ACTA ORTHOPAEDICA et TRAUMATOLOGICA TURCICA
www.aott.org.tr

Research Article

Is elective surgery during the COVID-19 pandemic safe? A multi-center prospective study in a high incidence area

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ARTICLE INFO

Article history:
Submitted March 22, 2021
Received in revised form
July 5, 2021
Accepted December 8, 2021

Keywords:
COVID-19
Surgery
Orthopaedics
Elective surgery

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ABSTRACT

Objective: The aim of this study was to describe the evolution of patients admitted for elective orthopaedic surgery during the immediate post-COVID-19 peak of the pandemic.

Methods: This is a multi-center, observational study conducted in 8 high complexity hospitals of Catalonia, one of the highest COVID-19 incidence areas in Spain. We included patients ≥18 years of age undergoing elective surgery (total knee or hip arthroplasty, knee or hip revision arthroplasty, shoulder or knee arthroscopy, hand or wrist surgery, forefoot surgery, or hardware removal) after the COVID-19 peak (between May 5th and June 30th, 2020). The main exclusion criterion was a positive result for SARS-CoV-2 PCR within the 7 days before the surgery. The primary outcomes were postoperative complications within 60 days (+/-30) or hospital readmission due to a COVID-19 infection. Following the recommendations of the International Consensus Group (ICM), elective surgeries were re-started when the nationwide lockdown was lifted. Before the surgery, patients were contacted by phone to rule out any exposure to confirmed COVID-19 cases, a reverse transcription-polymerase chain reaction (PCR) assay was performed in all patients 48-72 hours before hospital admission, and they were asked to maintain home confinement until the day of the surgery.

Results: 675 patients were included: 189 patients in the arthroplasty group (28%) and 486 in the ambulatory surgery group (72%). Mean [SD] age was 57.6 [15.3] years. The mean Charlson Comorbidity Index score was 2.21 (SD = 2.01, Min = 0, Max = 13). A total of 84 patients (12.75%) obtained an American Society of Anesthesiologists (ASA) score ≥ 3, showing no association between the ASA score and the risk of developing COVID-19 symptoms at follow-up (χ 2 (4) = 0.77, P = 0.94). The mean occupation rate of hospital beds for COVID-19 patients was 13% and the mean occupation rate of critical care beds for COVID-19 patients was 27% at the time of re-introducing elective surgeries. These were important rates to consider to decide when to reintroduce elective surgeries after lockdown. Surgical time, time of ischemia and intra-operative bleeding were not related with a higher risk of developing COVID-19 post-operatively (χ 2 (1) = 0.00, P = 0.98); (χ 2 (2) = 2.05, P = 0.36); (χ 2 (2) = 0.37, P = 0.83). Only 2 patients (0.3 %) presented with a suspected COVID-19 infection at follow-up. None of them presented with pneumonia or required confirmation by a reverse transcription PCR assay. Hospital re-admission was not needed for these patients.

Conclusion: The risk of developing COVID-19 during the immediate post-COVID-19 peak in a region with a high incidence of COVID-19 has not been proved. These data suggest that elective orthopaedic surgeries can be resumed when assertive and strict protocols are followed.

Level of Evidence: Level II, Prognostic Study

Introduction

On December 31st 2019, China reported a cluster of cases of pneumonia with an unknown aetiology in the city of Wuhan.[1] On March 11th 2020, the World Health Organization declared the Coronavirus disease 2019 (COVID-19) outbreak as a pandemic.

Within Spain, Catalonia was one of the most affected regions during the COVID-19 pandemic, with a high mortality rate (58,000 cases; 12,000 deaths in a ~7 million population region) at the start of the study period.[2]

To restrain the outbreak, containment and mitigation policies were endorsed worldwide using different measures, including the total paralysis of elective surgeries.

