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■ ARTHROPLASTY

The effect of COVID-19 restrictions on rehabilitation and functional outcome following total hip and knee arthroplasty during the first wave of the pandemic

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Aims

The primary aim was to assess the patient-perceived effect of restrictions imposed due to COVID-19 on rehabilitation following total hip arthroplasty (THA) and total knee arthroplasty (TKA). Secondary aims were to assess perceived restrictions, influence on mental health, and functional outcome compared to patients undergoing surgery without restriction.

Methods

During February and March 2020, 105 patients underwent THA (n = 48) or TKA (n = 57) and completed preoperative and six-month postoperative assessments. A cohort of 415 patients undergoing surgery in 2019 were used as the control. Patient demographic data, BMI, co-morbidities, Oxford Hip Score (OHS) or Knee Score (OKS), and EuroQoL five-domain (EQ-5D) score were collected preoperatively and at six months postoperatively. At six months postoperatively, the 2020 patients were also asked to complete a questionnaire relating to the effect of the social restrictions on their outcome and their mental health.

Results

Nearly half of the patients (47.6%, n = 50/105) felt that the restrictions imposed by COVID-19 had limited their rehabilitation and were associated with a significantly worse postoperative OKS (p < 0.001), EQ-5D score (p < 0.001), and lower satisfaction rate (p = 0.019). The reasons for the perceived limited rehabilitation were: being unable to exercise (n = 32, 64%), limited access to physiotherapy (n = 30, 60%), and no face-to-face follow-up (n = 30, 60%). A quarter (n = 26) felt that their mental health had deteriorated postoperatively; 17.1% (n = 18) felt depressed and 26.7% (n = 28) felt anxious. Joint-specific scores and satisfaction for the 2020 group were no different to the 2019 group, however patients undergoing THA in 2020 had a significantly worse postoperative EQ-5D compared to the 2019 cohort (difference 0.106; p = 0.001) which was not observed in patients undergoing TKA.

Conclusion

Half of the 2020 cohort felt that their rehabilitation had been limited and was associated with worse postoperative Oxford and EQ-5D scores, and lower rates of patient satisfaction, but relative to the 2019 cohort their overall outcomes were no different, with the exception of THA patients who had a worse general health score.

Level of evidence: Prospective study, Level 2

Introduction

Elective non-urgent NHS surgical procedures were suspended from 17 March 2020 in the UK to help the service deal with the COVID-19 pandemic.[1] Following this, the UK entered a state of lockdown on 23 March 2020 due to escalation of the first wave of the coronavirus disease 2019 (COVID-19).[2] Lockdown and the associated social restrictions may have influenced the recovery of patients

undergoing total hip arthroplasty (THA) or total knee arthroplasty (TKA) immediately prior to the introduction of these restrictions, due to reduced or absence of exercise, physiotherapy, face-to-face follow-up, support from friends and family, and restricted access to medical services.

Patients undergoing THA and TKA would normally have an outpatient visit following surgery.[3] This is a point of contact for advice and support for patients after their procedure. At this visit, the team ensures that patients have a clear understanding of their rehabilitation goals and the importance of doing the exercises prescribed to achieve these goals. As a result of lockdown, close contact with patients following discharge from hospital may not have been possible. Face-to-face visits were reserved for cases where postoperative care could not be self-provided or remotely delivered. Most studies relating to arthroplasty during the pandemic examine the nosocomial rate of COVID-19, mortality, and the safety of patient pathways.[4-6] However, the authors of the current study are not aware of information regarding the functional outcome of elective joint arthroplasty and the effect of limited personal clinical contact during the pandemic, consequent to lockdown, and the social restrictions on patient recovery. Patients at risk of perceived limitation of rehabilitation following THA and TKA may benefit from targeted intervention to improve their functional outcome, should all face-to-face contact be limited.

The primary aim of this study was to assess the effect of the social restrictions (March to August 2020) imposed due to first wave of the COVID-19 pandemic on rehabilitation and outcome six months after THA and TKA, as perceived by the patient. Secondary aims were to assess the ways in which patients felt that the social restrictions had limited their rehabilitation, access to healthcare and the influence of COVID-19 on mental health following surgery, and whether these influenced functional outcome and satisfaction rate relative to patients undergoing THA and TKA without such restrictions.

Methods

Ethical approval was obtained from the regional ethics committee (Research Ethics Committee A, South East Scotland Research Ethics Service, Scotland (16/SS/0026)) for analysis and publication of the presented data.

