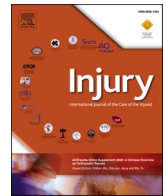




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## Morbidity and mortality in hip surgery patients due to fracture during the COVID-19 pandemic

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### ABSTRACT

**Background:** The COVID-19 epidemic generated major changes in general surgical management protocols. The literature has reported high mortality rates for hip fracture surgery in patients with COVID-19. This study describes the morbidity and mortality in patients undergoing surgery due to hip fractures in 12 Colombian institutions between March and September 2020.

**Methodology:** This was a retrospective observational descriptive study. Medical records of 12 hospitals were reviewed. Consecutive patients who underwent hip fracture surgery from March 6 to September 6, 2020, were included. Data collected were sociodemographic profile, type of fracture, surgical treatment, complications, and early (1 month) or mid-term (1–6 months) mortality associated or not with COVID-19.

**Results:** Five hundred twenty patients with hip fractures requiring surgery in the 12 institutions were included. 364 (70%) were women; mean age was 77.7 years (SD: 13.8), mean BMI was 25.1, 91.73% of patients had at least one comorbidity, 60.38% were classified as ASA II and 25.77% as ASA III. There were 267 (51.34%) pertrochanteric fractures, 227 (43.65%) femoral neck fractures, and 26 (5.0%) subtrochanteric fractures. 274 (52.69%) patients were treated with osteosynthesis, 244 (46.92%) with arthroplasty, and 2 (0.38%) with girdlestone. Surgery was performed less than 24 h after the fracture for 115 (22.11%) patients, between 24 and 72 h for 208 (40.0%) patients, and more than 72 h for 197 (37.88%) patients. One hundred six patients in total suffered a medical or surgical complication throughout the different follow-up stages, amongst the most frequent were respiratory failure, coronary events, surgical site infection, cutting-out and peri-implant fracture. 25 (4.8%) patients required attention in the Intensive Care Unit (ICU). 13 patients had COVID-19 throughout the follow-up period. 27 patients died due to any cause, and 3 of them had reported a positive COVID-19 test any time during follow-up period, of which one died during the first month, and two died between 1 and 6 months. Statistically significant associations were found between age older than 75 years old, ASA classification, ICU requirement, and death.

**Conclusion:** 520 patients received surgical treatment for hip fracture during the first six months of the COVID-19 pandemic in 12 medical centers in Colombia. 21.10% suffered a complication during the early stage (30 days) and 4.77% during the midterm stage (1–6 months). 4.8% were admitted in the ICU during the early stage. All-cause death was 27 patients, early death was 11 (40.74%) and midterm death was 16 (59.25%). 13 patients were positive for COVID-19, 3 died, one (1/5=20%) on the first 30 days and the other two (2/8=25%) from month 1 to 6.

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## Introduction

Epidemics have a major impact on the socioeconomic structure, health systems, and population control [1,2]. In 1918 the Spanish flu, recognized as one of the worst pandemics in history, reported global population mortality of approximately 3% [2,3].

During the last two decades, the world has suffered the impact of three coronaviruses, the type 1 coronavirus that causes severe acute respiratory syndrome (SARS-CoV-1) from 2002 to 2004, and the Middle East respiratory syndrome (MERS-CoV) in 2012, with mortality rates close to 9.6% and 34.4% respectively [2].

The World Health Organization (WHO) decreed a state of a pandemic for a third coronavirus, the type 2 coronavirus (SARS-CoV-2) that causes COVID-19 since March 11, 2020, [2]. This situation represented a medical challenge and required new action plans and patient care strategies. For this reason, the orthopedics and trauma services proposed management protocols for musculoskeletal injuries that were constantly treated but now had to be addressed in a different context [1,4].

One of the musculoskeletal pathologies that have a great impact on morbidity and mortality in older adults is hip fractures, which have an overall mortality rate of 24% at one year and close to 36% at 6 months [5] with a high rate of complications mainly due to respiratory infections [6]. However, morbidity and mortality have decreased with the application of multidisciplinary approaches and early surgery in these patients [7].

