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ARTHROPLASTY

Insights into patient preferences for elective surgery during the COVID-19 pandemic

A PROSPECTIVE ANALYSIS OF 400 PATIENTS AWAITING ARTHROPLASTY

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Aims

To investigate factors that contribute to patient decisions regarding attendance for arthroplasty during the COVID-19 pandemic.

Methods

A postal questionnaire was distributed to patients on the waiting list for hip or knee arthroplasty in a single tertiary centre within the UK. Patient factors that may have influenced the decision to attend for arthroplasty, global quality of life (QoL) (EuroQol five-dimension three-level (EQ-5D-3L)), and joint-specific QoL (Oxford Hip or Knee Score) were assessed. Patients were asked at which 'COVID-alert' level they would be willing to attend an NHS and a "COVID-light" hospital for arthroplasty. Independent predictors were assessed using multivariate logistic regression.

Results

Of 540 distributed questionnaires, 400 (74.1%; 236 awaiting hip arthroplasty, 164 awaiting knee arthroplasty) complete responses were received and included. Less than half (48.2%) were willing to attend for hip or knee arthroplasty while a UK COVID-19 epidemic was in circulation (COVID-alert levels 3 to 5). Patients with worse joint-specific QoL had a preference to proceed with surgery at COVID-alert levels 3 to 5 compared to levels 1 and 2 (hip arthroplasty odds ratio (OR) 1.54 (95% confidence interval (CI) 1.45 to 1.63); knee arthroplasty OR 1.16 (1.07 to 1.26)). The odds of patients with worse joint-specific QoL being willing to attend for surgery at COVID-alert levels 3 to 5 increased further if surgery in a private, "COVID-light" hospital was available (hip arthroplasty OR 3.50 (95% CI 3.26 to 3.71); knee arthroplasty OR 1.41 (95% CI 1.29 to 1.53).

Conclusion

Patient decisions surrounding elective surgery have been influenced by the global COVID-19 pandemic, highlighting the importance of patient involvement in ensuring optimized provision of elective surgery during these challenging times.

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Keywords: COVID-19, Arthroplasty, Patient reported outcomes

Introduction

The COVID-19 pandemic has severely impacted health systems globally. One challenge has been addressing growing waiting lists and waiting list times for elective surgery.[1,2] In the UK, nonurgent care was postponed for three months from April 2020 in an effort to divert resources to the care of patients affected by COVID-19, and to mitigate risks to patients attending for elective treatment.[3] By June 2020, the proportion of patients who had waited more than 18 weeks for elective treatment had risen to 48% from 16.5% since the start of the year.[4] Specifically in orthopaedic surgery in the UK, it was estimated that by October 2020, 302,426 patients would be on the waiting list for over 18 weeks and 24,000 patients for

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Table I. COVID-19 alert level.

Stage of outbreak	Description
Level 1	COVID-19 is not present within the UK population
Level 2	COVID-19 is present but the number of cases and transmission is low
Level 3	COVID-19 epidemic is in general circulation
Level 4	Transmission of COVID-19 is high and rising exponentially
Level 5	Healthcare services are at risk of being over-burdened by COVID-19

over one year.[5] With a need to address growing waiting lists while balancing resource and risk, it is important that surgical teams help patients who are awaiting elective surgery in the current climate to make fully informed decisions regarding COVID-19-related risks.[6,7]

The European Hip and Knee society,[7] Royal College of Surgeons (RCS),[8] and NHS England[9] have recently published documents that aid decision-making in elective surgery during the COVID-19 pandemic. The recommended approach integrates the experience of clinicians with potential changes in patients' conditions, circumstances, and preferences as a result of the COVID-19 pandemic. In the NHS, new waiting list classifications were introduced to allow patients to formally defer surgical treatment because of COVID-19.[9] The aim was to ensure waiting lists run effectively and in a clinically validated way in response to the change in NHS capacity and varying patient circumstances. The RCS recommended the use of private sector hospitals (termed "COVID-light" centres) in order for the NHS to continue offering elective surgery and address growing waiting lists, while reducing risks of patient exposure to COVID-19.[8] To ensure the service offered is safe, sustainable, and acceptable, it is important to understand patient preferences and which factors influence their decisions to attend for surgery.[10] However, there are little data available about change in patient preferences and how private ("COVID-light") hospitals may influence these decisions.[11,12]

In the UK, patients have been identified by NHS England and their general practitioners as either 'moderate risk' or 'high risk' based on their age and medical history.[13] Patients classified as 'high risk' were advised to limit face-to-face contact as much as possible.[13] On 11 May 2020, the UK issued a five-level alert system that defines the severity of COVID-19 within the UK population. These range from level 1 (the least severe) to level 5 (the most severe) (Table I), and inform the general public regarding the risk of COVID-19 spread.[14]

The aim of this study was to investigate the factors that influence patient decisions regarding the attendance for elective hip or knee arthroplasty in view of the UK COVID-19 epidemic.

Methods

All patients who were on the waiting list for either primary hip or knee arthroplasty at a single tertiary hospital within the UK (Addenbrooke's Hospital, Cambridge University Hospitals, UK) before 23 March 2020 were eligible for inclusion. Patients were excluded if they had died since joining the waiting list or if they were an inpatient at the time of distributing the questionnaire. Returned questionnaires were excluded if either incomplete or illegible.

