

## Original article

# Is performing joint arthroplasty surgery during the COVID-19 pandemic safe?: A retrospective, cohort analysis from a tertiary centre in NCR, Delhi, India



Om Prakash Meena<sup>a</sup>, Pulkit Kalra<sup>a</sup>, Ajay Shukla<sup>a</sup>, Ananta Kumar Naik<sup>a</sup>,  
Karthikeyan P. Iyengar<sup>b</sup>, Vijay Kumar Jain<sup>a,\*</sup>

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

<sup>b</sup> Trauma and Orthopaedic Surgeon, Southport and Ormskirk NHS Trust, Southport, PR8 6PN, UK

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## ABSTRACT

**Purpose:** Resuming joint replacement arthroplasty amidst the COVID-19 pandemic and lockdown has come with various challenges that had to be dealt with utmost caution. Patients with severe arthritis experiencing a state of intolerable pain, could not be left unaddressed. Guidelines published by surgical associations, collaborative surgical author groups including public health organisations had to be modified to suit the Indian scenario and obtain optimal functional outcomes in these patients.

**Methods:** A retrospective cohort analysis of 147 patients who underwent arthroplasty during the pandemic (March 2020 to April 2021), for either primary or secondary arthritis, was performed. We assess the efficacy and safety of the newly established Institutional surgical peri-operative protocol at our tertiary care centre in the National Capital Region, India in response to COVID-19 guidelines. The primary outcome measures appraised was 30-day mortality and the secondary outcome measures included length of stay, peri-operative complications and COVID-19 infection.

**Result:** The most common indication for arthroplasty during the pandemic was neglected trauma. One patient died, due to myocardial infarction during the follow-up period. About 67% of patients were discharged to their usual residence within 7 days of admission. Two patients tested positive for COVID-19 postoperatively, but none required Intensive Care Unit admission.

**Conclusion:** Joint replacement arthroplasty can be undertaken safely with diligent patient selection, application of a stringent COVID appropriate behaviour and a 'ring-fenced' peri-operative pathway.

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## 1. Introduction

Arthroplasty for the hip and the knee have been shown to be cost-effective interventions in alleviating pain, restoration of function and improve Health-related Quality of life (QoL) outcomes in the management of patients with moderate to severe, end stage arthritis.<sup>1,2</sup> Traditionally, these surgical interventions are embarked on in patients who have exhausted all pharmacological and non-pharmacological modalities of treatments in managing their disability.<sup>3</sup> Characteristically, total joint replacement surgeries are

planned elective procedures in which patients are assessed in elective orthopaedic clinics (Not trauma or fracture clinics) after clinico-radiological evaluation. These patients are evaluated using validated scores such as Oxford Hip score (OHS) or Harris Hip score (HHS) to document functional disability, effect of arthritis on activities of daily life (ADL) and Quality of life (QoL). Finally, appropriate optimization for their co-morbidities like diabetes or blood pressure or anaemia correction before elective, planned surgery to achieve the best surgical outcomes.<sup>4-6</sup> The current study assesses an urgent requirement in patients, precipitated due to a deteriorating hip or knee function with conditions such as delayed hip fracture presentation or a collapse of Avascular necrosis (AVN) of the femoral head in the context of COVID-19 pandemic. This was necessary to relieve pain, improve function and ADL.

The novel coronavirus SARS-CoV-2 (COVID-19) pandemic has a profound impact on the healthcare systems across the world, with

\* Corresponding author. Department of Orthopaedics, Atal Bihari Vajpayee Institute of Medical sciences Dr. Ram Manohar Lohia Hospital, New Delhi, 110001, India.

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

suspension of elective surgical services including that of arthroplasty.<sup>7,8</sup> In India, elective orthopedic surgeries were suspended in most of the treatment referral centres with the aim of preserving healthcare resources and health care personnel to support the COVID-19 response.<sup>9</sup> Most of the government tertiary care centres and private hospitals were converted to either partial or full COVID-19 care facilities to deal with the public health emergency.<sup>10,11</sup> Trauma, emergency and urgent orthopaedic care were reorganized following the publication of Indian Orthopedic Association and British Orthopedic Association guidelines.<sup>12</sup>

Access to pain relieving joint replacement surgery was restricted due to infection prevention strategies such as national lockdown, quarantine, 'self-isolation' and lack of availability of hospital services. However, patient's awaiting surgery on the waiting list for advanced and deteriorating arthritis have described their state of intolerable pain.<sup>13</sup> This had to be addressed. Early reports published suggested increased mortality in patients undergoing surgical interventions during the COVID-19 pandemic.<sup>14,15</sup> The challenge facing the orthopaedic community in managing such patients with urgent deterioration of pain and function had arisen in presence of suspension of traditional elective surgery across the orthopaedic centres. Hence clinicians were faced with the situation of providing urgent joint replacement surgery balancing it with safety for the patients undergoing these surgery in a COVID-19 pandemic scenario and minimizing risk of viral transmission to the staff managing these patients.