During the study period (February to March 2020), a total of 48 consecutive primary THAs and 57 consecutive primary TKAs were undertaken at the study centre. This group was defined as the 2020 cohort that had social restrictions affecting their rehabilitation following surgery due to the COVID-19 pandemic. Existing databases of patients undergoing THA or TKA from January to May 2019 held at the study centre were used as the control cohort (2019 cohort: without social restrictions) to allow a comparison of functional outcome and satisfaction rates with the 2020 cohort.

The patient demographic data, BMI, and comorbidities were recorded preoperatively. Categories of comorbidity included: connective tissue disease, diabetes, back pain, and hypertension, which were recorded as dichotomous variables.

All patients were asked to complete joint-specific Oxford Hip (OHS) or Knee (OKS) score and[7,8] EuroQoL (EQ) questionnaire,[9] preoperatively (at the preassessment clinic) and six months postoperatively (using a postal questionnaire). The OHS and OKS were recorded preoperatively and at six months postoperatively. The OHS and OKS consist of 12 questions assessed on a Likert scale with values from 0 to 4, a summative score is then calculated where 48 is the best possible score (least symptomatic), and 0 is the worst possible score (most symptomatic).[10] The EQ general health questionnaire evaluates five domains (5D: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression).[9] The three-level version of the EQ questionnaire was used, with the responses to the five domains being recorded at three levels of severity. This index is on a scale of -0.594 to 1, where 1 represents perfect health and a negative value represents a state perceived as worse than death.[8] The minimal clinically important difference in the Oxford score was defined as five points or more[11,12] and 0.08 of more for the EQ-5D.[13]

All patients were also asked, "How satisfied are you following your surgery?" six months postoperatively. The response to the question was graded using a five-point Likert scale: very satisfied, satisfied, neither satisfied or dissatisfied, dissatisfied, or very dissatisfied. Responses were dichotomized for analysis, accepting 'satisfied' and 'very satisfied' responses as positive.[14]

In addition, at six months postoperatively, the 2020 cohort were also asked to complete COVID-19 questionnaire (Supplementary Material). Patients were asked: "Do you feel that the COVID-19 pandemic has limited your recovery after your joint arthroplasty?" The response to this question was a "yes" or "no". Those responding with a "yes" were asked to define what this was due to: limited access to physiotherapy, restrictions of lockdown, not being able to exercise, other health problems, lack of access to support from family and friends, and/or no face-to-face follow-up. They were also asked additional questions relating to whether they received physiotherapy, access to healthcare services regarding concerns during their recovery, if they would have had their surgery in light of the COVID-19 pandemic and associated restrictions, if their mental health had deteriorated during lockdown and because of social distancing, and whether they felt depressed and/or anxious (Table I). Fixed dichotomous (yes or no) responses were available for these questions.

Table I. Responses to the effect COVID-19 had on postoperative recovery for the study cohort.

Question	Response	Total, n %	Joint, n (%)		OR (95% CI)	p-value*
			THA (n = 48)	TKA (n = 57)		
Limited recovery due to COVID-19?	Yes	50 (47.6)	22 (45.8)	28 (49.1)	0.95 (0.43 to 2.07)	0.896
	No	53 (50.5)	24 (50.0)	29 (50.9)		
	Missing	2 (1.9)	2 (4.2)	0		
Did you receive physiotherapy after surgery?	Yes	28 (26.7)	12 (25.0)	16 (28.1)	0.90 (0.38 to 2.17)	0.822
	No	75 (71.4)	34 (70.8)	41 (71.9)		
	Missing	2 (1.9)	2 (4.2)	0		
Concerns about joint but not able to contact anyone?	Yes	23 (22.3)	7 (14.6)	16 (28.1)	0.45 (0.17 to 1.21)	0.107
	No	81 (77.1)	40 (83.3)	41 (71.9)		
	Missing	1 (1.0)	1 (2.1)	0		
Were you diagnosed with COVID-19 post-surgery?	Yes	2 (1.9)	2 (4.2)	0 (0)	N/A	0.116†
	No	102 (97.1)	45 (93.8)	57 (100)		
	Missing	1 (1.0)	1 (2.1)	0		
In light of COVID-19 restrictions would you have had your surgery?	Yes	93 (88.6)	43 (89.6)	50 (87.7)	1.08 (0.27 to 4.26)	0.918†
	No	9 (8.6)	4 (8.3)	5 (8.8)		
	Missing	3 (2.9)	1 (2.1)	2 (3.5)		
Do you feel your mental health has deteriorated?	Yes	26 (24.8)	13 (27.1)	13 (22.8)	1.24 (0.51 to 3.01)	0.642
	No	76 (72.4)	34 (70.8)	42 (73.7)		
	Missing	3 (2.9)	1 (2.1)	2 (3.5)		
Do you feel depressed?	Yes	18 (17.1)	9 (18.8)	9 (15.8)	0.81 (0.29 to 2.24)	0.688
	No	87 (82.9)	39 (81.3)	48 (84.2)		
	Missing	0	0	0		
Do you feel anxious?	Yes	28 (26.7)	14 (29.2)	14 (24.6)	0.79 (0.33 to 1.88)	0.595
	No	77 (73.3)	34 (70.8)	43 (75.4)		
	Missing	0	0	0		