Study design and data acquisition. All included patients were sent a postal questionnaire on 24 August 2020, five months after the start of the first UK national lockdown. Patients were invited to respond via post, online (Jisc Online Surveys, UK), or via telephone. The closing date for the questionnaire was six weeks following the distribution date (5 October 2020). Patients were informed that their participation and the answers they gave would not influence their care. The questionnaire included a quality of life (QoL) measure (EuroQol five-dimension three-level questionnaire (EQ-5D-3L) and EuroQol visual analogue scale (EQ-VAS))[15] and a joint-specific, patient-reported outcome measure (PROM) (either the Oxford Hip Score (OHS)[16,17] or Oxford Knee Score (OKS)).[18,19] Patient information was collected, including sex, age at the time of survey completion, length of time for which the patient had been on the waiting list, and whether the patient had received a previous joint arthroplasty. Patient-specific information regarding COVID-19 included self-reported COVID-19 risk status, personal history of COVID-19, and family or household history of COVID-19. Patients were asked the "COVID-19 alert" level at which they would be willing to receive arthroplasty surgery in an NHS hospital and in a (COVID-light) private sector hospital during the UK epidemic.

The project was registered as a service evaluation and the questionnaires were approved by the local Trust information governance team (PRN9129). Licencing for EQ-5D-3L (ID 36374), OHS (00OHS-870168), and OKS (00OKS-870166) questionnaires were obtained. EQ-5D-3L index scores were calculated using the UK value set[20] as outlined by EuroQol.[21] A state worse than death was classified as an EQ-5D-3L index score of less than 0.[21,22]

Patient and public involvement. Two patient representatives who were on the waiting list for joint arthroplasty at Cambridge University Hospitals were consulted prior to designing the patient survey. They provided insights into their top concerns regarding attending hospital for joint arthroplasty surgery during the COVID-19 epidemic in the UK, their thoughts underlying these concerns, and the information they would wish to know beforehand. These discussions underpinned the design of our questionnaire and informed our analysis.

Statistical analysis. Continuous variables were reported using means and standard deviations (SDs) if normally

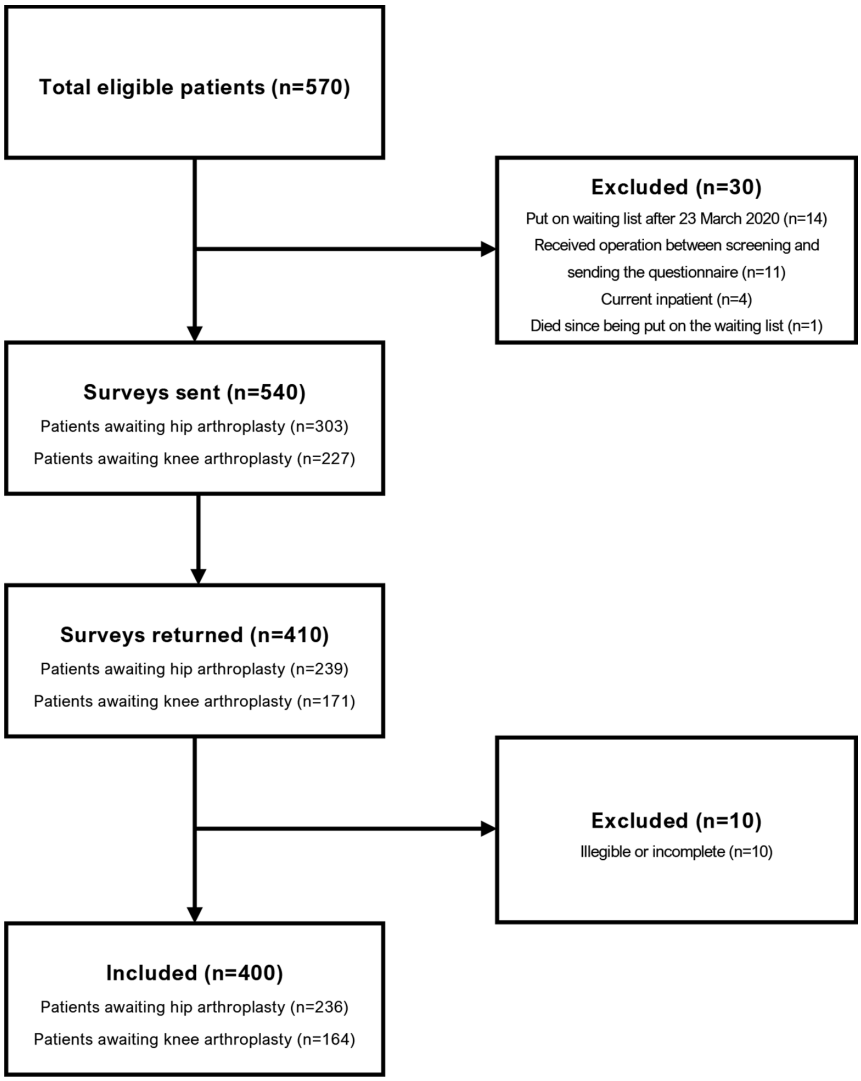


Fig. 1
Flow diagram of patient inclusion and exclusion.

distributed and medians and interquartile ranges (IQRs) if non-normally distributed. Categorical variables were presented as a percentage. Binary categorical variables were analyzed using either a binomial paired comparison or Fisher's exact test. Univariate analysis was performed using simple logistic regression and presented as proportional odds ratios (ORs). The differences between COVID-19-alert levels were assessed using the Kruskal-Wallis test for non-parametric continuous variables.

To assess the variables that influence the decision at which COVID-19-alert level patients were willing to attend for surgery, a multivariate ordinal regression model was built.[23] The model was built on the cohort awaiting hip arthroplasty (the larger group) and validated on the cohort awaiting knee arthroplasty. Due to a multimode approach being offered for questionnaire response, a response rate of between 50% and 60% was anticipated (152 to 182 responses).[24] With an r^2 of 0.30, a maximum of seven variables could be incorporated. Independent variables were decided a priori and were based on patient involvement and clinician experience. The variables were joint-specific QoL (OHS or OKS), global QoL (EQ-VAS and EQ-5D-3L index scores), personal or family history of COVID-19 infection, self-reported COVID-19-risk status, patient age, and sex. The EQ-VAS, OHS, and OKS were treated as continuous variables as they represent a continuous range of health states.[25] Results of the multivariate analysis were presented as adjusted ORs and probabilities. For all statistical tests, a significance level of $p < 0.05$ was used. All statistical analyses were performed using R in RStudio (Version 4.0.2, USA)

Results

Patient demographics and survey information. At the time of waiting list screening, 570 patients were waiting for a primary hip or knee arthroplasty and 540 were eligible for

Table II. Demographic and patient information.

