The negative impact of the COVID-19 lockdown on pain and physical function in patients with end-stage hip or knee osteoarthritis

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Abstract

Purpose The purpose of this study was to evaluate pain, functional impairment, mental health, and daily activity in patients with end-stage hip and knee osteoarthritis (OA) during the COVID-19 lockdown.

Methods The study included 63 patients, with hip or knee OA, who had been scheduled for arthroplasty that was postponed because of COVID-19. Patients were evaluated by telephone interviews during the first week after lockdown, in the fourth week, and again at the end of the lockdown. Patients rated their pain level on the basis of a visual analog scale (VAS) and completed WOMAC, SF-12 and Tegner activity scale (TAS) questionnaires.

Results VAS and WOMAC scores increased significantly during lockdown, while physical activity significantly decreased. At the final evaluation, VAS and WOMAC showed a significant negative correlation with TAS. The SF-12 subscale scores showed a significant decrease of the physical component during the lockdown, while the mental component remained largely unchanged. Patients with knee OA showed a faster progress of pain compared to those with hip OA. 50 patients (79%) stated they wished to have arthroplasty as soon as possible.

Conclusion The COVID-19 lockdown had a significant impact on pain, joint function, physical function, and physical activity in patients with end-stage hip and knee OA.

Level of evidence II (Prospective cohort study).

Keywords COVID-19 · Arthroplasty · Osteoarthritis, hip · Osteoarthritis, knee · Physical functional performance · Mental health

Abbreviations

COVID-19	Coronavirus disease 2019
OA	Osteoarthritis
SD	Standard deviation
SF-12	Short form 12
TAS	Tegner activity scale
THA	Total hip arthroplasty
TKA	Total knee arthroplasty

VAS	Visual analog scale
WOMAC	Western Ontario and McMaster Universities Arthritis Index

Introduction

On March 11th, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic. To minimize the rate of new infections and to prevent health institutions from capacity overload, most European countries started a complete national lockdown including closure of all non-essential businesses. To preserve medical resources, most elective orthopaedic surgical procedures across Europe were postponed, including total hip (THA) and total knee arthroplasty (TKA) [7, 13, 21].

Now that restrictions are started to be lifted, orthopaedic surgeons across Europe are preparing to restart arthroplasty surgery [15]. However, it remains unclear how the COVID-19 lockdown will affect daily clinical practice in the future

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[8]. In this context, new hygiene standards could result in a reduction of hospitals' surgical capacities, leading to even longer waiting times in the future [10].

To establish guidelines to adequately reorganize elective surgery in outpatient clinics and hospitals after the end of lockdown, not only economic and safety aspects but also patient-related factors including the development of patients' complaints while waiting for arthroplasty have to be considered [8, 16, 18]. Since no study has yet investigated the development of clinical symptoms of patients with end-stage hip and knee osteoarthritis (OA) waiting for arthroplasty surgery, the purpose of this study was to investigate the course of (1) pain, (2) functional impairment, (3) mental health, and (4) daily activities during the course of COVID-19 lockdown. The present study hypothesized that the COVID-19 lockdown will limit physical activity, which will consequently increase clinical symptoms and decrease physical and mental function in patients with end-stage hip and knee OA.

Materials and methods

This prospective study was approved by the Ethical Committee of the Medical University Innsbruck, Austria (Process no. 1098/2020).

Between March 16th and April 30th 2020, a total of 68 arthroplasty surgeries (42 total hip and 26 total knee replacements) were postponed in our department due to the COVID-19 lockdown. During the first week of lockdown (March 16th–March 22nd 2020), orthopaedic surgery residents contacted the patients via phone and informed them about their postponement. Furthermore, patients were informed about the purpose of this study and were asked for their consent to participate. Patients who agreed to participate received the written consent form by mail, which they had to return within 5 days after the start of lockdown (March 20th 2020). Patients who could not be contacted by phone, who refused participation or did not return their written consent were excluded. According to these criteria, a total of 63 patients