*Chi-squared test unless otherwise stated.
†Fisher's exact test.
N/A, not applicable; OR, odds ratio; THA, total hip arthroplasty; TKA, total knee arthroplasty.

All patients were reviewed at a pre-assessment clinic one week before their planned surgery. Nonurgent elective arthroplasty surgery was performed until 10 March at the study centre, after which all planned surgeries were cancelled, and arthroplasty inpatients prepared for discharge. In hospital a standardized rehabilitation protocol was used; patients were seen by a physiotherapist and, where possible, an occupational therapist. The patients were given advice on managing activities of daily living, home exercise programmes, and mobilization, all of which are important elements for achieving optimal levels of function and mobility. Patients were then reviewed at six to eight weeks postoperatively by an arthroplasty practitioner as part of their postoperative follow-up; in the 2019 group this was at a clinic appointment whereas in the 2020 group this as conducted over the telephone.

Statistical analysis. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software (IBM, USA) version 17. Parametric tests were used to assess continuous variables for significant differences between groups. For numerical variables an independent-samples t-test (normally distributed data) was used to compare means between groups, and a paired t-test was used to assess mean change within the groups.

Dichotomous variables were assessed using a chi-squared test or Fisher's exact test (if less than five in one cell) for the between group comparisons. Multivariate linear analysis was used to assess the independent association of restrictions imposed by COVID-19 on outcome (postoperative OHS and EQ-5D) after adjusting for confounding variables. A p-value of < 0.05 was defined as statistically significant for the primary outcome (OKS).

A power calculation was performed using the minimum clinically important difference of five points in the Oxford score,[12] a standard deviation (SD) of ten points, an α of 0.05, two tailed independent-samples t-test, and a power of 80% would need a minimum of 40 in the 2020 and 160 in the 2019 cohorts using a 1:4 ratio.

Results

During the study period 105 patients reported their six-month patient-reported outcomes (PROMs) and the COVID-19 rehabilitation questionnaire. There were 44 (41.9%) male and 61 (58.1%) female patients with a mean age of 69.5 years (34 to 91).

The patient-perceived effect of COVID-19 restrictions on their rehabilitation and influence on their outcome six months following surgery. Nearly half (47.6%, n = 50/105) of the 2020 cohort felt that their recovery was

Table II. Patient demographic data and preoperative functional scores for patients undergoing total hip arthroplasty according to group. Two patients from the total hip arthroplasty group did not complete the question as to whether their recovery was limited and thus were excluded from analysis.

Demographic	Limited by COVID-19		OR/difference (95% CI)	p-value
	Yes (n = 50)	No (n = 53)		
Sex, n			OR 1.32 (0.29 to 1.39)	0.251*
Male	18	25		
Female	32	28		
Mean age, yrs (SD)	68.3 (9.5)	70.1 (10.8)	Diff 1.8 (-2.2 to 5.8)	0.373†
Mean BMI, kg/m² (SD)	30.6 (5.2)	29.7 (6.7)	Diff 0.9 (-1.5 to 3.3)	0.451†
Comorbidity, n (% of group)				
No disease	Reference			
Connect tissue	7	8	OR 1.09 (0.37 to 3.27)	0.875*
Diabetes	9	6	OR 0.58 (0.19 to 1.77)	0.337*
Back pain	23	16	OR 0.51 (0.23 to 1.14)	0.098*
Hypertension	13	14	OR 1.02 (0.42 to 2.46)	0.962*
Joint			OR 0.95 (0.44 to 2.07)	0.896*
THA	22	24		
TKA	28	29		
Mean functional measures (SD)				
OHS (n = 46)				
Preoperative	18.6 (8.4)	20.0 (7.7)	Diff 1.3 (-3.4 to 6.1)	0.568†
Postoperative	33.8 (9.2)	39.3 (10.1)	Diff 5.4 (-0.3 to 11.2)	0.064†
OKS (n = 57)				
Preoperative	18.8 (7.9)	21.2 (7.2)	Diff 2.4 (-1.7 to 6.3)	0.244†
Postoperative	30.8 (7.8)	40.3 (6.2)	Diff 9.5 (5.8 to 13.3)	< 0.001†
EQ-5D (n = 103)				
Preoperative	0.315 (0.316)	0.392 (0.315)	Diff 0.077 (-0.046 to 0.201)	0.216†
Postoperative	0.635 (0.226)	0.833 (0.214)	Diff 0.198 (0.112 to 0.283)	< 0.001†
Satisfied			OR 5.63 (1.15 to 27.52)	0.019‡
Yes	40	50		
No	9	2		
Not answered	1	1		