Variable	All patients (n = 400)	Hip arthroplasty (n = 236)	Knee arthroplasty (n = 164)
Median age, yrs (IQR)	72.0 (64.0 to 77.0)	71.0 (60.8 to 78.0)	73.0 (66.0 to 77.0)
Female, n (%)	249 (62.3)	153 (64.8)	96 (58.5)
Previous hip arthroplasty, n (%)	72 (18.0)	55 (23.3)	17 (10.4)
Previous knee arthroplasty, n (%)	85 (21.3)	20 (8.5)	65 (39.6)
Either previous hip or knee arthroplasty, n (%)	145 (36.3)	69 (29.2)	76 (46.3)
Mean time on waiting list, days (SD)	272.3 (86.4)	272.5 (86.1)	272.0 (87.1)
COVID-19 risk status, n (%)			
High	47 (12.1)	31 (13.5)	16 (9.9)
Medium	30 (7.7)	11 (4.8)	19 (11.8)
Low	6 (1.5)	3 (1.3)	3 (1.9)
Not known	307 (78.7)	184 (80.3)	123 (76.4)
Personal or family history of COVID-19, n (%)	24 (6.2)	17 (7.4)	7 (4.3)
Median PROMs (IQR)			
EQ-VAS	50 (30.0 to 70.0)	45.0 (26.0 to 67.5)	60.0 (40.0 to 56.4)
EQ-5D-3L index	0.085 (-0.074 to 0.587)	-0.016 (-0.074 to 0.516)	0.159 (-0.016 to 0.620)
Oxford Hip Score	N/A	11.0 (8.0 to 20.0)	N/A
Oxford Knee Score	N/A	N/A	15.0 (10.0 to 22.0)

EQ-5D-3L, EuroQoL five-dimension three-level questionnaire; EQ VAS, EuroQol visual analogue scale; IQR, interquartile range; N/A, not applicable; PROMs, patient-reported outcome measures; SD, standard deviation.

inclusion (Figure 1). The final analysis included 400 complete responses (400/540, 74.1%), of which 236 patients were awaiting hip arthroplasty and 164 patients were awaiting knee arthroplasty. Patient information including demographic details, arthroplasty history, COVID-19-related factors, and patient-reported outcome measures are shown in Table II. Patients were asked to self-report COVID-19 risk status as determined by their primary care providers. Of the 400 completed responses, 307 patients (78.7%) reported not knowing their COVID-19 risk status.

In the full cohort, 51.7% (207/400) of the included patients expressed a preference to delay their joint arthroplasty until transmission of COVID-19 was either low or nonexistent (COVID-19 alert levels 1 or 2). The remaining 48.3% (193/400) were willing to undergo surgery while "a COVID-19 epidemic is in general circulation" (COVID-19 alert levels 3 to 5), which increased significantly to 54.0% if a private, "Covid-light" hospital was available (p = 0.024, binomial paired comparison).

Preference for timing and setting of surgery in patients awaiting hip arthroplasty. In the cohort awaiting hip arthroplasty, 54.6% (129/236) were willing to attend an NHS hospital for surgery when a "Covid-19 epidemic is in circulation" (COVID-19 alert level 3 and above). Patients were significantly more likely to be willing to attend a private sector ("COVID-light") hospital compared to an NHS hospital at COVID-19 alert levels 3 (65.3% vs 54.6%, p = 0.024), 4 (35.2% vs 22.0%, p = 0.022), and 5 (18.6% vs 10.2%, p = 0.012, binomial paired comparison) (Figure 2a).

Male sex was significantly associated with a preference for surgery at the more severe COVID-alert levels for hip arthroplasty (OR 1.75, (95% confidence internal (CI) 1.07 to 2.86), p = 0.024, simple ordinal logistic regression). Patient factors that did not significantly influence the COVID-19 alert level that patients were willing to attend for surgery were age at the time of the questionnaire, previous joint arthroplasty surgery, and time on the waiting list (Supplementary Table i). Self-reported COVID-19 risk status and personal or family history of confirmed COVID-19 infection did not significantly influence the COVID-19 alert level that patients were willing to attend for hip arthroplasty surgery (Supplementary Table i).

The median EQ-5D-3L index score of patients awaiting hip arthroplasty was -0.016 (IQR -0.074 to 0.534) and 54.2% (128/236) reported a score "worse than death". The median EQ-VAS of patients awaiting hip arthroplasty was 45 (IQR 27.5 to 70.0). In univariate analysis, patients with lower EQ-5D-3L index scores and EQ-VAS had a preference for surgery at the more severe COVID-19 alert levels (EQ-5D-3L index score: proportional OR 5.00 (95% CI 2.42 to 11.1), p < 0.001; EQ-VAS: proportional OR 1.02 (95% CI 1.01 to 1.03), p < 0.001).

The median OHS for the cohort awaiting a hip arthroplasty was 11/48 points (IQR 8 to 20). Patients reporting lower OHS had increased odds of being willing to attend for surgery at a more severe COVID-19 alert level (proportional OR 1.10 (95% CI 1.07 to 1.14), p < 0.001, simple ordinal logistic regression). Patients choosing COVID-19 alert level 1 and 2 had significantly higher OHS compared to patients who were willing to have surgery at COVID-19 alert levels 3, 4 and 5 (Supplementary Figure aa).

