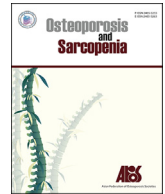




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Original article

Epidemiology and postoperative complications of hip fracture during COVID-19 pandemic

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ABSTRACT

Objectives: This study aims to analyze the changes in epidemiology and the postoperative outcomes in patients with hip fractures during the COVID-19 pandemic compared to non-pandemic period.

Methods: According to the date of declaration of “mandatory social distance”, we separated patients into 2 groups over a 1-year period: Period A and period B. We assessed the overall time to surgery, delay in surgery (> 24 hours, > 36 hours, and > 48 hours), reason of delay, length of hospital stay, type of surgery, and postoperative complications.

Results: The number of operated hip fractures and other trauma decreased in period B compared with period A by 17%, and 23%, respectively. The number of patients with delay in surgery by > 24 hours and > 36 hours was significantly higher in period B compared to that in period A ($P = 0.035$, $P = 0.012$, respectively). However, no significant difference in the number of delay in surgery > 48 hours and mean overall time to surgery between the 2 groups was observed ($P = 0.856$, $P = 0.399$, respectively). There was no difference in the duration of hospital stay, type of surgery, and postoperative complications between periods A and B.

Conclusions: During the COVID-19 pandemic, the decrease in hip fractures was relatively fewer compared to the decrease in orthopedic trauma. Although hip fracture surgeries were delayed for over 24 hours and 36 hours, there was no increase in delay for over 48 hours and postoperative complications.

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1. Introduction

The outbreak of coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a pandemic by the World Health Organization on March 11, 2020 [1]. The first patient with COVID-19 in South Korea was reported on January 19, 2020, and the Ministry of Health and Welfare and the Centers for Disease Control and Prevention introduced “mandatory social distancing” on March 21, 2020. The number of confirmed cases worldwide at the time of writing was 160 million. In South Korea, with hundreds of confirmed cases per day, the total number of patients is > 130 000.

Elderly patients with hip fractures are particularly vulnerable during pandemics. Fewer visits from relatives and caregivers result

in a significant increase in the number of patients living alone, which can increase the risk of falls [2]. Social alarm and fear of SARS-CoV-2 infection affect the timing of patients' visits to the hospital after a fall injury [3]. Many studies published prior to the COVID-19 pandemic showed an increase in the risk of 30-day mortality or other complications in patients with hip fracture who delayed surgery by > 24–48 h [4–7].

During the COVID-19 pandemic, the severity of the lockdown, distribution of the elderly population in the region, number of elderly patients with hip fractures requiring surgery, and redistribution of medical resources in hospitals may affect hip fracture outcomes. Therefore, understanding of the epidemiology and outcome of hip fractures according to the situation during the COVID-19 pandemic may help in preparing guidelines for the management of hip fracture in the elderly in future pandemics. The objective of this study is to analyze the changes in the epidemiology and postoperative outcomes in patients with hip fractures during the COVID-19 pandemic.

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2. Methods

2.1. Ethical approval

This study was approved by the Institutional Review Board of Konyang University Hospital (KYUH-2021-08-022). Given that the databases used in this present study included only de-identified data, informed consent was not required. The study strictly followed the ethical principles of biomedical research and approval from the ethics committee was obtained.

2.2. Study design

This was an observational, descriptive, and retrospective study of hip fractures in patients aged ≥ 65 years treated at a single institution. The hip fractures included in this study were femoral neck, intertrochanteric, and subtrochanteric fractures (the proximal third of the femur). Patients with poly-trauma and those with non-traumatic, pathological, open, peri-prosthetic fractures were excluded. Two different periods were studied. Based on the date of declaration of “mandatory social distance stage” by the Korea Centers for Disease Control and Prevention (March 12, 2020), we divided the analysis period into 2 parts: Period A, from March 12, 2019, to March 11, 2020; and period B, from March 12, 2020, to March 11, 2021.

2.3. Institution and population of study

According to the Korean Statistical Information Service (<https://kosis.kr/index/index.do>) and Health Insurance Review and Assessment (<https://www.hira.or.kr/main.do>), institutions where this study was conducted provided acute hospital and community health services to 2.21 million people living in its catchment area [8,9]. In 2020, there were 605 654 people aged ≥ 65 years in the region. Hospital’s policy for management of hip fracture is that elderly patients with hip fractures who are willing and able to meet the requirements of surgery should underwent urgency surgery.

