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Reduction in hospital length of stay and increased utilization of telemedicine during the "return-to-normal" period of the COVID-19 pandemic does not adversely influence early clinical outcomes in patients undergoing total hip replacement: a case-control study

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Background and purpose — Elective total hip replacement (THR) was halted in our institution during the COVID-19 surge in March 2020. Afterwards, elective THR volume increased with emphasis on fast-track protocols, early discharge, and post-discharge virtual care. We compare early outcomes during this "return-to-normal period" with those of a matched pre-pandemic cohort.

Patients and methods — We identified 757 patients undergoing THR from June to August 2020, who were matched 1:1 with a control cohort from June to August 2019. Length of stay (LOS) for the study cohort was lower than the control cohort (31 vs. 45 hours; $p < 0.001$). The time to first postoperative physical therapy (PT) was shorter in the study cohort (370 vs. 425 minutes; $p < 0.001$). More patients were discharged home in the study cohort (99% vs. 94%; $p < 0.001$). Study patients utilized telehealth office and rehabilitation services 14 times more frequently (39% vs. 2.8%; $p < 0.001$). Outcomes included post-discharge 90-day unscheduled office visits, emergency room (ER) visits, complications, readmissions, and PROMs (HOOS JR, and VR-12 mental/physical). Mann–Whitney U and chi-square tests were used for group comparisons.

Results — Rates of 90-day unscheduled outpatient visits (5.0% vs. 7.3%), ER visits (5.0% vs. 4.8%), hospital readmissions (4.0% vs. 2.8%), complications (0.04% vs. 0.03%), and 3-month PROMs were similar between cohorts. There was no 90-day mortality.

Interpretation — A reduction in LOS and increased telehealth use for office and rehabilitation visits did not adversely influence 90-day clinical outcomes and PROMs. Our findings lend further support for the utilization of fast-track arthroplasty with augmentation of postoperative care delivery using telemedicine.

The United States experienced a major turning point in the practice of total joint replacement beginning in early March 2020 when the World Health Organization declared a worldwide pandemic from Coronavirus disease 2019 (COVID-19). In response, the Surgeon General and the Centers for Medicare and Medicaid Services (CMS) recommended cessation of all elective procedures and the deployment of many orthopedic surgeons in emergency rooms and intensive care units (1-4). The New York State government banned elective surgery from March 15 to June 1, 2020. As the peak of the pandemic passed, elective surgeries recommenced with adaptations in the setting of system-wide constraints to create capacity for the continued care of COVID-19 patients.

The waiting lists for elective total hip replacement (THR) soared during this period. Given deterioration in the quality of life and health status of patients with debilitating hip pain from arthritis, many were willing to undergo THR in the early "return-to-normal" period after the peak of the pandemic (5). Due to the increased demand and the risk of COVID-19 for patients and healthcare workers, early mobilization and discharge protocols were maximized.

At our institution, rapid recovery protocols involve a coordinated approach including the primary use of neuraxial anesthesia, expeditious surgery, earlier mobilization with more intensive physical therapy, and early discharge home as opposed to a rehabilitation facility (6,7). In addition, the telemedicine and telerehabilitation program was rapidly expanded. As there were a substantial number of changes in perioperative care during the "return to normal" period, and there is limited literature on the safety of resumption of elective THR during the pandemic, we sought to determine how the impact of these factors affected clinical outcomes including in-hospital complications, post-discharge, 90-day unscheduled office visits,

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Table 1. Descriptive statistics of pre-surgical and intraoperative patient characteristics. Values are count (%) unless otherwise specified