Multivariate analysis of preferred COVID-19 alert status at which patients are willing to receive hip arthroplasty surgery. Controlling for EQ-5D index score, EQ-VAS, COVID-19 risk status, personal or family history of COVID-19, age, and sex, a lower OHS (adjusted OR 1.10

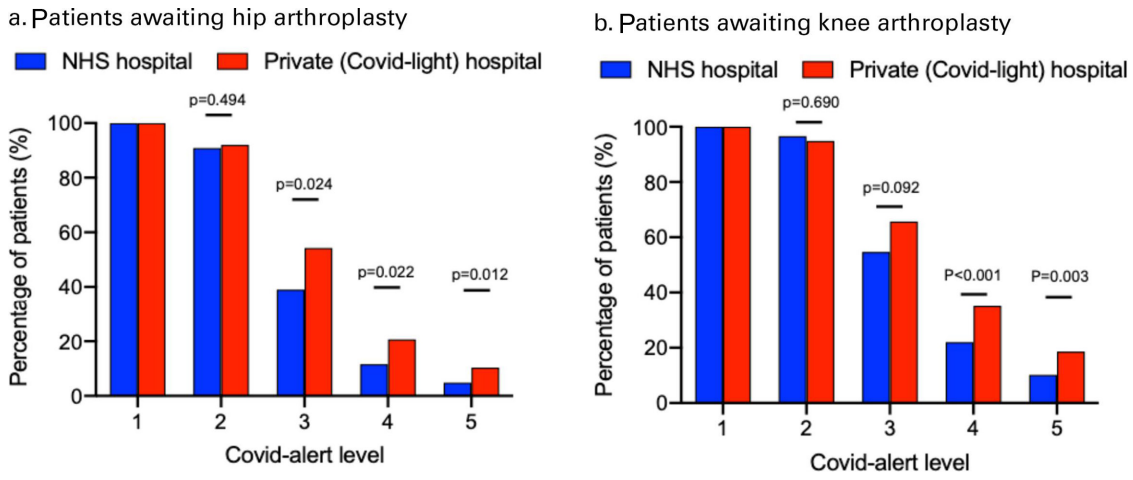


Fig. 2

Percentage of patients on the hip and knee arthroplasty waiting list who would be willing to receive a) hip arthroplasty and b) knee arthroplasty at each of the five COVID-19 alert levels (Table I) in either an NHS hospital (blue bars) or a private sector (COVID-light) hospital (red bars). Exact p-values displayed, binomial paired comparison.

Table III. Results of multivariate ordinal regression analysis assessing global quality of life, joint-specific quality of life, personal or family history of COVID-19 infection, COVID-19 risk status, age, and sex on the COVID-19 alert level that patients would be willing to attend surgery.

Variable	OR (95% CI)	p-value
Patients awaiting total hip arthroplasty		
Decreasing OHS	1.10 (1.05 to 1.17)	< 0.001
Increasing age and male	0.99 (0.97 to 1.01)	0.431
Increasing age and female	0.97 (0.96 to 0.99)	0.039
EQ-5D-3L index	1.33 (0.39 to 4.58)	0.647
EQ-VAS	0.99 (0.95 to 1.04)	0.085
Personal or family history of COVID-19	0.88 (0.15 to 4.79)	0.788
Self-reported COVID-19 risk status		
High risk	0.89 (0.43 to 1.80)	0.740
Medium risk	1.35 (0.45 to 4.01)	0.591
Low risk	0.38 (0.40 to 3.18)	0.411
Patients awaiting knee arthroplasty		
Decreasing OKS	1.14 (1.06 to 1.22)	< 0.001
Increasing age and male	1.00 (0.96 to 1.04)	0.969
Increasing age and female	0.99 (0.95 to 1.04)	0.761
EQ-5D-3L index	0.64 (0.15 to 2.77)	0.551
EQ-VAS	0.99 (0.95 to 1.04)	0.363
Personal or family history of COVID-19	0.88 (0.15 to 4.79)	0.885
Self-reported COVID-19 risk status		
High risk	0.63 (0.21 to 1.86)	0.412
Medium risk	1.29 (0.51 to 3.30)	0.583
Low risk	2.54 (0.18 to 34.89)	0.480

CI, confidence interval; EQ-5D-3L, EuroQol five-dimension three-level questionnaire; OHS, Oxford Hip Score; OKS, Oxford Knee Score; OR, odds ratio; VAS, visual analogue scale.

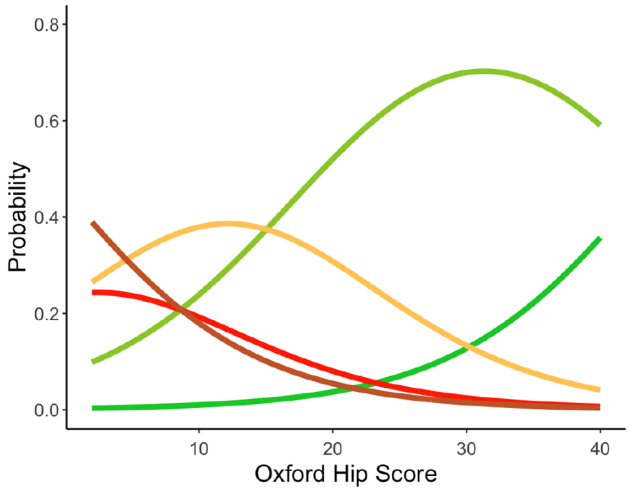
(95% CI 1.05 to 1.17)) was significantly associated with patients willing to attend for hip arthroplasty surgery at higher COVID-19 alert levels (Table III). As the OHS increased, the probability that a patient would be willing to receive arthroplasty surgery while transmission of COVID-19 was low or nonexistent (COVID-19 alert levels 1 or 2) increased. Conversely, as the OHS worsened, the probability that a patient would be willing to attend while "a COVID-19 epidemic is in general circulation" (COVID-19 alert levels 3, 4, or 5) increased (Figure 3a).