2.4. Data collection and variables

Number of operated hip fractures and other orthopedic injuries were collected from the operating theater management software. Incomplete or implausible data was queried and checked against electronic medical records for accuracy. Data regarding patient demographics, type of surgery, and postoperative outcomes were obtained from electronic medical records. Demographic variables considered in this study included age, sex, American Society of Anesthesiologists (ASA) grade, pre-admission residence, and fracture type. The delay in surgery was determined by times of arrival at the emergency room and entering the operating room. Number of patients with delayed surgery > 24 hours, > 36 hours or > 48 hours, as well as the reason for the delay, and types of treatment were also analyzed. Postoperative outcomes included length of inpatient stay, postoperative complications, death during inpatient stay, and 30-day mortality.

2.5. Patient pathway

From March 21, 2020, before being admitted to the ward or entering the operating room from the emergency department, all patients with hip fractures were tested for SARS-CoV-2 infection using real-time quantitative reverse transcription polymerase chain reaction. All patients were admitted to the isolation ward until SARS-CoV-2 test results were negative. Specimens were collected at 4 PM and delivered to an external company; test results

were confirmed the next day at 9 AM. As a result, patients were admitted to the isolation ward for at least 17 hours until a negative test result was obtained. According to the guidelines of our hospital’s Infection Control Office, any COVID-19-positive patients were reported immediately and transferred to the designated hospital for further treatment before surgery.

2.6. Statistical analysis

A general descriptive analysis of the data was initially performed. Continuous variables are reported as means and standard deviations (SD). Categorical variables are presented as absolute numbers and percentages. Analysis of variance and paired *t* tests were used to compare continuous variables, whereas the Pearson chi-square test was used to compare categorical variables. Statistical significance was set at $P \leq 0.05$. IBM SPSS Statistics (IBM Corp., Armonk, New York, USA) was used for data analysis.

3. Results

3.1. Demographics

Patients’ demographics were provided in Table 1. There were no statistically significant differences with regard to age, sex, ASA score, preoperative residence, and the types of fractures between the 2 periods (Table 1).

3.2. Number of operated hip fractures versus other orthopedic injuries

There was a 22% decrease ($n = 846$ vs $n = 660$) in the total number of operated orthopedic injuries in period B compared with period A. A total of 340 patients with hip fractures were operated during the 2 years. There was a 17% decrease ($n = 186$ vs $n = 154$) in the number of operated hip fractures, and 23% decrease ($n = 660$ vs $n = 506$) in the number of operated other orthopedic injuries. There was a 22% decrease ($n = 846$ vs $n = 660$) in the total number of operations for operative orthopedic cases in period B compared with period A. A total of 340 patients with hip fractures were operated during the 2 years. There was 17% decrease ($n = 186$ vs $n = 154$) in the number of operations for hip fractures, and 23% decrease ($n = 660$ vs $n = 506$) in the number of operations for other orthopedic injuries (Fig. 1).

Table 1
Patient demographics.

Variables	Period A	Period B	P-value
Operated hip fractures (N)	186	154	
Age mean (yr, SD)	78.3 (10.9)	79.0 (12.2)	0.573
Gender (%)			0.698
Female	72.1	70.2	
Male	27.9	29.8	
ASA score Grade (%)			0.482
1	0	0	
2	45.16	44.16	
3	53.23	51.94	
4	1.61	3.9	
Pre-admission residence (N)			0.927
Nursing care institution	11	12	
Own home	175	142	
Fracture type (N)			0.561
Femoral neck	73	56	
Subtrochanteric	8	7	
Intertrochanteric	105	99	
Screening test positive	0	0	1.000

N: number, SD: standard deviation, ASA: American Society of Anesthesiology.

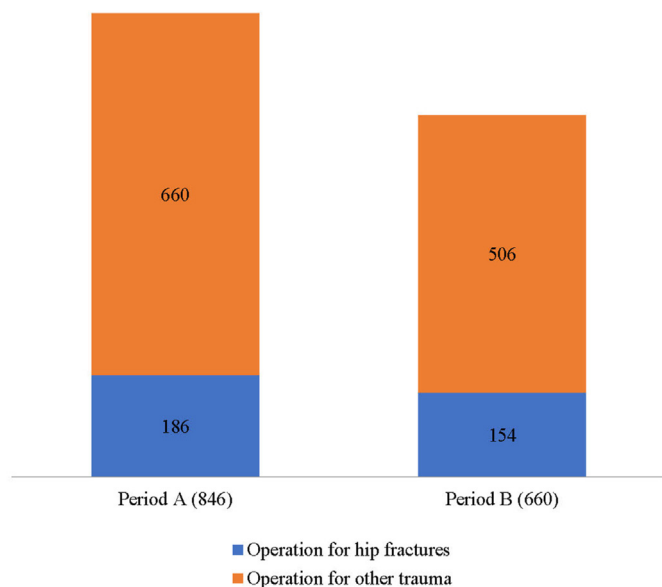


Fig. 1. Number of operations performed for hip fractures versus all other trauma operations.

