

# Orthopaedic and Trauma Management in covid-19 era: common problems and their probable solution in literature, a narrative review

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## Abstract

**Purpose:** COVID-19 has affected more than 200 countries and has warranted change in the hospital policies and patient management worldwide. It has brought forward many challenges which were and still are being faced by the health care setup in various nations. There still are many unanswered questions and doubts arising in the minds of orthopaedic trauma surgeons all over regarding this pandemic. This article is an attempt to summarise the current knowledge about COVID-19 in relation to orthopaedic trauma.

**Methods:** This is a review article presenting concise, collected ideas from exhaustive literature taken from PubMed, Google Scholar and Cochrane reviews. Key words such as “COVID-19”, “Management”, “Orthopaedics” and “Trauma” were used and information from various articles has been presented in a concise manner, including the authors’ own personal experience.

**Results:** There has been a reduction in major trauma cases presenting to the emergency and a dramatic reduction in trauma admissions during the COVID-19 pandemic. Orthopaedic surgeons need to work alongside other frontline health care workers to tackle this calamity. Hospital resources need to be appropriately used in order to provide optimal patient care alongside minimising the risk of spread of infection to other patients and hospital personnel. The decision to operate needs to be a fine balance between suspected orthopaedics and trauma related complications and worsening of respiratory function in patients who are COVID-19 positive.

**Conclusion:** As orthopaedic surgeons, it is our moral responsibility to try to reduce the impact of the pandemic in which ever manner possible. There is still a lot to discover and guidelines are constantly changing, so it is also important that surgeons stay up to date on the latest protocols.

**Keywords:** COVID-19. Management. Orthopaedic. Trauma.

## Introduction

Since its outbreak in Wuhan, China in December 2019, COVID-19 has affected more than 200 countries and was declared as a pandemic on March 11, 2020 by WHO [1]. It has warranted change in the hospital policies and patient management worldwide [2]. Globally, as on 5 July 2020, there have been 11,125,245 confirmed cases of COVID-19, including 528,204 deaths

reported to WHO [3]. India reported its first COVID case on 30 January 2020 [4] and since then this novel malady has shown its massive impact on almost all aspects of human existence including social, economic and healthcare [5]. Since no vaccine or proven prophylactic drug is available, social distancing, travel restrictions, quarantine and lockdowns have been the primary tools used to curb the spread of this virus [6]. These tools have shown their efficacy in controlling the spread of this disease but at its own cost. The “COVID first” approach although necessary, has caused some collateral damage especially to those patients suffering from other illness yet

requiring urgent care. Trauma victims are one group of patients who have fallen prey to this calamity. Paucity of literature, lack of specific guidelines and prevailing panic has created new hurdles for management of the patients.

This pandemic has brought forward novel challenges for orthopaedicians and traumatologists. Assets are reduced due to mobilization of resources to COVID unit. Elective surgeries and OPDs have been suspended in most of the institutes [7]. There is a rise in conservative management of orthopaedic injuries wherever possible, and encouragement of surgical intervention only when it is absolutely necessary [8]. Assessing the

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risks and benefits for the patients in view of this additional risk of acquiring infection during hospital stay has been challenging. Ensuring the safety of operating team, anaesthetists and allied staff has been a major concern as transmission is possible through asymptomatic patients [6]. Follow up and rehabilitation of orthopaedic patients has also been a challenge during this time. Lastly, there is dilemma as to when to start with elective orthopaedic surgeries. Guidelines are constantly changing, so it is also important that surgeons stay up to date on the latest protocols and be flexible, adaptable, and ready to spin rapidly to changing events [8].

This is a review article presenting concise, collected ideas from exhaustive literature taken from PubMed, Google Scholar and Cochrane reviews. It is an attempt to summarise the current knowledge about COVID-19 in relation to orthopaedics and trauma so as to answer some of the common questions that have risen in relation to all aspects of patient care.

### How to select patients for admission/intervention?

In light of the complete/partial lockdown imposed in many cities all around the globe, there has been a reduction in major trauma cases presenting to the emergency and a dramatic reduction in trauma admissions during the COVID-19 pandemic [9]. In Ireland [10] it was reported that a 40% reduction in trauma admissions was observed and a 60% reduction in sports-related injuries and road traffic accident-related injuries was noted during the COVID-19 lockdown. Also, a 17% increase in patients sustaining trauma because of domestic accidents was observed.