Fig. 1 Patient flow chart

(28 men and 35 women) with 39 OA hips and 24 OA knees were available for further evaluation (Fig. 1). Of these, 28 (44%) were females and 35 males (56%). The mean age of participants was 62.4 years (range 26–86 years, standard deviation (SD): 11.84 years, Table 1). Patients waiting for THA were significantly younger (mean age: 59.7 years) than those waiting for TKA (mean age: 66.8 years). The mean BMI was 27.8 kg/m² (SD 4.5) with no significant difference between the groups. Indication for surgery was degenerative joint disease in all cases (four cases with hip dysplasia, one case with posttraumatic osteoarthritis of the hip). Most patients were assigned ASA (American Society of Anaesthesiologists) class 1 or 2 and more than half of our patients suffered from one or more comorbidities (Table 1). All patients

included were asked to rate their hip- or knee-related pain on a visual analog scale (VAS) from 0 to 10 [11]. Furthermore, they completed a Western Ontario and McMaster Universities Osteoarthritis questionnaire (WOMAC) [4, 19] based on an 11-point numerical rating scale (from 0 to 10), the Short Form 12 (SF-12) [22, 23] and the Tegner activity scale (TAS) [20, 24].

The interviews were repeated in the fourth week of lockdown (April 6th–April 12th 2020) and after the end of lockdown (May 4th–May 8th 2020). The observers were blinded for the previous results. During the final interview, patients were also asked if they currently had reservations regarding in-patient treatment, and whether they preferred their

Table 1 Demographic and clinical characteristics of the study population

	All patients (<i>N</i> =63, 100%)		Total hip arthroplasty (<i>N</i> =39, 61.90%)		Total knee arthroplasty (<i>N</i> =24, 38.10%)		<i>p</i> *
	Mean ± SD	Min–max	Mean ± SD	Min–max	Mean ± SD	Min–max	
Age (years)	62.40 ± 11.84	26–86	59.67 ± 11.31	26–82	66.83 ± 11.53	46–86	0.018
BMI (kg/m ²)	27.76 ± 4.52	19.78–37.56	27.08 ± 4.33	19.79–36.52	28.87 ± 4.69	20.57–37.56	0.128
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Gender							
Female	28	44.44	17	43.59	11	45.83	
Male	35	55.56	22	56.41	13	54.17	
Indication							
Primary OA	58	92.06	34	87.18	24	100.00	
Hip dysplasia	4	6.35	4	10.26	0	0.00	
Posttraumatic OA	1	1.59	1	2.56	0	0.00	
Kellgren Lawrence grade							
2	9	14.28	3	7.69	6	25.00	
3	42	66.67	29	74.36	13	54.17	
4	12	19.05	7	17.95	5	20.83	
ASA classification							
1	16	25.40	11	28.21	5	20.83	
2	35	55.56	22	56.41	13	54.17	
3	4	6.35	1	1.59	3	12.50	
Unknown	8	12.70	5	12.82	3	12.50	
Co-morbidities							
Hypertension	35	55.56	20	51.28	15	62.50	
Cardiovascular	15	23.81	9	23.08	6	25.00	
Cerebrovascular	5	7.94	1	2.56	4	16.67	
COPD	5	7.94	3	7.69	2	8.33	
Diabetes	8	12.70	3	7.69	5	20.83	
Unknown	8	12.70	5	12.82	3	12.50	
Prefers to do surgery as soon as possible							
Yes	50	79.37	30	76.92	20	83.33	
No	13	20.63	9	23.08	4	16.67	

BMI body mass index, ASA American Society of Anaesthesiologists, *N* number, SD standard deviation, *Min* minimum, *Max* maximum, *kg* kilogram, *m*² unit square meter, OA osteoarthritis, COPD chronic obstructive pulmonary disease

*p value of independent *t* test (age, BMI) for inter-group (THA/TKA) differences of distribution; *p* value <0.05 significant (bold font)

Table 2 Pre-, during- and post-COVID-19 lockdown clinical measurements from all patients waiting for arthroplasty surgeries