Variable	Study group n = 757	Control group n = 757	p-value
Age, n [a]	757	757	
median [IQR]	66 [59–72]	66 [60–72]	1
Sex [a]			
Female	439 (58)	439 (58)	1
Male	318 (42)	318 (42)	
BMI, n [a]	757	757	
median [IQR]	27.8 [24–32]	27.8 [25–32]	1
CCI [a]			
0	557 (74)	557 (74)	1
1	100 (13)	100 (13)	
≥ 2	100 (13)	100 (13)	
RAPT score, n	625	596	
median [IQR]	10 [9–11]	10 [9–11]	0.2
Laterality			
Left	335 (44)	353 (47)	0.4
Right	422 (56)	404 (53)	
Approach:			
Anterior	164 (22)	164 (22)	1
Posterior	593 (78)	593 (78)	
Anesthesia			
Regional	742 (98)	734 (97)	0.2
Other	15 (2.0)	23 (3.0)	
Use of nerve block	134 (18)	130 (17)	0.8

[a] Indicates matching variable.
IQR = interquartile range; BMI = body mass index;
CCI = Charlson Comorbidity Index;
RAPT = Risk Assessment and Prediction Tool.

Table 2. Descriptive statistics of postoperative, in-hospital, and post-discharge variables related to patient care. Values are count (%) unless otherwise specified

Variable	Study group n = 757	Control group n = 757	p-value
Discharge MMEs, n	716	718	
median [IQR]	180 [150–180])	315 [210–315]	< 0.001
Minutes to 1st ambulation, n	757	757	
median [IQR]	370 [278–1009]	425 [311–1071]	< 0.001
IP PT visits, n	757	755	
median [IQR]	3 [2–4]	3 [2–4]	0.2
IP visits to clear PT, n	684	614	
median [IQR]	3 [2–4]	3 [2–4]	0.8
Transfusion	21 (2.8)	12 (1.6)	0.1
LOS, n	757	757	
median [IQR]	31 [25–51]	45 [27–53]	< 0.001
Patient's DC on POD 0 or 1	398 (53)	327 (43)	< 0.001
Discharge home	746 (99)	712 (94)	< 0.001
Days to 1st PD encounter			
(in-person/telehealth), n	751	751	
median [IQR]	30 [1–40]	36 [23–41]	< 0.001
Post-discharge			
unscheduled visits	38 (5.0)	55 (7.3)	0.07
in-person encounters	642 (85)	666 (88)	0.07
in-person PT encounters	668 (88)	644 (85)	0.07
telephone encounters	532 (70)	508 (67)	0.2
telehealth encounters			
office	63 (8.3)	2 (0.3)	< 0.001
rehab	257 (34)	19 (2.5)	< 0.001
total	295 (39)	21 (2.8)	< 0.001

IQR = interquartile range; MME = morphine milligram equivalent;
IP = inpatient; PT = physical therapy; LOS = length of stay; DC = discharge;
POD = postoperative day; PD = post-discharge.

emergency room (ER) visits and readmissions, and patient-reported outcome measures (PROMs).

Patients and methods

Study design and patients

Using our institution's electronic medical record (EMR) for chart review, we identified 757 patients undergoing elective primary unilateral THR for osteoarthritis during the return-to-normal period (June 2020–August 2020) following the peak of the pandemic at a high-volume tertiary orthopedic hospital. During this period, we selected healthy patients to undergo THR and generally did not operate on patients with multiple comorbidities (coronary artery disease, poorly controlled diabetes, advanced renal or liver disease) unless pain was intractable. This cohort (study group) was matched 1:1 with a control group consisting of 757 patients undergoing elective primary unilateral THR during the same time period of the prior year (2019). The cohorts were matched by age (±5 years), sex, BMI (±5), and Charlson Comorbidity Index (CCI) (±2). Exclusion criteria were patients with a preoperative diagnosis of fracture, post-traumatic arthritis, inflammatory arthritis, patients undergoing bilateral THR or other lower extremity arthroplasty within 90 days. In addition to the previously stated matching criteria, groups were similar in their risk assessment and prediction tool (RAPT) score, laterality, surgical approach, anesthesia type, regional nerve block usage, number of in-hospital PT visits/visits to clear PT, and number of allogeneic blood transfusions received (Tables 1 and 2). No patient was lost to follow-up.