3.3. Time to surgery and reasons of surgical delay

There was no significant difference in the mean overall time to surgery between period A (68.7 hours) and period B (75.8 hours) ($P = 0.399$). The number of patients with delay in surgery of > 24 hours and > 36 hours was significantly higher in period B compared to that in period A ($P = 0.035$, $P = 0.012$, respectively), but there was no significant difference in the number of delay in surgery > 48 hours between A and B ($P = 0.856$) (Table 2). During period B, in the > 24 hours, > 36 hours, and > 48 hours delay in surgery groups, there was a significant increase in delays due to “awaiting medical investigation” ($P = 0.007$, $P = 0.017$, $P = 0.001$, respectively), and a significant decrease in delays due to “administrative list over/waiting theater space” ($P = 0.001$, $P = 0.004$, $P = 0.005$, respectively) (Fig. 2A). However, no significant difference was observed in delays due to reversal of anticoagulation in the > 24 hours, > 36 hours, and 48 > hours delay groups between periods A and B ($P = 0.167$, $P = 0.312$, $P = 0.159$, respectively) (Fig. 2B, Fig. 2C).

3.4. Type of surgery for hip fracture

Overall, there were no significant differences in the type of hip fracture surgery performed between the 2 time periods. ($P = 0.235$) (Table 2).

3.5. Postoperative outcomes

The length of inpatient stay was not significantly different between periods A and B ($P = 0.589$). There was no difference in postoperative complications, including pneumonia, urinary tract infection, pulmonary thromboembolism, 30-day mortality, and in-hospital death ($P = 0.714$, $P = 0.914$, $P = 0.395$, $P = 0.312$, and $P = 1.000$, respectively) between periods A and B (Table 3). There was no concomitant SARS-CoV-2 infection in any patient with hip fracture.

4. Discussion

Social distancing to prevent the spread of COVID-19 is expected to reduce the incidence of fractures due to restricted social activity. In our study, the incidence of total orthopedic trauma also decreased. Interestingly, the decrease in number of hip fracture (17.0%) was relatively smaller than the decrease in orthopedic trauma except for the hip (23.0%). Some authors reported a decrease in the incidence of hip fracture during the COVID-19 pandemic, while others reported an increase [10–13]. The authors explained why incidence of hip fractures are not significantly affected by the COVID-19 pandemic, stating, although hip fractures caused by outdoor activity decreased, fragility fractures occurred primarily at home or in nursing institutions, and this was due to fewer visits from relatives and caregivers, which resulted in a significant number of patients living alone and with lower relationship satisfaction, which increased the risk of falls [2,4,14,15]. Minarro et al [3] reported that due to social alarm and fear of contracting COVID-19 during the state of alarm, 18.75% of patients with a hip fracture (all living with a relative) delayed their visit to the hospital by a mean of 2.5 days.

Our study showed that there was a surgical delay 24 > hours and > 36 hours during the COVID-19 pandemic, but there was no difference in the overall time to surgery between the groups. Operating room availability and preoperative medical evaluation are common factors responsible for postponement of surgeries globally

Table 2
Time to operation and type of surgery for hip fracture patients.

Variables	Period A	Period B	P-value
Operated hip fractures (N)	186	154	
Mean overall time to surgery – hours (SD)	68.77 (81.07)	75.89 (72.63)	0.399
Delay in surgery 24 > hours			0.035
Yes	147	135	
No	39	19	
Delay in surgery 36 > hours			0.012
Yes	126	123	
No	60	31	
Delay in surgery 48 > hours			0.856
Yes	96	81	
No	90	73	
Type of surgery			0.235
Total hip replacement	5	1	
Bipolar hemiarthroplasty	82	73	
Internal fixation			
Dynamic hip screw	1	3	
Cannulated screw	5	0	
Intramedullary nail fixation	93	77	

N: number, SD: standard deviation.