To address patient safety, the concepts of safe corridors of care and 'Green recovery' pathways have been conceptualized with an aim of conducting joint arthroplasty surgery in a COVID-19 protected environment.<sup>16,17</sup> A 'Green recovery' pathway is a COVID-19 protected pathway with safety "checks" and inspections at every step of the patient peri-operative surgical journey. It starts at the pre-operative assessment-with careful screening of patients, informed consent, COVID-19 RT-PCR test and self-isolation prior to surgery. COVID Appropriate Behaviour (CAB) is maintained through the ward admission, theatre and post-recovery ward of patient and staff safety is paramount.

The purpose of this review was to analyze safety and efficacy of the Institutional surgical protocol followed in our tertiary care centre for arthroplasty surgeries during the COVID-19 pandemic.

## 2. Patients and methods

### 2.1. Study design

A retrospective cohort analysis of all patients who underwent arthroplasty surgeries such as total hip and knee replacement, bipolar hemiarthroplasty, revision arthroplasty of the hip performed during the pandemic period from March 2020 to April 2021 at our institution was undertaken.

### 2.2. Statement of ethics

The study protocol was approved by the Institutional Ethics Committee. All clinical procedures were undertaken with appropriate patient consent.

### 2.3. Inclusion & exclusion criteria

Patients with intolerable pain and bedridden, requiring urgent arthroplasty surgery due to hip pathology (such as avascular necrosis of the femoral head (AVN), rheumatoid arthritis, post-traumatic osteoarthritis and other causes of secondary OA), delayed treatment of displaced neck femur fracture in the elderly and severe degenerative arthritis of the knee were included in the

study assessment group. This decision was undertaken based on clinico-radiological evaluation and disability due to pain. Patients with clinico-radiological arthritis but who were able to manage pain with minimal limitation of day-to-day activities with non-operative interventions were assigned to a waiting group category of surgical prioritization.

### 2.4. Data collection

Data was collected from institutional medical database for all patients including in-patient records, pathology, radiology imaging studies, discharge summaries and follow-up visits. Patient demographics, associated co-morbidities, clinical indication of surgery and the peri-operative course was recorded. The primary outcome measure assessed was 30-day mortality in the study group. The secondary outcome measures included length of stay (LOS) in the hospital, COVID-19 infection, peri-operative complications, both systemic and orthopaedic including any subsequent need for surgery.

### 2.5. Our Institution's surgical protocol for arthroplasty surgery patient pathway (Fig. 1)

#### 1. Pre-operative assessment and diagnosis

On confirmation of the clinical and radiological diagnosis of the joint involved, all hematological investigations were thoroughly reviewed and a pre-anesthetic check-up was organised. Laboratory parameters like haemoglobin, total protein and serum albumin were evaluated.<sup>18</sup> Patients were examined by the anaesthesia assessment team using COVID appropriate behavior, personal protective equipment (PPE) and infection prevention guidelines.

#### 2. COVID-19 testing regime

Patients who were declared fit by the anesthetic team were advised two weeks of home self-isolation. SARS-CoV-2 reverse transcription-polymerase chain reaction (RT-PCR) test undertaken immediately at the end of the self-isolation period and within 48–72 h prior to surgery. Patients were admitted one day before surgery to the dedicated orthopedic ward following a negative COVID-19 RT-PCR test. Patients who were found positive on the RT-PCR test and had mild symptoms were advised self-isolation at home for monitoring or were admitted to our COVID-19 care facility if hospitalization was indicated.

#### 3. 'Dedicated Orthopaedic- Ring fenced' ward

One of the critical steps in developing Institution's surgical peri-operative protocol for arthroplasty has been the establishment of a dedicated orthopaedic 'Ring-fenced ward' with principles of a 'Green recovery' pathway.<sup>16</sup> The strategy was to develop a COVID-19 protected environment with focus on patient and staff safety. COVID Appropriate behaviour (CAB) protocol was mandated along the peri-operative pathway. No attendants were allowed to mix with patients. The use of N-95 or surgical mask, PPE, hand-hygiene, 'social distancing' and infection prevention strategies were made essential for everyone in the ward. Resident doctors and faculty working or supervising COVID-19 care wards were not allowed in the orthopaedic ward premises before completion of post COVID-19 duty quarantine period.

#### 4. Operating theatre (OT) management-theatre list, Personnel, Anaesthesia

The number of staff called in the OT was deliberately reduced to minimize exposure for the patient and the medical team. The number of surgeries per day was reduced to minimum e.g. one or two cases to avoid any compromise in CAB. All patients included in the review underwent surgery under combined spinal-epidural anaesthesia and an Intensive Care Unit (ICU) bed was reserved for postoperative recovery.