The massive number of patients affected by severe respiratory symptoms overwhelmed healthcare systems. In most severe cases ventilatory support was required, causing Intensive Care Units (ICU) to collapse. Many areas in hospitals, such as Post Anaesthetic Care Units, had to be adapted with ventilators from operating theatres to increase the capacity of ICU beds.[3,4]

Most elective surgeries[5] were deferred, except for oncologic surgeries, to ensure adequate hospital capacity and anaesthesiologists dedication to ICUs, to prioritize ventilators for severe COVID-19 cases, and to avoid nosocomial infections. A significant drop in

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Cite this article as: *Sastre S, Jornet-Gibert M, Yela-Verdú C, et al. Is elective surgery during the COVID-19 pandemic safe? A multi-center prospective study in a high incidence area. Acta Orthop Traumatol Turc 2022; 56(1):14–19.*

DOI: 10.5152/j.aott.2021.21153

surgical activity triggered a substantial impact on patients' wellbeing and potentially devastating consequences for healthcare systems.[5,6]

Resuming deferred activity was considered when hospitals' occupation with COVID-19 patients and the number of new cases in the area tended to decrease. Both institutions and enlarged patient waiting lists, surgeries having been cancelled or postponed, presented a great pressure to the health system.[7] Institutions started considering strategies to resume elective surgeries in safe conditions. Guidelines for planning the resumption of elective surgeries arose simultaneously to the restart of elective activity.[8,9]

The main objective of this study is to describe the evolution of patients admitted for elective orthopaedic surgeries during the immediate post COVID-19 peak of the SARS-CoV-2 pandemic, aiming to develop a therapeutic guide recommendation for these patients. Our hypothesis is that re-introduction of elective orthopaedic surgeries (arthroplasties and ambulatory surgeries) in the immediate post COVID-19 period, in patients who are not infected by the COVID-19, is safe and does not increase the risk of COVID-19 infection and complications.

Materials and Methods

Study design

We performed a national, multicentre, prospective, observational, cohort study with patients who underwent elective surgery after the COVID-19 pandemic peak in eight hospitals in Catalonia, Spain (see full list in Acknowledgements). The study was approved by the IRB of each institution (HCB/2020/0678, protocol V. 1.1). Written informed patient consent was obtained for the use of data for scientific purposes either at the time of the surgery or at follow-up.

The study was performed according to the STROBE guidelines for observational studies.[10]

Participants

Each participating hospital included all patients ≥18 years of age undergoing elective surgeries including total knee or hip arthroplasty, knee or hip revision arthroplasty, shoulder or knee arthroscopy, hand or wrist surgery, forefoot surgery, or hardware removal.

The main exclusion criterion was a positive SARS-CoV-2 result on a PCR within 7 days before the surgery. Patients were generally screened for SARS-CoV-2 before the surgery. The study was initiated at the same time that elective surgeries restarted, immediately after the COVID-19 pandemic peak in Spain. It included surgeries performed from May 5th to June 30th, 2020. Participating hospitals prospectively screened patients for eligibility to ensure that all patients who met the eligibility criteria were recruited.

Following the recommendations of the International Consensus Group (ICM),[11] elective surgeries were restarted when the nationwide lockdown was lifted.

HIGHLIGHTS

- Reintroducing orthopaedic elective surgeries after the COVID-19 outbreak is a safe medical strategy.
- Assertive and strict protocols to screen for COVID-19 should be followed.
- Post-surgery COVID-19 infection, surgical mortality, and complications are not significantly higher in these patients.

Before surgery, the patients were contacted by phone, asking them whether they had presented with any COVID-19 related symptoms in the previous two weeks, possible risk of contact with infected population and previous travels. A reverse transcription polymerase chain reaction (PCR) assay in nasopharyngeal swabs was performed in all patients 48-72 h before hospital admission and they were asked to maintain home confinement from the moment the PCR assay was performed until the day of the surgery.

During hospital stay, family visits were restricted, and the use of a face-covering mask was mandatory. On admission, vital signs such as temperature, oxygen saturation, blood pressure and heart rate were recorded, and patients were asked again about COVID-19 related symptoms and contacts.

Hospital occupation (ward beds and ICU beds) was registered for each of the participating hospitals at the moment of re-starting elective surgeries. Most of the hospitals had to transform speciality wards into COVID-19 spaces. The occupation of ward beds with COVID-19 patients ranged from 3 to 28%, from which the occupation of critical care areas with COVID-19 patients was 6 to 39% (Table 1).

