




Impact of Sars-Cov-2 pandemic on hip fractures: Clinical and radiographic outcomes

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Abstract

Introduction: Hip fractures affecting older people are at a higher risk of complications during the SARS-CoV-2 pandemic. The aim of this study is to provide data about proximal femoral fractures management and early outcomes during COVID-19 pandemic compared to the same period in 2019. **Material and Methods:** Retrospective and comparative study performed in two different periods were analyzed: from March 15, 2020, to April 30, 2020 (the first six weeks of Spain's current confinement) and the same period in 2019. Data regarding demographics (age and sex, housing), type of fracture, surgical performance, early outcomes (at 30 days), and at 1-year follow-up were collected. A total of 146 patients were evaluated, 89 in 2019 and 57 in 2020. **Results:** Despite the drop ~35.6% in hip fractures during SARS-CoV-2 period, distribution (age ($P = 0.985$), sex ($P = 0.43$), housing ($P = 0.61$), type of fracture ($P = 0.41$)) and Charlson comorbidity index ($P = 0.12$) were similar to a 2019 period. Surgical performance did not worsen in spite of the tough situation and the use of personal protective equipment, improving in some radiological variables (tip-to-apex and calcar reduction). In terms of postoperative outcomes, although there is a tendency to a short-term mortality increase (from 3.4% to 5.2%, $P = 0.22$), there were no differences at 1-year follow-up (20.2% in 2019 and 20.4% in 2020, $P = 0.587$). In the same line, although in both groups the patients lost functionality at 1 year, there were no significant differences ($P = 0.42$). **Conclusion:** Even in challenging times, protocols and adequate organization ensure proper outcomes, reaching satisfying clinical and surgical outcomes during the COVID-19 pandemic, despite an increasing trend in short term mortality not seen at 1-year follow-up.

Keywords

hip fracture, SARSCOV-2, fragile patient, orthogeriatrics

Introduction

The outbreak caused by SARS-CoV-2 virus, first detected in Wuhan, China,^{1–3} unleashed a worldwide pandemic, as stated by the World Health Organization (WHO) on March 11, 2020.⁴ Nowadays, SARS-CoV-2 impacted every single country, with ~100 million confirmed cases and almost ~2.5 million deaths.⁴ Spain was one of the first countries hit by this pandemic and Madrid the most devastated region accounting for up to ~3 million cases and ~70k deaths.⁵

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Orthopedic and trauma activity was dramatically modified in order to treat COVID-19 patients.⁶ Surgeons had guidelines and recommendations changing continuously, as the whole country was adapting daily to this unprecedented situation, and sophisticated protective equipment was necessary for surgical practice.^{7–10} Elective surgery was suspended, and hip fractures were the most frequent orthopedic surgical procedure performed during SARS-CoV-2.⁶ Elderly patients suffering from proximal femoral fractures were among the most vulnerable and also the most affected by the virus.¹¹ Higher mortality rate in hip fracture and SARS-CoV-2 disease was recently evidenced.¹² It remains unclear how clinical and functional outcomes in this group of patients were affected during this pandemic. The overcrowding and changes made to cope with this disease, as well as the stressful situation might have an impact in long-term outcomes.

The aim of this study is to describe our experience treating proximal femoral fractures in the epicenter of SARS-CoV-2 pandemic. We evaluated radiographic, clinical, and functional outcomes, comparing them to a standard situation during the same period in 2019. Our hypothesis is a decrease in hip fractures number during the quarantine period, increased mortality due to COVID-19 infection, but similar surgical results.

Materials and methods

Study design

An observational retrospective study analyzing the incidence and outcomes of hip fractures treated in two different scenarios was performed: pre and intra-epidemic SARS-CoV-2 at our hospital in Madrid, Spain. It is a public tertiary-level hospital, equivalent to a level I trauma center according to the American College of Surgeons classification. This specific period took place during the lockdown that associated confinement measures by the Spanish government, from March 15 to April 30, 2020. We treated both COVID and non-COVID patients during the lockdown. The same outcomes were evaluated and measured in patients during 2019. Patients suffering from an acute low energy hip fracture who attended our Emergency Department in the defined period were included. Patients younger than 50 years old diagnosed with pathological or periprosthetic fractures were excluded. Outcomes at short-term follow-up assessed 30 days after hospital discharge and at medium-term follow-up at 1 year were evaluated. Institutional review board approval was obtained and patients signed informed consent. In our center, since 2018, all hip fracture patients, signed an informed consent to be included in our hip fracture registry.

