

Impact of COVID-19 first wave on the in-hospital length of stay of operated proximal femur fracture patients in an industrial hospital in Eastern India

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ABSTRACT

Objective: The objective of this article is to study the impact of coronavirus disease 2019 (COVID-19) pandemic first wave on the in-hospital length of stay of operated proximal femur fractures. **Materials and Methods:** A retrospective analysis of data collected through the electronic record system of the hospital, after applying inclusion and exclusion criteria, was done. The data were collected from the pre-pandemic, early part first wave and later part first wave of COVID-19 pandemic to calculate the average preoperative stay (POS) and total length of stay (LOS) of operated proximal femur fracture patients. Also, a sub-analysis of POS and LOS was done as per age (male/female), sex (<60/≥60 years) and fracture subtype (intertrochanteric, neck of femur and subtrochanteric fracture) of the patients to study if any of these had a significant direct impact on the POS and LOS. **Results:** The LOS and POS were found to be significantly increased during early part of first wave of COVID-19 pandemic in comparison to the pre-pandemic era (13.6 ± 7.7 days vs. 11.1 ± 5.7 days). The later part of the first wave of the pandemic however saw the LOS and POS to return to near pre-pandemic values, although still remaining higher. **Conclusion:** The study highlights that unpreparedness during the early part of the unprecedented pandemic event leads to a significant increase in LOS of operated patients with its associated implications; however, prompt action by the government, hospital administration and hospital staff the LOS could be reduced to near pre-pandemic values in the later part of the first wave of the pandemic. Analysis of the causes that lead to a significant increase in LOS can help for better future management of similar events in future.

Keywords: COVID, first wave, length of stay, preoperative stay, pre-pandemic era, proximal femur fractures

Introduction

The severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) virus pandemic has impacted every sector in countries throughout the world and the orthopaedic practice in India is no exception.^[1] With rapid spread of the virus in India from the month of March 2019, multiple new guidelines were

proposed and existing models of social, domestic and hospital care altered^[2] with the orthopaedic treatment protocols also adapting to the changing novel scenario.^[3,4]

Proximal femur fractures are among the most common of fractures encountered in any hospital set-up and the majority are indicated for an operative treatment requiring in-hospital stay, and even in this pandemic situation, care of patients with hip and femoral fractures remained a surgical priority.^[2-4]

Average length of stay (LOS) refers to the average number of days patients spend in the hospital. The LOS affects the total cost of treatment, utilisation of manpower and infrastructure,

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health of patient in terms of mortality and morbidity and is an often-used indicator of quality care, hospital efficiency and for health planning purposes.^[5,6] In the pandemic scenario, the risk of increased exposure to the patient, their family members and hospital staff to the virus and risk of propagation of the spread of infection further increased the significance of LOS. In view of the importance of LOS, we studied how the first wave of the coronavirus disease 2019 (COVID-19) pandemic affected the LOS of operated patients of proximal femur fractures in an industrial hospital in Eastern India.

Methods

The analysis was done in an industrial hospital of Eastern India, after clearance from the hospital ethical committee. It is a retrospective study in which data over three time periods were analysed. The first-time period was of 6 months from September 2019 to February 2020 and was labelled as ‘immediate pre-pandemic era (PPE)’. The second period was of 6 months from April 2020 to September 2020 and was labelled as ‘Early Part of First wave COVID (EFWC)’. The third-time period was of 3 months from October to December 2020 and was labelled as ‘Later Part of First Wave COVID (LFWC)’. The timeline from beginning of April 2020 to end of December 2020 and its split into early and later part of first wave was chosen as per the rise and fall in the incidence of COVID cases in India during the first wave as depicted in the graph in Figure 1.^[7]

During the above-mentioned time periods, details of all employee patients operated for unilateral proximal femur fracture, namely, intertrochanteric fractures, neck of femur fractures and sub-trochanteric femur fracture, were collected from the hospital electronic medical record system.