For total knee arthroplasty (TKA), surgery was performed under a pneumatic tourniquet, in supine position using a midline incision. Surgery for hip arthroplasty was performed in lateral position using posterior approach. A negative suction drain was applied in all surgeries and removed 24 h after surgery.

### 5. Staff protection and personnel

All surgeries were performed keeping in mind the safety of patients as well as healthcare personnel. The stock of essential items or the number of healthcare personnel posted on essential COVID-19 duty was not jeopardised with in any manner on account of these surgeries.

### 6. Post-operative regime

Post-operatively patients were managed on the dedicated orthopaedic 'Ring-fenced ward'. Some patients requiring close monitoring in the post-operative period or those with multiple comorbidities were shifted to ICU for observation and stabilization. Hematological investigations were scrutinized specifically for haemoglobin and serum albumin<sup>18</sup>. If found deficit, appropriate treatment was initiated in time to reduce the risk of postoperative complications. Immediate post-operative rehabilitation was initiated with physiotherapy supervision once the patient was stabilized. Venous Thromboembolism (VTE) prophylaxis regime consisted Low molecular weight heparin for 10 days followed by aspirin for 4 weeks in hip arthroplasty and Aspirin for 14 days in knee arthroplasty.

Patients were discharged after wound examination and first dressing change on day 3 to minimize risk of exposure to COVID-19 infection post-surgery. Patients who were anxious about post-operative pain or with increased risk of infection or hesitant about early discharge had a slightly longer Length of stay (LOS) on the 'Ring-fenced ward'. On discharge, all patients were followed up for a minimum period of one-month following their index surgery in the outpatient clinics. Further Patient counselling and rehabilitation instructions were conducted regularly using telephone and/or video consultations.<sup>19</sup> We have incorporated the principle of 'Safety Netting' in follow-up of these patients. 'Safety Netting' involves providing a continuous support during the post-operative recovery period at their home residence. Patients have a 24/7 contact phone number which they can ring to discuss their concerns with clinicians and physiotherapist team. If it is necessary to see the patient in an clinic for a face-to-face review, this is immediately organised and patient assessed in a face-to-face clinic to decide further management.

### 3. Statistical analysis

The data were analyzed using IBM SPSS Version 25. Categorical variables were expressed in frequency and proportion and continuous variables as mean and standard deviation. Association between categorical variables was assessed using the Chi-square

test of independence. And for the association between continuous variables unpaired *t*-test was used. A value of  $P \leq 0.05$  was considered statistically significant.

## 4. Results

A total of 147 arthroplasty surgeries were performed at our tertiary care center from initiation of first lockdown in March 2020 to initiation of the second lockdown on account of second COVID wave in April 2021.

### 4.1. Footfall & comorbidities

The month of March in 2021(16.4%) witnessed the highest number of arthroplasty surgeries followed by February 2021(14.3%). This was just before the initiation of the second lockdown at the time of the second wave surge (Fig. 2). Demographics with varied personal habits like smoking (20.5%), alcohol consumption (7.5%) and comorbidities are described in Table 1.

### 4.2. Surgery performed

Our analysis demonstrated that the majority (38%) of arthroplasty surgeries performed were for patients with joint sequelae of trauma. This included elderly patients with neck of femur fracture (displaced and >3 weeks old), nonunion femoral neck of femur fractures, and advanced post-traumatic arthritis. This was followed by secondary osteoarthritis due to AVN of the hip constituting for about 28.7% of arthroplasty surgeries. (Table 1). Total hip arthroplasty (THA) (71 patients) was the most common surgery performed during this period. Out of these 71 patients, 91.5% (65 patients) had an unilateral arthroplasty whereas 8.5% (6 patients) underwent bilateral simultaneous arthroplasty procedure. Total knee arthroplasty constituted for 16.4% of patients (24) while revision arthroplasty of the hip was performed in 4.1% of patients (6).

### 4.3. Laboratory analysis

A comparison of preoperative and postoperative laboratory parameters like haemoglobin, total protein, and serum albumin is shown in Table 2.

### 4.4. Blood loss & transfusion

About 72% of the patients operated during the pandemic suffered a blood loss of less than 500 ml whilst 23% of patients had blood loss between 500 and 1000 ml, the rest 5% patients had more than 1000 ml blood loss. 28% of patients (41) received whole blood or blood products intraoperatively or postoperatively to replenish blood lost during surgery. 80% (33 patients) of those who were transfused received one unit of packed red blood cells.