In patients with COVID-19, the decision to operate should also be based on the patient's clinical status, in particular his or her respiratory function [11]. The

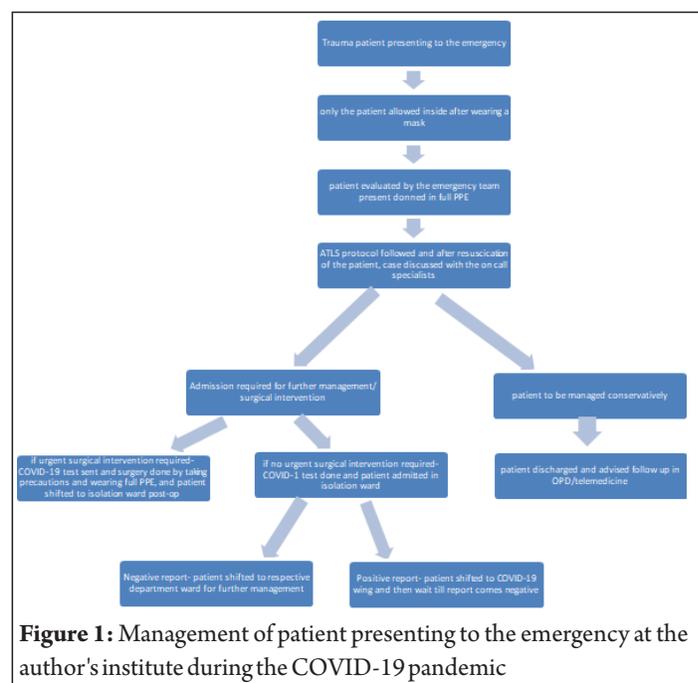
decision to operate needs to be a fine balance between suspected fracture related complications (e.g., fat embolism from long bone fractures) and worsening of respiratory function in patients who are COVID-19 positive due to the added stress of anaesthesia and surgery itself. Some authors recommended that only emergency surgeries should be scheduled on COVID-19 patients [12].

Wong et al reported an 81-year-old woman with intertrochanteric fracture was admitted to their institute during the Severe Acute Respiratory Syndrome (SARS) outbreak. She had no history of contact with SARS patients, and underwent close reduction and Gamma nail fixation under spinal anaesthesia one day after admission. The next day the patient developed oxygen desaturation and shortness of breath and expired after 7 days. Typical findings of SARS were revealed on autopsy [13]. Fang also reported two patients treated with fracture during SARS crisis in Hong Kong, both of which expired and SARS was confirmed post-mortem [14]. Given the uncertainty regarding the behaviour of the virus after the surgery as a second hit insult to the previously in-danger patient, it is a big concern if we are misleading a stable COVID-19 patient towards a patient with aggravated comorbidity. Adverse outcomes in COVID-19 patients are associated with underlying comorbidities and weakened immune system [15,16]. On the other hand, delayed surgery is fraught with the possible requirement of complex surgeries which will be less

easily handled. Risk assessment in urgent orthopaedics surgeries in COVID-19 patients includes an aggregate of the real risk of proceeding and that of postponing for weeks.

Literature supports damage control orthopaedics (DCO) in borderline and severe trauma patients to reduce the rate of the adult respiratory distress syndrome (ARDS) and the multiple organ dysfunction (MOD) [17], so the question arises that is it not logical to apply the same protocol in COVID-19 patients? In some instances, patients may be treated conservatively until they are fit enough for a surgical procedure. Whereas in cases such as femoral shaft fractures and per-trochanteric fractures, early intervention in the form of definitive fixation or sequential surgeries using external fixator becomes necessary due to possibilities of fat embolism, increased risk of pulmonary complication associated with prolonged bedrest [18-20].

Confirmed COVID-19 positive patients can be divided into 4 types, Critical, Symptomatic, Mild symptomatic/history of exposure and Healed/healthy [21,22]. The median duration of viral shedding and dyspnea in



**Figure 1:** Management of patient presenting to the emergency at the author's institute during the COVID-19 pandemic

COVID-19 survivors is reported to be 20 days, and in critical patients there is uncertainty regarding the behaviour of the virus [23]. Hence, to wait for the patient to become asymptomatic or healed, it takes almost 3 to 4 weeks [24]. Such postponement due to a more critical condition may necessitate a delayed trauma surgery in the future e.g. neglected tendon injuries, inappropriate non-operatively treated hip and/or acetabular fractures, established malunion, etc [24].

