



# Pooling of neglected and delayed trauma patients – Consequences of ‘lockdown’ and ‘Unlock’ phases of COVID-19 pandemic- A retrospective cohort analysis from a tertiary centre



Naresh Saini, Ravi Ranjan, Vijay Kumar Jain\*, Ajay Shukla

Department of Orthopaedics, Atal Bihari Vajpayee Institute of Medical Sciences, Dr. Ram Manohar Lohia Hospital, New Delhi, 110001, India

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## ABSTRACT

**Background:** The COVID-19 pandemic resulted in nationwide lockdown and quarantine strategies to break the chain of transmission of the SARS-CoV-2 virus in India. Management of patients with trauma has been particularly challenging across the country.

**Aims:** To evaluate the effect of delay in surgery in patients with traumatic injuries along with the peri-operative outcomes during the ‘Lockdown’ and ‘Unlock’ phases of the COVID-19 pandemic at a Level I Trauma centre in the National Capital Region (NCR) of India.

**Methods:** This retrospective, observational cohort study included 488 patients. Comparative analysis to assess patient characteristics, mechanism of trauma, clinical outcomes in patients managed operatively during ‘Lockdown period’ (24 March 2020 to 31 May 2020) Group A with Group B, who presented during ‘Unlock phases’ (01 June 2020 to 31 December 2020).

**Results:** The average delay in surgery, surgical time and hospital stay was significantly increased in group B patients ( $p$ -value  $<0.05$ ). The average blood loss, stay in the Intensive Care Unit (ICU) and blood transfusion requirement were clinically higher in group B but these differences were not statistically significant ( $p$ -value  $>0.05$ ). Only in group B; 9.01% patients (42 out of 466) required bone grafting.

**Conclusion:** ‘Neglect’ and delay in receiving operative management of orthopaedic trauma has led to unprecedented rise in number of complications of fractures, such as mal-union, delayed union or non-union during COVID-19 Pandemic. Patients have had to undergo longer surgical procedures with increased risk of intra-operative blood loss, need of peri-operative blood transfusion and bone grafting supplementation to facilitate union. Diligent attention to achieve the most optimal configuration of fractures should be planned in conservatively managed injuries during the pandemic to minimize future intra-operative difficulties.

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## 1. Introduction

The SARS-CoV-2 virus outbreak leading to coronavirus disease 2019 (COVID-19) pandemic has had a profound effect on the health care system in India, including that of trauma and orthopaedic services.<sup>1–4</sup>

To control the COVID-19 pandemic and stem SARS-CoV-2 virus viral transmission, on 23 March 2020, the Government of India ordered a nationwide ‘Lockdown’ for 21 days, limiting movement of the entire population of India as a preventive measure.<sup>5</sup> The

nationwide lockdown was extended till 31 May 2020. On 01 June 2020, the ‘Unlock period’ was initiated with lifting of ‘Lockdown’ restrictions except in containment zones. It was termed as “Unlock 1.0”. Phase II of the ‘Unlock’ period began on 01 July 2020. Now the country has completed several phases of ‘Unlock with continued restrictions limited to containment zones.’<sup>6–8</sup>

The ‘Lockdown’ and ‘Unlock’ phases led to an unprecedented effect on the daily life of the public, disruption in public transport services, difficulty in accessing medical care and shortage of medical resources.<sup>9,10</sup> The trauma and orthopaedic services in India had to be re-organised to provide a continuity of care to these patients in accordance with the recommendations published by the Indian Orthopaedic Association (IOA) guidelines.<sup>10–13</sup>

Delay in access to appropriate health care following injuries is

\* Corresponding author.

E-mail address: [drvijayortho@gmail.com](mailto:drvijayortho@gmail.com) (V.K. Jain).

not unknown in India due to disproportionate Doctor to population ratio and poor socio-economic conditions.<sup>14,15</sup> This leads to delay in the optimal time required for the best clinical outcomes in patients with trauma and orthopaedic injuries.<sup>16</sup> Delay in surgery is also associated with increased morbidity and is a risk factor for higher in-hospital mortality.<sup>17</sup> It was expected that cases with neglected trauma would rise due to the lockdown during the pandemic because of impositions to halt the transmission of COVID-19.<sup>3</sup>

Several studies have been published on the impact of COVID-19 on the practice of trauma and orthopaedics from India and worldwide.<sup>18,19</sup> However, most of these are based on data from the initial phase of the pandemic or during the 'Lockdown' phase or on elective orthopaedic services.<sup>20–22</sup>

COVID -19 pandemic led to rise in the number of trauma cases whose management was delayed due to a multitude of reasons e.g. due to self-treatment at home, unscientific treatment by non-trained health workers (quacks), osteopaths, fear of attending hospitals, amongst others. 'Lockdown' restrictions, lack of access, limitation of health resources and limited operating theatre capacity compounded the situation. As a consequence, these led to 'neglect' of trauma and a huge backlog of patients with neglected trauma, requiring reconstructive and extended surgical procedures due to added complexity of injuries.