### 4.5. Duration of stay in ICU and hospital

Out of a total of 147 arthroplasties, 67.8% of patients (99) were discharged from the orthopaedic ward within 1 week following surgery to their place of residence. 32% of patients were observed for more than one week following surgery for various reasons. These included patients undergoing Revision hip arthroplasty,

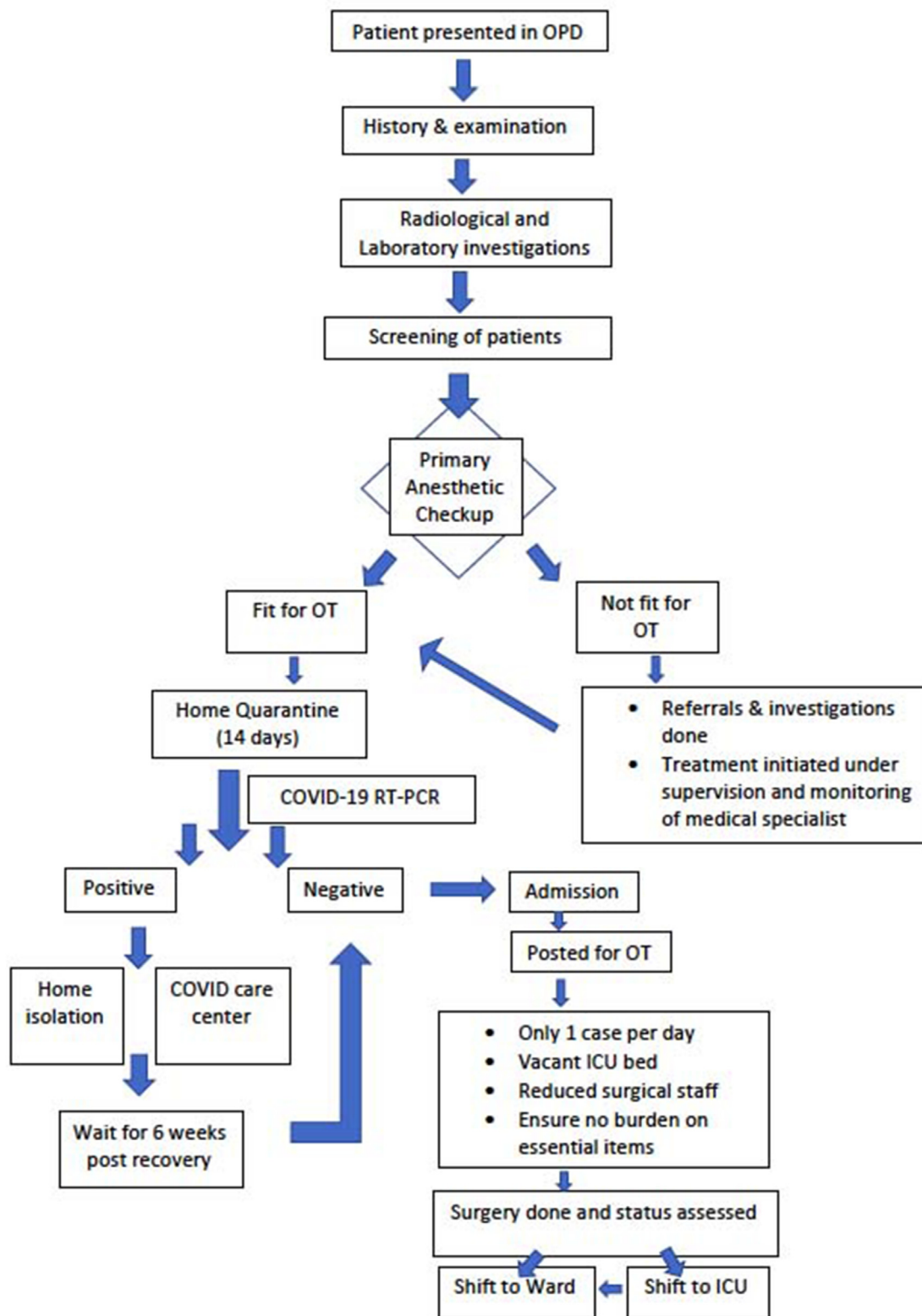


Fig. 1. Institution Surgical Protocol for patient pathway undergoing elective arthroplasty surgeries during the COVID-19.

those with multiple comorbidities and patients from regions with restricted movement of people due to lockdown or containment zones. Patients with polytrauma patients who required continual treatment for associated injuries also remained under observation

for a longer duration.