Outcomes

The primary outcomes of the study were the appearance of postoperative symptoms compatible with COVID-19 or a confirmed diagnosis of COVID-19 within 60-days (± 30), establishing the day of the surgery as day 0.

Data collection

We collected only routinely anonymised data with no change to clinical care pathways.

Demographic, clinical, treatment, and outcome data were extracted from electronic medical records using a customized online data collection form.

The reported clinical variables included medical history and comorbidities, the American Society of Anesthesiologists (ASA) score at the time of the surgery and blood test results before the surgery.

Physiological variables were recorded immediately before the surgery.

Operative variables included the type of primary surgical procedure and the anaesthesia technique performed.

The length of hospital stay and the need for Intensive Care Unit admission was also recorded.

Follow-up was carried out by reviewing the medical records of the patients. This included notes of the family doctor or other specialists

Table 1. COVID-19 occupation in the participating hospitals at the time of restarting elective orthopaedic surgeries

Hospital no.	Hospital level	Total number of beds	COVID-19 occupation	Total number of ICU beds	COVID-19 ICU occupation
1	III	1108	65 (6%)	82	28 (34%)
2	III	755	85 (11%)	37	11 (30%)
3	III	718	101 (14%)	62	21 (24%)
4	III	321	89 (28%)	18	6 (33%)
5	II	343	80 (23%)	18	7 (39%)
6	II	328	10 (3%)	33	2 (6%)
7	II	250	14 (6%)	22	4 (18%)
8	II	120	28 (23%)	-	

ICU, Intensive Care Unit.

who had visited the patient, and laboratory reports of clinical analysis from any centre of the public network of hospitals existing in Catalonia. Patients who were not visited at the intervention centre within 60 days post-operatively were contacted by telephone.

Statistical analysis

Continuous data were tested for distribution, with normally distributed data presented as mean and Standard Deviation (SD). The statistical analysis of study outcomes was performed using the independent samples *t*-test for continuous variables with normal distributions. Categorical variables were compared using the chi-squared (χ^2) test.

A multivariate logistic regression model was performed to analyse the probability of developing complications related to the surgery. The Charlson comorbidity index, sex and age, type of surgery performed, blood differential test, and pre-operative diagnosis of a COVID-19 infection were entered as variables.

Statistical significance was set at $P < 0.05$ for all analyses. Statistical analyses were carried out using the Stata software package (StataCorp, TX, USA).

Results

Patients

A total of 675 patients from eight different hospitals were included: 189 patients underwent an arthroplasty surgical procedure (including 87 total knee arthroplasties (TKA), 60 total hip arthroplasties (THA), 26 knee revision arthroplasties, and 16 hip revision arthroplasties) and 486 patients underwent ambulatory surgical procedures (including 56 shoulder arthroscopies, 106 knee arthroscopies, 166 hand or wrist surgeries, 123 forefoot surgeries, and 35 hardware removal surgeries). We grouped the latter procedures under the ambulatory surgery term, which comprises overnight stay or hospital discharge within the first 24 hours. There were missing data for five patients.

Table 2 shows a summary of the main demographic and surgical variables. The variables were described for the total number of included patients. A total of 11 patients (1.63%) had a previous diagnosis of COVID-19, not active at the time of the surgery, and 22 patients (3.28%) reported having had contact with a COVID-19 patient or a positive subject in the days before surgery, but not in the period that could imply an exclusion criterion. All patients reported not having had contact with COVID-19 patients between the PCR assay was taken and the surgery. Chest radiograph was normal in 311 patients (46.07%). In 5 patients (0.75%) it showed pulmonary infiltrates and in 29 patients (4.32%) it showed some pathological image, although not compatible with the COVID-19 typical radiograph presentation. The chest radiograph was considered not necessary in 330 patients (49.18%).

A total of 84 patients (12.75%) had ASA scores ≥3, showing no association between the ASA score and the risk of developing COVID-19 symptoms during follow-up ($\chi^2(4) = 0.77$, $P = 0.94$).