	All patients (<i>N</i> = 63)			Comparison of distribution with	
	Mean ± SD	Median	Min–max	Pre-lockdown (<i>p</i> value)	During (<i>p</i> value)
VAS (pre)	5.95 ± 1.78	6	2–10		
VAS (during)	6.54 ± 1.79	7	2–10	0.009**	
VAS (post)	6.59 ± 2.21	7	2–10	< 0.001**	0.029**
WOMAC (pre)	43.37 ± 12.38	42.92	8.75–75.00		
Pain	9.03 ± 3.21	8.33	0.83–16.25		
Stiffness	3.73 ± 1.88	4.17	0.00–7.08		
Physical function	30.61 ± 9.04	30.42	4.58–53.55		
WOMAC (during)	47.11 ± 14.62	48.75	9.17–76.67	0.004*	
Pain	9.93 ± 3.42	10.00	0.83–17.92	0.007*	
Stiffness	3.88 ± 2.19	4.17	0.00–7.50	0.324*	
Physical function	33.31 ± 10.86	33.33	5.42–59.17	0.005*	
WOMAC (post)	53.99 ± 16.39	56.67	17.92–83.75	< 0.001*	< 0.001*
Pain	11.38 ± 3.66	12.08	2.92–18.33	< 0.001*	< 0.001*
Stiffness	5.61 ± 1.77	5.83	1.25–7.92	< 0.001*	< 0.001*
Physical function	38.37 ± 12.15	39.17	10.42–62.08	< 0.001*	< 0.001*
SF-12 PCS (pre)	37.89 ± 8.92	36.13	20.16–56.68		
SF-12 PCS (during)	37.36 ± 9.08	36.13	20.16–56.68	0.204**	
SF-12 PCS (post)	35.48 ± 9.62	34.54	18.83–52.88	0.026**	0.071**
SF-12 MCS (pre)	59.81 ± 6.76	61.66	38.97–69.32		
SF-12 MCS (during)	59.24 ± 6.77	60.81	38.97–69.04	0.130**	
SF-12 MCS (post)	59.49 ± 5.45	60.02	48.73–69.41	0.929**	0.755**
TAS (pre)	n.r.	3	0–5		
TAS (during)	n.r.	2	0–5	0.046**	
TAS (post)	n.r.	2	0–5	0.017**	0.059**

N number, *SD* standard deviation, *Min* minimum, *Max* maximum, *VAS* Visual Analog Scale, *WOMAC* Western Ontario And McMaster Universities Osteoarthritis Index, *SF-12* short-form health survey, *PCS* physical component summary, *MCS* mental component summary, *TAS* Tegner Activity Scale, *n.r.* not reported

*Paired samples *t* test

**Wilcoxon Signed Rank test; *p* value < 0.05 significant (bold font)

surgery to be re-scheduled as soon as possible or if they preferred a further delay.

Statistical methods

Initially, a Shapiro–Wilk analysis was performed to test linear data for normal distribution. Mean WOMAC scores were compared using a paired sample *t* test. Results from the VAS scales, the SF-12 and the TAS were compared with a Wilcoxon signed-rank test. A Mann–Whitney *U* test was applied to test for equality of distribution of VAS, SF-12 and TAS. Furthermore, a Spearman Rank-Order analysis was performed to calculate the correlation between TAS, VAS and WOMAC. *p* values of < 0.05 were considered statistically significant.

Results

The mean VAS scores increased significantly between the first and second and between the second and final interviews (Table 2). Likewise, the mean WOMAC scores increased continuously during the lockdown. The SF-12 physical component summary scores (SF-12 PCS) decreased significantly between the first and the last interview (Table 2). In contrast, the SF-12 mental component summary scores (SF-12 MCS) showed no significant difference between the measurements. The Tegner activity scale (TAS) decreased significantly during lockdown (Table 2). The majority of our patients (79%) preferred to have surgery as soon as possible, while the remaining 21% wished to further delay their treatment until after the end of the COVID-19 pandemic (Table 1).