According to some authors, during the COVID-19 lockdown major and activity-related trauma was reduced but it was not the case for fragility fractures [8]. The incidence of hip fractures was unchanged as reported by the literature, and given the fragility and the high mortality rates of these patients, particularly in the presence of an unknown virus with a predominant impact on the elderly, urgent care was a priority [9].

The literature has reported high mortality rates in patients undergoing surgery during the COVID-19 pandemic and a high incidence of serious complications associated with immunosuppression, hypercoagulability, and pulmonary complications [2]. These findings were presented during the meetings of the Colombian Society of Orthopedic Surgery and Traumatology (SCCOT) and the Colombian Society of Hip and Knee (SOCCAR). In an unprecedented initiative in the history of Colombian scientific production, we decided to carry out a multicenter study to describe how morbidity and mortality behaved as a population epidemiological variable in patients who underwent surgery for hip fracture during the first phase of the COVID-19 pandemic in Colombia and to generate data related to this common type of fracture, absent in our national literature. Morbimortality was classified according to Castronovo 2011 [10], in early mortality (1 month) and midterm mortality (1–6 months) [10].

The aim of this study was to describe the morbidity and mortality presented in patients undergoing surgery due to hip fracture during the first months of the COVID-19 pandemic in Colombia and characterizes the effects that the first six months of the pandemic had on this group of patients. The information collected in this study might allow for establishing early actions to treat potential complications and designing the necessary adaptations to care services and biosafety protocols for the surgical management of hip fractures.

## Materials and methods

We conducted a retrospective observational descriptive study to analyze patients with hip fractures who required surgical treatment in 12 public and private institutions in different regions of the country from March 6, 2020, when the first case of COVID-19 was diagnosed in the country, until September 6, 2020.

All participating institutions' ethics committees approved the study. Consecutive patients both male and female of all ages requiring surgical procedure to treat a hip fracture were included, patients requiring additional surgical procedures were excluded.

The study variables were extracted from the patient's medical records in the 12 participating institutions.

Given the rapidity of the contagion curve growth and the greater risk of premature respiratory, vascular and systemic complications, the data collection and analysis was conducted in three different stages: the initial care stage included the collection of demographic data, type of fracture, classification of the American Society of Anesthesiology (ASA), comorbidities, date of hospital admission, date of surgery, type of surgical procedure performed, intraoperative and immediate postoperative complications; the early stage included complications and mortality presented during the first postoperative month; and the midterm stage included complications and mortality between 1 and 6 postoperative months.

## Statistical analysis

Quantitative variables were described using means with standard deviations, and qualitative variables were evaluated using percentages and absolute frequencies. IBM SPSS for Windows version 20 (SPSS Inc., Armonk, NY, USA) was used to analyze the data. The association between different qualitative variables was determined using the Chi-square test of independence or the Fisher test in case the expected values were lower than 5. Statistical significance was established with a  $p < 0.05$ .

## Results

### Sociodemographic variables

Between March 6 and September 6, 2020, 520 patients with hip fractures required surgical treatment in the 12 participating hospitals. 436 patients completed follow-up at 1 month (early stage), and 377 completed follow-up at 6 months (mid-term). Fig. 1 presents the diagram of included patients and follow-ups.

The sample consisted of 520 patients with an average age of 77.7 years (SD 13.8), 69.04% were older than 75 years, 70% were female, 91.73% of patients had at least one comorbidity, hypertension being the most frequent with 62.88%, and 86.15% of the patients were classified in the initial stage as ASA II or ASA III (Table 1).

### Type of fracture and surgery

The fracture types were classified according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). There were 267 (51.34%) pertrochanteric fractures (S721), 227 (43.65%) femoral neck fractures (S720), and 26 (5.0%) subtrochanteric fractures (S722). The time elapsed between the fracture and the surgery was less than 24 h in 115 patients (22.11%), between 24 and 72 h in 208 (40.0%), and more than 72 h in 197 (37.88%) patients.