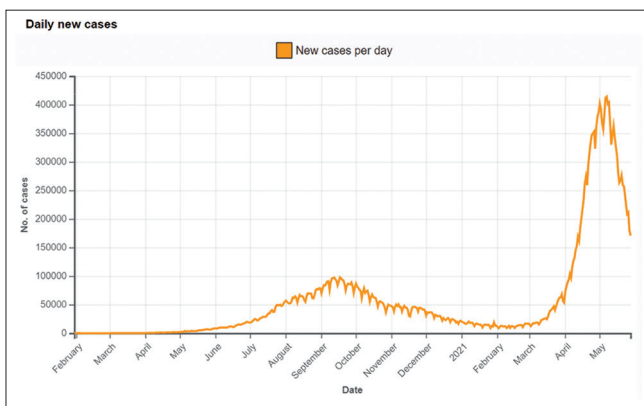


Figure 1: Graph showing rise and fall of new cases of COVID-19 in India

The patients were divided according to age group (less than 60 years and more than or equal to 60 years), sex (male and female) and fracture type (intertrochanteric, sub-trochanteric, neck of femur). The duration of preoperative stay (POS) and total LOS were tabulated in days for these patients during the three time periods studied. The overall mean LOS and POS, and the mean LOS, POS according to the age group, sex group and fracture subtype were also calculated. The data were then statistically analysed to find out how the LOS and POS were affected during the EFWC and LFWC in comparison to each other and in comparison to the PPE. This analysis was also done for each age and sex group and fracture subtype to find if the changes in LOS and POS were correlated to them.

Statistical analysis was done using independent two-sample unpaired *t*-test and ANOVA, and *P* values calculated for statistical significance.

Results

The break-up in terms of age (less than 60 years, more than or equal to 60 years), sex (male, female) and fracture subtype (intertrochanteric fracture, sub-trochanteric fracture, neck of femur fracture) included in the study have been summarised in Table 1.

The average LOS and POS of patients, in the EFWC with proximal femur fractures, have been summarised in Table 2.

The average LOS and POS of patients, in the LFWC with proximal femur fractures, have been summarised in Table 3.

The average LOS and POS of patients, in the PPE with proximal femur fractures, have been summarised in Table 4.

The statistical analysis of the data using unpaired *t*-test and ANOVA was done and *P* values calculated. There was a statistically significant increase in POS in EFWC (*P*-value 0.0001) in comparison to the PPE. The LOS increase in the EFWC was also statistically significant (*P* value 0.0094) as compared to the PPE. In the LFWC, the LOS and POS both decreased in comparison to the EFWC. When compared to the PPE, the LFWC saw the LOS returning to near pre-pandemic values (no statistical significant difference, *P* value 0.202). The POS in the LFWC also though returned to near pre-pandemic values, there was still a statistically significant difference (*P* value 0.022), with the former still being higher.

When the association between age and LOS/POS was ascertained, we found that in people less than 60 years, the LOS/POS increased

Table 1: Data of patients operated in three time periods

Time period	Total cases	Males	Females	<60 years	≥60 years	IT#	NOF#	STF#
PPE	153	56	97	11	142	88	55	10
EFWC	65	21	44	9	56	38	21	6
LFWC	48	13	35	3	45	31	16	1

PPE=Prepandemic era, EFWC=early part first wave COVID, LFWC=later part first wave COVID, IT#=intertrochanteric fracture, NOF#=neck of femur fracture, STF#=sub-trochanteric femur fracture

Table 2: LOS and POS in early first wave COVID period

	Early part first wave COVID	
	LOS (days)	POS (days)
Overall	13.6±7.7	9.3±4.6
Males	14.1±5.7	10.6±5.4
Females	13.3±8.6	8.6±4.2
<60 years	14.9±11.2	9.0±6.3
≥60 years	13.4±7.1	9.3±4.4
IT#	12.5±4.7	9.1±5.0
NOF#	13.2±9.6	8.4±3.3
STF#	21.9±11.6	13.3±5.0

IT# = Intertrochanteric fracture, NOF# = neck of femur fracture, STF# = sub-trochanteric femur fracture