Based on this, the patient's selected COVID-19 alert level was categorized into a binary outcome of low alert level (levels 1 and 2) versus high alert level (levels 3, 4, and 5). When controlling for the same variables, patients with lower OHS had higher odds of being willing to attend while "a COVID-19 epidemic is in general circulation" (COVID-19 alert levels 3, 4, or 5) (adjusted OR 1.54 (95% CI 1.45 to 1.63)). Furthermore, patients with lower OHS were more likely to choose a private, "COVID-light" hospital while "a COVID-19 epidemic is in general circulation" (COVID-19 alert levels 3, 4, or 5) (adjusted OR 3.50 (95% CI 3.26 to 3.71)) (Figure 4a).

Preferences for elective surgery among patients awaiting knee arthroplasty. Patients awaiting elective knee arthroplasty were significantly less willing to attend for surgery at an NHS hospital at COVID-19 alert level 3 and above compared to those awaiting elective hip arthroplasty (64/164, 39.0%; p < 0.001, Fisher's exact test). Patients awaiting knee arthroplasty were significantly more willing to attend a private sector hospital than an NHS hospital for their surgery at COVID-19 alert levels 4 (20.7% vs 11.6%, p < 0.001) and COVID-19 alert level 5 (10.4% vs 4.9%, p = 0.003) but not at COVID-19 alert level 3 (54.3% vs 39.0%, p = 0.092, all binomial paired comparison) (Figure 2b).

In patients waiting for knee arthroplasty, male sex did not have a significant association with the COVID-19 alert level that patients would be willing to attend for their surgery in an NHS hospital (proportional OR 1.28 (95% CI 0.71 to 2.33), p = 0.405, simple ordinal logistic regression). Similar to the hip cohort, factors not significantly

a. Patients awaiting hip arthroplasty



Level 1 – Covid-19 is not known to be present in the UK.

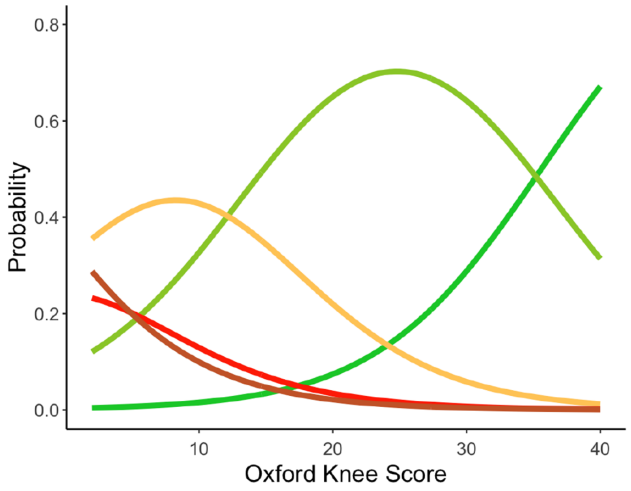
Level 2 – Covid-19 is present in the UK, but the number of cases and transmission is low.

Level 3 – A Covid-19 epidemic is in general circulation.

Level 4 – A Covid-19 epidemic is in general circulation; transmission is high or rising exponentially.

Level 5 – As for level four but there is a material risk of healthcare services being overwhelmed.

b. Patients awaiting knee arthroplasty



Level 1 – Covid-19 is not known to be present in the UK.

Level 2 – Covid-19 is present in the UK, but the number of cases and transmission is low.

Level 3 – A Covid-19 epidemic is in general circulation.

Level 4 – A Covid-19 epidemic is in general circulation; transmission is high or rising exponentially.

Level 5 – As for level four but there is a material risk of healthcare services being overwhelmed.

Fig. 3

The probability of patients choosing each individual COVID-19 alert level at each a) Oxford hip or b) Oxford knee score controlling for EuroQol (EQ)-index, EQ-visual analogue scale (EQ-VAS), patient-reported COVID-19 risk status, personal or family history of COVID-19, age, and sex.