*Chi-squared test.
†Independent-samples *t*-test.
‡Fisher's exact test
CI, confidence interval; EQ-5D, EuroQol five-dimension; N/A, not applicable; OHS, Oxford Hip Score; OKS, Oxford Knee Score; OR, odds ratio; SD, standard deviation; THA, total hip arthroplasty; TKA, total knee arthroplasty.

limited due to the restrictions imposed by COVID-19 following their surgery (Table I). Two patients did not answer this question. There were no differences in patient demographic data, BMI, comorbidities, joint replaced (THA/TKA), or preoperative Oxford and EQ-5D scores between those patients with and without perceived restrictions (Table II). However, patients who felt their recovery had been limited had a significantly worse postoperative OKS for those undergoing TKA, a worse postoperative EQ-5D score for both THA and TKA, and were more likely to be dissatisfied with the joint (Table II).

Patient perception of causation of limited rehabilitation. Patients reported that their recovery had been limited due to being able to exercise (n = 32, 64%), limited access to physiotherapy (n = 30, 60%), and no face-to-face follow-up (n = 30, 60%) (Table III). Patients undergoing THA were more likely to state that "other health problems" were a cause of the limitation in their recovery due to COVID-19 restrictions (Table III). Assessing the whole cohort, 71.4% (n = 75) of

patients felt they had not received physiotherapy and 22.3% (n = 23) felt they were unable to contact a healthcare professional about concerns following surgery (Table I). However, most patients (n = 93, 88.6%) would have had their surgery again despite the subsequent restrictions and limitations posed by COVID-19. One-quarter (n = 26, 24.8%) of patients felt that their mental health had deteriorated postoperatively due to the COVID-19 restrictions, 17.1% (n = 18) felt depressed, and 26.7% (n = 28) felt anxious (Table I).

Comparing functional outcomes and satisfaction to 2019 cohort. There were no differences in patient characteristics (demographic data, BMI, comorbidities, preoperative Oxford or EQ-5D scores) between the 2019 and 2020 cohort undergoing either THA (Table IV) or TKA (Table V), apart from connective tissue disease, which was more prevalent in the 2020 TKA cohort. Patients in the 2020 group undergoing THA had significantly worse unadjusted postoperative OHS and EQ-5D scores but this only exceeded the minimal clinically important difference for the EQ-5D (Table VI). After adjusting

Table III. Reasons for patients stating their recovery after surgery was limited due to COVID-19.

Question	Response	Cohort, n (%)	Joint, n (%) THA	TKA	Odds ratio (95% CI)	p-value*
Limited access to physiotherapy	Yes	30 (60)	12 (54.5)	18 (64.3)	1.50 (0.48 to 4.70)	0.485
	No	20 (40)	10 (45.5)	10 (35.7)		
Not being able to exercise	Yes	32 (64)	15 (68.2)	17 (60.7)	0.72 (0.22 to 2.34)	0.585
	No	18 (36)	7 (31.8)	11 (39.3)		
No support from family and friends	Yes	22 (44)	13 (59.1)	9 (32.1)	0.33 (0.10 to 1.05)	0.057
	No	28 (56)	9 (40.9)	19 (67.9)		
Restrictions of lockdown	Yes	11 (22)	7 (31.8)	4 (14.3)	0.36 (0.09 to 1.43)	0.137†
	No	39 (78)	15 (68.2)	24 (85.7)		
Other health problems	Yes	21 (42)	15 (68.2)	6 (21.4)	0.13 (0.04 to 0.45)	0.001
	No	29 (58)	7 (31.8)	22 (78.6)		
No face-to-face follow-up	Yes	30 (60)	13 (59.1)	17 (60.7)	1.07 (0.34 to 3.34)	0.907
	No	20 (40)	9 (40.9)	11 (39.3)		

*Chi-squared test unless otherwise stated.
†Fisher's exact test.
CI, confidence interval; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Table IV. Patient demographic data and preoperative functional scores for patients undergoing total hip arthroplasty according to group.