We have evaluated the effect of delay in surgery in patients with traumatic injuries along with the perioperative outcomes during the 'Lockdown' and 'Unlock' phases of the COVID-19 pandemic at a Level I Trauma centre in the National Capital Region (NCR) of India.

## 1.1. Patient and methods

### 1.1.1. Study design

This retrospective, observational cohort study was carried out at a Level I tertiary trauma centre. Study protocol was approved by the institutional ethical committee.

### 1.1.2. Patients

All patients who were managed operatively at the institute between 24 March 2020 to 31 December 2020 were studied.

### 1.1.3. Inclusion criteria

The indications for surgery included failure of conservative treatment, obligatory injuries and fractures of necessity. All these fractures were closed injuries.

### 1.1.4. Exclusion criteria

We excluded patients who were involved in polytrauma or patients with open injuries or fractures associated with nerve and or vascular damage or patients with spinal injuries or had sustained pathological fractures. The protocols to treat patients with these injuries were different from the management protocol of the patients with closed traumatic injuries. Open fractures and fractures with neurovascular compromise were treated expeditiously.

### 1.1.5. Data collection

Data was collected from in-hospital records, operation theatre and discharge summaries. 488 patients (329 males and 159 females), who met our inclusion criteria were studied. Patients were grouped into Group A, those who presented during 'Lockdown period' (24 March 2020 to 31 May 2020) and Group B, who presented during 'Unlock phases' (01 June 2020 to 31 December 2020).

The time to surgery (TTS)/delay in surgery (time from initial injury to operative theatre procedure), type of surgery, anaesthesia, surgical time, blood loss, blood transfusion requirements and the need of Intensive Care Unit (ICU) admission was assessed in both group of patients. Additionally, requirement of bone grafting,

complications, mortality and length of hospital stay was reviewed in both groups of patients. All patients underwent radiological evaluation prior to surgery with plain radiographs (X-rays). A non-contrast Computerised Tomography (NCCT) of the injured area was undertaken in patients with complex injuries. All of the patients underwent routine preoperative anaesthetic assessment and COVID-19 screening with reverse transcriptase-polymerase chain reaction (RT-PCR) test within 72 h prior to surgery.

### 1.1.6. Follow-up

Patients were followed up 30 days after discharge. Complications (e.g. implant failure, infection and mortality) if any, were recorded.

### 1.1.7. Statistical methods

Microsoft Excel data sheet was used for data collection. SPSS 24.0 software (SPSS Inc. Chicago, Illinois, USA) was used for statistical analysis. Mean and standard deviation were used to summarize the data for continuous variables and frequency/percentage for categorical variables. An independent sample *t*-test with 95% confidence level was performed to compare parameters in both groups. A *p* value of <0.05 was considered significant.

### 1.1.8. Statement of funding

The author(s) received no specific grant/financial support for the research.

## 2. Results

A total of 488 patients with closed fractures underwent operative surgery between 24 March 2020 to 31 December 2020. Only 22 patients (14 males and 8 females) were operated on during 'Lockdown phase'. The mean age of group A patients was  $33.75 \pm 22.44$  years with a range 1.5–78 years. 466 patients (323 males and 143 females) were operated during 'Unlock phases'. The mean age of group B patients was  $38.83 \pm 19.63$  years with a range 2–84 years (Table 1). 22.73% patients of group A and 15.24% patients of group B have associated co-morbidities (Table 1).

There were 341 patients with lower limb fractures, 147 patients with upper limb fractures who underwent operative procedures. In the lower limb, approximately 49.56% patients presented with proximal femur (peri-trochanteric or neck of femur) fractures (Table 1). Distal humerus fractures were the commonest in the upper limb (38.78%).

The average delay in surgery (Time from initial injury to operative theatre procedure) in group A patients was  $8.23 \pm 6.14$  days (Range 3–28 days) whilst in group B patients it was  $21.38 \pm 26.14$  days (Range 3–190 days) (Table 2). The average surgical time, intra-operative blood loss, blood transfusion requirement, ICU stay and percentage of patients who required bone grafting in both groups are illustrated in Table 2. Characteristics of the patients who had undergone interventions for non-union and mal-union are depicted in Table 3. In group B, length of hospital stay was significantly increased (Table 1). In group B there were a total 5 patients who presented with implant failure which were treated with reoperation and 5 patients with superficial surgical site infection; managed with dressing and antibiotics during 30 days of follow-up. One patient in group A presented with surgical site infection was managed with dressing and antibiotics. There was no mortality recorded in both groups during this follow-up period.

