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Impact of COVID-19 Pandemic on Open Fracture Management at Vajira Hospital

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ABSTRACT

Objectives: Patients with open fractures were often treated later than usual during the COVID-19 pandemic, which could impact their outcomes, particularly regarding infection risks. However, some studies suggest that the timing of surgery does not directly influence infection rates. We aimed to examine how the COVID-19 pandemic affected the way open fractures were managed, focusing on any changes in treatment timing and patient outcomes before and during the pandemic.

Materials and Methods: Retrospective data at Vajira Hospital were collected and divided into two groups: one group received treatment before the COVID-19 pandemic (pre-COVID group), and the other group during the COVID-19 pandemic (COVID group). Key factors such as injury time, time to first surgery, and time to first dose of antibiotics were considered. The primary outcome was the difference in waiting times for surgery. Secondary outcomes included infection rate, nonunion rate, and reoperation rate.

Results: The researchers collected data from a total of 76 patients for each of the pre-COVID and COVID groups. No significant differences were found in waiting times for surgery or in the time to the first dose of antibiotics between the two groups. The mean waiting time for surgery was shorter in the COVID group (587.2 min) compared to the pre-COVID group (683.4 min), but this difference was not statistically significant. The mean time to the first dose of antibiotics in the COVID group (183.8 min) was shorter than in the pre-COVID group (212.2 min), but did not meet the statistically significant threshold. There were no significant differences in complication rate (infection rates, nonunion rates, and reoperation rates) between groups.

Conclusion: COVID-19 did not affect the waiting time for the treatment of open fractures and did not impact the outcomes or complications of open fracture treatment at Vajira Hospital. This may be attributed to the hospital's strict criteria for emergency surgeries, prioritizing critically needed cases, ensuring timely and standard treatment.

Keywords: complication, COVID-19, open fracture

INTRODUCTION

The COVID-19 pandemic began in early 2020. As the virus spreads through droplets, strict hygiene and respiratory protection measures were implemented nationwide, significantly impacting hospital management, leading to shortages in medical resources. Routine practice guidelines were adjusted to accommodate the situation, which resulted in longer waiting times due to additional procedural steps. For example, patients requiring urgent surgery might undergo the GeneXpert test. A rapid molecular test that provides quicker results than the reverse transcription-polymerase chain reaction, but still delays the surgical preparation. Additionally, treatment delays occurred due to a shortage of medical staff, blood supplies, and equipment.

Open fractures are an urgent orthopedic condition, requiring prompt management for irrigation and debridement upon arrival at the emergency room. It was traditionally believed that surgical intervention for open fractures should occur within 6 h[1] (the "6-h rule") to reduce the risk of infection. However, recent studies suggest that the timing of surgery may not directly affect infection rates. A study by Weber et al.[2] found no significant difference in the time from injury to surgery for open long bone fractures between patients who developed infections and those who did not, though the infection rate was influenced by the severity of the fracture as classified by the Gustilo-Anderson system. In another study Higgin et al.[3] found a higher infection rate in patients who underwent surgery within 12 h compared to those after 12 h. Additionally, Charalambous et al.[4] found no difference in outcomes between surgeries performed within 6 h and those performed later. Many studies have explored risk factors for postoperative infections in open fractures, with the time from injury to surgery not identified as a significant factor. Current guidelines in England state that there is no evidence-based support for the 6-h rule.[5] However, there are still no definitive studies outlining the optimal time frame for surgery in open fracture treatment.

It is assumed that delays in treatment, compared to pre-pandemic times, may affect the treatment outcomes. Several studies have examined the impact of the COVID-19 pandemic on the treatment of open fractures, all finding longer times from injury to surgery than before the pandemic. However, the infection rate did not differ. Additionally, some studies noted that definitive treatment also took longer.

No studies have been conducted in Thailand regarding the effects of the COVID-19 pandemic on open fracture treatment. Treatment approaches vary systematically between countries, including differences in patient demographics. Analyzing these variations can provide valuable insights and help guide future open fracture treatments in Thailand.