Demographic	Year 2019 (n = 192)	2020 (n = 48)	OR/difference (95% CI)	p-value
Sex, n			OR 1.11 (0.58 to 2.12)	0.743*
Male	81	19		
Female	111	29		
Mean age, yrs (SD)	69.3 (10.5)	68.9 (12.2)	Diff 0.4 (-3.1 to 3.9)	0.821†
Mean BMI, kg/m² (SD)	28.5 (5.6)	29.0 (5.1)	Diff 0.5 (-1.3 to 2.2)	0.603†
Comorbidity, n (% of group)				
No disease	Reference			
Connect tissue	16	3	OR 0.73 (0.21 to 2.63)	0.633‡
Diabetes	16	6	OR 1.57 (0.58 to 4.26)	0.371*
Back pain	85	22	OR 1.07 (0.56 to 2.01)	0.846*
Hypertension	54	10	OR 0.67 (0.31 to 1.44)	0.307*
Mean functional measures (SD)				
Preoperative OHS	20.5 (9.5)	20.0 (8.3)	Diff 0.6 (-2.4 to 3.5)	0.693†
Preoperative EQ-5D	0.387 (0.328)	0.321 (0.321)	Diff 0.066 (-0.038 to 0.170)	0.212†

*Chi-squared test.
†Independent-samples *t*-test.
‡Fisher's exact test.
CI, confidence interval; Diff, difference; EQ-5D, EuroQol five-dimension questionnaire; N/A, not applicable; OHS, Oxford Hip Score; OR, odds ratio; SD, standard deviation.

for confounding variables, the difference in postoperative EQ-5D between the cohorts remained clinically and statistically significantly worse in the 2020 cohort (difference 0.106 (95% CI 0.045 to 0.168); p = 0.001, multivariate linear analysis). There were no significant differences in the postoperative OKS or EQ-5D scores between the 2019 and 2020 cohorts for those patients undergoing a TKA (Table VII). There were no significant differences in the rate of satisfaction between the 2020 and 2019 cohorts for either patients undergoing a THA or TKA (Table VIII).

Discussion
This study has shown that nearly half of patients in the 2020 arthroplasty cohort felt that their recovery following surgery was limited due to the restrictions imposed in response to the first wave of the COVID-19 pandemic. The patient-perceived limitation on their recovery was associated with worse postoperative PROMs and lower rates of patient satisfaction. Not being able to exercise, access physiotherapy, or experience face-to-face follow-up were the main reasons stated for their limited recovery. One-quarter of patients felt that their mental health had deteriorated postoperatively due to the COVID-19 social restrictions. Other than a worse postoperative EQ-5D in the 2020 THA cohort, there was no objective clinically significant difference in postoperative PROMs between the 2020 cohort (cases) and the 2019 cohort (controls).

This study has some limitations. The measurement of subjective concerns assessed has not been validated, and the results of the current study reflect the experience of a single centre with a specific catchment population. The

Table V. Patient demographic data and preoperative functional scores for patients undergoing total knee arthroplasty according to group.

| Demographic | Year | | OR/difference (95% CI) | p-value |
	2019 (n = 223)	2020 (n = 57)		
Sex, n				
Male	97	25	OR 0.99 (0.55 to 1.77)	0.961*
Female	126	32		
Mean age, yrs (SD)	69.7 (8.6)	69.7 (8.1)	Diff 0.0 (-2.5 to 2.5)	0.995†
Mean BMI, kg/m² (SD)	31.3 (6.5)	30.9 (6.6)	Diff 0.4 (-1.5 to 2.3)	0.673†
Comorbidity, n (% of group)				
No disease	Reference			
Connect tissue	23	12	OR 2.32 (1.07 to 5.00)	0.029*
Diabetes	31	10	OR 1.32 (0.60 to 2.88)	0.488*
Back pain	66	18	OR 1.10 (0.59 to 2.06)	0.771*
Hypertension	59	18	OR 1.28 (0.68 to 2.42)	0.440*
Mean functional measures (SD)				
Preoperative OKS	20.6 (7.4)	20.0 (7.6)	Diff 0.6 (-1.6 to 2.8)	0.570†
Preoperative EQ-5D	0.389 (0.308)	0.395 (0.312)	Diff 0.006 (-0.084 to 0.097)	0.890†

*Chi-squared test.
†Independent-samples *t*-test.
CI, confidence interval; Diff, Difference; EQ-5D, EuroQol five-dimension questionnaire; N/A, not applicable; OKS, Oxford Knee Score; OR, odds ratio; SD, standard deviation.