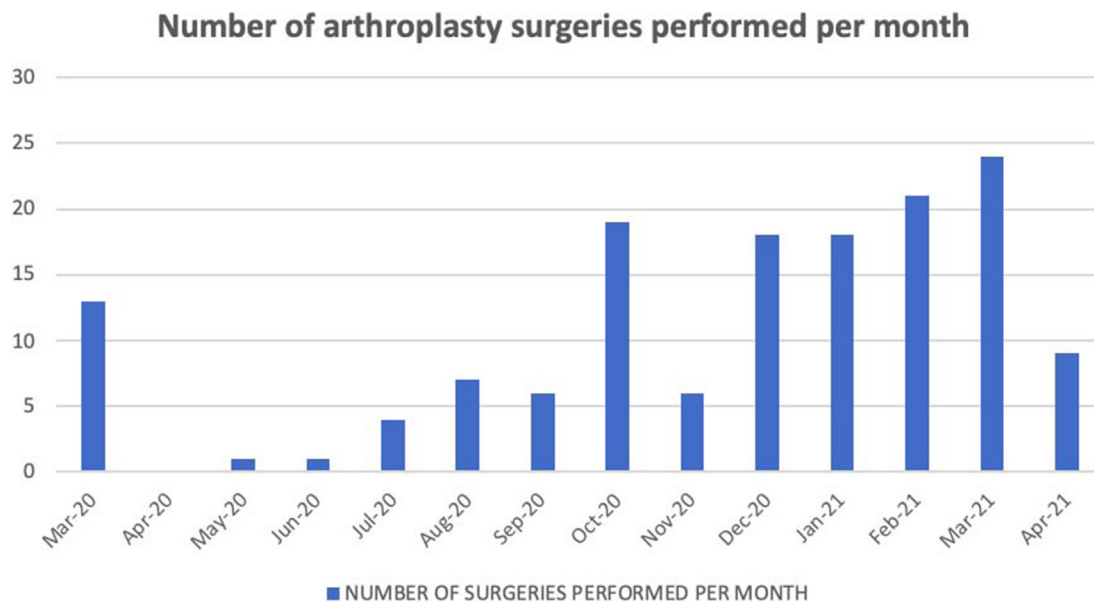


Fig. 2. Figure shows number of elective joint arthroplasty surgeries performed per month during the pandemic.

Table 1

Demographics, co-morbidities and clinico-radiological of patients undergoing joint arthroplasty surgeries during the COVID-19.

Age	Number of Patients	Proportion
0–50 years	57	38.7%
51–60 years	35	23.8%
61–70 years	35	23.8%
>70 years	20	13.6%
Sex		
Male	86	58.5%
Female	61	41.5%
Comorbidity		
None	40	27.3%
HTN	36	24.6%
DM	17	11.6%
Pulmonary Koch's	12	8.2%
Psychiatric/Neurologic Disorder	9	6.1%
COPD/Asthma	6	4.1%
Hypothyroidism	5	3.4%
CAD	5	3.4%
Habit		
Tobacco chewer/smoker	30	20.5%
Alcohol consumption	11	7.5%
Diagnosis		
Trauma (hip)	56	38%
AVN Hip	43	29.2%
TB Hip	3	b%
OA Hip	7	4.7%
Ankylosing Spondylitis (hip)	3	2%
Protrusio Acetabuli	5	3.4%
PJI (hip)	1	0.6%
Aseptic Loosening of prosthesis (hip)	2	1.3%
Chronic Dislocation (hip)	3	2%
Knee, Osteoarthritis Knee	24	16.3%

HTN: Hypertension, DM: Diabetes Mellitus, CAD: Coronary Artery Disease, COPD: Chronic Obstructive Pulmonary Disease, AVN: Avascular Necrosis, TB: Tuberculosis, OA: Osteoarthritis, PJI: Prosthetic Joint Infection.

4.6. Mortality

During the study period, one patient died in the peri-operative period. This 54-year-old patient was diagnosed with bilateral AVN

of femoral head with secondary osteoarthritis and underwent left side THA. The patient had history of chronic smoking and was hypertensive on anti-hypertensive medication. The patient expired on fourth postoperative day following a sudden massive myocardial infarction, not related to COVID-19. No autopsy was performed for the patient to rule out the cause of death.

4.7. Complications

Although peri-operative mechanical and chemical thromboprophylaxis was strictly followed in our protocol, two patients (1.3%), developed deep vein thrombosis (DVT) in the postoperative period. The first patient was 70-year-old male with history of hypertension diagnosed with neglected neck femur fracture on the right side. He underwent a hip hemiarthroplasty. The other patient was 65-year-old male with osteoarthritis of the right hip joint. He had a background history of hypertension and excess alcohol consumption. This patient has undergone unilateral THA. Post-operatively one unit blood was transfused due to low hemoglobin. Both patients were treated with therapeutic anticoagulation with full weight bearing mobilization.

Two patients (1.3%) manifested COVID-19 symptoms and tested positive on RT-PCR tests. Contact tracing of these patients was performed as per the state government guidelines in order limit disease transmission. They were shifted to the dedicated COVID-19 care ward. Both COVID-19 positive patients did not require ICU, artificial or invasive ventilation and were discharged after testing negative for COVID-19. Of the two positive patients, one suffered dislocation in the postoperative period. A close reduction of the joint replacement was carried out in the OT under anaesthesia. However, on Examination under Anaesthesia (EUA) revealed instability. Due to medical concerns, the close reduced joint was managed temporarily with on-line traction during the isolation and quarantine period. Once the COVID-19 test returned a negative test, the patient was readmitted and underwent open reduction with restoration of stability. Another patient, who had chronic hypertension and on long term antipsychotic medication, suffered fracture of femur shaft during total hip arthroplasty. The intraoperative fracture was managed with enhanced stabilization of the

**Table 2**

Peri-operative haemoglobin, serum protein and total albumin levels for (nutritional status) in patients undergoing joint arthroplasty surgeries during the COVID-19 at our centre.