In the author's institute (Level 1 trauma centre) most of the orthopaedic trauma surgeries are being done after COVID-19 test report. Although, few emergency procedures like debridement and fixator application for high grade open fractures and fixation of long bone fractures are being done without waiting for the test result after taking full precautions and donning of personal protection by the surgical as well as the anaesthetic team.

Zhen Chang Liang et al stated that wherever possible, patients should be managed conservatively without unduly compromising clinical care. Most upper limb fractures can be managed conservatively, and in the lower extremity, tibia fractures can be considered for conservative management [11]. Emergency orthopaedic surgeries were undertaken without waiting for the COVID-19 test results in specific cases such as life and limb-threatening injuries (e.g., high-grade open fractures with gross contamination, fractures with vascular compromise or compartment syndrome, cauda equina, or infections such as necrotizing fasciitis). These were performed with the surgical team donned in full protective gear.

### **How to optimally utilize the available resources?**

The overall goal is to create a system-sustaining model that allows for appropriate resource allocation to provide optimal patient care, while

minimizing viral spread to other patients and members of the treatment team. Schwartz et al described the creation of a two-team system where each team functions completely independent of one another with one team working in the hospital and the other working remotely [25]. In this system, the teams are designed to transition every other week, allowing for the appropriate incubation period for the viral symptoms to be present before the return to hospital. Given that exposed individuals may remain asymptomatic for up to 14 days [26], consideration should be given to establishing a 3-team approach where one team is working in the hospital involved in direct patient care, while the other teams are rotating through 14 days away from the hospital essentially working remotely in a cyclical "quarantine" between episodes of direct patient care.

After the outbreak of the COVID-19, the first implementation of a regional hospital in Northern Italy was creation of an institutional "Crisis unit" to facilitate rapid and efficient action [2]. This team consisted of the general manager of the hospital, the chief of anaesthesiology, the chief of the orthopaedic department, the scientific director, hospital medical director, risk manager, head of the nursing team and the communication manager. The first decision was to rationalize surgical activity, blocking all elective surgery and performing only trauma cases. Regulation of access to the hospital, both for employees and patients was done. Only one gateway was maintained, with body temperature screening and a station for hand washing with an alcoholic solution. Considering the reduction of clinical activity, working shift and rest period were organized to minimize presence in the hospital.

In the United States additional measures were taken such as screening all persons (providers, staff, and patients) before entering the building with questioning and temperature, excluding additional

visitors, and separating teams that are appropriately streamlined to include only essential personnel into different clinic zones. Waiting rooms were modified to allow social distancing. Patients were given the option to wait in their car or another less crowded location and be called when ready for their in-person visit [27].

### **How to segregate health care workers (HCW) to ensure their safety?**

Orthopaedic surgeons are not in the frontline but definitely they are affected by this crisis. In the most affected countries, orthopaedic surgeons are urged to work outside their specific areas of training and expertise; surgeons are re-trained and transferred to primary and emergency care units to help in overwhelmed specialties [28]. Orthopaedic surgeons are not trained in management of emergency medical situations and hence appropriate training sessions should be undertaken before engaging in to patient care. Also training regarding the use of PPE and other protective measures should be encouraged. In our institute HCWs from various departments ranging from consultants and resident doctors to nursing officers and hospital attendants, were educated and trained in COVID management as each had a specific role to play.

### **How to manage patients in emergency area?**

In many institutes in northern Italy it was planned to hospitalize patients with a positive COVID-19 test, from the emergency department rather than from different wards. An oropharyngeal swab was performed in the emergency room for all patients needing to be admitted, and patients were moved to a specific ward made up of single rooms to wait for results [2].

In our institute a combined emergency department was formed where minimal health care workers (HCW) were

stationed, donned in full personal protective equipment (PPE). HCW teams were formed which worked in rotation. All patients coming to the emergency were considered as suspected COVID-19 positive and were examined, given primary emergency treatment as per ATLS protocols. These cases were then discussed with the on-call specialists and a decision was made to admit the patient if required. The patients were then admitted in the isolation ward after COVID-19 test directly from the emergency department, and handed over to the respective departments after the test report came negative. If the report came positive, patients were shifted to the COVID isolation wing (Figure.1).

### **Where to admit the covid-19 positive patients?**

A hospital ward was converted to a COVID-19 exclusive patient ward in an institute in Northern Italy. This area was restricted to selected trained employees, with the use of personal protection equipment (PPE) following World Health Organization and regional recommendations [2].