Table 3: LOS and POS in later part first wave COVID period

	Later part first wave COVID-19	
	LOS (days)	POS (days)
Overall	11.1±5.7	7±3.5
Males	12.8±4.5	9.1±3.5
Females	12.1±5.0	8.1±3.7
<60 years	11.3±5.8	7.3±2.3
≥60 years	12.3±4.8	8.4±3.7
IT#	12.0±5.0	8.1±3.8
NOF#	12.9±4.6	8.9±3.3
STF#	-	-

IT# = Intertrochanteric fracture, NOF# = neck of femur fracture, STF# = sub-trochanteric femur fracture

Table 4: LOS and POS in immediate pre-pandemic era

	Immediate pre-pandemic era	
	LOS (days)	POS (days)
Overall	11.1±5.7	7±3.5
Males	11.5±7.4	7.7±4.1
Females	10.9±4.5	6.6±3.1
<60 years	9.7±4.3	6±2.3
≥60 years	11.2±5.8	7.1±3.6
IT#	10.6±5.8	6.6±3.1
NOF#	12.0±6.0	7.5±4.3
STF#	10.8±3.0	7.5±2.5

IT# = Intertrochanteric fracture, NOF# = neck of femur fracture, STF# = sub-trochanteric femur fracture

in the early pandemic but it was not statistically significant compared to people less than 60 years in PPE (P -value LOS/POS 0.166/0.156). In the LFWC, the LOS/POS returned to near pre-pandemic levels with no statistical significance (P value LOS/POS 0.591/0.388). In people, more than 60 years also the LOS/POS increased in the EFWC and the increase was statistically significant compared to patients more than 60 years in PPE (P value LOS/POS 0.029/0.0002). In the LFWC, the LOS/POS decreased and returned to near pre-pandemic levels with no statistical significant difference in the LOS (P value 0.243) but still statistically significant difference in POS compared to PPE, with the LFWC POS being high (P value 0.031).

The age groups when compared to each other, that is, less than 60 years versus more than or equal to 60 years patients, we observed that there was no statistically significant effect on LOS/POS in the three time periods studied.

When the association between sex (male/female) and LOS/POS was considered, we found that for females the increase in LOS/POS seen in the EFWC as compared to females in PPE was statistically significant (P value 0.027/0.001 LOS/POS). For male patients, however, the increase was only significant for the POS (P value 0.014) and not statistically significant for LOS (P value 0.151) compared to males in PPE. The changes in LOS or POS, when compared to each other, that is, male versus female, we observed that it was not affected by sex during any of the individual periods studied, that is, PPE, EFWC, and LFWC.

The data analysis to see correlation between fracture subtype and LOS/POS revealed that the LOS and POS increased for all three subtypes of proximal femur fractures included in the study in the EFWC as compared to the PPE. For intertrochanteric fractures, the increase in LOS/POS during the EFWC in comparison to the PPE was statistically insignificant for LOS (P value 0.078) but statistically significant for POS (P value 0.0008). In the later part of first wave of pandemic, the LOS for intertrochanteric fractures decreased to near PPE values with no statistically significant difference between the two time periods (P value 0.221) but the POS although decreased in comparison to the EFWC was still higher than the PPE with a statistically significant difference (P value 0.037).

For sub-trochanteric fractures the increase in LOS/POS was statistically significant in the EFWC when compared to the PPE (P value 0.019/0.007 LOS/POS). During the LFWC, the only one case of sub-trochanteric fracture was included in the study and hence statistical analysis could not be done.

For neck of femur fractures, the increase in LOS/POS during the EFWC in comparison to the PPE was statistically insignificant (P value 0.514/0.403 LOS/POS). In the LFWC, the LOS/POS for neck of femur fractures decreased to near PPE values with no statistical difference between the two time periods (P value 0.597/0.245 LOS/POS).

When the changes in LOS/POS were analysed for comparison among each other of fracture subtypes during the three periods, we found that the LOS or POS was not affected in a statistically significant way by a fracture type in PPE, EFWC, and LFWC except a statistically significant increase in LOS in the EFWC in case of sub-trochanteric fractures (P value 0.017) in comparison to the other two subtypes.