Laboratory Parameter		Preoperative	Postoperative	P value
<b>Hemoglobin (gram/dl)</b>	<9	0	16	<b>&lt;0.001</b>
	9–11	30	59	
	11.1–13	61	59	
	>13	56	13	
<b>Total Protein (gram/dl)</b>	<6	14	24	<b>0.0011</b>
	6–8	113	119	
	>8	20	4	
<b>Serum Albumin (gram/dl)</b>	<3	19	23	<b>0.0025</b>
	3–5	114	124	
	>5	14	0	

prosthesis. One patient with hip arthroplasty was readmitted with features of superficial wound infection,. This was managed conservatively with intravenous antibiotics, monitoring of clinical and inflammatory markers.

## 5. Discussion

### 5.1. COVID-19 scenario in India with elective surgery and total joint replacement

COVID-19 has a profound impact on the delivery of orthopedic services in India with suspension of major elective surgical services.<sup>9</sup> Arthroplasty for severe arthritis should not be delayed as it can lead to less favourable outcomes due to disabling pain and disruption of activities of daily living for the patient. Hence resumption of arthroplasty in a safe manner has been a key challenge. Although guidelines for conducting surgeries during pandemic have been issued by surgical associations and collaborative surgical author groups, these protocols had to be modified according to infrastructure and workforce available at every centre.<sup>20,21</sup> Jain et al. and others in their review laid emphasis on promoting non-operative management for elective cases over surgical intervention.<sup>22–24</sup> However, conservative, non-operative management is difficult to apply in patients with sequelae of obligatory hip injuries (e.g. following hip fracture) or disabling pain due to AVN or advanced arthritis. Scott et al. concluded that majority of such patients will need surgeries rather than non-operative management due to state of intolerable pain.<sup>13</sup> We addressed various issues encountered in triaging of patients by previous authors and cautiously selected patients for arthroplasty surgery. In agreement with findings of Rizkalla et al., we prioritized patients requiring urgent arthroplasty in the unprecedented setting of COVID-19 pandemic.<sup>25</sup> By presenting our findings we intend to highlight the safety and efficacy of a protocol followed at our tertiary care center for carrying out arthroplasty surgeries during the pandemic.

### 5.2. Number of patients and footfall

Due to sudden nationwide lockdown imposed by the Central government of India in March 2020, arthroplasty procedures were postponed. Patients developed a fear of the unknown in this pandemic. Lockdown led to no arthroplasty procedure being performed in the month of April followed by gradual resumption to pre-COVID-19 levels. This collates with the findings of Vaishya et al. in their epidemiological study on the impact of COVID-19 on orthopaedics and trauma for the pandemic year.<sup>11</sup> The gradual, steady increase in joint replacement surgery can be attributed not only to the sequential unlocking of national restrictions from 1<sup>st</sup> June 2020, but also to the efforts made by various government and non-

government organisations regarding public awareness.

### 5.3. Comorbidities

Preoperative comorbidities have been shown to be predictive of certain postoperative complications which in turn are linked to LOS of patients in the hospital.<sup>26</sup> Among patients with comorbidities, hypertension and diabetes mellitus were the most common associated conditions. Studies from pre-COVID time suggest circulatory and endocrine diseases as the most common comorbidities associated with patients undergoing arthroplasty.<sup>27</sup> In such patients, strict monitoring and regular review of medication for comorbidities, no direct co-relation with extended LOS was seen.

### 5.4. Diagnosis and indications for arthroplasty

Arthritis following trauma formed the most common indication for arthroplasty during the pandemic at our institution. Patients from rural areas who normally constitute majority of referrals for trauma surgery at our center could not avail the necessary standard surgical facility due to restricted movements during the pandemic, presenting late with either disabling non-union or post-traumatic arthritis. The fear of contracting COVID during operative treatment in elderly age group further contributed to this delayed presentation. This finding differed from Prasoon et al. where primary osteoarthritis was the leading cause for THA followed by AVN, inflammatory diseases and trauma.<sup>28</sup>

### 5.5. Surgery performed

THA was the most performed procedure at our institute during the pandemic, followed by hemiarthroplasty and TKR. Although Agrawal et al. have included trauma cases in their single center study yet details of the procedure performed for these patients is not available.<sup>29</sup> Other reviews and studies available did not include hemiarthroplasty procedures; which in our opinion should be included as the care and vigilance for hemiarthroplasty is nonetheless comparable to total joint arthroplasty.