Table 3 The correlations between physical activity and clinical measurements

Variable	Spearman's rank-order correlation with TAS					
	All patients		Total hip arthroplasty		Total knee arthroplasty	
	r_s	p	r_s	p	r_s	p
Before lockdown						
VAS	− 0.129	0.314	− 0.042	0.801	− 0.260	0.220
WOMAC	− 0.135	0.291	− 0.032	0.849	− 0.152	0.479
Pain	0.013	0.918	0.002	0.989	0.115	0.592
Stiffness	0.022	0.862	0.121	0.464	− 0.026	0.906
Physical function	− 0.180	0.158	− 0.066	0.691	− 0.270	0.201
SF-12 PCS	0.353	0.005	0.381	0.017	0.300	0.154
SF-12 MCS	− 0.066	0.608	− 0.205	0.211	0.191	0.371
During lockdown						
VAS	− 0.201	0.133	− 0.201	0.219	− 0.203	0.342
WOMAC	− 0.268	0.034	− 0.248	0.128	− 0.259	0.222
Pain	− 0.140	0.274	− 0.128	0.438	− 0.094	0.664
Stiffness	0.003	0.983	0.014	0.933	0.075	0.728
Physical function	− 0.286	0.023	− 0.233	0.154	− 0.329	0.116
SF-12 PCS	0.431	< 0.001	0.565	< 0.001	0.245	0.249
SF-12 MCS	− 0.017	0.895	− 0.124	0.453	0.204	0.338
Post lockdown						
VAS	− 0.470	< 0.001	− 0.506	0.001	− 0.486	0.016
WOMAC	− 0.495	< 0.001	− 0.454	0.004	− 0.520	0.009
Pain	− 0.344	0.006	− 0.367	0.022	− 0.351	0.092
Stiffness	− 0.433	< 0.001	− 0.473	0.002	− 0.421	0.040
Physical function	− 0.481	< 0.001	− 0.466	0.003	− 0.489	0.015
SF-12 PCS	0.663	< 0.001	0.677	< 0.001	0.546	0.006
SF-12 MCS	− 0.030	0.816	− 0.313	0.052	0.489	0.015

r_s Spearman's rank correlation coefficient; p value < 0.05 significant (bold font)

VAS Visual Analog Scale, WOMAC Western Ontario And McMaster Universities Osteoarthritis Index, SF-12 short-form-health survey, PCS physical component summary, MCS mental component summary, TAS Tegner Activity Scale

Additional results attained by the correlations between physical activity, pain, physical and mental function (Table 3), the intra- and inter-group analysis for the hip and knee OA patients (Table 4), and the intra- and inter-group analysis of patients who prefer surgery as soon as possible compared to those who want to wait (Table 5) are given in the corresponding tables, respectively.

Discussion

The data from this study confirm our hypothesis that the COVID-19 lockdown significantly affects the level of physical activity, joint function and physical function in patients

with advanced hip and knee OA. Mental health remained unaffected during the lockdown.

The difference in WOMAC scores between the beginning and the end of lockdown exceeds the minimum score difference that has been reported as clinically important [6]. This suggests a clinically relevant loss of joint function during the lockdown. Overall, patients with hip OA showed higher WOMAC scores compared to patients with knee OA. This phenomenon has been previously described in clinical trials with high volume samples [2, 4, 5]. VAS pain scores and TAS showed a significant deterioration during lockdown as well. However, observed changes of VAS and TAS were of limited clinical significance.

During lockdown, VAS and WOMAC scores showed an increasing correlation with the level of activity (TAS).

Table 4 Pre-, during- and post-COVID-19 lockdown (intra- and inter-group analysis for hip and knee OA)