Data analyzed

Information was collected anonymously from our hospital database. 2019 patients were found using the hospital hip fracture registry.

Demographic data and baseline patients' characteristics

Age, sex, habitual residence (family home or nursing home), medical records, comorbidities measured using the Charlson comorbidities index (CCI) including age, and ASA classification were collected. Regarding preoperative blood test, hemoglobin, albumin, and cholesterol were collected in order to detect differences in patients baseline status at the time of admission. Functional status was measured with functional ambulation classification (FAC) as it is used in the Spanish national hip fracture registry and it is validated for hip fractures patients.¹³ Medium follow-up was 512 days from discharge in 2019 and 295 in 2020.

COVID-19 infection status

Hip fractures evaluated during the pandemic were divided into three groups according to their COVID-19 infection status regarding the SARS-CoV-2 novel coronavirus: positive, negative, and unknown if no test was performed. COVID-19 infection status was studied using the polymerase chain reaction (PCR) test (FluoroCycler XT, HAIN Lifescience, Nehren, Germany) at admission at the emergency room before hospitalization.

Fracture distribution

Fracture type was classified as intracapsular (femoral neck fractures) or extracapsular (intertrochanteric or subtrochanteric fractures). Extracapsular fractures were also divided into stable and unstable fracture patterns, according to AO criteria.¹⁴ Data extraction and clinical and radiographic evaluation of eligible patients were performed by two individuals (FGS, SGC) with independent verification by a third reviewer (GLA). Disagreements were resolved by consensus or a fourth reviewer (EC) arbitration.

Surgical performance

Since surgery might have been hindered during the pandemic due to epidemiological conditions and due to the necessity of using protection equipment for all COVID-19 infected patients, surgery delay was defined as those procedures performed more than 48 hours after the fracture. All COVID-19 patients were operated even infected,

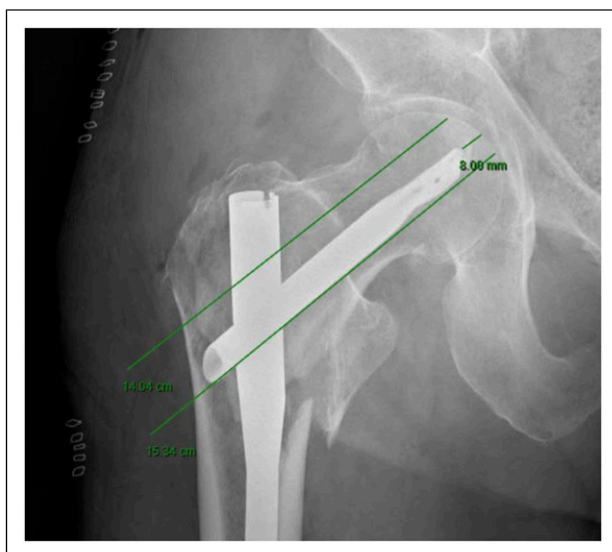


Figure 1. Example of reduction measurement in a antero-posterior radiograph, analyzing both Tip-Apex distance and position of the cephalic screw in the femoral neck (inferior, middle or inferior).

but hemodynamically stable, then they were kept in isolation until PCR-COVID test was negative.

Surgical timing, the shift in which surgery was performed (from 8 AM to 3 PM was considered morning to early afternoon, from 3 PM to 10 PM late afternoon to evening and from 10 PM to 8 AM night) and the quality of surgical performance were analyzed (Figures 1 and 2). Surgical performance in extracapsular fractures was assessed by estimating fracture reduction quality and fixation achieved by measuring calcar reduction, tip-to-apex distance (mm) and screw position (superior, center, or inferior) in AP X-ray images. Calcar reduction quality was classified according to the method described by Chang et al,¹⁵ which measures the relationship between the two medial cortices. If the proximal fragment is medial, it is classified as positive; if lateral as negative; and neutral if there was no displacement.¹⁵ Regarding femoral neck fractures, leg length discrepancy, presence of intra-operative calcar fracture, varus–valgus stem position, and type of implant were collected. A femoral stem was considered to be positioned in a varus or valgus position if the angle between the stem and the femoral diaphysis was superior to 3°.¹⁶