Table VI. Unadjusted analysis: postoperative outcome measures and the difference relative to preoperative scores for total hip arthroplasty patients according to group.

| Functional measure | Mean (SD) | | Difference in mean (95% CI) | p-value* |
	2019 (n = 192)	2020 (n = 48)		
Preoperative OHS	20.5 (9.5)	19.9 (8.3)	0.6 (-2.4 to 3.5)	0.693
Postoperative OHS	39.3 (8.3)	36.4 (10.1)	3.0 (0.2 to 5.7)	0.035
Mean difference	18.8 (10.1)	16.5 (11.2)	2.4 (-0.9 to 5.6)	0.158
95% CI	17.4 to 20.2	13.2 to 19.7		
p-value†	< 0.001	< 0.001		
Preoperative EQ-5D	0.387 (0.328)	0.321 (0.321)	0.066 (-0.038 to 0.170)	0.212
Postoperative EQ-5D	0.819 (0.179)	0.705 (0.286)	0.113 (0.049 to 0.179)	0.001
Mean difference	0.433 (0.316)	0.384 (0.371)	0.052 (-0.053 to 0.157)	0.330
95% CI	0.387 to 0.478	0.276 to 0.491		
p-value†	< 0.001	< 0.001		

*Independent-samples *t*-test.
†Paired *t*-test.
CI, confidence interval; EQ-5D, EuroQol five-dimension questionnaire; OHS, Oxford Hip Score; SD, standard deviation.

subjective results of the patients may be related to the services and care available within this region, which may not have been the same elsewhere. However, the study centre is typical of arthroplasty centres throughout the UK, and is a large volume centre performing more than 2,000 arthroplasties per year.[15] Therefore, the postoperative care is likely representative of other centres across the UK when entering lockdown in March 2020; a postoperative face-to-face review was carried out but outpatient physiotherapy was not routine.[3] In addition, the patient-reported outcomes were assessed at a relative early timepoint of six months, the same timepoint used by the National Joint Registry to collect PROMs.[16] Though one-year outcomes may have been preferable,[17] the same timepoint for assessment was used for the control group (2019 patients) and therefore offers a representative comparison. This cohort was relatively small with just over 100 patients; despite being powered to the Oxford

Score, further studies are needed to affirm the results of the current study.

Optimal postoperative care following surgery should aim to support and help patients during their recovery to obtain maximum benefit from their arthroplasty, however the current study would suggest that half of patients during the first lockdown felt their rehabilitation was limited due to the social restrictions of COVID-19. Normally, patients can access sufficient support and information from the arthroplasty team as well as from friends and family postoperatively, and it is recognized that postoperative recovery planning should start before surgery takes place.[18,19] However, the COVID-19 pandemic may have resulted in diminished access to both formal and informal support networks during the patient's postoperative recovery. Due to national restrictions patients were unable to make contact with the appropriate hospital staff, or have face-to-face follow-up, and would have also

Table VII. Unadjusted analysis: postoperative outcome measures and the difference relative to preoperative scores for total knee arthroplasty patients according to group.

Functional measure	Mean (SD)		Difference in mean (95% CI)	p-value*
	2019 (n = 223)	2020 (n = 57)		
Preoperative OKS	20.6 (7.4)	20.0 (7.6)	0.6 (-1.6 to 2.8)	0.570
Postoperative OKS	35.1 (9.1)	35.6 (8.4)	0.7 (-1.9 to 3.4)	0.581
Mean difference	14.5 (11.5)	15.6 (10.4)	1.1 (-2.2 to 4.4)	0.511
95% CI	12.9 to 16.1	12.8 to 18.4		
p-value†	< 0.001	< 0.001		
Preoperative EQ-5D	0.434 (0.304)	0.379 (0.344)	0.006 (-0.084 to 0.969)	0.890
Postoperative EQ-5D	0.731 (0.264)	0.584 (0.408)	0.017 (-0.048 to 0.085)	0.580
Mean difference	0.296 (0.333)	0.205 (0.374)	0.004 (-0.096 to 0.104)	0.941
95% CI	0.283 to 0.310	0.071 to 0.340		
p-value†	< 0.001	0.004		

*Independent-samples *t*-test.
†Paired *t*-test.
CI, confidence interval; EQ-5D, EuroQol five-dimension questionnaire; OKS, Oxford Knee Score; SD, standard deviation.

Table VIII. Rate of satisfaction at one year for total hip arthroplasty and total knee arthroplasty according to group.