	Total hip arthroplasty (<i>N</i> = 39)			Total knee arthroplasty (<i>N</i> = 24)			<i>p</i> ***
	Mean ± SD	Median	Min–max	Mean ± SD	Median	Min–max	
VAS (pre)	6.03 ± 1.58	6	2–10	5.83 ± 1.31	6	4–8	0.592
VAS (during)	6.64 ± 1.83	7	2–10	6.38 ± 1.77	6.5	3–9	0.576
<i>p</i> value**	0.034			0.108			
VAS (post)	6.65 ± 2.28	7	2–10	7.13 ± 1.87	7.5	3–10	0.682
<i>p</i> value** (pre during)	0.013	0.336		0.003	0.018		
WOMAC (pre)	46.30 ± 13.83	45.00	8.75–75.00	38.61 ± 7.67	41.25	20.83–49.17	0.015
WOMAC (during)	50.06 ± 14.92	50.42	9.17–76.67	42.31 ± 13.01	42.92	12.92–61.67	0.040
<i>p</i> value*	0.032			0.065			
WOMAC (post)	56.68 ± 17.72	61.25	17.92–83.75	49.64 ± 13.16	52.29	17.92–66.67	0.098
<i>p</i> value* (pre during)	< 0.001	0.001		< 0.001	0.002		
WOMAC pain (pre)	9.40 ± 3.74	9.17	0.83–16.25	8.44 ± 2.03	8.13	4.58–12.08	0.251
Pain (during)	10.33 ± 3.55	10.42	0.83–17.92	9.27 ± 3.17	8.75	3.33–15.00	0.236
<i>p</i> value*	0.041			0.083			
Pain (post)	11.50 ± 3.98	12.08	2.92–18.33	11.20 ± 3.15	12.50	3.75–15.42	0.757
<i>p</i> value* (pre during)	0.001	0.016		< 0.001	0.001		
WOMAC stiffness (pre)	3.87 ± 1.83	4.17	0.00–7.08	3.51 ± 2.00	4.58	0.00–5.83	0.465
Stiffness (during)	4.00 ± 2.16	4.17	0.00–7.50	3.68 ± 2.25	4.38	0.00–7.08	0.582
<i>p</i> value*	0.550			0.328			
Stiffness (post)	5.49 ± 1.91	5.83	1.25–7.92	5.80 ± 1.53	6.04	1.67–7.50	0.508
<i>p</i> value* (pre during)	< 0.001	< 0.001		< 0.001	0.001		
WOMAC physical function (pre)	33.03 ± 9.97	31.67	4.58–53.33	26.67 ± 5.47	27.92	14.58–35.42	0.006
Phys. func. (during)	35.74 ± 11.04	35.83	5.42–59.17	29.36 ± 9.50	30.42	7.50–47.08	0.022
<i>p</i> value*	0.039			0.061			
Physical function (post)	40.82 ± 13.30	44.17	10.42–62.08	34.39 ± 8.92	36.67	14.17–47.92	0.040
<i>p</i> value* (pre during)	< 0.001	0.001		< 0.001	0.002		
SF-12 PCS (pre)	36.23 ± 8.24	35.41	22.57–56.68	40.59 ± 9.49	43.07	20.16–53.85	0.047
SF-12 PCS (during)	35.61 ± 8.27	35.80	20.63–56.68	40.20 ± 9.78	40.55	20.16–53.85	0.072
<i>p</i> value**	0.456			0.724			
SF-12 PCS (post)	34.64 ± 9.99	32.67	21.52–52.88	36.84 ± 9.03	39.22	18.83–50.07	0.388
<i>p</i> value** (pre during)	0.283	0.420		0.019	0.054		
SF-12 MCS (pre)	60.81 ± 6.47	62.14	43.64–69.32	58.19 ± 7.05	59.27	38.97–67.15	0.118
SF-12 MCS (during)	60.56 ± 6.39	62.14	42.93–69.04	57.14 ± 6.97	58.86	38.97–67.15	0.031
<i>p</i> value**	0.228			0.004			
SF-12 MCS (post)	60.04 ± 5.87	61.17	48.93–69.41	58.59 ± 4.66	59.02	48.73–65.88	0.234
<i>p</i> value** (pre during)	0.922	0.827		0.819	0.415		
TAS (pre)	n.r.	2	1–5	n.r.	3	0–4	0.459
TAS (during)	n.r.	2	0–5	n.r.	3	0–4	0.724
<i>p</i> value**	0.102			0.194			
TAS (post)	n.r.	2	0–5	n.r.	3	0–4	0.821
<i>p</i> value** (pre during)	0.074	0.166		0.101	0.157		

SD standard deviation, *Min* minimum, *Max* maximum, VAS Visual Analog Scale, WOMAC Western Ontario And McMaster Universities Osteoarthritis Index, SF-12 short-form-health survey, PCS physical component summary, MCS mental component summary, TAS Tegner Activity Scale, n.r. not reported

*Comparison of the distribution of values pre-/during-/post-COVID-19 lockdown within the group using a paired *t* test

**Comparison of the distribution of values pre-/during-/post-COVID-19 lockdown within the group using the Wilcoxon Signed-Rank test

***Comparison between the groups (prefers near time surgery: yes/no) using an independent *t* test, respectively, the Mann–Whitney *U* test for non-normal distributed results (italic font); *p* value < 0.05 significant (bold font)

Table 5 Pre-, during- and post-COVID-19 lockdown inter-group analysis of patients who prefer near time surgical intervention compared to those who do not