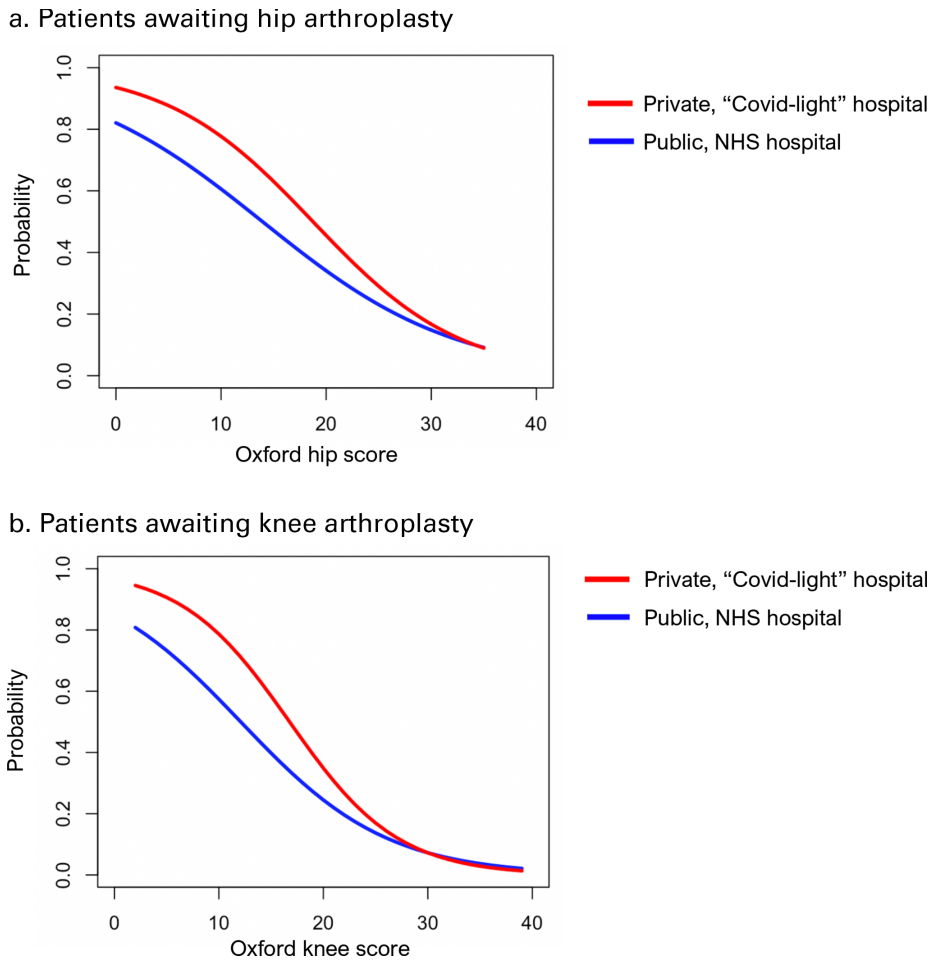


Fig. 4

The probability of patients choosing COVID-19 alert levels 3, 4, or 5 at each a) Oxford Hip or b) Oxford Knee Score controlling for EuroQol (EQ)-index, EQ-visual analogue scale (VAS), patient-reported COVID-19 risk status, personal or family history of COVID-19, age, and sex.

associated with the COVID-19 alert level at which patients were willing to attend for surgery were age, previous joint arthroplasty surgery, time on the waiting list, self-reported COVID-19 risk status, and personal or family history of COVID-19 (Supplementary Table i).

The EQ-VAS and EQ-index scores in the knee arthroplasty group were significantly higher when compared to the hip arthroplasty group (median EQ-VAS: 60.0, median EQ-5D-3L index score: 0.159; both $p < 0.001$; Mann-Whitney U test). There was also a lower proportion of patients waiting for knee arthroplasty reporting an EQ-5D-3L index score that was worse than death (34.8%, 57/164). Patients awaiting knee arthroplasty with a lower EQ-5D-3L index score and EQ-VAS had a preference in attending for surgery at higher COVID-19 alert levels (EQ-5D-3L index score: proportional OR 14.9 (95% CI 5.70 to 38.5), $p < 0.001$; EQ-VAS: proportional OR 1.03 (95% CI 1.01 to 1.04), $p = 0.002$, all simple ordinal logistic regression).

The median OKS for the cohort awaiting a knee arthroplasty was 15 out of 48 (IQR 10 to 22). Patients reporting lower OKS had increased odds of being willing to attend at a higher COVID-19 alert level (proportional OR 1.16 (95% CI 1.11 to 1.21), $p < 0.001$). Patients choosing COVID-19 alert level 1 and 2 had significantly higher OKS compared to patients who were prepared to have surgery at COVID-19 alert levels 3, 4, and 5 (Supplementary Figure ab).

Using a multivariate analysis, controlling for factors hypothesized to play a role in influencing a patient's decision for surgery (age, sex, EQ-VAS, EQ-5D-3L index score, personal or family history of COVID-19 infection, and reported COVID-19 risk status) demonstrated that lower OKS was significantly associated with an increased odds of patients being willing to have their surgery in an NHS hospital at a higher COVID-19 alert level (adjusted OR 1.14 (95% CI 1.06 to 1.22), $p < 0.001$) (Table III). As OKS increased, the probability that patients would prefer to attend for surgery at a lower COVID-19 alert level (level 1 or 2) increased. Conversely, as the OKS decreased, the probability that a patient would be willing to attend for surgery at a higher COVID-19 alert level (level 3, 4, or

5) increased (Figure 3b). When using a binary outcome (COVID-19 alert levels 1 and 2 vs levels 3, 4, and 5) and controlling for the same variables, patients reporting lower OKS had an increased odds of being willing to attend at COVID-19 alert levels 3, 4, or 5 in an NHS hospital (adjusted OR 1.16 (95% CI 1.07 to 1.26)). These odds increased further if surgery in a private (COVID-light) hospital was available (adjusted OR 1.41 (95% CI 1.29 to 1.53)) (Figure 4b).

Discussion

Approximately half of the patients who were put on the waiting list for either hip or knee arthroplasty prior to the UK COVID-19 epidemic had a preference to receive surgery in an NHS hospital at the less severe COVID-19 alert levels. The patients who opted for surgery at the higher COVID-19 alert levels had lower self-reported joint-specific QoL. Patients with lower joint-specific QoL expressed a preference for receiving surgery in a private sector (COVID-light) hospital compared to an NHS hospital at higher COVID-19 alert levels.

Patients waiting for total hip arthroplasty reported significantly worse global QoL compared to those waiting for total knee arthroplasty. Patients awaiting hip arthroplasty were more willing to have surgery at COVID-19 alert levels 3, 4, or 5 compared to those awaiting knee arthroplasty, which may be explained by lower global QoL and therefore joint-specific QoL.[25] The difference in score between patients awaiting hip and knee arthroplasty may only represent a regional variation that is observed in our centre. Despite this, joint-specific QoL was an important factor in influencing the decision to proceed with surgery in both cohorts.

Since the start of the UK epidemic, it has been reported that 71.2% of patients have had a deterioration in symptoms while waiting for elective orthopaedic operations.[26] In the present study, 54.2% of patients awaiting hip arthroplasty and 34.8% of patients awaiting knee arthroplasty reported an EQ-5D state that was 'worse than death' which is higher when compared to before the pandemic.[22] However, this is difficult to confirm without direct comparison of QoL scores in the patients in our cohort under the same survey conditions.

Implications for clinicians and policymakers. Our results demonstrate how patient perceptions around elective orthopaedic surgery have changed in the context of the pandemic. Understanding how factors such as joint-specific QoL influence the decision to undergo surgery is of great importance to surgeons, waiting list management teams, and commissioners. Informed consent for a surgical procedure is only valid if a patient understands and accepts the risks involved.[27] The present data has made it clear that COVID-19 alert levels play an important role for patients in their assessment of the risks of surgery during the pandemic and therefore should be accounted for during the consenting process.