Postoperative outcomes

Time elapsed from trauma to emergency department attendance, hospital stay, discharge destination (home or nursing home), visits to the emergency room or any hospitalization event that occurred during the first postoperative 30 days, and mortality were recorded at 30 days

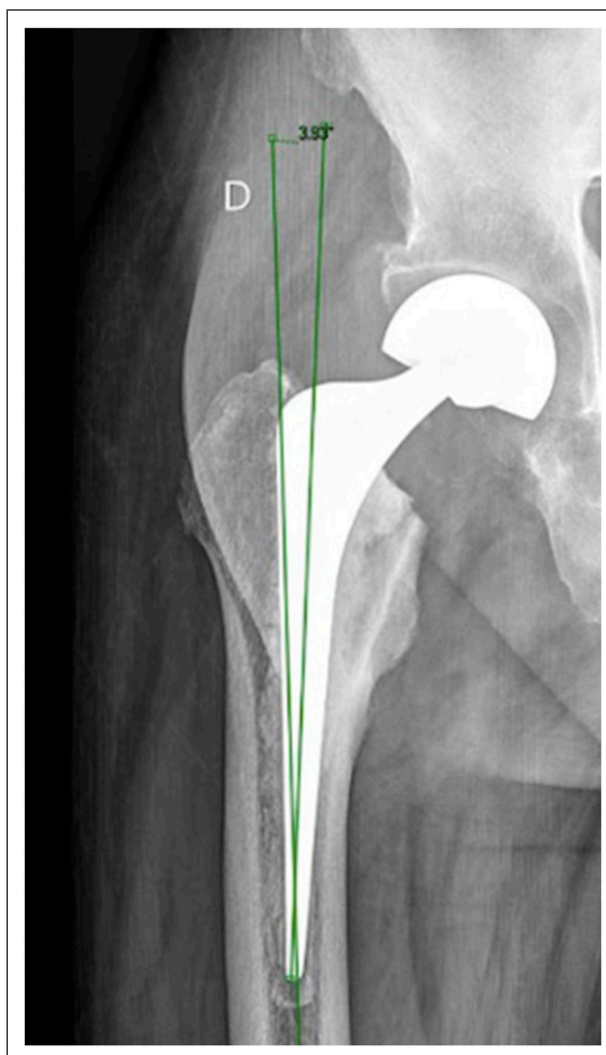


Figure 2. Example of varus–valgus stem position evaluation in a anteroposterior radiograph.

and 1 year. Functional ambulation recovery information using the FAC (functional ambulation classification) scale was also collected within our follow-up period in order to evaluate the impact of the lockdown in these patients considering that no physiotherapy could be provided in the immediate postoperative period (Figure 3).¹³ In addition, medical complications in patients treated in both periods were recorded and functional outcomes of COVID-19 patients were compared to those who were not infected in 2020.

Statistical analysis

Relevant data were inserted into an electronic database (Microsoft® Excel for Windows® (Microsoft Corp, Redmond, WA) for further analysis. Mean and standard deviation were used to describe quantitative variables,

Classification	Definition
0	Absolute inability to walk even with external help.
1	Requires external help to be able to walk.
2	Only able to walk on flat surfaces and known spaces like home.
3	Able to walk inside and outside of home but limited distances.
4	Able to walk anywhere but with obvious limp or need of technical assistance.
5	Normal deambulation.

Figure 3. Functional ambulation classification (FAC) scale.

Table 1. Demographic and preoperative variables.

	2019 (N = 89)	2020 (N = 57)	P-value
Age	83.5 (10.4 SD)	83.8 (11.9 SD)	<i>P</i> = 0.98
Sex (women)	58 (65.2%)	41 (71.9%)	<i>P</i> = 0.43
Anticoagulant (yes)	30 (33.7%)	10 (17.5%)	<i>P</i> = 0.003
ASA	3	3	
Dementia	30 (33.7%)	19 (33.3%)	<i>P</i> = 0.84
Habitual residence (familia home)	69 (77.5%)	43 (75.4%)	<i>P</i> = 0.69
Blood test			
Hemoglobin g/dL	12.6 (1.3 SD)	12.7 (1.5 SD)	<i>P</i> = 0.81
Albumin g/dl	3.5 (0.5 SD)	3.3 (0.4 SD)	<i>P</i> = 0.01
Cholesterol mg/dL	142.2 (39.3 SD)	132.3 (36.8 SD)	<i>P</i> = 0.07
Prefracture FAC	3.5 (1.5 SD)	2.8 (1.4 SD)	<i>P</i> = 0.14
Charlson comorbidity index	6 (2.2 SD)	5.3 (1.7 SD)	<i>P</i> = 0.12