Discussion

The in-hospital LOS affects not only the overall cost of treatment but also has an impact on the overall health of the patient in terms of long-term mortality and morbidity. During this unprecedented event of the COVID-19 pandemic, with worldwide measures of social distancing, use of face mask and sanitisation being taken to contain the spread of the virus, any increase in the in-hospital LOS of patients would not only dent the efforts to break the chain of transmission of the pandemic but also lead to inefficient

utilisation of the already overburdened healthcare infrastructure and manpower. The sudden outburst of the novel virus with few authentic studies available about the virus pathogenicity, transmission modes, treatment, prevention and long-term effects combined with a high infectivity rate,^[8,9] the treatment protocols for orthopaedic conditions were not clearly defined and saw a change with more emphasis towards conservative management,^[10] especially during the first wave of the pandemic and thus it was expected to affect the LOS.

As per our hospital protocol and due to limitations of infrastructure in the early part of the pandemic first wave, routine reverse transcriptase polymerase chain reaction (RTPCR) was not available for all preoperative patients. Hence, only those patients who showed clinical signs of COVID like fever, decreasing oxygen saturation, respiratory distress along with raised values for indirect tests like increased serum LDH, serum ferritin and CRP were tested by RTPCR for COVID. Those who tested COVID positive on RTPCR test were shifted to the COVID wards and given a derotation boot with bar along with traction to achieve acceptable fracture reduction. Repeat bedside X-rays were done at weekly intervals to ensure reasonably acceptable fracture alignment and to look for any early signs of fracture union. This protocol of treatment was implemented in our hospital keeping in view the changes in orthopaedic practice protocols seen worldwide with concerns raised on virus transmission through aerosol-generating orthopaedic procedures like reaming, drilling and guidelines suggesting to minimise the use of such procedures and preference for conservative treatment wherever possible,^[10] and also the early studies reporting increased mortality rates in orthopaedically operated COVID-positive patients. The studies show that the 30- and 90-day mortality post-surgery to be significantly higher.^[11-21] Hence in our hospital only after their COVID results came as negative via RTPCR, they were offered options of surgical versus conservative treatment with their associated pros and cons communicated and documented. In our hospital, none of the patients opted for a surgical procedure after testing COVID positive and hence were managed conservatively in a derotation boot and bar with traction for intertrochanteric and sub-trochanteric fractures. For neck of femur fractures, we had only one female in age group above 60 years who was diagnosed as COVID positive postoperatively and had to be shifted to the COVID ward. She was then discharged after she became COVID negative. COVID-positive patients who did not opt for surgical treatment were not included in the study.

In our study, we found that the total in-hospital LOS and POS for proximal femur fracture patients increased significantly during the EFWC when compared to a similar period in the PPE. The increase in LOS or POS could not be attributed to any sex type, age group type or fracture type (except a statistically significant increase in LOS of sub-trochanteric fractures compared to the other two subtypes during early part of first wave of COVID). On further analysis of the data, we found that the increase in the LOS was mainly due to a significant increase in the POS of the patients. This increase of the LOS during the EFWC could

be attributed to factors like non-availability of routine RTPCR/RAT screening for all preoperative patients and hence increased waiting time to rule out COVID based on clinical symptoms and ancillary blood reports like S. LDH, S. Ferritin and CRP. Further, the limited availability of manpower including primary physicians, surgeons, anaesthetists, nursing staff and other technical and nontechnical staff due to their utilisation in other wards and set-ups directly dealing with COVID patients lead to increased waiting time for surgery posting. Also, the limitations of infrastructure such as limited number of operating theatres due to some being nominated for COVID patients, sudden increase in the workload of pathology labs, limited indoor admission beds available for orthopaedic patients, limited ICU beds available for post-operative orthopaedic patients impacted the overall LOS of patients.

With strict lockdown measures implemented by the government and gradual availability of facilities like PPE kits, routine RTPCR for all preoperative patients and molecular diagnostic rapid tests like TRUNAT and RAT tests for all admission cases supplemented with more clear idea on the modes of transmission of the virus, the LFWC saw a decrease in the LOS of the patients and values reaching to almost the LOS in the PPE.