MATERIALS AND METHODS

This study was approved by the Vajira Institutional Review Board (COA 019/2566). Retrospective data were collected using the EPHIS database, divided into two groups: those who visited before the COVID-19 pandemic (pre-COVID group) and those who visited the emergency department at Vajira Hospital, a level I trauma center, during the pandemic (COVID group). Key factors that may affect treatment outcomes, such as injury time, time to first surgery, and time to the first dose of antibiotics, were considered. The primary outcome was the time to first surgery. The secondary outcomes included the infection rate, nonunion rate, and reoperation rate. This retrospective review included patients diagnosed with open long bone fractures between January 1, 2018, and December 31, 2021, at Vajira Hospital. The pre-COVID group included data from January 1, 2018 to December 31, 2019 and the COVID group included data from January 1, 2020 to December 31, 2021. Full medical records were available, containing information on injury time, surgery time, diagnosis, and waiting time for the first antibiotic dose. Some missing demographic data were collected from telephone interviews. All patients had a follow-up period of at least 3 months after definitive treatment. Patients with pathological fractures, such as those caused by infection or cancer, were excluded. This study calculated the sample size by setting a Type I error of 0.05 and a power of 80%. The variances were referenced from the study by Gupta et al.,[6] resulting in 76 patients per group. For the result, the T-test and the Chi-square were used for statistical analysis.

RESULTS

A total of 152 patients who received the treatment for open long bone fractures were included (76 in the pre-COVID and 76 in the COVID group). The demographic data for each group are shown in **Table 1**. The results indicated similar gender and age distributions

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Table 1 Demographic Characteristics

Group	COVID	Pre-COVID
Total, number	76	76
Sex (%)		
Male	62 (81)	57 (75)
Female	14 (19)	19 (25)
Age, mean (SD)	39.87 (10.8)	35.2 (12.4)
Smoking, number (%)	22 (29)	13 (17)
Underlying disease (%)		
Hypertension	7 (9)	6 (7.8)
Diabetes mellitus	2 (2.6)	3 (3.9)
Dyslipidemia	6 (7.8)	2 (2.6)
Stroke	1 (1.3)	1 (1.3)
Heart disease	1 (1.3)	1 (1.3)
Other	3 (3.9)	4 (5.2)
Operation (%)		
Fixation	56 (73.7)	60 (78.9)
No implant	20 (26.3)	16 (21.1)

Abbreviation: SD, standard deviation

between the two groups. However, the COVID group had a higher number of smokers than the pre-COVID group. Regarding underlying conditions, the COVID group had a higher prevalence of dyslipidemia compared to the pre-COVID group, while the incidence of other conditions was similar in both groups. As for surgical procedures, both groups underwent fixation and debridement without fixation, with similar distributions between the groups.

The time to surgery was shorter for patients who visited during the COVID group compared to those who visited before the pandemic, but this difference was not statistically significant (587.2 min vs 683.4 min, P = 0.09). Similarly, the time to the first dose of antibiotics was shorter in the COVID group, but no significant difference (183.8 min vs 212.2 min, P = 0.27). (Table 2)

Regarding the secondary surgical outcomes. For infection rates, both groups had a rate of 9.2%. Additionally, the nonunion rate was higher in the pre-COVID group but not statistically significant (1.3% vs 3.9%, P = 0.23). The reoperation rate was found to be higher in the COVID group but did not reach statistical significance (10.5% vs 7.9%, P = 0.39) (Table 3). The operation rate was collected from all types of operations, including second-third look debridement and revision surgery.

DISCUSSION

During the COVID-19 pandemic, hospitals had to implement additional procedures in the patient care process to prevent viral spread. These included wearing personal protective equipment, cleaning protocols, COVID-19 screening tests, and limitations on the number of staff and available facilities. As a result, the care provided to each patient took longer than usual, leading to the hypothesis of this study that the

Table 2 Time to Surgery and Time to the First Dose of Antibiotics

		Group		P-value
		COVID (n = 76)	Pre-COVID (n = 76)	
Time to surgery	Mean(min)	587.2	684.4	0.09
	Standard deviation	394.4	302.3	
	Standard error mean	45.2	34.6	
Time to the first dose of antibiotics	Mean (min)	183.8	212.2	0.27
	Standard deviation	182.6	134.0	
	Standard error mean	20.9	15.3	

Abbreviation: n, number

Table 3 Surgical Outcomes between Groups

Outcomes	Group		P-value
	COVID (n = 76)	Pre-COVID (n = 76)	
Infection, number (%)	7 (9.2)	7 (9.2)	1.00
Nonunion, number (%)	1 (1.3)	3 (3.9)	0.23
Re-operation, number (%)	8 (10.5)	6 (7.8)	0.39

Abbreviation: n, number

treatment of patients with open fractures might be delayed and could potentially increase the risk of postoperative complications.