median was used for ordinal variables, and frequency and percentage for qualitative variables. Statistical differences were assessed using Student t-test, chi-square test, Wilcoxon, and Mann–Withney tests. Data analysis was carried out using IBM SPSS version 24.0 (IBM SPSS, Armonk, NY, USA), and significance of pooled estimates was set at $P < .05$. A total of 146 fractures were analyzed: 89 fractures in 2019 (~60%) and 57 (~40%) in SARS-CoV-2 pandemic.

Results

Demographic data, SARS-Cov-2 infection status, and baseline patient's characteristics are shown in [Table 1](#). Patients in both groups were similar regarding age, gender, habitual residence, dementia, ASA, hemoglobin and cholesterol levels, as well as prefracture FAC and Charlson comorbidity index. Albumin levels were lower during the pandemic, reaching statistical significance. PCR-COVID tests were only performed routinely from

March 26, so only 38 (66.6%) in 2020 patient were tested, 13 (22%) of them positive.

During 2019 period, there were 3 (3.4%) fractures treated non-surgically and only 1 (1.8%) in 2020 period, with no statistically significant differences ($P = 0.491$). Although the number of fractures treated later than 48 hours decreased, the number of patients operated in the morning shift increased during the SARS-CoV-2 period, differences did not reach significance ([Table 2](#)).

While no statistical differences were observed in fractures patterns in the two periods analyzed, there was a drop in proximal femoral fractures in SARS-CoV-2 period, decreasing up to 35.6% during the same period. ([Table 3](#)).

Unstable fractures had similar incidence in both periods (45.8% in 2019 vs 44.4% in 2020) ($P = 0.57$). Regarding quality of surgical performance in extracapsular fractures, calcar reduction and tip-to-apex distance in SARS-CoV-2 period were better compared to those in the previous year. However, the ratio of fractures where the screw was implanted in a central position increased significantly from 23

Table 2. Surgical performance variables.

	2019 (N = 89)	2020 (N = 57)	P-value
Surgical treatment	86 (96.6%)	56 (98.2%)	$P = 0.56$
Delay to surgery (hrs)	40.3 (54.3 SD)	36.29 (51.2 SD)	$P = 0.66$
COVID-19		13 (22.8%)	
Work shift			$P = 0.30$
Morning to early afternoon	42 (47.2%)	33 (58.9%)	
Late afternoon to evening	42 (47.2%)	23 (41.1%)	
Night	2 (2.2%)	0 (0%)	
Surgery time (min)	68.7 (28.7 SD)	78.34 (42.9 SD)	$P = 0.11$
Mean hospital stay (days)	9 (6.8 SD)	6.95 (8.1 SD)	$P = 0.62$

Table 3. Extracapsular fracture patterns.

	2019 (N = 89)	2020 (N = 57)	P
Fracture pattern			$P = 0.41$
Intertrochanteric	40 (44.9%)	32 (56.1%)	
Intracapsular	40 (44.9%)	21 (36.8%)	
Subtrochanteric	9 (10.1%)	4 (7.1%)	

Table 4. Surgical performance in extracapsular fractures.¹⁴

	2019 (N = 48)	2020 (N = 36)	P
Reduction			$P = 0.39$
Negative	7 (14.5%)	3 (8.3%)	
Neutral	25 (52%)	24 (66.6%)	
Positive	16 (33.3%)	9 (25%)	
Screw position			$P = 0.04$
Superior	8 (16.6%)	3 (8.3%)	
Neutral	26 (54.1%)	29 (80.5%)	
Inferior	14 (29.1%)	4 (11.1%)	
Tip-apex (mm)	20.42 (7 SD)	16.3 (6.6 SD)	$P = 0.55$
Unstable	22 (45.8%)	16 (44.4%)	$P = 0.57$

(~53%) in 2019 to 29 (80%) fractures in SARS-CoV-2 period ($P = 0.04$). Radiological data are detailed in [Table 4](#).