Regarding surgical procedures, the most frequently performed was osteosynthesis in 274 cases (52.69%) distributed in osteosynthesis with cephalomedullary nail in 242 (88.32%) patients, osteosynthesis with Dynamic Hip Screw (DHS) / Dynamic Condylar Screw (DCS) in 23 (8.39%) patients, and osteosynthesis with cannulated screws in 9 (3.28%) patients. Arthroplasty was the second most frequently performed surgical procedure, with 244 (46.92%) patients, of which 179 (73.36%) were total replacements and 65 (26.63%) were hemiarthroplasties. Of the total hip replacements, there is information on 78 (43.57%) non-cemented procedures, 24 (13.40%) cemented, and 13 (7.26%) hybrid. Two (0.38%) patients underwent Girdlestone arthroplasty. (Table 2)

### Complications

A total of 106 patients presented a medical or surgical complication during the 6 months follow-up. 74 (69.81%) patients presented

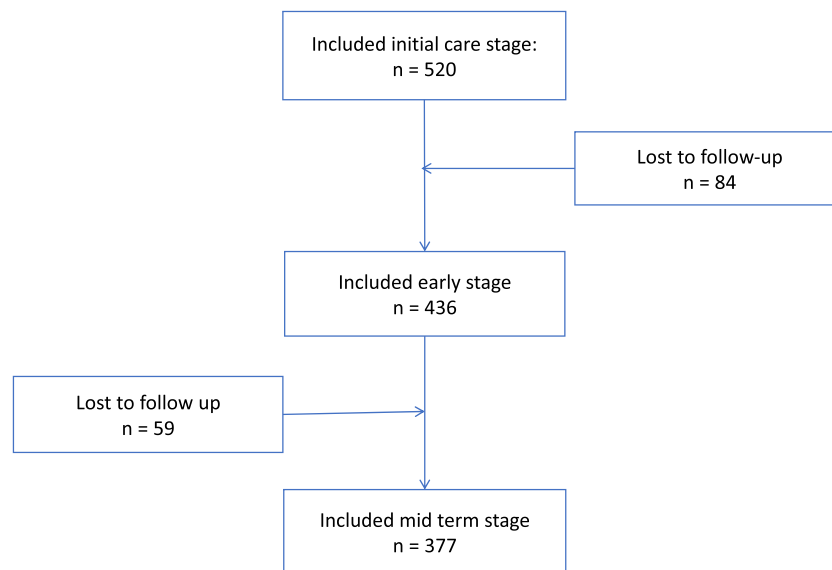


Fig. 1. Flowchart of patient inclusion per follow-up stage.

Table 1

Sociodemographic characteristics of patients with hip fracture.

Variable	N = 520
Age, mean (SD)	77.7 (13.8)
Over 75 yo, n (%)	359 (69.04%)
Gender F/M n (%)	364 (70.00%) / 156 (30.00%)
Weight in Kg, mean (SD)	63.5 (12.2)
BMI, mean (SD)	25.1 (7)
Fracture laterality L/R n (%)	268 (51.54%) / 252 (48.46%)
Type of health insurance, n (%)	
EPS Subsidized	132 (25.38%)
EPS Contributive	292 (56.15%)
Prepaid medicine	91 (17.50%)
Private insurance	5 (0.96%)
With one or more comorbidities, n(%)	477 (91.73%)
Most frequent comorbidities, n (%)	
Arterial hypertension	327 (62.88%)
Diabetes	97 (18.65%)
Respiratory disease	82 (15.77%)
Coronary heart disease	49 (9.42%)
Smoking	20 (3.85%)
ASA classification, n (%)	
I	65 (12.50%)
II	314 (60.38%)
III	134 (25.77%)
IV	7 (1.35%)

Abbreviations: yo, years old; BMI, Body mass index; EPS, Entidad promotora de salud (public/private health insurance).

Table 2

Surgical procedures by type of fracture.

Type of procedure	Femur neck fracture N = 227 n (%)	Petrochanteric fracture N = 267 n (%)	Subtrochanteric fracture N = 26 n (%)
Osteosynthesis with cephalomedullary nail	27 (11.89%)	196 (73.40%)	19 (73.07%)
Osteosynthesis with DHS/DCS	4 (1.76%)	13 (4.86%)	6 (23.07)
Osteosynthesis with cannulated screws	8 (3.52%)	1 (0.37%)	0
Total arthroplasty	155 (68.28%)	23 (8.61%)	1 (3.84)
Hemiarthroplasty	31 (13.65%)	34 (12.73%)	0
Girdlestone	2 (0.88%)	0	0

complications during the initial care stage, while 14 (13.20%) patients presented complications in the early stage, and 18 (16.99%) patients suffered complications during the mid-term stage.