Recent documents published throughout Europe emphasize the importance of prioritizing patient preferences in elective surgery[8,9] and elective orthopaedic surgery.[5,7] A high response rate to our survey was achieved at 74.1% (400/540). Postal surveys without financial incentives have been documented as typically achieving a response rate of around 25%,[28] with the rate increasing if financial incentives are offered or if the survey is of high interest to the population being surveyed.[29] Factors contributing to our high response rate may include the multimodal methods for return of the questionnaire (online, mail, telephone), and the topic being a high priority to patients.[24] Our strong survey response indicates the importance in engagement of patients in the planning of surgical waiting lists, and that patients want to be involved in this process.

The OHS, OKS, and EQ-5D-3L are widely used patient-reported outcome measures (PROMs) in research, audits, and clinical practice.[30] Indicators of patient experience are prioritized at policy, commissioning, and management levels and are widely used within NHS accountability frameworks. Conversely, PROM questionnaires are rarely included in such frameworks nor do they routinely form part of the patient-surgeon consultation. We recommend surgeons consider prospectively performing QoL questionnaires with patients at the time of being placed on the waiting list. This will help patients weigh up the risks versus benefits of surgery based on their individual QoL and joint symptoms against a backdrop of the pandemic.

Study strengths and limitations. One strength of our study is the high patient response rate achieved. We consulted with patient representatives to help design our survey and plan our analysis a priori. Patients were offered a range of options for returning their questionnaires, supported by existing evidence that different methods of questionnaire return do not significantly influence the reliability of completion of QoL questionnaires.[31] Self-reported measures can be vulnerable to 'response bias' where a person's response to a survey can be influenced by a number of factors, including perceived desirability of a given response (for example, some individuals may select extreme responses in order to expedite surgery). To avoid this, the cover letter accompanying the survey stated that 'response would not impact clinical care'. While we offered multimodal methods of questionnaire return, there may be a proportion of patients who experience barriers to completing such forms, owing to literacy levels or language barriers. Further, such services could include alternative language options. One factor that we hypothesized would play a role in a patient's decision for surgery was the personal COVID-19 risk status. However, only 21.3% knew their COVID-19 risk status and therefore only limited data were available to assess whether

this factor effects the COVID-19 alert level that patients are willing to receive surgery.

Strengths and limitations in the context of a changing COVID-19 landscape. One challenge to translating the findings of this study into clinical practice is posed by the changing landscape of the UK's response to managing COVID-19. On 12 October 2020, one week after our study period closed, the UK's categorization of the COVID-19 alert level changed such that each area of England was categorized as medium, high, or very high-alert according to the risk of infection in that area. On 23 October the introduction of a new five-tier system was announced in Scotland. This regional approach means that some neighbouring areas may be assigned different tiers. Therefore, a patient can be resident in an area in a different tier to that of the hospital at which they are awaiting surgery. This is important, given how significantly COVID-19 alert level impacts patients' decisions on proceeding with surgery.

In conclusion, while the magnitude of delayed elective surgical procedures poses serious challenges for healthcare systems, patients are also facing challenges with regards to understanding the proportionality of risk associated with surgery during the ongoing pandemic. We have reported on the use of patient-reported QoL to aid shared decision-making and guide prioritization on elective waiting lists. We recommend that QoL measures form a component of prioritization frameworks, ensuring patient preferences are carefully considered against the background of a fluctuating COVID-19 landscape.

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Supplementary material

A figure displaying the patient-selected COVID-19 alert level that patients are willing to undergo total hip and knee arthroplasty in an NHS hospital against joint-specific quality of life measure, and a table showing the results of univariate analysis assessing different patient factors that influence whether patients would be willing to attend an NHS hospital for hip and knee arthroplasty surgery at different COVID-19 alert levels.