Variable	2019	2020	OR (95% CI)	p-value*
THA	n = 192	n = 48	0.42 (0.13 to 1.31)	0.124
Satisfied	181	42		
Not satisfied	9	5		
Not answered	2	1		
TKA	n = 223	n = 57	1.17 (0.46 to 2.98)	0.748
Satisfied	193	50		
Not satisfied	27	6		
Not answered	3	1		

*Chi-squared test (patients who did not answer were excluded from test).
CI, confidence interval; OR, odds ratio; THA, total hip arthroplasty; TKA, total knee arthroplasty.

been denied physical contact with those friends and family who would, under normal circumstances, have been able to offer additional help and support. This is supported by the subjective reasons given by the patients, who felt their recovery was limited due to the restrictions in the current study.

Despite the perceived limitation on patient recovery during lockdown the joint-specific PROMs were no different compared to patients in the control group. Preoperative psychological status is recognized to influence postoperative recovery,[19] and preoperative anxiety and/or depression is an important predictor of dissatisfaction with surgical outcome,[20] and can affect patient dissatisfaction for up to two years after surgery.[21] Furthermore, poor mental health has a negative effect on postoperative recovery in terms of pain perception, return to work, and quality of life.[22] The COVID-19 pandemic may have had a profound effect on the patients' mental health status and their perception of their recovery during the six months following their arthroplasty surgery. This may be reflected by the observed worse general health outcome in patients undergoing THA in 2020 when compared to control, despite the same joint-specific functional improvement and satisfaction rate with their

hip arthroplasty. The EQ-5D was used to evaluate health related quality of life in the current study and two of five dimensions assess anxiety/depression and unusual activities,[23] both of which may have been influenced by the lockdown. One-quarter of the patients in 2020 felt their mental health had deteriorated during lockdown, with one in four patients feeling anxious and one in five feeling depressed, which may explain the worse postoperative EQ-5D score in the THA patients. Furthermore, the question relating to the usual activities in the EQ-5D questionnaire may have been influenced by the restrictions of lockdown, as these "normal activities" may not have been possible.

There were no factors associated with the risk of patient-perceived limited outcome and therefore no specific group could be identified that may benefit from targeted follow-up in future restrictions to prevent this from occurring. Restricted access to traditional face-to-face care should be recognized as a patient concern, and provision of a point of access to physiotherapy or joint-specific teams made. Telecommunication links were used here but appeared insufficient; web links may aid patients postoperatively and a move towards a virtual follow-up model may be sufficent.[24] Provision of adequate and relevant preoperative and postoperative information is vital and is part of enhanced care protocols, however easy access to an appropriate support system, including physiotherapy, is also important.[20] In addition, other potential factors not assessed in the current study, such as access to social support networks and internet services, may influence the patients' perceived limitations to rehabilitation during lockdowns.

When patients felt that the social restrictions imposed by the COVID-19 pandemic had limited their recovery, this was associated with worse OHSs and OKSs, worse EQ-5D scores, and lower rates of patient satisfaction. However, compared to a control cohort from 2019 there was no difference in joint-specific outcomes (OHS, OKS) or satisfaction following

THA or TKA, though general heath EQ-5D scores following THA were worse in 2020 compared to 2019. Postoperative face-to-face care for reassurance appears to be important to the patient and may be considered as part of a normal care package. Patients could be reassured that despite their perceived limitations of their rehabilitation they would be expected to achieve a similar early (six months) joint-specific outcome compared to patients undergoing surgery prior to the social restrictions of COVID-19.

In conclusion, half of the 2020 cohort felt that their rehabilitation had been limited and was associated with worse postoperative Oxford and EQ-5D scores, and lower rates of patient satisfaction, but relative to the 2019 cohort their overall outcomes were no different, with the exception of THA patients who had a worse general health score.

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Supplementary material

e   Arthroplasty rehabilitation during the COVID-19 pandemic questionnaire.