	Prefers near time surgery (<i>N</i> = 50)			Does not want near time surgery (<i>N</i> = 13)			<i>p</i> ***
	Mean ± SD	Median	Min–max	Mean ± SD	Median	Min–max	
VAS (pre)	6.08 ± 1.44	6	2–10	5.46 ± 1.56	5	4–8	<i>0.133</i>
VAS (during)	6.80 ± 1.73	7	2–10	5.54 ± 1.76	6	3–8	0.026
<i>p</i> value**	0.002			0.943			
VAS (post)	7.43 ± 1.94	8	2–10	5.46 ± 2.18	6	2–8	0.006
<i>p</i> value**	< 0.001	0.010		0.904	0.829		
WOMAC (pre)	43.86 ± 12.18	43.33	8.75–72.50	41.51 ± 13.45	38.75	28.75–75.00	0.546
WOMAC (during)	48.12 ± 14.38	49.17	9.17–76.67	43.24 ± 15.47	40.00	20.00–75.00	0.287
<i>p</i> value*	0.003			0.586			
WOMAC (post)	56.12 ± 14.53	57.50	20.00–83.75	45.83 ± 20.85	52.08	17.92–75.83	0.043
<i>p</i> value* (pre during)	< 0.001	< 0.001 (dur)		0.347	0.475		
WOMAC pain (pre)	9.18 ± 3.18	9.17	0.83–16.25	8.46 ± 3.40	7.92	5.00–16.25	0.475
Pain (during)	10.18 ± 3.40	10.42	0.83–17.92	8.94 ± 3.48	8.33	3.33–16.25	0.248
<i>p</i> value*	0.008			0.505			
Pain (post)	11.90 ± 3.17	12.29	4.58–18.33	9.39 ± 4.77	10.42	2.92–16.67	0.027
<i>p</i> value* (pre during)	< 0.001	< 0.001		0.371	0.552		
WOMAC stiffness (pre)	3.84 ± 1.82	4.38	0.00–7.08	3.30 ± 2.13	2.92	0.00–6.67	0.361
Stiffness (during)	4.00 ± 2.16	4.38	0.00–7.50	3.40 ± 2.32	2.92	0.00–6.67	0.380
<i>p</i> value*	0.335			0.787			
Stiffness (post)	5.83 ± 1.59	6.04	1.25–7.92	4.78 ± 2.22	5.42	1.67–7.50	0.056
<i>p</i> value* (pre during)	< 0.001	< 0.001		0.110	0.118		
WOMAC physical function (pre)	30.83 ± 8.94	30.83	4.58–53.33	29.74 ± 9.72	29.17	15.83–52.08	0.702
Physical function (during)	33.93 ± 10.76	33.75	5.42–59.17	30.90 ± 11.35	30.42	15.83–52.08	0.374
<i>p</i> value*	0.004			0.615			
Physical function (post)	39.82 ± 10.95	39.17	10.42–62.08	32.82 ± 15.21	39.17	13.33–52.50	0.064
<i>p</i> value* (pre during)	< 0.001	< 0.001		0.339	0.478		
SF-12 PCS (pre)	38.18 ± 8.84	36.63	20.16–56.68	36.77 ± 9.50	36.03	22.57–53.85	<i>0.547</i>
SF-12 PCS (dur.)	37.61 ± 9.04	36.42	20.16–56.68	36.40 ± 9.55	36.03	22.01–53.85	<i>0.671</i>
<i>p</i> value**	0.186			0.893			
SF-12 PCS (post)	34.40 ± 9.29	33.02	19.87–52.88	39.59 ± 10.14	41.45	18.83–50.07	<i>0.077</i>
<i>p</i> value** (pre during)	0.004	0.012		0.173	0.136		
SF-12 MCS (pre)	59.59 ± 7.17	60.81	38.97–69.32	60.66 ± 5.03	61.84	51.70–67.15	<i>0.845</i>
SF-12 MCS (dur.)	58.70 ± 6.98	60.18	38.97–69.04	61.33 ± 5.63	63.15	48.39–67.15	<i>0.197</i>
<i>p</i> value**	0.006			0.889			
SF-12 MCS (post)	59.70 ± 5.68	60.77	48.73–69.41	58.68 ± 4.56	57.81	49.74–65.73	<i>0.552</i>
<i>p</i> value** (pre during)	0.761	0.332		0.345	0.209		
TAS (pre)	n.r.	2	0–5	n.r.	3	2–4	<i>0.101</i>
TAS (during)	n.r.	2	0–5	n.r.	3	0–4	<i>0.261</i>
<i>p</i> value**	0.132			0.180			
TAS (post)	n.r.	2	0–5	n.r.	3	0–4	<i>0.092</i>
<i>p</i> value** (pre during)	0.034	0.054		0.257	1.000		