A multicenter cohort study from the United States and Canada found an increase in the number of cases that did not meet the 24-h waiting time for open fracture surgery during the COVID-19 period (2.7% vs 3.9%).[7] A cohort study from the United Kingdom reported a significant decrease in cases meeting the 12-h surgical benchmark during the pandemic, from 57.1% to 31.8% (P = 0.004), with no significant change in infection rates.[8] A study from India found longer times for the first dose of antibiotics and a higher infection rate during the COVID-19 period, although this difference was not statistically significant.[8] The findings from our institute showed that the waiting times for antibiotic administration and surgery were not significantly different from the pre-pandemic period. Several factors can explain this. Due to the government's lockdown policy, the number of accident patients decreased. Stricter criteria for defining urgent cases in the emergency room led to a reduced patient volume, along with more stringent emergency surgery indications, resulting in fewer surgical cases overall. Additionally, effective management policies under resource constraints, including limited equipment, tools, operating rooms, and staff, helped maintain treatment standards similar to pre-pandemic conditions. In our institute, a policy has been implemented to cancel elective surgeries and to operate the surgical rooms only for urgent cases that require immediate surgical intervention. This has significantly reduced the number of operating room sessions compared to the pre-COVID period, making the waiting list for receiving the treatment shorter, and the number of personnel is sufficient to handle the workload, even under conditions with limited staffing. Campbell et al.[9] reported a 64% decrease in emergency department visits during the lockdown at the Royal London Hospital, with an 18% decrease in open lower extremity fracture cases. Choudhary et al.[10] found that open fracture admissions were 21% lower than usual, and the waiting time for surgery was significantly reduced, with no difference in infection rates. The results of this study indicate that, despite the challenges posed by the pandemic, which hindered urgent care delivery, effective management following strict standard treatment guidelines and proper operating room management can maintain treatment outcomes at the expected level and reduce the incidence of complications.

Traditionally, the "6-h rule" recommended early surgical management for open fractures within 6 h to reduce the risk of infection.[1] However, recent studies have challenged this rule (9.7 h vs 11.4 h, P = 0.09), suggesting that the timing of surgery, "6-h rule", does not directly correlate with infection rates.[3,5,11-13] Different guidelines are used in various institutes based on current evidence and surgeon preferences. The BOAST Guideline[5] (British Orthopedic Association Standards for Trauma and Orthopedics) recommends surgery within 12 h for high-energy injuries and 24 h for low-energy injuries. In Thailand, open fractures are still considered urgent, and the time for surgery outside regular operating room hours varies between hospitals, depending on the situation and available resources. Our findings align with this view, as we observed no significant difference in infection rates based on the timing of surgery, the mean time to surgery was more than 6 hours in both groups (9.8h for COVID vs 11h for pre-COVID), resulting in the rate of infection at 9%, not higher compared to the overall infection rate from other recent literature (13-18% in long bone fracture).[14,15] The operation can be considered an urgency rather than an emergency condition. Moreover, a systematic review and meta-analysis by Kortram et al.[12] highlighted that factor, like fracture severity, rather than the surgery timing, may have a more significant effect on infection rates. However, there is still a lack of high-quality studies to establish a consensus on the optimal timing for surgery in open fractures.[16]

There were some limitations in our study, such as its retrospective design and the potential for

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selection bias. Additionally, since the study was conducted in a single institution, findings may not be fully applicable to other settings. Some missing information, which is not recorded in the medical data, such as smoking status, was obtained by the researcher through telephone interviews with the patients, which may have been related to issues of recall bias. Some incomplete data, which could affect the surgical outcomes, such as the level of contamination and soft tissue injury, may cause the research findings to be distorted from reality. Therefore, future research should include these details to provide more accurate and reliable conclusions. Furthermore, our study was underpowered to detect small differences in infection, nonunion, and reoperation rates, as indicated by the post hoc power analysis (5%, 18%, and 9%, respectively). Thus, the absence of significant differences does not necessarily exclude a clinically meaningful effect.

CONCLUSION

While the COVID-19 pandemic posed significant challenges in managing open fractures, our study indicates that, despite these challenges, the quality of care for open fracture patients remained consistent. No significant differences were found in the time to receive the surgery or, time to the first dose of antibiotics. The clinical outcomes, such as infection, nonunion, and reoperation, did not show a statistically significant difference. Further research is needed to understand the long-term impact of the pandemic on fracture management and to identify strategies for optimizing care during similar crises. In summary, hospitals should maintain strict standards for prioritizing urgent necessary treatments first, especially in situations with limited resources and risks of infectious outbreaks, to ensure satisfactory treatment outcomes and reduce complications from the care provided.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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