. The detailed treatment plan should depend on the children’s infection status, their emergency presentation, and developmental considerations. By April 30, this global pandemic has infected about three million cases in the world. A recent study reported that only 2.16% of symptomatic infected patients were children [11]. For confirmed or suspected COVID-19-infected children, although some of them may present as mild or even symptomless infections, the virus may “awaken” and the symptoms might worsen with the progression of infection during surgery or anaesthesiology. We had no confirmed case of COVID-19 in our series, and it is difficult to know how many children could be infected (may be none) in our series. During the outbreak, the impact of insufficient medical resources for paediatric surgical diseases may be greater than the infection itself. Therefore, to avoid that children became perversely suffering for the benefit of adults, once the treatment is available,

children who really need surgical intervention should not be delayed.

Conclusion

In conclusion, our series has probably some limitations, as the number of patients, and as probably imperfection in management and screening patients, but at the time of writing, even if there are some other papers on adult trauma in the literature, our series is the only one reporting management of children fractures during the COVID-19 outbreak. Also, it is the only one discussing the frequency of COVID-19 in the trauma population, and evaluating the safety of the management pathways in the real life and not as theory.

Now patients admitted directly to our hospital for surgery are all tested for COVID-19, unless they have had a recent (less than 7 days) negative test. Until the results of the test are available, they are seen in a “gray” area, which includes the resuscitation room as well as a CT scan and MRI. Patients who need urgent early surgery are treated as COVID-19 positive until the definitive test results are obtained. Once the diagnostic tests have been completed, patients who need surgery are scheduled.

Compliance with ethical standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical approval All procedures were 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.

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

References

1. World Health Organization (2020) Coronavirus disease 2019 (COVID-19) situation report-78. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200407-sitrep-78-covid-19.pdf?sfvrsn=bc43e1b_2. Accessed 2020 Apr 21
2. Sarac NJ, Sarac BA, Schoenbrunner AR, Janis JE, Harrison RK, Phieffer LS, Quatman CE, Ly TV (2020) A review of state guidelines for elective orthopaedic procedures during the COVID-19 outbreak. *J Bone Joint Surg Am*. <https://doi.org/10.2106/JBJS.20.00510>
3. Mavrogenis AF, Quaile A, Scarlat MM (2020) The virus crisis affects orthopaedic surgery and scientific activities worldwide. *Int Orthop* 44(5):813–817. <https://doi.org/10.1007/s00264-020-04557-2>
4. Zhu Y, Chen W, Xin X, Yin Y, Hu J, Lv H, Li W, Deng X, Zhu C, Zhu J, Zhang J, Ye F, Chen A, Wu Z, Ma Z, Zhang X, Gao F, Li J, Wang C, Zhang Y, Hou Z (2020) Epidemiologic characteristics of

- traumatic fractures in elderly patients during the outbreak of coronavirus disease 2019 in China. *Int Orthop*. <https://doi.org/10.1007/s00264-020-04575-0>
5. Mi B, Chen L, Xiong Y, Xue H, Zhou W, Liu G (2020) Characteristics and early prognosis of COVID-19 infection in fracture patients. *J Bone Joint Surg Am*. <https://doi.org/10.2106/JBJS.20.00390>
 6. Muñoz Vives JM, Jornet-Gibert M, Cámara-Cabrera J, Esteban PL, Brunet L, Delgado-Flores L, Camacho-Carrasco P, Torner P, Marcano-Fernández F, Spanish HIP-COVID (2020) Investigation Group Mortality rates of patients with proximal femoral fracture in a worldwide pandemic preliminary results of the Spanish HIP-COVID observational study. *J Bone Joint Surg Am*. <https://doi.org/10.2106/JBJS.20.00686>
 7. Samsami M, Zebarjadi Bagherpour J, Nematihonar B, Tahmasbi H (2020) COVID-19 pneumonia in asymptomatic trauma patients; report of 8 cases. *Arch Acad Emerg Med* 8(1):e46 eCollection
 8. Catellani F, Coscione A, D'Ambrosi R, Usai L, Roscitano C, Fiorentino G (2020) Treatment of Proximal femoral fragility fractures in patients with COVID-19 during the SARS-CoV-2 outbreak in Northern Italy. *J Bone Joint Surg Am*. <https://doi.org/10.2106/JBJS.20.00617>
 9. Giorgi PD, Villa F, Gallazzi E, Debernardi A, Schirò GR, Crisà FM, Talamonti G, D'Aliberti G (2020) The management of emergency spinal surgery during the COVID-19 pandemic in Italy. *Bone Joint J* 23:xxx. <https://doi.org/10.1302/0301-620X.102B6.BJJ-2020-0537>
 10. Mattisson L, Bojan A, Enocson A (2018) Epidemiology, treatment and mortality of trochanteric and subtrochanteric hip fractures: data from the Swedish Fracture Register. *BMC Musculoskelet Disord* 19(1):369
 11. Wu Z, McGoogan JM (2020) Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA*. 323(13): 1239–1242. <https://doi.org/10.1001/jama.2020.2648>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.