



■ GENERAL ORTHOPAEDICS

Elective orthopaedic surgery with a designated COVID-19-free pathway results in low perioperative viral transmission rates

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Aims

The safe resumption of elective orthopaedic surgery following the peak of the COVID-19 pandemic remains a significant challenge. A number of institutions have developed a COVID-free pathway for elective surgery patients in order to minimize the risk of viral transmission. The aim of this study is to identify the perioperative viral transmission rate in elective orthopaedic patients following the restart of elective surgery.

Methods

This is a prospective study of 121 patients who underwent elective orthopaedic procedures through a COVID-free pathway. All patients underwent a 14-day period of self-isolation, had a negative COVID-19 test within 72 hours of surgery, and underwent surgery at a COVID-free site. Baseline patient characteristics were recorded including age, American Society of Anaesthesiologists (ASA) grade, body mass index (BMI), procedure, and admission type. Patients were contacted 14 days following discharge to determine if they had had a positive COVID-19 test (COVID-confirmed) or developed symptoms consistent with COVID-19 (COVID-19-presumed).

Results

The study included 74 females (61.2%) and 47 males (38.8%) with a mean age of 52.3 years \pm 17.6 years (18 to 83 years). The ASA grade was grade I in 26 patients (21.5%), grade II in 70 patients (57.9%), grade III in 24 patients (19.8%), and grade IV in one patient (0.8%). A total of 18 patients (14.9%) had underlying cardiovascular disease, 17 (14.0%) had pulmonary disease, and eight (6.6%) had diabetes mellitus. No patients (0%) had a positive COVID-19 test in the postoperative period. One patient (0.8%) developed anosmia postoperatively without respiratory symptoms or a fever. The patient did not undergo a COVID-19 test and self-isolated for seven days. Her symptoms resolved within a few days.

Conclusion

The development of a COVID-free pathway for elective orthopaedic patients results in very low viral transmission rates. While both surgeons and patients should remain vigilant, elective surgery can be safely restarted using dedicated pathways and procedures.

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Introduction

COVID-19 was declared a pandemic by the World Health Organization (WHO) on 11 March 2020.¹ Globally, healthcare systems faced the enormous challenge of managing the peak of the pandemic while limiting the number of lives lost. The initial response to the pandemic included the cessation of routine

services including elective orthopaedic surgery. Many orthopaedic staff were redeployed to the intensive therapy unit (ITU), formed “proning” teams, and managed minor injury units in the emergency department.^{2,3} However, as the peak of the pandemic passes, the challenge shifts to the safe resumption of routine medical services including elective orthopaedic surgery.

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There is apprehension among both surgeons and patients about restarting elective surgical services. A recent study suggested that only 56.8% of patients previously booked for surgery wanted to undergo their planned procedure once elective services resumed.⁴ The high mortality rate in perioperative patients who contract COVID-19 is of particular concern. One study reported a 30-day mortality rate of 23.8% in patients who had contracted COVID-19 in the perioperative period.⁵ In addition, London, UK, has become one of the worst affected cities globally; as of 17 June 2020, there were 27,354 confirmed cases and 6,079 deaths in patients with COVID-19 in London hospitals alone.⁶ This highlights the dilemma faced by healthcare systems in restarting elective surgical services while trying to minimize potential COVID-19 transmission, particularly in an epicentre such as London.

A designated COVID-19-free pathway was developed in our institution to minimize the risk of COVID-19 transmission in elective surgical patients. The hospital was separated into two separate “zones” including a “green” COVID-19-free zone and a “blue” potential COVID-19 zone. Additionally, two independent private hospitals were converted into COVID-19-free sites for National Health Service (NHS) use. All patients undergoing elective surgery are required to self-isolate for a period of 14 days and test negative for COVID-19 within 72 hours prior to their surgery. In addition, these patients are all admitted through the COVID-free pathway in order to minimize viral transmission risk. In contrast, all patients admitted through the emergency department (ED), including all trauma patients, are admitted under the “blue” COVID-19 pathway due to uncertain COVID-19 exposure and status.

The aim of this study is to assess the effectiveness of a designated COVID-19-free pathway in minimizing viral transmission rates in elective orthopaedic patients. Our hypothesis is that a preoperative 14-day period of self-isolation, negative COVID-19 test within 72 hours of surgery, and admission through a COVID-19-free pathway results in low transmission rates of the virus.