### 5.6. Laboratory parameters and peri-operative course

Authors of a Spanish Hip study in their evaluation emphasized the importance of laboratory investigations in managing peri-operative recovery of patients.<sup>30</sup> Measurement of laboratory parameters have shown to be of prognostic significance in patients with COVID-19. Serum Lactate Dehydrogenase (LDH) and D-dimer were done only in patients who tested positive for COVID-19. These parameters were not included in the protocol for all arthroplasty patients to circumvent extra load on the already burdened healthcare services in the pandemic. Other basic laboratory

investigations that have shown to be predictors of complications following arthroplasty like serum albumin and haematocrit were included in the protocol and analyzed.<sup>31</sup> Patients with borderline protein/albumin content were started on high protein diet to promote early healing and recovery. Although no patient with anaemia was selected for arthroplasty following protocol, yet one cross-matched blood bag was reserved prior to every surgery.

### 5.7. COVID-19 testing

Patients found fit for arthroplasty after anesthetic checkup were asked to undergo COVID-19 testing after a 14-day home quarantine. If tested negative, they were planned for surgery the following morning. This was undertaken to minimize preoperative exposure, avoid strain on COVID testing facilities and not speculate infection status.

### 5.8. Institutional protocol

At our centre measures were taken in time to ensure adequacy of staff numbers, infection prevention strategies, availability of adequate personal protective equipment, health care resources in the form of maintenance of a continuous supply chain for surgical materials, triage provision, in-hospital beds, ICU bed provision and perioperative care. The aim was to reduce financial and psychological burden on the patient. All patients with comorbidities, which predispose them to risk of infection were thoroughly screened and assessed either physically or by telephone consultation prior to surgery. Patients with severe arthritis and multiple comorbidities were prioritized as a principal case for surgery on that day for focussed care and peri-operative monitoring. This idea of organisation of patients for the operating list, especially arranging patients with multiple comorbidities in a day has not been mentioned in other studies.

### 5.9. Mortality

Perioperative mortality can occur following arthroplasty. Perioperative mortality has been found to increase due to pulmonary complications during the COVID-19 pandemic especially in patients who contracted COVID-19.<sup>14</sup> In present study one COVID-19 negative patient died in post-operative period due to myocardial infarction. It has been observed that smoking is associated with increased incidence of medical complications, higher analgesia usage and mortality following arthroplasty.<sup>32</sup> Further subclinical and or clinical myocardial infarction has been reported after arthroplasty especially in elderly and hypertensive patients.<sup>33</sup>

### 5.10. Complications

Post-operative complication is a concern following any joint replacement surgery. A higher incidence of thromboembolic events has been reported during COVID-19.<sup>34</sup> In addition to arthroplasty and other surgeries, trauma, immobilization, history of a prior thromboembolic event along with several medical conditions such as atherosclerosis, hypertension, dyslipidemia, and chronic kidney disease have been associated with the development of DVT.<sup>35</sup> VTE prophylaxis, early full weight bearing mobilization prevents these complications to a large extent. However, there is still an element of 0.1% risk of non-fatal and fatal PE which causes death in such patients. This was discussed in the consent process. In our study, 2 patients developed deep vein thrombosis in the postoperative care despite strict thromboprophylaxis. Both patients had hypertension as a risk factor for developing DVT. These were managed conservatively, with pharmacotherapy and physical therapy in our ward.

Our post-operative protocol of early, weight bearing mobilisation and lower incidence of venous thrombo-embolism in the Indian sub-continent compared to western countries, helped mitigate this common complication.<sup>36</sup>

Although we intended to discharge patients early in the post-operative course, certain patients with excessive blood loss or undergoing revision surgery or from places with a difficult follow-up visit and patients with polytrauma were kept admitted for observation for a longer duration.

In the study by Agrawal et al., three patients (1.3%) were readmitted within 30- days of discharge. One death (0.45%) occurred, due to SARS-CoV-2 infection after an emergency procedure. Further, there was no observed spike in complications during in-hospital stay or in the early postoperative period.<sup>29</sup> Similarly, the results of a study by Stoneham et al. showed a low incidence of contracting COVID-19 virus during admission for arthroplasty surgeries for trauma and there was no significant sequelae and mortality. In their study only 2% patients contracted COVID-19 during inpatient stay with no mortality.<sup>37</sup> The result of our study and findings of Agrawal et al., Stoneham et al. show that performing arthroplasty surgeries during COVID-19 period is safe, when undertaken with appropriate precautions.

A brief assessment of our findings in comparison with other previous studies is shown in [Table 3](#).

### 5.11. Current situation and vaccination

At the time of writing this article, India is experiencing a second wave of COVID-19 pandemic. Efforts by both state and central governments are underway to flatten the curve and ramping up the vaccination programme to prevent third wave of pandemic. Mass vaccination will help curtail public fear, lead to improved public footfall for arthroplasty and risk of contracting peri-operative COVID-19 infection.