Some patients suffered more than one complication medical and/or surgical, hence complications were counted individually and classified as medical or surgical. There was a total of 122 medical complications and 29 surgical complications during the entire six months follow-up. Table 3 shows the distribution of complication type per follow-up period.

The most frequent medical complication was respiratory failure 21/122 (17.21%), followed by coronary events 12/122 (9.83%). The most frequent surgical complications were surgical site infection 6/29 (20.68%), cutting-out 5/29 (17.24%), and peri-implant fracture in 3/29 (10.34%).

The total number of patients who required attention in the ICU during the initial care stage was 25/520 (4.80%). Age older than 75 years old and worse condition at admission according to ASA classification were found to have a statistically significant association with admission to the ICU. No other demographic variables were statistically associated with ICU admission. Table 4 shows the demographic characteristics of the patients who required ICU.

### Mortality

During the 6-month follow-up, there were 27 all-cause deaths; 11/27 (40.74%) occurred during the early stage and 16/27 (59.25%) during the mid-term stage. Statistically significant associations were found between death and age older than 75 years old, worse condition at admission according to ASA classification, and UCI admission (Table 5).

### Morbidity and mortality associated with COVID-19 infection

During the first months of the pandemic, while this study was carried out, there was no standardization of the COVID-19 diagnosis or

Table 3

Distribution of type of complication per follow-up period.

Type of complication	Initial care n (%)	Early state n (%)	Midterm stage n (%)
<b>Medical</b>	69 (81.17%)	18 (69.23%)	35 (87.50%)
<b>Surgical</b>	16 (18.82%)	8 (30.76%)	5 (12.50%)
<b>TOTAL</b>	85	26	40

**Table 4**

Demographics of ICU patients and associations.

ICU patients	N = 25	P value
Age, mean, (SD)	81.4 (SD 9.6)	
**<75 yo	3 (12.00%)	.013
**>75 yo	22 (88.00%)	
*ASA n,%		.007
I	3 (12.00%)	
II	8 (32.00%)	
III	14 (56.00%)	
**Elapsed time to surgery n,%		.657
Less than 24 h	7 (28.00%)	
Between 24–72 h	8 (32.00%)	
More than 72 h	10 (40.00%)	
**Type of fracture n,%		.409
S720	13 (52.00%)	
S721	12 (48.00%)	
**Type of surgical procedure n,%		.753
Cephalomedullary nail	13 (52.00%)	
Arthroplasty	12 (48.00%)	

\* Fisher's exact test.

\*\* Chi-square Test of Independence.

**Table 5**

Demographics of deceased patients and associations.

Deceased patients	N = 27	P value
Age, mean, (SD)	83.1 (DS 10.2)	
**<75 yo	5 (18.51%)	.019
**>75 yo	22 (81.48%)	
*ASA n,%		.029
I	2 (7.41%)	
II	11 (40.74%)	
III	14 (51.85%)	
**Elapsed time to surgery n,%		.542
Less than 24h	5 (18.52%)	
Between 24–72h	9 (33.33%)	
More than 72h	13 (48.15%)	
**Type of fracture n,%		.401
S720	11 (40.74%)	
S721	16 (59.26%)	
**Type of surgical procedure n,%		.715
Cephalomedullary nail	14 (51.85%)	
Arthroplasty	13 (48.15%)	
*Required ICU n,%		.034
Yes	4 (14.81%)	
No	23 (85.19%)	

\* Fisher's exact test.

\*\* Chi-square Test of Independence.

presumption protocols. The COVID-19 screening methods applied in this study included an epidemiological survey in 283 (45.5%) patients, CT-Scan or chest X-ray in 110 (17.7%) patients, RT-PCR in 23 (3.7%) patients, IgG in 10 (1.6%), IgM in 12 (1.9%) patients and no screening on 173 (27.8%) patients. Some patients underwent more than one screening method.