## 3. Discussion

'Lockdown' strategy to prevent the spread of SARS-CoV-2 virus led to delay in seeking treatment for orthopaedic injuries due to a

**Table 1**  
Baseline demographics, patient characteristics and clinical outcomes of operated trauma patients during 'Lockdown' and Unlock phases of COVID-19.

Variable	Group A (N = 22)		Group B (N = 466)		P value (P < 0.05 is significant)	
	Number	Proportion	Number	Proportion		
Age	Mean age ± SD	33.75 ± 22.44		38.83 ± 19.63	0.289*	
Gender	Male	14	63.64%	323	69.31%	0.574**
	Female	8	36.36%	143	30.69%	
Co-morbidities	CVD	1	4.55%	32	6.87%	0.611**
	Pulmonary Disease	1	4.55%	12	2.58%	
	Diabetes	2	9.09%	22	4.72%	
	Renal disease	1	4.55%	5	1.07%	
ASA grade	1	18	81.81%	377	80.90%	0.99**
	2	3	13.64%	68	14.59%	
	3	1	4.55%	21	4.51%	
	4	0	0.00%	0	0.00%	
Anaesthesia	GA	8	36.36%	97	20.82%	0.213**
	Regional	13	59.09%	350	75.11%	
	GA + Regional	1	4.55%	19	4.07%	
Time to Surgery within	24 h	0	0%	0	0%	0.846**
	48 h	0	0%	0	0%	
	72 h	2	9.09%	37	7.94%	
	96 h or more	20	90.91%	429	92.06%	
	Sites	Upper Limb	8	36.36%	139	
Procedure for Hip fractures	Lower Limb	14	63.64%	327	70.17%	
	Hemiarthroplasty	1	4.55%	19	4.08%	
	DHS	1	4.55%	56	12.02%	
	IM nail	7	31.82%	141	30.26%	
Procedure for upper limb fractures	THR	0	0.00%	0	0.00%	
	Platting	4	50%	97	69.78%	
	IM nailing	0	0.00%	2	1.44%	
	K- wire fixation	4	50%	38	27.34%	
	Hemi-replacement shoulder	0	0.00%	2	1.44%	
Delayed Type	Non union	0		39		
	Malunion	0		6		
Complications		1		10		
Mortality	30-days	0		0		
Length Hospital of Stay	Mean ± SD		Range 3 to	Mean ± SD	Range 3 to	0.0245*
		10.51 ± 6.70	31	14.64 ± 8.46	42	

Abbreviations: N=Number; SD= Standard Deviation; CVD = Cardiovascular Disease; ASA = American Society of Anaesthesiologists Physical Status Classification System, GA = General Anaesthesia; DHS = Dynamic Hip Screw; IM= Intra-medullary; THR = Total hip replacement; \* - p value for student's t-test for comparison of means of paired data/\*\* - p value for chi square test for comparison of frequencies of paired data.

**Table 2**  
Showing details of Time to surgery, surgical time, blood loss, blood transfusion requirements, need of Intensive Care Unit (ICU) facility and bone grafting.

Parameters	Group A (N = 22)	Group B (N = 466)	p-value
Time to Surgery/Delay in surgery (Days)	8.23 ± 6.14 (Range 3–28)	21.38 ± 26.14 (Range 3–227)	0.019
Surgical time (Minutes)	92.50 ± 23.98 (Range 75–120)	107.45 ± 25.32 (Range 40–180)	0.007
Blood loss (ML)	250 ± 129.1 (Range 100–400)	315.1 ± 216.6 (Range 50–1200)	0.163
ICU stay (Days)	0.75 ± 0.96 (Range 0–2)	0.82 ± 1.27 (Range 0–5)	0.914
Blood transfusion (PRBCs units)	0.5 ± 0.58	0.23 ± 0.54	0.336
Bone grafting Requirement	0%	9.01%	

Results are in mean ± standard deviation, except for bone grafting which is presented in percentage. Abbreviations: N = number; ML = millilitres; ICU= Intensive care unit; PRBCs = packed red blood cells.