The values in LOS and POS though reduced in the LFWC of the pandemic were not restored to the PPE values due to continued manpower and infrastructural limitations with the still ongoing fight against the pandemic.

To our knowledge, this is the first study that does a detailed analysis of the effect of the COVID-19 pandemic first wave on the hospital LOS and POS of operated patients with proximal femur fractures in the Indian scenario. The study group has been chosen meticulously to ensure the exclusive impact of COVID-19 pandemic first wave on the LOS and POS could be ascertained by ruling out variables like multiple co-existing injuries and financial factors via exclusion criteria. We also individually analysed if sex, age group or fracture subtype did have any effect on the LOS or POS.

A similar retrospective multi-centre cohort study by Wignall *et al.*^[2] analysed the impact of COVID-19 on the demographics, presentation, clinical management and outcomes of patients with proximal femoral (hip) fractures by comparing all patients admitted with hip fractures over a 3-month period during the pandemic with a similar period during the pre-pandemic era. In contrast to our study, their study found a significantly shorter total LOS of patients during the COVID period as compared to pre-COVID period. Only the COVID-positive patients who were operated for proximal femur fractures showed significantly longer LOS and POS compared to COVID-negative patients admitted during the same period. Similar reports were published by a study conducted at a single NHS hospital trust comprising 157 hip fracture patients admitted in March–May 2020 with approximate length of hospital stay for COVID-19-negative patients which was lower at 12 days versus 17 days, although

not statistically significant.^[22] Another multicentre UK study comprising 404 hip fracture patients admitted in March 2020 again showed similar findings; approximate length of hospital stay for COVID-19-negative patients was statistically significantly lower at 14 days versus 18 days.^[23] The lower LOS reported by these studies may be due to better health infrastructure and more routine availability of laboratory tests for COVID in all patients.

The weakness of our study is lack of objective analysis of the limitations faced during the COVID pandemic that lead to an increase in LOS and POS. The limitations mentioned though seem to be correct as addressing those in the later part of the pandemic saw LOS/POS return to near pre-pandemic values. Secondly, the study reports the LOS and POS during a limited time period. But keeping in mind the sudden unprecedented experience of the pandemic and the fact that the maximum unpreparedness on part of our hospitals was expected during the first wave of the pandemic, the time period of the study can be justified. Further the time period of the first wave of the pandemic has been split into early and later parts in accordance with the nationwide trend of the incidence of cases.

Our study gives an insight and first-hand experience on the impact of pandemic on LOS/POS and how to be better prepared for such situations in future. It also underlines the importance of investing on better hospital infrastructure facilities and manpower including recruitment and training of more primary care physicians to avoid utilisation of specialists to overcome shortage of doctors. The results of the study give a vital information to all primary care physicians who are usually the first line of contact with patients in the society. In a pandemic scenario, COVID-positive patients not willing to take the risk of surgery or otherwise not fit for surgery may be managed conservatively by the primary care physician, thus avoiding unnecessary hospital admission and its implications on LOS. Further, the results may serve as a guide for government policies to prepare better by investing on medical research and education for future waves of the pandemic and similar unprecedented events.

Conclusion

The COVID-19 pandemic leads to a significant rise in the LOS and POS of patients admitted for proximal femur fracture surgeries in the early part of the first wave which however returned to near pre-pandemic values in the later part of first wave due to continuous efforts of government, medical personnel and researchers.

This study highlights the following take-home messages:

1. A pandemic situation especially an unprecedented one leads to increase in LOS with its associated implications on cost and patient well-being.
2. A quick response as part of a teamwork involving the administration, primary physicians and other medical specialities along with other hospital staff could restore the LOS to near pre-pandemic values.

3. The first wave of COVID pandemic necessitates us to strengthen our health infrastructure, medical research and education for better preparedness of such unprecedented events in future.
4. Future studies to more objectively analyse the causes of increase in LOS should be undertaken.

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Conflicts of interest

There are no conflicts of interest.

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