SD standard deviation, *Min* minimum, *Max* maximum, VAS Visual Analog Scale, WOMAC Western Ontario And McMaster Universities Osteoarthritis Index, SF-12 short-form-health survey, PCS physical component summary, MCS mental component summary, TAS Tegner Activity Scale, n.r. not reported

*Comparison of the distribution of values pre-COVID-19 with during/post COVID-19 within the group using a paired *t* test

**Comparison of the distribution of values pre-COVID-19 with during/post COVID-19 within the group using the Wilcoxon Signed Ranks test

***Comparison between the groups (total hip arthroplasty/total knee arthroplasty) using an independent *t* test, respectively, the Mann–Whitney *U* test for non-normal distributed results (italic font); *p* value < 0.05 significant (bold font)

This supports our hypothesis that the continuous decrease of physical activity is associated with an increase in pain and loss of joint function. These findings are in accordance with the results of prior studies and demonstrate the importance of home exercise programs to decrease symptoms during a possible second lockdown [3, 12, 14]. Knee OA patients showed a faster deterioration in pain score compared to hip OA patients during lockdown, which suggests that loss of activity has a higher impact on OA knees.

A recent Chinese study showed that social isolation during the COVID-19 lockdown significantly affected the psychological health of the population in the Hubei province [1]. Consequently, the authors underlined the importance of mental health services and provisioning of psychiatric treatments during an elongated lockdown [1, 9]. In contrast to these findings, the patients evaluated in our study did not show any deterioration of their mental status, which suggests that psychiatric assistance may be of minor importance in patients with hip and knee OA. However, our study was not designed to detect a significant difference of mental health and the SF-12 mental component summary score may not adequately assess mental criteria.

In the evaluated cohort, nearly 80% of patients stated that they desired surgery as soon as possible. Only 20% wished to further delay their treatment, mainly because they wished to wait until things could get back to normality again. Subgroup analysis showed that patients who preferred their surgery sooner suffered from significant pain and function decline during the lockdown; whereas, patients who preferred a further delay did not significantly deteriorate. This suggests that the patients' decision depended predominantly on the development of their symptoms and not on any reservations regarding in-house treatment.

Based on the findings of this study, the authors assume that lockdown not only affected patients with end-stage OA but also those with advanced OA, which could result in a higher request for arthroplasty surgery in Europe in the months to come [18].

However, our findings may not be generalizable: in countries without a national health service or governmental health insurance, economic crises are usually associated with increasing loss of commercial health insurance due to unemployment [16]. As result, many patients are unable to afford surgery. It must be expected that arthroplasty volume will decrease in these countries even though there is an increased demand [16, 17, 25].

The present study has several limitations. The relatively small sample size may inhibit adequate analysis of the physical function and mental condition of our cohort. Moreover, the absence of a control group limits the explanatory power of our results. There is a potential systemic bias since patients may have hoped for earlier appointments for surgery if they reported higher pain

values. Furthermore, the authors are unable to determine if the observed deteriorations are reversible after the end of lockdown. However, further investigation of this question would raise ethical concerns as we are striving to treat patients suffering from severe pain as soon as possible.

Conclusion

The COVID-19 lockdown had a significant impact on pain, joint function, physical function, and physical activity in patients with end-stage hip and knee OA. Our results can be taken as a basis for the course of OA patients' complaints, if patient-related factors are considered when reorganizing arthroplasty surgery after the end of lockdown.

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Author contributions E. F collected data, drafted the manuscript, performed statistical analysis, and acts as first author. B. M. drafted the manuscript and acts as corresponding author. L. M. collected data and acts as co-author. S. A. participated in the study design and acts as co-author. W. M. collected data and acts as co-author. B. A. conceived of the study, generated its design, and acts as senior author.

Compliance with ethical standards

Conflict of interest The authors declare that they have neither financial nor non-financial competing interests.

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Informed consent Informed consent was obtained from each subject prior to inclusion.

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