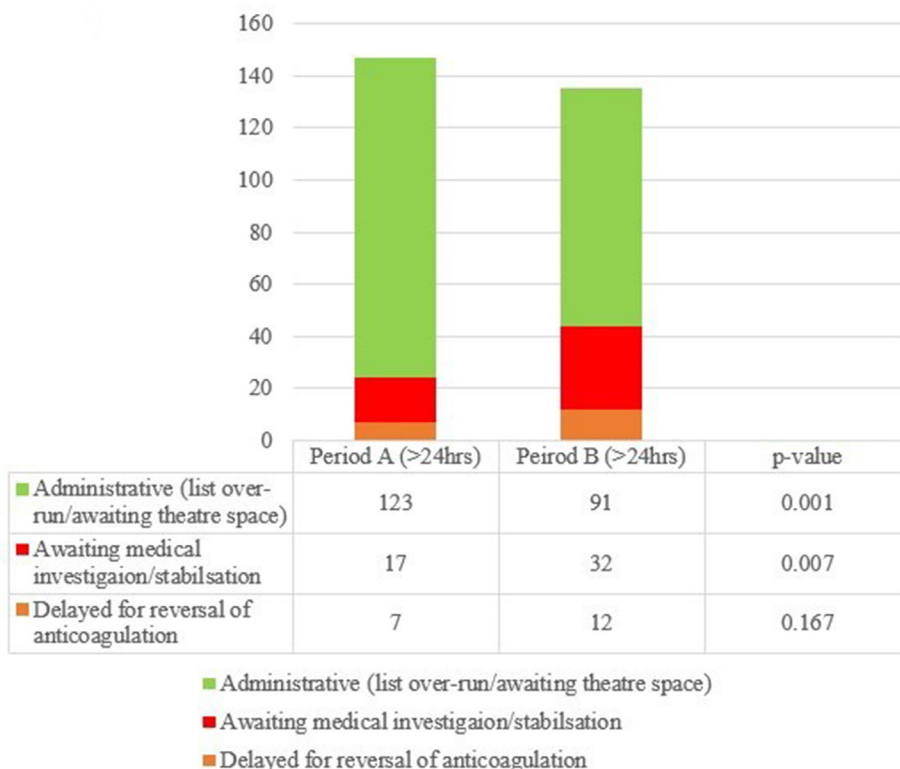


Fig. 2A. Reason for delay in surgery >24 hours.

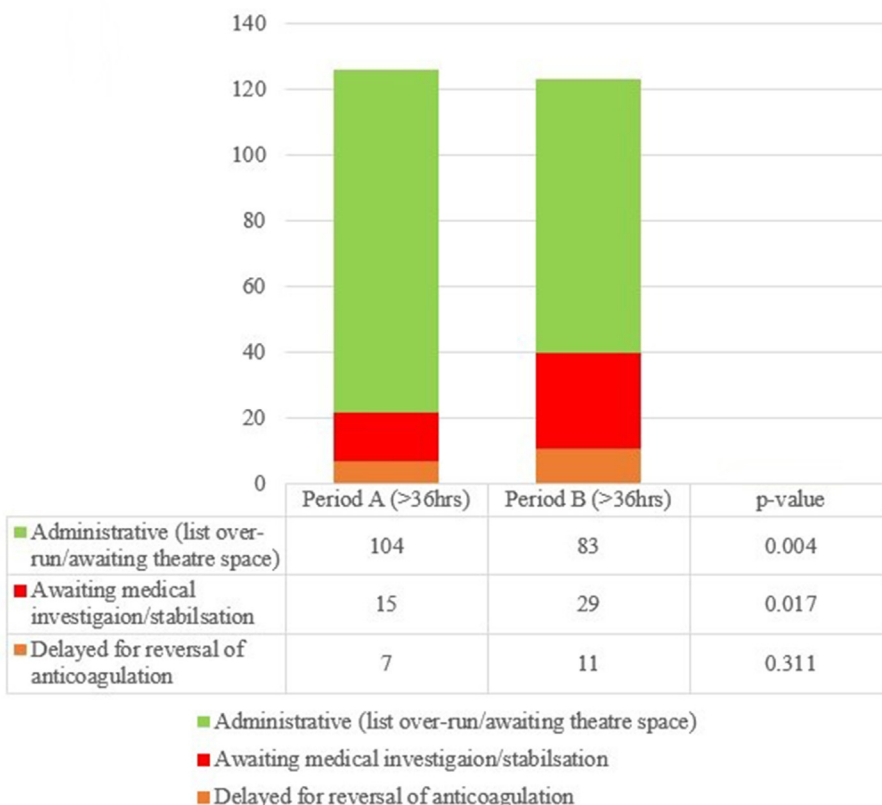


Fig. 2B. Reason for delay in surgery >36 hours.