## 6. Limitation of the study

There were a few limitations to this study. Firstly, the retrospective nature of this study reduces the robustness of the observations. However, it has allowed us to assess clinical results and outcomes in patients undergoing arthroplasty surgery in a challenging situation of COVID-19. The lessons learnt during this experience will help us to prepare for the future in the form of streamlining COVID-19 testing and setting up peri-operative protocols.

Secondly, India does not have a well-established National Joint Registry as one existing in the United Kingdom, Europe and Australia. Hence, it is difficult to compare our results with those in other parts of India due to lack of such a national database and reporting system. However, it has provided a unique insight in managing such patients in a safe manner in a government funded health care system in the background of COVID-19. This can provide a template to replicate across the country.

### 6.1. Conclusion

There is scarcity of evidence to guide restarting joint arthroplasties during the COVID-19 pandemic especially in a resource stretched and populous country such as India. It can be observed from our study that performing arthroplasty for severe OA of hip and knee joints and for fracture neck femur in the elderly is safe during the post lockdown period, with diligent attention to infection control strategies. It requires a meticulous selection of patients scheduled for arthroplasty surgery. A stringent peri-operative surgical institution protocol can optimise patient care and safe

**Table 3**  
Studies in Literature highlighting clinical outcomes in patients undergoing joint arthroplasty during COVID-19.

Author	Centres involved	F:M	Surgeries performed	Duration of study (months)	Age Mean $\pm$ SD (Years)	Duration of stay in hospital, n(%)	Complications
Agrawal et al. <sup>29</sup>	Single centre (also include trauma)	2.2:1	224 (total)	3	69.4	<7 days = 183 (82%) 8–14 days = 29 (13%) >14 days = 12 (5.3%) 7 days (Median)	Positive: 6 (3%) Mortality: 2 (0.9%) 16.7% mortality if COVID +
Stoneham et al. <sup>37</sup>	4 centres (arthroplasty)	2.42:1	48 (total)	4	73		Positive: 1 (2.1%) Dislocation: 1 (2.1%) Blood transfusion: 4 (8.3%) AKI: 2 (4.2%) HAP: 1 (2.1%) Delirium: 1 (2.1%) Electrolyte imbalance: 2 (4.2%)
Nicholas et al. <sup>38</sup>	Multicentre (arthroplasty)	NA	1073 (total)	1	NA	NA	Positive: 6 (0.6%) (including 1 symptomatic but not tested) Mortality: 3 (0.3%) 20% mortality if COVID +
Kazubski et al. <sup>39</sup>	2 centres (arthroplasty)	1.51:1	141 (total) THR = 91 TKR = 32 Rev = 18	8	68.13	5.8 days (Mean)	NA
Decruz et al. <sup>40</sup>	Single centre (arthroplasty)	2.9:1	47 (total) TKR = 32 THR = 3 UKA = 10 Rev = 2	3	68 (min age 50)	<5 days = 29 (61.7%) 5–10 days = 16 (34%) >10 days = 2 (4.2%)	NA
Our study	Single centre (arthroplasty)	1:1.38	147 (total) THR = 71 TKR = 24 HEMI = 45 Rev = 6	14	54.55 $\pm$ 16.67	<7 days = 99 (67.3%) 8–14 days = 31 (21%) >14 days = 16 (10.8%)	Positive: 2 (1.3%) Dislocation: 1 (0.6%) Blood transfusion: 41 (28%) Infection: 1 (0.6%) Fracture: 1 (0.6%) DVT: 2 (1.3%) Mortality: 1 (0.6%)

Abbreviations: F:M: Female to male ratio; THR: Total Hip Replacement; TKR: Total Knee Replacement; UKA: Unicompartmental Knee Arthroplasty; Rev: Revision Arthroplasty; NA: Not Available; AKI: Acute Kidney Injury; HAP: Hospital Acquired Pneumonia; DVT: Deep Vein Thrombosis.

environment to conduct such surgery.

Minimizing number of members in the surgical team in the operating room and rationalizing the number of surgical cases per day can not only help prevent post-operative surgical site infection (SSI) but also reduce the risk of acquiring COVID-19 infection by patients and surgical staff. This ensures efficient utilization of essential health resources.

As nationwide vaccination program against COVID-19 progresses, pre-operative SARS-CoV-2 vaccine strategy will help conduct safe arthroplasty surgery and reduce complications attributable to COVID-19 in the peri-operative period.

### Contributors

OPM involved in Conceptualization, literature search. PK, VKJ involved in data collection, literature search, manuscript writing and editing. AS, KPI, AKN involved in review of manuscript, supervision of the project and approved the final draft. All authors have read and agreed the final manuscript submitted.

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### Declaration of competing interest

“The authors declare no conflict of interest”.

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