Methods

Study design. This is a prospective study of 121 consecutive patients who underwent an elective orthopaedic procedure in the first four weeks following the resumption of elective operating services during the COVID-19 pandemic. The study dates are from 26 May 2020 to 19 June 2020. Patients were included if they self-isolated 14 days prior to surgery, had a negative COVID-19 test within 72 hours of surgery, and were admitted through the COVID-19-free pathway. Patients who underwent emergency procedures and trauma operations were excluded. Ethical approval was not required as this was considered a necessary evaluation of service.

Table 1. Questionnaire derived from the NHS diagnosis criteria for COVID-19.⁸

Question asked	Answer
Have you experienced a high temperature since the date of your operation?	Yes/No
Have you developed a new cough since the date of your operation?	Yes/No
Have you experienced any shortness of breath since the date of your operation?	Yes/No
Have you noticed any loss of smell since the date of your operation?	Yes/No
Have you noticed any change in taste since the date of your operation?	Yes/No
Have you had a COVID-19 swab since being discharged from the hospital?	Yes/No
Have you developed any other concerning symptoms since your operation?	Yes/No

NHS, National Health Service

Outcomes. Baseline characteristics including sex, age, American Society of Anaesthesiologists (ASA) grade, body mass index (BMI), comorbidities, surgical procedure, and admission type were recorded. The primary outcome was transmission of COVID-19 infection in the perioperative period following elective orthopaedic surgery. Patients were considered COVID-19-positive for the virus if they had a positive COVID-19 laboratory test, irrespective of symptoms experienced (COVID-19 confirmed).⁷ Patients were also considered COVID-19-positive if they experienced any of the main criteria described by the NHS including a high temperature, a new or continuous cough, and/or a loss or change in sense of smell or taste. Patients were designated as COVID-19 presumed if they did not undergo a confirmatory laboratory test or had an inconclusive test.⁸ All patients were contacted by a member of the orthopaedic team 14 days after discharge and were asked questions from a pre-designed questionnaire derived from the diagnostic criteria by NHS England (Table 1).⁸ This included determining whether patients had a confirmed positive test or experienced symptoms of COVID-19 within 14 days of hospital discharge.

COVID-free pathway for elective orthopaedic patients. The British Orthopaedic Association (BOA) and the NHS have released guidelines for the safe resumption of elective surgical services.^{9,10} These guidelines include a period of self-isolation prior to surgery, a preoperative COVID-19 test, and surgery in a designated COVID-19-free zone. At our institution, a central London tertiary centre, the hospital was divided into a COVID-19-free zone and a “possible” COVID-19 zone. Each zone had designated entrances, wards, operating theatres, and staff. Patients in the COVID-19-free pathway used a separate entrance to the hospital, designated elevators, and were admitted to COVID-19-free wards. In addition, hospital staff are divided into separate teams that cannot cross pathways within the same 24-hour period in order to minimize the risk of viral transmission. Two independent hospitals were also

designated as COVID-19-free areas for NHS use; the risk of cross-contamination at these sites is likely reduced further.

Patients with clinically urgent procedures and who were deemed low risk for COVID-19-related complications were prioritized. However, urgent procedures in higher-risk patients were also undertaken. All elective surgical patients, and their respective households, were instructed to self-isolate for a period of 14 days prior to surgery. A self-isolation period of 14 days was selected on evidence that 99% of patients will develop symptoms within 14 days of exposure to the virus.¹¹ Pre-assessment clinics were carried out in a face-to-face manner approximately 15 days prior to the scheduled procedure before the self-isolation period. In addition, all patients underwent a reverse transcription polymerase chain reaction (RT-PCR) COVID-19 test within 72 hours of their scheduled operation date. Only patients with a negative test were allowed to proceed with surgery. Patients were tested at a “drive-through” facility to enable easy and rapid testing with appointments staggered to maintain social distancing and reduce the risk of viral transmission. Patients were also advised to avoid taking public transport to the hospital both for their COVID-19 test and for their operation.

Once admitted to hospital, social distancing measures were observed and patients were allocated private rooms where possible. All patients and hospital staff wore surgical masks in the hospital and full personal protective equipment (PPE), including FFP3 masks, protective visors, gloves, and gowns for any aerosol-generating procedures. Prior to surgery, all patients were specifically consented for the risk of COVID-19 transmission in the perioperative period. The potential complications associated with the disease including intensive therapy unit (ITU) admission and an increased perioperative mortality rate of up to 23.5% were discussed. Postoperatively, all patients were admitted to a COVID-free ward. Only staff assigned to the COVID-19-free pathway were able to care for the patients while they remained in hospital in order to minimize the risk of viral transmission.