Among the comorbidities, the most frequent were diabetes mellitus (11.79%), chronic obstructive pulmonary disease (COPD) (6.84%), the presence of a tumour (6.43%), rheumatoid disease (5.37%), peripheral vascular disease (4.91%), myocardial infarction (3.88%), liver disease (3.58%), peptic ulcer disease (3.44%), and chronic kidney disease (CKD) (2.98%). The mean Charlson comorbidity index score was 2.21 (SD = 2.01, min = 0, max = 13).

Table 2. Demographics and surgical characteristics

Variable	Total N = 675
Age	
Mean (SD)	57.59 (15.27)
Sex	
Female (%)	406 (60.15)
Male (%)	269 (39.85)
Residence	
Home (%)	659 (98.21)
Care/nursing home (%)	12 (1.79)
Contact with COVID-19 patients or positive cases	
No (%)	461 (68.81)
Yes (%)	22 (3.28)
Unknown (%)	187 (27.91)
COVID-19 previous diagnosis	
No (%)	664 (98.37)
Yes (%)	11 (1.63)
ASA score	
I (%)	163 (24.73)
II (%)	412 (62.52)
III or higher (%)	84 (12.75)
Charlson comorbidity index	
Mean (SD)	2.21 (2.01)
Type of surgery	
Ambulatory (%)	486 (72.00)
Arthroplasty (%)	189 (28.00)
Anaesthesia	
Regional (%)	314 (46.52)
Spinal (%)	254 (37.63)
General (%)	107 (15.85)

ASA, American Society of Anesthesiologists.

Post-operative COVID-19 and complications

Two patients presented with symptoms suggestive of COVID-19 post-operatively. None of them presented with pneumonia or required confirmation by a PCR assay; however, they were confirmed by an Antigen test. Hospital admission was not required for these patients. Table 3 describes the demographic characteristics of these patients.

The surgical time (≤50 min/>50 min) was neither related to the risk of developing COVID-19 post-operatively ($\chi^2(1) = 0.00$, $P = 0.98$) or to the appearance of complications after discharge ($\chi^2(1) = 2.58$, $P = 0.11$).

Table 3. Demographic characteristics of COVID-19 positive patients

Case	Patient 1	Patient 2
Sex	Female	Female
Age	42	76
Previous contact with COVID-19 patients or positive cases	No	Unknown
Comorbidities	Rheumatic disease	Stroke
Chest radiograph	Not performed	Not performed
Blood test	Normal	Normal
ASA score	I	II
Type of surgery	Wrist or hand	TKA
Surgery time (min)	40	65
Ischemia (min)	No ischemia	70
Post-operative complications	No	No
Time of COVID-19 diagnosis	Before the 15-day follow-up	Before the 15-day follow-up
Satisfaction with surgery	Yes	Yes

ASA, American Society of Anesthesiologists; TKA, Total Knee Arthroplasty.

The time of ischemia was neither related to the risk of developing COVID-19 ($\chi^2(2) = 2.05$, $P = 0.36$) or post-operative complications ($\chi^2(2) = 1.87$, $P = 0.39$).

Intra-operative bleeding was not related with the risk of developing COVID-19 ($\chi^2(2) = 0.37$, $P = 0.83$). However, intra-operative bleeding >150mL was related to a higher risk of post-operative complications ($\chi^2(2) = 25.68$, $P < 0.001$).

The overall average hospital stay was 1.63 days (SD = 3.79, min = 0, max = 56). Regarding arthroplasty procedures, the average hospital stay was 4.99 days (SD = 5.79, min = 0, max = 56). The average hospital stay for minor surgeries was 0.30 days (SD = 0.86, min = 0, max = 8). One patient required admission to the Intensive Care Unit post-operatively; nevertheless, this was not related with COVID-19.

Nineteen patients required hospital re-admission after discharge (8 of them within 15 days after the surgery). Seventeen re-admissions were directly related to the surgery. One patient was re-admitted to undergo another elective surgery, and one patient suffered from ascites.