**Table 3**  
Characteristics of patients who had intervention undertaken for mal-union and nonunion fractures.

		Nonunion fractures	Mal-union Fractures
Numbers		39	6
Gender	Males (%)	27 (69.23%)	4 (66.67%)
	Females (%)	12 (30.77%)	2 (33.33%)
Site of Fracture	Humerus (%)	8 (20.51%)	1 (16.67%)
	Olecranon (%)	2 (5.13%)	0
	Radius and Ulna (%)	9 (23.08%)	3 (50%)
	Patella (%)	3 (7.69%)	0
	Tibia (%)	15 (38.46%)	2 (33.33%)
	Talus (%)	2 (5.13%)	0
Bone Grafting Requirement (%)		39 (100%)	3 (50%)
Osteotomies Requirement (%)		0	6 (100%)

multitude of reasons predominantly in health care systems in developing countries.<sup>1–3,19,21,23</sup>

'Unlock' Phases' brought different challenges in the management of traumatic injuries during the COVID-19 pandemic with 'delayed' presentation of fractures. This resulted in an increase in numbers of neglected trauma and other complications of fractures. Difficult tasks in management of such injuries and consequent poor outcomes for patients with resultant pain, deformity, disability and loss of function are emerging concerns.<sup>24</sup>

In the present study no patient was operated within two days of presentation to the hospital because of clinical adjustment in protocol of management of trauma patients. Requirement of a mandatory negative COVID-19 RT-PCR report, preference to open injuries and orthopaedic infection (septic arthritis and osteomyelitis) as well as significant reduction in operation theatre capacity and resources led to delay in surgery of displaced, closed fractures or even obligatory injuries. A trend towards revisiting conservative orthopaedic management during the early part of the pandemic was suggested. It was acknowledged, that later reconstructive or complex surgery may be required due to malunion.<sup>25,26</sup>

The delay in surgery during the 'Lockdown' period (Group A) was due to restrictions, 'stay at home orders', fear, lack of access, limitation of health resources and operating theatre capacity.<sup>27,28</sup> However, the average delay in surgery in the 'Unlock phases' (Group B) was significantly greater than group A patients. This difference might be because of the stacking up of patients who remained untreated during lockdown restrictions as well as reduced numbers of operation theatre capacity. We also observed an increase in inter-hospital transfer to our institute since it is a Level I trauma referral centre. These neglected and mal-united fractures required more operative time than acute injuries with the situation of limited resources to perform enough procedures in a day.

The average surgical time in group A patients was significantly lower than the group B patients. This difference might be due to increased surgical difficulties (e.g., switch to open reduction of fractures, increased blood loss) in management of neglected fractures. Some of these patients required additional surgical procedures (e.g., osteotomies, bone grafting) for management of the malunion and non-union of fractures.

Bone grafting was required in all non-union and three mal-united fractures in group B patients whilst no patient in group A required bone grafting suggesting increased complexity of injuries.

The average intra-operative blood loss, ICU stay and blood transfusion difference in both groups was not statistically significant.

### 3.1. Limitations of the study

This is a retrospective, observational study based on operative management of delayed trauma data presenting at a Level I trauma centre in northern India. Hence, it's findings may not be fully applicable to health care systems in developed countries, where the magnitude of such a situation may not be at par with that faced in India. Also, elective orthopaedic procedures were not evaluated, which may have given a more comprehensive review of orthopaedic clinical practice. As COVID-19 is still evolving, further multi-centre, collaborative studies are needed to assess the problems due to delayed presentation of orthopaedic trauma.

## 4. Conclusion

Our study reveals 'Lockdown' and 'Unlock' phases have brought different challenges in the management of traumatic injuries during the COVID-19 pandemic with 'delayed' presentation of

fractures. Management of such delayed or neglected trauma has become more difficult with patients requiring more complex surgery, extended operative time, increased risk of intra-operative blood loss, higher need of peri-operative blood transfusion and bone grafting supplementation to facilitate union.

With resurgence of COVID-19, fear of further waves of the pandemic and 'Lockdown' periods, lessons learnt from such studies will help to formulate management of orthopaedic trauma in context of restricted access and stretched out resources. What we need to learn from the results of this study, is that all trauma cases must be attended properly and the medical treatment is a must for displaced fractures in order to minimize above complications. Diligent attention to achieve the most optimal configuration of fractures should be planned in conservatively managed injuries during the pandemic to minimize future intra-operative difficulties.

Strategies to mitigate complications due to delayed presentation of displaced fractures and/or dislocations will result in better patient functional outcomes. Further we recommend that similar studies should be done in the future to know the burden of these neglected and delayed trauma cases during the pandemic.

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## Author's statement

VKJ, NS: Conceptualization, Methodology, RP, NS: Data Collection, Writing- Original draft preparation. AS, VKJ: Supervision; VKJ Writing- Reviewing and Editing.

## Declaration of competing interest

No competing interest declared.

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