Institutional protocols for fast-track THR and protocol changes in return-to-normal period

The authors' institution has protocols in place for perioperative care around THR, including short-acting neuraxial anesthesia with predictable earlier return of motor function, multimodal analgesia, and early rehabilitation. Patients are typically seen by the physical therapist (PT) on the day of surgery (DOS). Although the preoperative, intraoperative care, multimodal analgesia protocols, and discharge criteria did not change during the study period, there were substantial changes to postoperative care including more intensive in-hospital rehabilitation leading to shorter hospitalization, discharge only to home, and an emphasis on post-discharge telemedicine care and telerehabilitation in order to maximize social-distancing measures. At our institution, discharge criteria include adequate pain relief by means of oral medication without dizziness or nausea, the ability to ambulate 100 feet (approximately 30 m) with a cane or rolling walker, and the ability to navigate stairs for the patients with stairs at home.

The median LOS for study patients was 31 hours, compared with 45 hours amongst controls (p < 0.001). A greater proportion of study patients were discharged on the DOS and postoperative day (POD) 1 compared with controls (53% vs. 43%; p < 0.001). Additionally, the study group had a greater proportion of patients who were discharged home (99% vs. 94%; p < 0.001). Compared with controls, study patients experienced a shorter time interval between the surgery and the first postoperative ambulation (370 vs. 425 minutes; p < 0.001) and surgeon encounter either in-person or through telehealth (25 vs. 32 days; p < 0.001), and there was a higher proportion of patients who had at least one telehealth office visit (8.3% vs. 0.3%; p < 0.001), telerehabilitation visit (34% vs. 2.5%; p < 0.001), or any telehealth (39% vs. 2.8%, p < 0.001) compared with controls. Study patients had a lower median morphine milligram equivalent (MME) consumption within the inpatient setting (180 vs. 315 total MMEs; p < 0.001) (Table 2).

Outcome measures

The primary outcomes included unscheduled in-person office visits, emergency room (ER) visits, hospital readmissions, and CMS complications. In addition, PROMs were collected preoperatively and postoperatively at 6 weeks and 90 days. CMS-defined surgical complications include acute myocardial infarction, pneumonia, sepsis/septicemia/shock during the index admission or within 7 days from the index admission, surgical site bleeding, pulmonary embolism, or death during the index admission or within 30 days from the index admission, mechanical complications, or periprosthetic joint infection/wound infection during the index admission or within 90 days from the index admission (8,9). Each CMS complication and unscheduled visit to a care facility (office, ER, and readmission) was counted. 90-day follow up information was obtained from the EMR and using a standardized telephone survey. Complete follow-up was obtained for all patients. PROMs of interest included the Hip injury and Osteoarthritis Outcome Score for Joint Replacement (HOOS-JR) and Veteran's Rand 12-item mental/physical questionnaire.

Statistics

Patient demographics, in-hospital characteristics, and 90-day postoperative outcomes were reported using descriptive statistics. Continuous variables were reported as means (SD) or median (IQR) for normally and non-normally distributed data, respectively. Comparisons between groups were investigated using independent samples t-tests or Mann–Whitney U-tests depending on data distribution. Categorical variables were presented as frequencies and percentages and compared using Pearson's chi-square tests or Fisher's exact tests when appropriate. All tests were 2-tailed. P-values < 0.05 were considered statistically significant. Statistical analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Using a significance level of 0.05 and a power of 90%, power analysis revealed a 3-hour difference (10) in hospital LOS would be detected with 462 patients in each cohort. To account for a potentially high dropout rate in the midst of the pandemic, we aimed to increase our patient cohort by over 50%.