110 patients (16.30%) developed one or more complications post-operatively. Seventeen patients suffered a complication before hospital discharge, 65 patients presented with a complication at the 15-day follow-up visit, and 63 patients presented with a complication at the 60-day follow-up visit. 565 patients had no recorded complications. Table 4 compares the demographic and surgical characteristics of both groups.

Previous COVID-19 infection or contact with a COVID-19 patient or positive subject was not related to a higher risk of complications.

There was no association between the laboratory tests and the risk of developing COVID-19 symptoms at follow-up (haemoglobin: ($\chi^2(1) = 2.03$, $P = 0.15$); leukocyte count: ($\chi^2(1) = 0.01$, $P = 0.91$); lymphocyte count: ($\chi^2(1) = 2.04$, $P = 0.15$); creatinine: ($\chi^2(1) = 1.97$, $P = 0.16$).

Patients who had undergone arthroplasty procedures developed more post-operative complications (33.5%) than those who had undergone ambulatory surgeries (12.9%). Regarding the type of surgery, the reported complication rates for each procedure were 32.9% for TKA, 34.7% for THA, 25.0% for knee revision arthroplasty, 46.7% for hip revision arthroplasty, 4.7% for shoulder arthroscopy, 10.3% for knee arthroscopy, 10.8% for hand or wrist surgery, 20.2% for forefoot surgery, and 17.2% for hardware removal.

The Charlson comorbidity index score was significantly associated with complications (see Table 5). The model is corrected for heteroscedasticity using robust standard errors.

Of the 675 patients included, 587 answered to the question of whether they would undergo the surgical procedure again, according to their current experience. 560 of them (95.40%) answered yes.

Table 4. Demographics and surgical characteristics in patients with and without post-operative complications

Variable	Post-operative complications N = 110	No complications N = 565	*P*
Age			0.00[b]
Mean (SD)	64.08 (13.10)	55.64 (15.29)	
Sex			0.08[a]
Female (%)	74 (67.27)	284 (58.20)	
Male (%)	36 (32.73)	204 (41.80)	
Residence			0.02[a]
Home (%)	104 (95.41)	479 (98.76)	
Care/nursing home (%)	5 (4.59)	6 (1.24)	
Contact with COVID-19 patients or positive cases			0.30[a]
No (%)	74 (67.27)	410 (72.56)	
Yes (%)	1 (0.91)	18 (3.18)	
Unknown (%)	34 (30.91)	138 (24.42)	
COVID-19 previous diagnosis			0.77[a]
No (%)	108 (98.18)	558 (98.76)	
Yes (%)	2 (1.82)	7 (1.24)	
ASA score			0.00[a]
I (%)	11 (10.09)	176 (31.15)	
II (%)	73 (66.36)	331 (58.58)	
III or higher (%)	26 (23.85)	58 (10.26)	
Charlson Comorbidity Index			0.00[b]
Mean (SD)	2.96 (1.74)	2.03 (2.06)	
Type of surgery			0.00[a]
Ambulatory (%)	53 (48.18)	433 (76.63)	
Arthroplasty (%)	57 (51.81)	132 (23.36)	
Anaesthesia			0.00[a]
Regional (%)	38 (32.71)	276 (48.84)	
Spinal (%)	58 (54.21)	196 (34.69)	
General (%)	14 (13.08)	93 (16.46)	
Haemoglobin (g/dL)			0.01[b]
Mean (SD)	13.59 (1.48)	14.04 (1.49)	
Leukocyte count (cells/μL)			0.68[b]
Mean (SD)	7144.95 (2125.12)	7241.37 (2128.07)	
Lymphocyte count (cells/μL)			0.03[b]
Mean (SD)	2039.38 (778.97)	2218.25 (775.87)	
Creatinine (mg/dL)			0.77[b]
Mean (SD)	0.80 (0.16)	0.80 (0.20)	

[a]Pearson χ^2 test.
[b]Two-sample *t*-test with equal variances.
ASA, American Society of Anesthesiologists.