Results

A total of 125 elective orthopaedic cases were scheduled from 26 May 2020 to 19 June 2020. Four of these procedures (3.2%) were cancelled: two patients (1.6%) postponed their operations at the last minute due to fear of COVID-19 contraction; and two patients (1.6%) were deemed not fit for surgery after being seen in the pre-assessment clinic.

Overall, 121 patients underwent elective orthopaedic procedures in the study period. The study included 74 females (61.2%) and 47 males (38.8%) with a mean age of 52.3 ± 17.6 years (18 to 83) (Table II). The ASA grade was classified as grade I in 26 patients (21.5%), grade II

Table II. Baseline patient characteristics.

Characteristic	Variable
Overall, n	121
Age yrs, mean (range)	52.3 ± 17.6 (18 to 83)
Sex, n (%)	
Female	74 (61.2)
Male	47 (38.8)
ASA grade, n (%)	
I	26 (21.5)
II	70 (57.9)
III	24 (19.8)
IV	1 (0.8)
Comorbidities, n (%)	
Cardiovascular disease	18 (14.9)
Pulmonary disease	17 (14.0)
Diabetes	8 (6.6)
Admission type, n (%)	
Day case	58 (47.9)
Inpatient	63 (52.1)

ASA, American Society of Anaesthesiologists.

in 70 patients (57.9%), grade III in 24 patients (19.8%), and grade IV in one patient (0.8%). The BMI was 28.0 ± 6.3 (19.2 to 50.6). A total of 18 patients (14.9%) had a history of cardiovascular issues, 17 patients (14.0%) had a history of pulmonary disease, such as asthma and chronic obstructive pulmonary disease (COPD), and eight patients (6.6%) had underlying diabetes mellitus. The various surgical procedures performed are listed in Table III. There were 58 day-case procedures (47.9%) and 63 inpatient procedures (52.1%).

One patient (0.8%) developed anosmia 12 days post-operatively and was designated as COVID-19 presumed. However, this patient did not develop a fever or other respiratory symptoms; fortunately, the symptoms resolved within a few days. The patient did not undergo a COVID-19 test and self-isolated for seven days after developing symptoms. None of the other patients in our cohort experienced any positive symptoms of COVID-19 and, as a result, did not warrant a COVID-19 test.

Discussion

The resumption of routine medical and surgical services after the peak of the COVID-19 pandemic poses a great challenge to healthcare systems globally. There is increasing debate over the safest time to resume routine services, including elective orthopaedic services. While the concern of hospital-acquired COVID-19 transmission is significant, the true risk is uncertain.¹²

Our study demonstrates that elective orthopaedic surgery can be safely restarted following a designated COVID-19-free pathway. At our institution, no patients tested positive for COVID-19 postoperatively and one patient was classified as a presumed COVID-19 case due to the development of anosmia 12 days after surgery.

Table III. Elective orthopaedic procedures performed.

Procedure	Number
Overall	121
Primary knee arthroplasty	14
Primary hip arthroplasty	32
Revision knee arthroplasty	1
Revision hip arthroplasty	4
Knee arthroscopy (including meniscectomy/meniscal repair)	8
Knee ligament reconstruction	6
Hand and wrist procedures	16
Removal of metalwork	8
Unicompartmental/patellofemoral knee arthroplasty	4
Primary shoulder arthroplasty	1
Revision shoulder arthroplasty	1
Shoulder arthroscopic procedures	5
Foot and ankle procedures	4
All other procedures	17

That patient did not undergo a confirmatory test after the onset of her symptoms. Fortunately, this patient did not develop a fever or cough and the symptoms resolved within a few days. It is also possible that her symptoms were not related to her perioperative care as the patient did not self-isolate following hospital discharge and the onset of symptoms was late. While our institution is still in the early phases of restarting elective surgery, there is growing confidence that elective procedures can be performed in a safe environment that greatly minimizes the risk of COVID-19 transmission and its associated complications.