References

1. **Iacobucci G**. COVID-19: all non-urgent elective surgery is suspended for at least three months in England. *BMJ*. 2020;368:m1106.
2. **Scott CEH**, **Holland G**, **Powell-Bowns MFR**, **et al**. Population mobility and adult orthopaedic trauma services during the COVID-19 pandemic: fragility fracture provision remains a priority. *Bone Jt Open*. 2020;1(6):182–189.
3. **Hamilton DF**, **Beard DJ**, **Barker KL**, **et al**. Targeting rehabilitation to improve outcomes after total knee arthroplasty in patients at risk of poor outcomes: randomised controlled trial. *BMJ*. 2020;371:m3576.
4. **Clement ND**, **Ng N**, **Simpson CJ**, **et al**. The prevalence, mortality, and associated risk factors for developing COVID-19 in hip fracture patients: a systematic review and meta-analysis. *Bone Joint Res*. 2020;9(12):873–883.
5. **Hall AJ**, **Clement ND**, **Farrow L**, **et al**. IMPACT-Scot report on COVID-19 and hip fractures. *Bone Joint J*. 2020;102-B(9):1219–1228.
6. **Chang JS**, **Wignadasan W**, **Pradhan R**, **Kontoghiorghe C**, **Kayani B**, **Haddad FS**. Elective orthopaedic surgery with a designated COVID-19-free pathway results in low perioperative viral transmission rates. *Bone Jt Open*. 2020;1(9):562–567.
7. **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.
8. **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-B(1):63–69.
9. **Brooks R**. EuroQol: the current state of play. *Health Policy*. 1996;37(1):53–72.
10. **Murray DW**, **Fitzpatrick R**, **Rogers K**, **et al**. The use of the Oxford hip and knee scores. *J Bone Joint Surg Br*. 2007;89-B(8):1010–1014.
11. **Clement ND**, **MacDonald D**, **Simpson AHRW**. The minimal clinically important difference in the Oxford knee score and short form 12 score after total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc*. 2014;22(8):1933–1939.
12. **Beard DJ**, **Harris K**, **Dawson J**, **et al**. Meaningful changes for the Oxford hip and knee scores after joint replacement surgery. *J Clin Epidemiol*. 2015;68(1):73–79.
13. **Larsen K**, **Hansen TB**, **Søballe K**. Hip arthroplasty patients benefit from accelerated perioperative care and rehabilitation: a quasi-experimental study of 98 patients. *Acta Orthop*. 2008;79(5):624–630.
14. **Clement ND**, **Bell A**, **Simpson P**, **Macpherson G**, **Patton JT**, **Hamilton DF**. Robotic-Assisted unicompartmental knee arthroplasty has a greater early functional outcome when compared to manual total knee arthroplasty for isolated medial compartment arthritis. *Bone Joint Res*. 2020;9(1):15–22.
15. **NHS National Services Scotland**. The Scottish arthroplasty project. Annual report. 2018. https://www.arthro.scot.nhs.uk/docs/2018/2018-08-14-SAP-Annual-Report.pdf (date last accessed 11th November 2020).
16. **No authors listed**. National Joint registry of England, Wales and Northern Ireland. NJR StatsOnline. 2020. https://www.njrcentre.org.uk/njrcentre/Healthcare-providers/Accessing-the-data/StatsOnline/NJR-StatsOnline (date last accessed 1 September 2020).
17. **Clement ND**, **Ng N**, **MacDonald D**, **Scott CEH**, **Howie CR**. One-Year Oxford knee scores should be used in preference to 6-month scores when assessing the outcome of total knee arthroplasty. *Knee Surg Relat Res*. 2020;32(1):43.
18. **Dahlberg K**, **Jaensson M**, **Nilsson U**, **Eriksson M**, **Odencrants S**. Holding it together - patients' perspectives on postoperative recovery when using an e-assessed follow-up: qualitative study. *JMIR Mhealth Uhealth*. 2018;6(5):e10387.
19. **Jaensson M**, **Dahlberg K**, **Nilsson U**. Factors influencing day surgery patients' quality of postoperative recovery and satisfaction with recovery: a narrative review. *Perioper Med*. 2019;8:3.
20. **Ali A**, **Lindstrand A**, **Sundberg M**, **Flivik G**. Preoperative anxiety and depression correlate with Dissatisfaction after total knee arthroplasty: a prospective longitudinal cohort study of 186 patients, with 4-year follow-up. *J Arthroplasty*. 2017;32(3):767–770.
21. **Adogwa O**, **Carr K**, **Fatemi P**, **et al**. Psychosocial factors and surgical outcomes: are elderly depressed patients less satisfied with surgery? *Spine*. 2014;39(19):1614–1619.
22. **Aspari AR**, **Lakshman K**. Effects of pre-operative psychological status on post-operative recovery: a prospective study. *World J Surg*. 2018;42(1):12–18.
23. **Devlin NJ**, **Brooks R**. EQ-5D and the EuroQol group: past, present and future. *Appl Health Econ Health Policy*. 2017;15(2):127–137.
24. **King D**, **Emara AK**, **Ng MK**, **et al**. Transformation from a traditional model to a virtual model of care in orthopaedic surgery: COVID-19 experience and beyond. *Bone Jt Open*. 2020;1(6):272–280.

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