Table 5. Logistic regression analysis examining the association between baseline and pre-operative study outcomes upon post-operative complications

Predictors	Odds ratio	95% CI	*P*
Female	1.49	0.90-2.47	0.13
Charlson comorbidity index	1.19	1.08-1.31	<0.001
Haemoglobin	0.92	0.78-1.08	0.31
Lymphocyte count	1.00	1.00-1.00	0.22
COVID-19 previous diagnosis	0.44	0.06-3.27	0.42

CI, Confidence Interval.
Pseudo $R^2 = 0.04$.

Discussion

The SARS-CoV-2 pandemic is causing profound changes in our societies worldwide. Fear of contracting the disease is present in all areas. At a surgical level, there is still limited data on the development of COVID-19 symptoms in the immediate post-operative period for patients undergoing elective procedures.[12]

High nosocomial infection rates had been reported in patients surgically treated during the COVID-19 peak.[13] Available data suggest that the development of peri-operative complications is increased, and surgically treated patients during the SARS-CoV-2 pandemic have a higher mortality rate. Some studies published during the beginning of the COVID-19 outbreak reported mortality rates between 20.5% and 38.5% in patients who underwent elective surgeries.[14,15] All the

patients reported developed pneumonia shortly after surgery, and 44.1% required ICU admission.[14]

According to Doglietto et al.,[16] the mortality (OR, 9.5) and complications (OR, 4.98) were significantly higher in COVID-19 patients who underwent some surgical treatment compared with patients without COVID-19 during the peak of the pandemic in Italy. The mortality rate for COVID-19 patients was reported to be approximately 20%. Our data supports that re-introducing elective orthopaedic surgeries does not imply a higher mortality rate, nor a higher incidence of SARS-CoV -2 infection in the early follow-up when COVID-19 screening is performed, as Nakai et al.[17] also highlighted. We have not recorded any patients affected by pneumonia shortly after the surgery, none of them required ICU admission or hospital re-admission due to COVID-19 after surgery.

An international multicentre study identified a high rate of post-operative pulmonary complications in patients with a peri-operative SARS-CoV-2 infection, and suggested its association with a high mortality rate. Although patients undergoing ambulatory surgeries developed fewer complications than those undergoing major surgeries, the mortality rate in patients undergoing minor surgeries was higher than usual. Authors recommended limiting the indications for surgery during the SARS-CoV-2 pandemic, especially in patients older than 70 and in patients with comorbidities (ASA III-V), emphasizing the risk-benefit of the procedures.[6] Despite these findings, our results corroborate that it is safe to re-start elective orthopaedic surgeries after the COVID-19 outbreak, even in patients over 70 years of age.

Other authors have been critical about re-introducing non-emergent surgeries,[17] giving special attention to a preliminary screening for COVID-19 symptoms and emphasizing cross-infection prevention.[11,18] Based on our results, we also recommend a strict pre-operative COVID-19 screening for patients undergoing elective surgeries.

In another study about patients scheduled for elective surgeries during the incubation period of a COVID-19 infection, Wu et al.[19] concluded that old age, comorbidities, longer surgical time, and the difficulty of the surgery may be risk factors for a poor outcome, and were associated with a greater risk of developing acute respiratory distress syndrome (ARDS) and death. Gruskay et al.[20] reported that 12.1% of patients tested positive for SARS-CoV-2 pre-operatively, of which 58.3% were asymptomatic. These results highlight the need to have clear pre-operative protocols to screen for possible SARS-CoV-2 positive but asymptomatic patients.

Some authors have hypothesized about the re-introduction of elective surgeries and the use of diagnostic tests to screen the surgical risk.[7,17] In our study, we have verified how the pre-surgical PCR assay detection of SARS-CoV-2 would be sufficient to rule out active COVID-19 infection and thus avoid immediate post-operative complications.