References

1. **Kayani B**, **Onochie E**, **Patil V**, **et al**. The effects of COVID-19 on perioperative morbidity and mortality in patients with hip fractures. *Bone Joint J.* 2020;102-B(9):1136–1145.
2. **Haddad FS**. COVID-19 and orthopaedic and trauma surgery. *Bone Joint J.* 2020;102-B(5):545–546.
3. **Hampton M**, **Clark M**, **Baxter I**, **et al**. The effects of a UK lockdown on orthopaedic trauma admissions and surgical cases: a multicentre comparative study. *Bone Jt Open.* 2020;1(5):137–143.
4. **Reed S**, **Scobie S**. Chart of the week: the proportion of people waiting more than 18 weeks for planned treatment has rocketed since COVID-19. 2020. The Nuffield Trust. https://www.nuffieldtrust.org.uk/resource/chart-of-the-week-the-proportion-of-people-waiting-more-than-18-weeks-for-planned-treatment-has-rocketed-since-covid-19 (date last accessed 9 April 2021).
5. **British Orthopaedic Association**. Progress on restarting elective orthopaedic surgery. 2020. https://www.boa.ac.uk/resources/progress-on-restarting-elective-orthopaedic-surgery.html (date last accessed 16 October 2020).
6. **Clement ND**, **Hall AJ**, **Makaram NS**, **et al**. IMPACT-Restart: the influence of COVID-19 on postoperative mortality and risk factors associated with SARS-CoV-2 infection after orthopaedic and trauma surgery. *Bone Joint J.* 2020;102-B(12):1774–1781.
7. **Donell ST**, **Thaler M**, **Budhiparama NC**, **et al**. Preparation for the next COVID-19 wave: the European hip Society and European knee associates recommendations. *Knee Surg Sports Traumatol Arthrosc.* 2020;28(9):2747–2755.
8. **Royal College of Surgeons England**. Survey findings: elective surgery during COVID-19. 2020. https://www.rcseng.ac.uk/news-and-events/news/archive/survey-results-elective-surgery-under-covid/ (date last accessed 9 April 2021).
9. **NHS England**. Clinical validation of surgical waiting lists: framework and support tools. 2020. https://www.england.nhs.uk/coronavirus/publication/validating-waiting-lists-framework/ (date last accessed 9 April 2021).
10. **Weldring T**, **Smith SMS**. Patient-Reported outcomes (pros) and patient-reported outcome measures (PROMs). *Heal Serv insight.* 2013;6:61–68.
11. **Liow MHL**, **Tay KXK**, **Yeo NEM**, **et al**. From "business continuity" to "back to business" for orthopaedic surgeons during the COVID-19 pandemic. *Bone Jt Open.* 2020;1(6):222–228.
12. **Gonzi G**, **Rooney K**, **Gwyn R**, **et al**. Trauma surgery at a designated COVID-19-free site during the pandemic. *Bone Jt Open.* 2020;1(6):302–308.
13. **NHS**. Who's at higher risk from coronavirus (COVID-19). 2020. NHS. https://www.nhs.uk/conditions/coronavirus-covid-19/people-at-higher-risk/whos-at-higher-risk-from-coronavirus/ (date last accessed 15 October 2020).
14. **Joint Biosecurity Centre**. Paper for SAGE small group: COVID-19 alert levels change criteria. 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/950765/s0573-covid-19-alert-level-change-criteria.pdf (date last accessed 9 April 2021).
15. **Rabin R**, **de Charro F**. EQ-5D: a measure of health status from the EuroQol group. *Ann Med.* 2001;33(5):337–343.
16. **Dawson J**, **Fitzpatrick R**, **Carr A**, **Murray D**. Questionnaire on the perceptions of patients about total hip replacement. *J Bone Joint Surg Br.* 1996;78-B(2):185–190.
17. **Murray DW**, **Fitzpatrick R**, **Rogers K**, **et al**. The use of the Oxford hip and knee scores. *J Bone Joint Surg Br.* 2007;89(8):1010–1014.
18. **Dawson J**, **Fitzpatrick R**, **Murray D**, **Carr A**. Questionnaire on the perceptions of patients about total knee replacement. *J Bone Joint Surg Br.* 1998;80(1):63–69.
19. **Murray DW**, **Fitzpatrick R**, **Rogers K**, **et al**. The use of the Oxford hip and knee scores. *J Bone Joint Surg Br.* 2007;89(8):1010–1014.
20. **Dolan P**. Modeling valuations for EuroQol health states. *Med Care.* 1997;35(11):1095–1108.
21. **EuroQol Offices**. EQ-5D user guides. 2018. https://euroqol.org/publications/user-guides/ (date last accessed 9 April 2021).
22. **Scott CEH**, **MacDonald DJ**, **Howie CR**. 'Worse than death' and waiting for a joint arthroplasty. *Bone Joint J.* 2019;101-B(8):941–950.
23. **Ranganathan P**, **Pramesh CS**, **Aggarwal R**. Common pitfalls in statistical analysis: logistic regression. *Perspect Clin Res.* 2017;8(3):148–151.
24. **Fincham JE**. Response rates and responsiveness for surveys, Standards, and the Journal. *Am J Pharm Educ.* 2008;72(2):43.
25. **Martín-Fernández J**, **Morey-Montalvo M**, **Tomás-García N**, **et al**. Mapping analysis to predict EQ-5D-5L utility values based on the Oxford Hip Score (OHS) and Oxford Knee Score (OKS) questionnaires in the Spanish population suffering from lower limb osteoarthritis. *Health Qual Life Outcomes.* 2020;18(1):184.
26. **Morris JA**, **Super J**, **Huntley D**, **Ashdown T**, **Harland W**, **Anakwe R**. Waiting Lists for symptomatic joint arthritis are not benign. *Bone Jt Open.* 2020;1(8):508–511.
27. **Cocanour CS**. Informed consent-It's more than a signature on a piece of paper. *Am J Surg.* 2017;214(6):993–997.
28. **Millar MM**, **Dillman DA**. Improving response to web and Mixed-Mode surveys. *Public Opin Q.* 2011;75(2):249–269.
29. **Edwards P**, **Roberts I**, **Clarke M**, **et al**. Increasing response rates to postal questionnaires: systematic review. *BMJ.* 2002;324(7347):1183.
30. **Price AJ**, **Kang S**, **Cook JA**, **et al**. The use of patient-reported outcome measures to guide referral for hip and knee arthroplasty. *Bone Joint J.* 2020;102-B(7):941–949.
31. **Burnand HG**, **McMahon SE**, **Sayers A**, **Tshengu T**, **Gibson N**, **Blom AW**. The EQ-5D-3L administered by text message compared to the paper version for hard-to-reach

populations in a rural South African trauma setting: a measurement equivalence study. *Arch Orthop Trauma Surg.* 2020:1–11.

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- All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.
- Two patient representatives who were on the waiting list for joint arthroplasty at Cambridge University Hospitals NHS Foundation Trust were consulted prior to designing the patient survey. They provided insights into their top concerns regarding attending hospital for joint arthroplasty surgery during the COVID-19 epidemic in the UK, their thoughts underlying these concerns and the information they would wish to know before attending for surgery during the ongoing epidemic in the UK. These discussions underpinned the design of our questionnaire and prompted us to invite open comments from our patient participants via the questionnaire. These open comments helped inform our analysis, alongside plans to disseminate results.

Data sharing:
- Access to the data will be made available on reasonable request from the corresponding author.

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- Ethical approval was obtained from the Cambridge University Hospitals NHS Foundation Trust quality improvement office as a service evaluation and the questionnaires were approved by the local Trust information governance team (PRN9129). Licences for the use of EQ-5D-3L (ID 36374), Oxford hip score (00OHS-870168) and Oxford knee score (00OKS-870166) questionnaires were obtained.