Concerning femoral neck fractures, cemented femoral stems were significantly more commonly used in SARS-CoV-2 period, but no differences were found in the distribution of different designs of non-cemented stems. No differences were found either in varus/valgus position ($P = 0.07$) or leg length discrepancy, ($P = 0.27$) evaluating postoperative images ([Table 5](#)).

Postoperative outcomes

Postoperative morbidity and mortality are detailed in [Table 6](#). Early mortality increased during COVID-19 period,

Table 5. Surgical performance in intracapsular fracture.

	2019 (N = 37)	2020 (N = 21)	P
Prostheses			$P = 0.07$
Cemented	16 (43.3%)	12 (57.1%)	
Uncemented	21 (56.7%)	9 (42.9%)	
Length discrepancy	1.59 (6.2 SD)	1.15 (5.7 SD)	$P = 0.27$
Varus/valgus	31 (84%)	16 (76.2%)	$P = 0.07$

from 3.4% in 2019 to 5.2% in 2020, but no statistically significant with $P = 0.22$. In contrast, at 1-year follow-up, there is no difference in mortality rate (20.2% in 2019 and 20.4% in 2020, $P = 0.587$). No PCR test performed in one fracture, and testing disclosed a positive and a negative test in the two other cases. In pre-SARS-CoV-2 period, the most common complication was delirium, followed by heart failure. In 2020, the main complication was COVID pneumonia, followed by heart failure. There were no significant differences in readmissions and destination after hospital discharge destination between both periods. Functional results, evaluated with the difference between prefracture FAC and post-fracture FAC measured as FAC worsening, were slightly worse, but again with statistically and clinically non-significant differences ($P = 0.42$).

With regard to clinical impact of COVID-19 on functional outcomes, patients with positive serology to COVID-19 showed a significant surgical delay and hospital stay, but this condition was not associated with a significant superior complications rate or mortality at short-term follow-up ([Table 7](#)).

Discussion

We found a hip fracture incidence decrease during the SARS-CoV-2 pandemic, contrary to recently published works.^{12,14} Difficult conditions in which patients were treated were associated neither with worse surgical

Table 6. Postoperative clinical outcomes.

	2019 (N = 89)	2020 (N = 57)	P
Complications			
Heart failure	11 (12.4%)	2 (3.5%)	
Delirium	28 (31.5%)	0 (0%)	
Kidney failure	9 (10.1%)	0 (0%)	
No COVID pneumonia	4 (4.5%)	1 (1.8%)	
COVID pneumonia	0 (0%)	2 (3.5%)	
Others	13 (14.6%)	10 (17.5%)	
Readmissions			
Rehospitalization	18 (20.2%)	8 (14%)	P = 0.57
Emergency attendance	22 (24.7%)	11 (19.3%)	P = 0.41
Discharge destination			
Family home	53 (62.3%)	36 (67.9%)	P = 0.33
Nursing home	32 (37.6%)	18 (33.9%)	
In-hospital mortality	2 (2.2%)	3 (5.2%)	P = 0.36
30 days mortality	3 (3.4%)	3 (5.2%)	P = 0.44
1 year mortality	16 (20.2%; N=79)	10 (20.4%; N=49)	P = 0.587
FAC worsening (1 year)	0.9 (1.2 SD; N = 64)	0.7 (1 SD; N = 40)	P = 0.42

Table 7. Outcomes in COVID-19 tested patients.

	COVID (N = 13)	No COVID (N = 25)	P
Surgery	12	25	P = 0.16
Delay to surgery (hrs)	56.5	24.8	P = 0.002
No	8	20	P = 0.62
ACOs	2	1	
Medical condition	2	1	
OR availability	1	1	
Surgery time (minutes)	78.8	81.0	P = 0.84
Hospitalization (days)	13.1 (12.8 SD)	5.3 (6.1 SD)	P = 0.013
Rehospitalization	3	2	P = 0.36
Complications	2	0	P = 0.11
30 days mortality	1 (7.6%)	1 (4%)	P = 0.498
1 year mortality	2 (20%; N = 10)	2 (6.8%; N = 25)	P = 0.267

performance nor significant higher mortality or differences in functional recovery.

A different hip fracture incidence could be reasonably explained by the confinement measures during those months. Due to home lockdown, people's physical activity decreased sharply, particularly for the elderly and at nursing homes, reducing falls and injuries. Fear of infection could be a delay factor for certain pathologies but not for hip fractures that are extremely painful and completely disabling. There is a possibility that patients attended other hospitals in our city; however, this is highly unlikely as transfers are scheduled based on where patients live, so patients do not decide which hospital to go to.