Our study demonstrates that the re-introduction of elective orthopaedic surgery in the immediate post-COVID-19 period in patients who have a confirmed negative COVID-19 PCR is safe and does not increase the risk of complications, even for the patients who had developed a COVID-19 infection before but were completely recovered and had a negative PCR by the time of the surgery. This has direct implications for clinical practice since it helps mitigate the effect of surgery cancellations due to the COVID-19 pandemic anticipated by some authors and professional associations.[6,21,22]

Brown et al.[23] highlighted that, although 85% of the patients understood and agreed with public health measures to curb infection, almost 90% of them planned to re-schedule their elective surgery as soon as possible. Our results regarding post-operative satisfaction indexes show that, at the moment of the pandemic in which this study was conducted, 95.40% of the patients would again choose to have the elective procedure performed.

Regarding complications related to the surgery, minor early complications such as haematoma, superficial infection, deep vein thrombosis (DVT), pneumonia, or urinary tract infection are common, ranging from 13% to almost 40% depending on the series.[24,25] Our results showed that there was no higher rate of complications in the immediate post-COVID-19 period.

Regarding the patients in the ambulatory surgery group, the complications described in the literature are diverse, especially when assessing all of types of surgery together. Complications associated with arthroscopies are risk of death, risk of DVT, risk of infection and an extremely small risk of nerve damage.[26,27] Regarding forefoot surgeries, the results mostly depend on patient factors such as diabetes, rheumatoid arthritis, thyroid disease, smoking, age, etc. and complication rates can reach up to 36%[28,29] Our complication rates go from 4.7% in arthroscopy to 20.2% for forefoot surgery; in all cases they were minor complications.

The Charlson comorbidity index is a prospectively applicable method for classifying comorbid conditions that might alter the risk of mortality. It is readily applicable in registry research and other studies about COVID-19.[30] In our results, we have found a positive relation between the Charlson Comorbidity Index score and the risk of developing some post-operative complications, but not with a greater risk of presenting with a COVID-19 infection in the post-operative period.

This study has several limitations. The follow-up period is limited, and only early complications could be reported. This is a multicentre study conducted in eight centres, with the implied limitations compared to a single centre study regarding homogeneity of procedures. Finally, the main limitation is the total number of patients, which does not allow detailed sub-population analyses for every particular group of elective orthopaedic surgeriesa. Future studies with larger cohorts are needed to determine the effect of COVID-19 between the different surgical procedures regarding specific surgical specialties.

This multicentre prospective observational cohort study states that re-starting the main orthopaedic elective surgical procedures after the peak of COVID-19 outbreak is totally safe when preventive measures are undertaken. Post-surgery COVID-19 infection, surgical mortality and complications are not significantly higher in these patients. The Charlson comorbidity index could be used as a predictor for surgical complications, but not for COVID-19 infection risk. Patients with a previous COVID-19 infection that have a negative PCR at the moment of the elective surgery do not have a higher risk of complication than the other patients.

Elective oncologic surgeries during the lockdown period has been probably the most affected area in orthopaedics (and the rest of surgical areas) due to operating room restrictions and ignorance about the future range of complications due to COVID-19 in these patients with a high complication rate.[31] We have not included the oncologic patients in our study due to the higher range of possible complications after surgery, and we have preferred to include only more standard surgeries.

Ethics Committee Approval: The study has been performed in accordance with the ethical standards in the 1964 Declaration of Helsinki. The Ethics Committee (HCB/2020/0678) of each centre approved the study (protocol V.1.1).

Informed Consent: Written informed consent was obtained from the patient.

Acknowledgements: The authors would like to thank the MBA Institute for making their human and technological resources freely available to develop the data collection tool and for their assistance in the data analysis.

Author Contributions: Concept - S.S.; Design - S.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.; Supervision - S.S., M.J.G.; Materials - S.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.; Data Collection and/or Processing - S.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.; Analysis and/or Interpretation - S.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.; Literature Review - S.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.; Writing - S.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.; Critical Review - AS.S., M.J.G., C.Y.V., I.P.T., M.B.C., S.M.M., G.C., L.B., P.T.

Conflict of interest: The authors have no conflicts of interest to declare. The authors have received selfless help from MBA Institute for the development of the data collection tool and for data analyses.

Financial Disclosure: The authors declared that this study has received no financial support.

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