A total of 13 patients received a positive COVID-19 diagnosis anytime during the 6-month follow-up period, and 3/13 (23%) died. Table 6 presents a description of mortality rates for patients with positive and negative diagnosis of COVID-19 according to the number of patients screened. A detailed description of mortality among patients with a positive test of COVID-19 throughout the follow-up period is

**Table 6**

Mortality rates in patients with positive and negative COVID-19 result.

	Survivor	Non-survivor	Total	Mortality rate
COVID-19 positive	10	3	13	23,08%
COVID-19 negative	310	24	334	7,19%
Total	320	27	347	7,78%

Calculations made with total number of patients screened for COVID-19.

presented in table 7.

Only one of the deceased patients presented COVID-19 indicative symptoms upon initial care stage hospital admission. This patient presented medical and surgical complications, which required attention in the ICU, and died on the 30th postoperative day. The second deceased patient was readmitted at the hospital 4 months after surgery with respiratory difficulties and cardiac arrest, the patient tested positive for COVID-19 and died. The last patient was readmitted 3 months after surgery with respiratory symptoms and other indicative COVID-19 symptoms, however, the COVID-19 test taken at the hospital was negative despite the fact that a test taken before hospitalization was positive; the patient died recently after hospitalization, but the death was never confirmed to be caused by COVID-19. The ten surviving patients positive for COVID-19 did not require ICU care or presented complications related to the virus.

## Discussion

This investigation described the morbidity and mortality of patients who underwent hip surgery due to fracture in 12 Colombian institutions during the first six months of the COVID-19 pandemic. The initiative to carry out this study arose from the data observed in the scientific literature showing high mortality rates in COVID-19 patients taken to surgery during the COVID-19 pandemic's first months.

By the time this study was conducted, the pandemic had been declared by the OMS, but in Colombia we did not have many cases reported in comparison with other countries. We were at the early stages of the pandemic and not yet in the first wave. Local health authorities and medical centers were preparing their strategies and protocols to handle the pandemic the best way they could, given the limitations of the health system and the particularities of the region. Based on the international health authority guidance, biosafety measures, surgical procedure protocols, and COVID-19 screening were established by each center, yet to be standardized nationally.

Furthermore, the pathophysiology of the virus was being discovered daily, far from being fully understood. The literature has now consistently showed that COVID-19 generates a higher postoperative risk of morbidity and mortality, with a predominantly high rate of pulmonary complications [11]. Without still being completely defined, the association between COVID-19 and postoperative morbimortality might be explained by two separate mechanisms [12]. The first is a proinflammatory response mediated by cytokines and immunosuppression created by the surgical procedure which is enhanced by the presence of a SARS-CoV-2 infection; and the other is due to the coagulopathy generated by the SARS-CoV-2 infection, which might also enhance the already present risks of pulmonary events and thromboembolism of any surgical procedure [12,13]. Thrombotic events are considered one of the major risk factors for increased mortality in patients with SARS Cov 2 [12,13].

By the time when this study was conducted, the common policy applied was, as reported by international experience, continue with surgical intervention for urgent and high mortality risk trauma including hip fracture surgery, and suspend elective orthopedic surgery.

Among the literature reports of the time about mortality rates in patients undergoing surgery, Lei S et al. 2020 [14] presented a group of 34 patients undergoing elective surgery, of which 44.1% required ICU admission and 20.5% died [14]. Hall et al. 2020 [8] presented 315 patients with hip fractures of which 27 were diagnosed with COVID-19 and 9 (27%) of them died [8], Biarnés-Suñé et al. 2021 [15] presented a

**Table 7**

COVID-19 patients and mortality by follow-up stage.

Stage	COVID-19 patients	Mortality n (%)
Early	5	1 (20.0%)
Midterm	8	2 (25%)
TOTAL	13	3 (23.07%)

group of 63 patients with hip fracture of which 18 presented COVID-19 and 20% of them died [15]. Dallary et al. 2021 [16] reported 477 patients with hip fractures, of which 53 presented COVID-19 during the first postoperative month, and 22.6% died [16]. Wignall et al. 2021 [17] presented 276 patients operated for proximal femur fracture, of which 34 were positive for COVID-19, and 38.2% died 30 days after surgery [17].