Table 3. Comparison of CMS complications between cohorts. Values are count (%)

CMS complication	Study group n = 757	Control group n = 757	p-value
Acute myocardial infarction	0 (0)	0 (0)	–
Pneumonia	1 (0.13)	0 (0)	1
Sepsis	0 (0)	1 (0.13)	1
Pulmonary embolism	2 (0.26)	0 (0)	0.5
Death	1 (0.13)	0 (0)	1
Surgical site bleeding	3 (0.40)	5 (0.66)	0.7
Mechanical complications	10 (1.3)	12 (1.6)	0.8
Surgical site infection	5 (0.66)	11 (1.5)	0.2
Total complications	22 (0.03)	29 (0.04)	0.2

CMS = Centers for Medicare and Medicaid Services.

Ethics, data sharing, funding, and potential conflicts of interest

This retrospective case-control study was approved by the Institutional Review Board (no. 2020-1028) at our hospital. Data sharing can be made available upon request. We are grateful to Carol and William Browne who funded this study with their generous donation. The authors report no conflict of interest.

Results

The study and control cohorts experienced similar rates of unscheduled outpatient (in-person and telehealth combined) visits (5.0% vs. 7.3%; p = 0.07), ER visits (5.0% vs. 4.8%; p = 0.8), and hospital readmissions (4.0% vs. 2.8%; p = 0.2). A majority of unscheduled outpatient visits were due to postoperative pain/swelling concerns (45% vs. 25%), wound-related issues (24% vs. 31%), and evaluations to assess potential mechanical failure (11% vs. 20%) (p = 0.07 for all combined). The 3 most frequent reasons for ER visits included mechanical complications (14% vs. 22%), venous thromboembolism (VTE) concerns and workups (19% vs. 14%), and cardiovascular workups (22% vs. 11%) (p = 0.8 for all combined). The 3 most frequent reasons for readmission included mechanical complications (27% vs. 24%), major superficial and deep joint infections (13% vs. 24%), and severe pain (6.7% vs. 24%) (p = 0.2 for all combined). Overall, the 3 most common reasons for readmission accounted for only 47% of the study group, but accounted for 74% of reasons for readmission in the control group.

The study and control cohorts also experienced similar rates of CMS complications (0.03% vs. 0.04%; p = 0.2) (Table 3).

Table 4. Results of our patient PROMs GEE analysis controlling for collection interval, date of surgery, and procedure laterality

Outcome Parameter	Estimate (95% CI)	Pr > IZI
HOOS JR		
Intercept	49.9 (48.8 to 51.1)	< 0.0001
Time – postop. 3 month vs. baseline	33.9 (32.5 to 35.3)	< 0.0001
Time – postop 6 week vs. baseline	26.4 (25.1 to 27.7)	< 0.0001
Group – control vs. study	0.6 (–0.8 to 2.0)	0.4
VR-12 Mental		
Intercept	55.0 (54.0 to 55.9)	< 0.0001
Time – postop 3 month vs. baseline	2.3 (1.4 to 3.2)	< 0.0001
Time – postop 6 week vs. baseline	1.0 (0.1 to 1.9)	0.03
Group – control vs. study	–0.2 (–1.3 to 0.8)	0.7
VR-12 Physical		
Intercept	30.8 (29.9 to 31.6)	< 0.0001
Time – postop 3 month vs. baseline	14.9 (14.0 to 15.8)	< 0.0001
Time – postop 6 week vs. baseline	8.4 (7.5 to 9.2)	< 0.0001
Group – control vs. study	0.5 (–0.5 to 1.4)	0.4

PROMs = patient-reported outcome measures; GEE = generalized estimating equation; HOOS JR = Hip injury and Osteoarthritis Outcome Score for Joint Replacement; VR-12 = Veteran's Rand 12-item questionnaire.

There were fewer medical complications (myocardial infarction, sepsis, pneumonia, pulmonary embolism, and death) than local complications (hematoma, deep infection, mechanical complication) in both cohorts (4 and 18 in study, 1 and 28 in control patients, respectively). All CMS complications except for 2 inpatient hip dislocations (1 in study group, 1 in control) occurred after discharge.