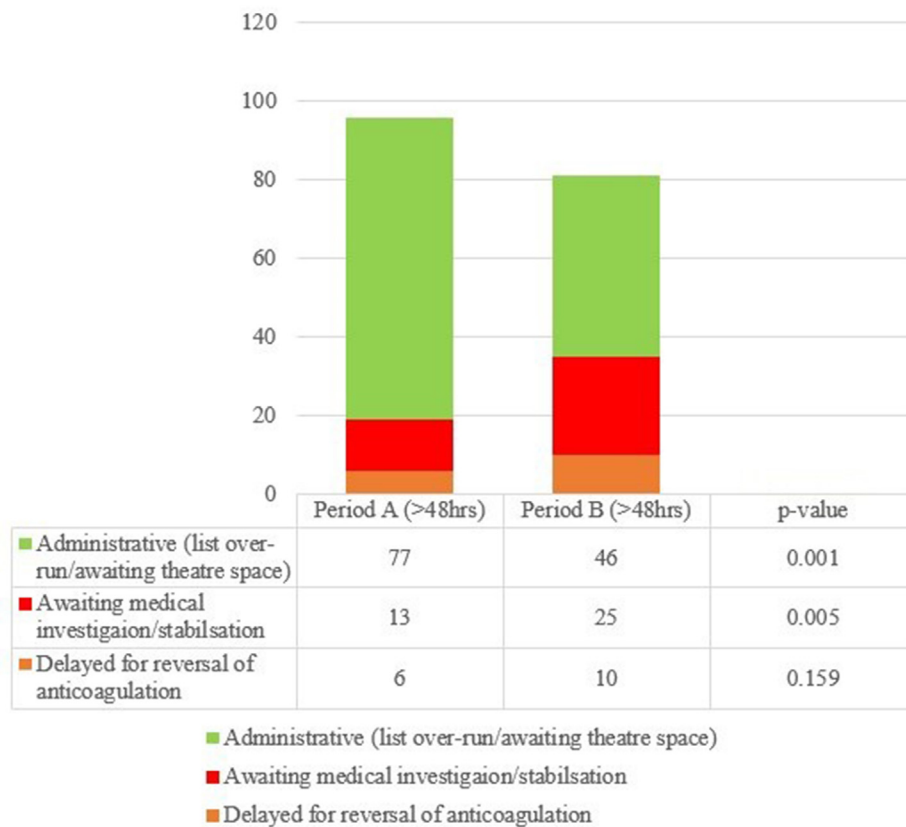


Fig. 2C. Reason for delay in surgery >48 hours.

Table 3
Post-operative outcomes.

Variables	Period A	Period B	P-value
Operated hip fractures (N)	186	154	
Mean length of inpatient stay - days mean (SD)	18.43 (9.36)	17.84 (9.53)	0.589
Post-operative complications (N)			0.734
Yes	39	30	
No	147	124	
Wound hematoma (N)			–
Yes	0	0	
No	186	154	
Gastrointestinal bleeding (N)			1.000
Yes	1	1	
No	185	153	
Pulmonary embolism (N)			0.395
Yes	11	6	
No	175	148	
Wound site infections (N)			–
Yes	0	0	
No	186	154	
Pneumonia (N)			0.714
Yes	9	15	
No	177	139	
Urinary tract infection (N)			0.914
Yes	18	8	
No	168	146	
Death during inpatient (N)			1.000
Yes	2	1	
No	184	153	
30-day mortality (N)			1.000
Yes	2	1	
No	184	153	

N: number, SD: standard deviation.

[16]. Our study revealed that the time required for obtaining medical investigation/stabilization was increased on during the pandemic period. As the patient was quarantined until the SARS-CoV-2 test report was negative, tests that required transportation of the patient outside the isolation room or contact with other people, such as during electrocardiography, pulmonary function testing, and imaging necessary for surgery, as well as consultation with other departments were delayed. However, the time required for administrative tasks (administrative list over/waiting for theater space) decreased during the pandemic period. Our hospital's policy of management of hip fractures may have influenced these findings.