This investigation included 520 patients with hip fractures who required surgical treatment in one of the 12 participating Colombian hospitals. Our sample is similar to those observed in the literature regarding demographic characteristics like sex, with 70% of female patients, an age average of 77.7 years, and a population with various comorbidities [6,14]. The ASA classification results of our population differ from those published by other authors. While in our sample, 25.77% were classified as ASA III and 60.38% as ASA II, Hall et al. 2020 [8] reported 57.6% of patients classified as ASA III and 25.6% as ASA II [8], Dallari et al. 2021 [16] found that 50% were ASA III and 40.5% were ASA II [16]. Biarnés-suñe et al., 2020 [15] found that, in their group of 63 patients older than 65 with hip fracture, 81.4% were ASA III and 18.6% were ASA II [15].

The frequency of pertrochanteric fractures in our study (51.34%) is very similar to that of femoral neck fractures (43.65%), reaching approximately 95% of all fractures, while the remaining 5% corresponds to subtrochanteric fractures. Similar results were reported by Backer et al. 2021 [18] with 187 patients and 42.8% pertrochanteric fractures, and by Dallari et al. 2021 [16], who reported 50.9% pertrochanteric fractures, 46.1% femoral neck fractures, and 2.9% subtrochanteric fractures. In contrast, Kebaetse et al. 2021 [19] reported a higher frequency of femoral neck fractures (55.4%) followed by pertrochanteric fractures (36.6%) [19].

According to recent guidelines for the management of hip fractures in the elderly from the American Academy of Orthopedic Surgeons (AAOS) [5], it is suggested to treat unstable pertrochanteric fractures with osteosynthesis with a cephalomedullary nail (strong recommendation) and stable ones with osteosynthesis with a cephalomedullary nail or a sliding hip screw system such as the Dynamic Hip Screw DHS (strong recommendation) [5]. Stable femoral neck fracture treatment recommendations include internal fixation, hemiarthroplasty, or nonsurgical treatment (moderate recommendation); while for unstable femoral neck fractures, they recommend arthroplasties over internal fixation (strong recommendation), and among arthroplasties, they recommend total arthroplasty over hemiarthroplasty (Strong recommendation) [5]. In patients with subtrochanteric or reverse oblique fractures, osteosynthesis is recommended using a cephalomedullary nail [5]. These recently published guidelines are consistent with the treatments reported in our study.

According to our results, 78.63% of patients with pertrochanteric fracture were treated with osteosynthesis, of which 73.40% with a cephalomedullary nail and 4.86% with DHS/DCS. 81.93% of femoral neck fractures were treated with arthroplasty, total replacements in 68.28% cases and hemiarthroplasty in 13.65%. 96.14% of the subtrochanteric fractures were treated with osteosynthesis, of which 73.07% with a cephalomedullary nail and 23.07% with DHS/DCS. Biarnés-Suñe et al. 2021 [15] revealed that 60.3% of the patients were treated with cephalomedullary nails and 33.3% with hip hemiarthroplasty [15]. Hall et al. 2020 [8] presented 317 patients with hip fractures, of which 54.2% were treated with osteosynthesis, 41.3% with arthroplasty, and 4.4% did not receive surgical treatment [8].

Hall et al. 2020 [8] reported that 67.5% of patients went to surgery before the first 36 h; Biarnés-Suñe et al. 2021 [15] reported that 30.5% patients were operated during the first 48 h [15]. In our study, 22.11% of the patients were operated on within 24 h, 40.0% between 24 and 72 h, and 37.88% after 72 h. These frequencies might be explained by the particularities of our health system, where predominantly in public hospitals, it could be difficult to perform a surgical procedure within 24 h due to administrative issues.

The AAOS guidelines for the management of hip fractures in the elderly recommend the use of cemented stems in femoral neck fractures (Strong recommendation) mainly due to the risk reduction of intraoperative periprosthetic fracture in older adults [5]. However, we found that in our study 48.8% of the arthroplasties used cemented stems, contrary to the AAOS guidelines. This is probably due to surgeons' preference for the shorter operation time of the uncemented arthroplasty procedure.