Similarly, it was stated by other authors that the facility for COVID-19 cases should be either a dedicated building or block separate from the rest of the hospital. Isolation areas like wards or rooms need to be different for suspected and confirmed cases and under no circumstances should be mixed [7]. In our institute as well the trauma center was converted to a dedicated COVID block and trauma care infrastructure was reorganized.

### **What changes are required in the functioning of the outpatient department?**

Outpatient clinics were modulated in many centres in Italy to reduce overcrowding in the waiting rooms [2]. All first consultations were blocked, only emergency cases or referrals were

entertained. Access was only permitted to people with a booked appointment or medical test. Patients with neoplastic diseases, rheumatic diseases, plaster removal, Parkinson and neurological diseases were noted. Patients had to come to the consultation alone, and in cases of babies or dependent people, only one accompanying person was allowed.

In many institutes all over Europe outpatient clinics have been shut down, elective operations are cancelled, and non-urgent operations have suspended for at least three months [28].

### **What are the changes required in the inpatient department?**

In visiting hours, access was only permitted to one relative for hospitalized patients and was not possible for COVID patients. The number of admissions was restricted; due to the potential lack of beds because of the large number of patients hospitalized for COVID-19, also to limit the exposure of the operated patient to a life-threatening risk. Limiting admissions also made more beds available during the outbreak of the disease which required intensive care in a high percentage of the infected [2].

Similarly, in our institute only one relative was allowed to stay with the patient and that to after COVID-19 test for the relative as well.

### **How to safely use operation theatres?**

Surgical masks need to be worn for all non-intubated patients during the transfer from the ward to the OT complex, and it is mandatory for all staff accompanying patients to be wearing full PPE including N95 masks, visors, or goggles. For intubated patients a dedicated transport ventilator must be used. Staff must be mindful to clamp endotracheal tubes when changing ventilators during the transfer process to avoid aerosolization. A specific route that is the most direct and least crowded must be taken from the isolation ward to the OT complex. This route, including

elevators, must be clearly sign-posted and cleared by security staff prior to transfer [11].

Aerosols are generated when making surgical incisions, using electrocautery for bleeding, drilling/reaming of bone, and during wound irrigation, which are all common components of most orthopaedic trauma procedures [29]. The combination of power surgical tools and ventilation systems can produce a viral wind into the operating room. These may turn the operating rooms into viral labs with strong casualties amongst the operating room and surgical personnel [28]. In routine practice, operating rooms have a positive pressure to minimise the risk of surgical site contamination. But aerosol-generating procedures on COVID-19 suspected or confirmed positive patients should ideally take place in negative pressure rooms, but this negative pressure can put patients who are having surgery at an increased risk of surgical site infections [11].

In patients where surgical intervention cannot be delayed until COVID-19 testing results are returned, the patient should be treated as COVID-19 positive until test results come [27].

In an institute in northern Italy four operating rooms were organized for trauma cases or non-deferrable orthopaedic surgery. An operating theatre with specific pathways for nurses and surgeons was organized for the treatment of positive or potentially positive patients [2].

The operating theatres were transformed into intensive care units (ICU) and reserved for ventilation and respiratory management of patients. Surgical operations being performed were reserved for trauma and life-threatening conditions such as cancer or severe infections [28].

### **How to use Personal Protective Equipment (PPE)?**

This consists of the N95 mask, goggles,

caps, shoe covers, gowns, and gloves. In Singapore powered air-purifying respirators (PAPRs) were worn if involvement in aerosol-generating procedures was anticipated [11].

In Northern Italy regional guidelines regarding use of PPE were shared by the hospital educational office both with residential and online-learning courses implemented to be more effective. The residential courses had to be structured in large meeting rooms, with all the attendees using a protection surgical mask and with a limited number of participants. PPE had to be applied correctly in the proper order before entry into the patient care area and should not be modified while in the patient care area. Removing used PPE is a high-risk process that required a structured procedure, a trained observer, an assistant and a designated area for removal to ensure protection. PPE had to be removed slowly in the correct sequence to reduce the possibility of self-contamination or other exposure to the virus [2].

In several institutions in the United States [27], the N95 respirators were only being used for SARS-CoV-2 positive patients or by members of the operative team for high risk, aerosolizing procedures in SARS-CoV-2 unknown patients. In many of these institutions, the N95 respirators were being reused for several days unless they were soiled or contaminated. This put both the user and others at risk of potential spread of the virus.