A significant concern for restarting elective surgery includes reports of high mortality rates in patients who contract COVID-19 in the perioperative period. An international cohort study involving 1,128 patients reported a 30-day perioperative mortality of 23.8% among COVID-19-positive patients.³ Additionally, another early COVID-19 study from Wuhan, China, reports a high complication rate and 20% mortality rate associated with patients who contracted COVID-19 in the early postoperative period.¹³

Despite these concerns, a significant proportion of patients want to proceed with their scheduled operations. A recent study suggested that 56.8% of patients who were previously listed for surgery wanted to proceed with their operations at the earliest opportunity. These patients were willing to self-isolate for 14 days and to be tested for COVID-19 within 72 hours prior to surgery.⁴

Elective orthopaedic procedures are typically performed to improve quality of life and physical function.^{14,15} Primary joint arthroplasty is one of the most successful procedures in terms of improving quality of life, and patients are often in significant pain and severely debilitated prior to surgery.¹⁶⁻¹⁸ Furthermore,

a significant deterioration in patients' physical and mental health can arise with a delay in surgery. One study reported that 19% of patients waiting for a total hip arthroplasty (THA) and 12% of those waiting for a total knee arthroplasty (TKA) are in a 'worse than death' state, based on the EuroQol five-dimension (EQ-5D) questionnaire, where pain is a key factor.¹⁹

Strategies to reinstate elective surgery have focused on patient risk assessment, surgical procedure and comorbidities.^{20,21} An international collaborative study reported an association between COVID-19 mortality with ASA grade and advanced age.⁵ In addition, age > 50 years, history of smoking, and the presence of comorbidities are all associated with a higher risk of mortality following COVID-19 infection.²² At our institution, low-risk patients with urgent procedures were prioritized for surgery. In our study, 79.3% of patients operated on were classified as ASA grade I or II. Initially, in the first week following resumption of elective services, all procedures were day cases, however, planned inpatient procedures were restarted the following week. In addition, high-risk patients who required urgent procedures also underwent surgery. As more complex elective procedures in higher-risk patients are performed, both surgeons and patients must remain alert in order to minimize virus transmission.

Our study has some limitations. At our institution, low-risk patients with urgent procedures were prioritized, with 96 patients (79.3%) classified as ASA grades I and II. This population is more likely to develop asymptomatic disease which may not be reflected in our results. As more complex procedures in higher-risk patients are performed, patients with more severe symptoms may be observed. Also, major surgery can have an impact on the immune system for a period that is greater than 14 days.²³ While performing the study 14 days post-discharge captures the perioperative transmission rate in hospital, patients may still be more vulnerable to viral transmission post-discharge in the community. However, as the incidence of COVID-19 continues to decrease in the UK, there is confidence that viral transmission rates and subsequent complications will follow. Another limitation is that not all patients were formally tested for COVID-19 in the postoperative period; it is possible that there is a percentage of asymptomatic COVID-positive patients in our group. At the time of this study, widespread testing of postoperative patients for COVID-19 was not feasible as tests were reserved for symptomatic patients. Future studies formally testing all postoperative patients for COVID-19 would likely provide a more accurate perioperative transmission rate. Multiple studies have described symptoms that have been associated with COVID-19.^{24,25} Clemency et al reported positive likelihood ratios (PLR) for certain COVID-19 symptoms in

a study involving 961 healthcare workers.²⁶ The study found that the loss of smell and taste had the greatest PLR (3.33, 95% confidence interval (CI) 2.60 to 4.06), followed by fever (1.79, 95% CI 1.56 to 2.03). No other symptom had a significant PLR.²⁶ These findings can be used to aid in the determination of who should be tested.

In addition, our institution is currently able to utilize the independent sector hospitals for NHS operating lists, where providing a COVID-19-free pathway is more straightforward. It may not be possible to replicate this type of arrangement in other healthcare systems. As care begins to shift from the independent sector, hospitals will need to continue to ensure that clearly designated COVID-free pathways exist in order to minimize transmission rates.

Restarting elective surgery during the COVID-19 pandemic remains a significant global challenge. While it is impossible to completely eliminate the risk of viral transmission, the development of a designated COVID-free pathway is an effective way to safely resume elective surgery. As elective operating returns to a “new normal”, surgeons must remain alert in order to minimize virus transmission and continue to provide appropriate and safe orthopaedic surgical care.



Take home message

- Elective orthopaedic surgery can be safely resumed with a designated COVID-free pathway.
- A designated COVID-free pathway results in low

perioperative viral transmission rates.

- Surgeons must remain alert in order to minimize virus transmission and continue to provide safe orthopaedic surgical care.

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- J. S. Chang: Generated the hypothesis, Prepared the manuscript, Interpreted the data.
- W. Wignadasan: Collected the data, Prepared the manuscript.
- R. Pradhan: Collected the data, Prepared the manuscript.
- C. Kontoghiorghe: Prepared the manuscript.
- B. Kayani: Interpreted the data, Prepared the manuscript.
- F. S. Haddad: Generated the hypothesis, Prepared the manuscript.

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Ethical review statement:

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