In the present study, a delay of > 24 hours or > 36 hours did not affect the in-hospital mortality and 30-day mortality during the COVID-19 pandemic. This finding was also attributed to no surgical delay of more than 48 h and no concurrent COVID-19 infection in our hip fracture patients. When comparing mortality rates after hip fractures between the pre-COVID-19 and COVID-19-pandemic periods, it is necessary to distinguish between patients with hip fractures with concomitant COVID-19 and those without COVID-19. In studies of hip fractures in patients without COVID-19, Afar et al. [11] found that the mortality was 11.5% during the COVID-19 pandemic, which was not different from the 11.7% mortality before the pandemic. Furthermore, Narang et al. [17] reported an operative delay > 36 hours during the COVID-19 pandemic, but there was no difference in mortality between the COVID-19-pandemic and pre-COVID-19 periods; mortality was 6.0% during both periods. According to Malik-Tabassum et al. [10], the proportion of patients with operative delay > 36 hours decreased from 10.7% during the pre-COVID-19 period to 8.8% during the COVID-19 pandemic.

The mortality rate is higher in patients with hip fractures and concomitant COVID-19 infection. According to reports, the 30-day mortality rate for patients with hip fractures without COVID-19 infection is 6%–11%, whereas the 30-day mortality rate for patients with hip fractures with COVID-19 infection is 30%–36% [11,18–20]. The time to surgery was longer in patients with COVID-19 than that in patients without COVID-19 [11,19,20]. Hip fracture surgery in patients with COVID-19 was associated with increased length of hospital stay, more admissions to the critical care unit, higher risk of perioperative complications, and increased mortality rates compared to those in patients without COVID-19 [11,20,21]. The high mortality rate in patients with concomitant COVID-19 can be explained by their old age and associated medical comorbidities, which makes them more vulnerable to COVID-19-related complications [22,23]. However, these findings do not imply that surgery should not be undertaken in patients with hip fractures with COVID-19; rather, surgery should be performed as soon as possible, and post-operative treatment should be more intense than in patients without COVID-19. Catellani et al. [23] reported that in elderly patients with COVID-19 who have hip fractures, surgery may contribute to the overall stability of the patient, seated mobilization, improvement in physiological ventilation, and respiratory parameters.

Treatment of osteoporosis should not be delayed in people with hip fractures because the risk of subsequent fragile fractures is high even during the COVID-19 pandemic [24–26]. To reduce the risk of being lost to follow-up in the post-discharge period, treatment of osteoporosis should be started upon admission. There is no evidence of impaired fracture healing in patients who receive early initial bisphosphonates and no increase in the risk or severity of COVID-19 or alteration of the disease course due to osteoporosis therapy [27]. However, there are early signs that COVID-19 may be accompanied by an increased risk for complications related to hypercoagulability [28,29]. It is recommended that estrogen and

raloxifene, which may increase the risk of thrombosis, be temporarily discontinued and replaced with alternative osteoporosis treatments [30].

In the present study, there was no difference in the type of surgery between the 2 periods. It is noteworthy that this study was conducted until only 1 year after the World Health Organization declared the pandemic, and the incidence of hip fractures did not decrease significantly during the COVID-19 pandemic. However, if the COVID-19 pandemic lasts, a shortage of implant stock, production disruption, or transportation issues may affect the use of surgical instruments or implants.

There are limitations to this study. First, this study has a single-center design, and limited sample size. As a result, this study has insufficient power to detect a small effect size, and the generalizability of the findings is unclear. Second, the number of operated hip fractures in this study includes not only fragility fractures but also non-fragility fractures. This may have affected the post-operative complications. Third, our study was the lack of research on the time lag between sustaining a hip fracture and visiting the hospital. Further study is needed to determine whether this affects the time to surgery or the post-operative outcome after a hip fracture.

5. Conclusions

Because of the increased waiting time due to the screening test for COVID-19, medical investigation and stabilization, there was surgical delay of more than 24 hours and 36 hours, respectively. However, the hospital policy to consider patients with hip fractures for immediate orthopedic surgery and collaboration with various departments ensured no increase in delay of more than 48 hours, the overall time to surgery and postoperative complications during COVID-19.

CRedit author statement

Kwang Kyoum Kim: Conceptualization, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing. **Soek-Won Lee:** Formal analysis. **Jae-Kyu Choi:** Data curation. **Ye-Yeon Won:** Supervision.

Conflicts of interest

The authors declare no competing interests.

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