Regarding complications, our study revealed that 106 patients presented a complication (medical or surgical), out of which 14.23% (74/520) during the initial care stage, 3.2% (14/436) during the early stage, and 4.77% (18/377) during midterm stage, which is lower than the data reported by Dallari et al. 2020 [16], who described 50.1% of patients experiencing complications including anemia, pneumonia, other respiratory complications, acute heart failure, urinary tract infection, acute kidney failure, sepsis, among others [16]. However, it is important to clarify that data collection methods, complication classification, and follow-up time was different in the two studies, which calls for a cautious interpretation of these results.

In our study, 4.8% of the patients were admitted to the ICU. Our results suggest an association between ICU admission and death as also reported by Gibson et al. 2014 [20], who found that admission to intensive care is an even stronger risk factor for death than the comorbidities suffered by patients [20].

In the present investigation, only 3.74% (13/343) patients were positive for COVID-19 excluding the 173 patients that did not receive any COVID-19 test, which contrasts with the higher frequencies presented in the literature with incidences at only 30 days between 11% and 28.6% [8,15,16,20]. This difference is due to the different challenges associated with COVID-19 that the European countries and Colombia went through between March and July 2020. According to the situation report No. 132 of the WHO as of May 31, 2020, the confirmed cases of COVID-19 in Colombia corresponded to 11% of what was reported in Spain, the United Kingdom, and Italy at the same time and the number of deaths corresponded to 3% of what was being reported in those countries at that time [21]. As reported by other investigators, early (1 month) all-cause mortality frequencies were between 6.7% and 17% [8,15,16,20], while ours was 2.52% (11/436). Early mortality of COVID-19 patients in the published studies was between 22.6% and 40% [8,15,16,20], which is similar to our results with 20%.

The results of this investigation reveal that the surgical practices for hip fractures in Colombia correspond to what is recommended by international reference institutions and to the medical practice of specialists in other countries. Age, ASA classification, and ICU requirement are associated with mortality in these patients, as described by other authors [20].

The retrospective nature of this investigation and potential information biases that may have been introduced during the data collection in the 12 participating institutions could be considered as a limitation of this study as well as the loss to follow-up patients that increased in each follow-up period. It is also worth noting that the outcome numbers are small, which can affect the statistical power. Thus, these results should be interpreted with caution and placed in context with comparability. The overall impact of the pandemic was different between our country and those where other investigations took place, which should also be considered for interpretation. Additionally, the guidelines for hip fracture management differed among the 12 institutions included herein. The COVID-19 screening protocols also varied by the time this study was conducted since the country was preparing to receive the first wave of the pandemic, and diagnostic protocols were not yet applied in a standardized protocol.

However, this is possibly the first multicenter study conducted by the Colombian Society of Orthopedic Surgery and Traumatology (SCCOT), with the participation of 12 public and private institutions in different regions of the country, providing valuable sociodemographic information regarding representative data on morbidity and mortality of

patients undergoing surgery due to hip fracture during the COVID-19 pandemic. The sample size obtained afforded initial insight into the impact of COVID-19 on hip fracture surgeries. The information generated by this study also provides a solid framework for future investigations.

## Conclusions

Among 520 patients that were surgically treated for hip fracture during the first six months of the COVID-19 pandemic in 12 medical centers around the country, 21.10% suffered a complication during the early stage (30 days) and 4.77% during the midterm stage (1–6 months). 4.8% were admitted in the ICU during the early stage. All-cause death was 27 patients with 11 (40.74%) dying during the early stage and 16 (59.25%) dying during the midterm stage. 13 patients received a positive COVID-19 diagnosis of which 3 died, one (1/5=20%) on the first 30 days and the other two (2/8=25%) between the 1–6 month postoperatively.

This study constitutes a generalizable representation of the Colombian population and a pioneering initiative for the continuous and growing development of research in orthopedics and traumatology in Colombia.

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## Authors' contributions

JARH made a substantial contribution to the concept of the work, the data collection and analysis. JARH, PV, NR, HT, MB, MV, JC, and JL participated in the data collection, data analysis and interpretation. JARH drafted the initial document while PV, NR, HT, MB, MV, JC, and JL critically reviewed the draft and approved the final version of the article.

## Declaration of Competing Interest

The authors have no conflict of interest to declare.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.injury.2023.04.018](https://doi.org/10.1016/j.injury.2023.04.018).

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