### **How to minimise risk during anaesthetic procedures?**

Anaesthetic procedures should be performed with particular attention, due to the potential spread of infected droplets and aerosol. In northern Italy all intubations were performed using a video laryngoscope to keep the head of the anaesthesiologist away from the patient's mouth and to allow a faster procedure, as there is high risk of

exposure to aerosols during intubation and extubation [2]. Where possible, local or spinal anaesthesia was preferred in COVID-19 patients to reduce the risk of overlapping pneumonia secondary to an invasive procedure. Similarly, in many centres in the United States, consideration was given to regional/peripheral nerve blocks or spinal/epidural anesthesia whenever possible with the patient's nose and mouth covered with a surgical or N95 mask. If the patient was not already intubated but it was necessary for surgery, intubation and extubation were performed either in a separate dedicated room for intubation/extubation or in the operating room without the surgical team present [27].

In many institutes in Singapore aerosol generation was minimized with specific anesthetic interventions like rapid sequence induction, avoidance of high-flow nasal cannulas and bag valve mask ventilation, and proper securing of endotracheal tubes to avoid air leaks [11]. Laryngeal mask airways were avoided for these patients, given their high propensity for leaking and absence of a closed circuit. All anesthetic interventions were completed before the surgical team entered the operating room.

### **What are the considerations for postoperative care and discharge?**

Early discharge from hospital, where feasible, must be practised [30]. NSAIDs should be judiciously used as there is speculation regarding the potential mechanisms ranging from dampening of the immune system to altered fluid shifts exacerbating pneumonia [31]. Some organisations have published advice on the use of steroids for non-operative pain control due to concerns over the potential for immunosuppression [32].

### **What is the role of Telemedicine?**

Previously high level of patient satisfaction has been achieved by using

telemedicine in orthopaedic trauma patients [33]. Various publications have demonstrated successful use of telemedicine in other specialties, and it has developed a clear roll during the COVID-19 pandemic [34,35].

Telemedicine is being used in some countries as a useful technique for offering advice on pain control and rehabilitation [28]. However, it might not be useful if a patient experiences a fracture. Orthopaedic surgeons can use telemedicine postoperatively with patients in three manners- to schedule follow-up, for routine monitoring and management of recovery issues [36].

### **When and how to start with elective surgery?**

In the United States surgeons and hospitals have largely been on their own to determine which procedures should continue to be performed and which should be postponed due to vague guidelines at the state level [37]. The international consensus group has come up with certain recommendations related to when and how elective surgeries can be resumed [38]. The authors state that elective surgery can be resumed once lockdown in the region has been lifted and the number of COVID-19 cases are consistently declining. Also, the institute should be able to follow all social distancing norms (as discussed before) preoperatively, intraoperatively and postoperatively. There should be enough stock of necessary equipment required to face a second wave of COVID-19 cases. All patients posted for elective surgery should undergo COVID-19 test within 3 days of the date of surgery, and in case the report comes positive, the surgery should be deferred till the patient tests negative for COVID-19. Surgeons should wear protective eyewear or face-shields and minimum required people to be present in the operating room. The operating rooms should have normal positive-pressure for elective procedures. There is no need to

convert to negative pressure rooms, but modalities to decrease efflux of contaminated air into the hallways, such as in-room air filters and negative-pressure antechambers, can be considered.

### Conclusion

There has been so much of research on COVID-19 in these past few months, yet little is known about this novel virus and the disease. There is still a lot to learn and

discover, hence this document cannot be considered as a doctrine as guidelines will keep changing as more evidence emerges. As orthopaedic surgeons, it is our moral responsibility to try to reduce the impact of the pandemic in which ever manner possible. Being vigilant is of utmost importance in these difficult times and trying to come out with innovative strategies to overcome the challenges posed by the pandemic should be a priority. Following social distancing,

prevention and control measures and creating more awareness amongst the people should be encouraged more. We must stand together, with each other and with the wider healthcare community in this time of COVID-19 crisis. Nonetheless, this pandemic has given us an opportunity to learn and be better prepared to face any other such calamity in future.

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**Conflict of Interest: NIL**  
**Source of Support: NIL**

#### How to Cite this Article

Dubey S, Mohindru S, Azam Md. Q, Sarkar B. Orthopaedic and trauma management in covid-19 era: common problems and their probable solution in literature, a narrative review. *Journal of Clinical Orthopaedics July-Dec 2020;5(2):13-19*.