Despite this change, fracture pattern distribution did not suffer changes during the pandemic. Similarly, no significant differences were found between patients' habitual residence either, nor their preoperative variables such as blood tests (hemoglobin and cholesterol), Charlson comorbidity index and pre-fracture functional scores. There were statistically differences in albumin levels that could explain patients during quarantine presented higher malnutrition status. We received fewer patients but with no important differences.

Regarding fracture management, we did not find differences in the overall time delay from admission to surgery, except for those patients in whom PCR tests were

positive for COVID-19, who required to be scheduled in specific operating and recovery rooms following strict epidemiological recommendations. On the other hand, the number of patients operated during the morning shift increased because there were more operating rooms available since elective surgery had been suspended. This could lead to a better surgery performance with better preoperative preparation and rested surgeons. The team of surgeons was similar in both scenarios, since residents operated most hip fractures.

Although not significant statistically, we also observed a clear decreasing trend in hospital stay in 2020, as recently reported.^{6,17} Confinement has increased family support for these patients and they played a key-role by taking care of them after discharge, coupled with the fear of SARS-CoV-2 in-hospital infection might explain this finding.

SARS-CoV-2 threatened health systems generating a serious concern for governments and individuals around the world.^{5,6,10,13} The lockdown has been a stressful situation, but particularly for health-care workers. In this study, we analyzed for the first time the potential impact of the pandemic on the surgical performance when operating hip fractures. This stress has been especially acute operating on COVID-19 patients, a novel situation for everyone that implied working in a special operating room, following strict protocols, and bearing uncomfortable personal protective equipment. In spite of this condition that might have hindered surgical performance, radiographic results were comparable with those in 2019. Furthermore, a significantly superior number of cases with a central position of the screw in the femoral head and a higher rate of satisfactory calcar reduction in extracapsular hip fractures were detected. Interestingly, this superior performance was achieved without requiring a superior operative time. We cannot give a clear satisfactory explanation for this finding, but the high level of responsibility and motivation of the surgical team to address this frequent procedure under stressful conditions seemed to have overcome difficulties, and better results in certain variables analyzed were obtained.

Mortality rates increased in our cohort at the short time, without being statistically significant, and were similar at 1-year follow-up, which is in line with other published studies.¹⁷ Contrary, most studies found major increased mortality in COVID patients at short time.¹⁸⁻²¹ We may fail to achieve statistical significance due to low sample size mainly. Re-entry rate and emergency attendance at 30 days decreased, but no statistical significance was observed.

Another interesting finding is the lack of differences in the degree of functional recovery according to the FAC scale. Although no physical therapy treatment was provided in the hospital during the lockdown, functional outcomes based on FAC scale were not significantly worse.

Regarding patients with a positive PCR test for SARS-CoV-2 in 2020, and compared to the rest of the patients that

suffered a hip fracture during this period, they showed more complications and rehospitalization events and an increase in average stay, as previously reported.¹² Differences were not statistically significant in this study probably due to the small sample size, and therefore, no conclusions should be drawn.

This investigation provides data on the management of proximal femoral fractures in a Department of Orthopedics and Traumatology at a hospital at the epicenter of SARS-CoV-2 pandemic in Europe. To our knowledge, this is the first investigation that takes into account not only medical variables but also surgical performance in a global pandemic scenario, with 1-year follow-up. This study has several drawbacks. Our main limitation was the low sample size as stated previously, which could underestimate our results. Although a 1-year follow-up is not enough to evaluate certain surgery complications as periprosthetic fracture, it is the longest follow-up available for COVID infection at this moment.

Information on the status with regard to the infection by SARS-CoV-2 could be registered in the majority, but not all patients were treated in 2020; we only found 13 COVID-19 positive patients. In addition, as a retrospective study, we have several inherent limitations like missing information and patient follow-up loss.

In summary, the decrease of hip fracture during the confinement has been a fact in our area, yet the management of proximal femoral fractures has been successful, with comparable result at 1-year follow-up with pre-pandemic clinical practice, despite the global emergency, and every patient received appropriate surgical treatment, even when all efforts were focused in SARS-CoV-2 patients and pandemic control.

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