The preoperative HOOS JR scores were statistically significantly lower amongst study patients compared with controls (50 vs. 53; p = 0.04), but 6-week and 3-month scores were similar. VR-12 mental and physical scores were also similar between study and control cohorts for all collection intervals. When computing the change (Δ) in PROs between preoperative and postoperative ratings at 6 weeks and 3 months, study patients exhibited greater improvements for HOOS JR (28 vs. 24; p = 0.004) at 6 weeks compared with controls. However, this difference fell below the HOOS JR minimal clinical important difference (MCID) of 7 (11). Additionally ΔVR-12 physical scores at 6 weeks also were superior amongst the study cohort (12 vs. 7.0; p = 0.005) and this difference met the VR-12 physical MCID of 3 (12). Further GEE cluster analysis controlling for interval of collection (repeated measurements), date of surgery, and procedure laterality demonstrated that there was no statistically significant difference in HOOS JR and VR-12 mental/physical between cohorts (Table 4).

Discussion

As the peak of the COVID-19 pandemic passed in 2020, the resumption of elective medical interventions like THR in a safe manner was necessary for patients enduring worsening quality of life as a result of hip pain and decreased mobility. Our institution responded to this early return-to-normal period with increased emphasis on early mobilization and hospital discharge to maintain capacity and minimize the risk of COVID-19 for patients and healthcare workers. The literature on the recommencement of elective THR during the COVID-19 pandemic continues to evolve. In the present study, we compared in-hospital and 90-day outcomes associated with our described institutional changes in postoperative patient care during the pandemic period to a matched cohort of pre-pandemic patients.

There were substantial changes in patient care after THR in the study group: hospital LOS decreased by approximately 30% during this time and more patients were discharged home on the DOS and POD1. There was a corresponding decrease in the number of days until the first postoperative encounter (telehealth or in-person) and an increase in the proportion of patients undergoing telehealth office and rehabilitation visits.

The changes in care implemented in the study period did not adversely influence 90-day complications, emergency room visits, and hospital readmissions. This decrease in LOS by about a half-day is a significant finding in the COVID-19 era, as this may mean the difference between a morning and evening discharge and thus bed availability for the day. While decreased LOS may be attributed to rapid recovery and fast-track protocols, in the setting of COVID-19, patients may also be accelerating their own recovery and discharge for fear of contracting a COVID-19 infection. Our main finding of decreasing LOS without an adverse effect on clinical outcomes is in accordance with previous literature regarding LOS pre-pandemic. We have previously reported (16) like others (17) that over the last decade there has been a steady decrease in hospital LOS after THR and TKR while the complication profile and readmission rates have not increased (13,14), refuting theoretical concerns that decreased LOS results in increased risk of perioperative complications. These findings are in line with those of others who reported increased complications with increased LOS (15). Furthermore, in the era of lowering healthcare costs, several studies have reported potential cost savings with early discharge THR protocols using time-driven activity-based costing (TDABC) methods (16,17).

In the COVID-19 era, our finding of decreased LOS is different from findings reported by Green et al. of increased LOS after THR and TKR following the resumption of elective orthopedic services in 2020 compared with a similar patient profile from the year prior in the United Kingdom (18). They attributed their increased LOS to the National Health Service's longer wait times during the pandemic resulting in worsening arthritis, deconditioning, and thus postoperative rehabilitation. Early mobilization and rehabilitation is an integral part of rapid recovery and fast-track protocols (7). At our institution, there was an increase in the number of PT working hours during the return-to-normal period to facilitate early mobilization as a way to achieve faster hospital discharge. As such, we noted a substantial decrease (13%) in the time to ambulation, which may in turn have affected postoperative rehabilitation and thus LOS. Furthermore, there were more post-discharge in-hospital and telehealth PT encounters in the study cohort, which differs from observations by MacDonald et al. (19), who reported that post-discharge COVID-19 restrictions (e.g., social distancing) resulted in a limitation in rehabilitation after THR and TKR compared with a similar cohort from the year prior.

There was a substantial increase in the utilization of telehealth services during the study period, as during the early phases of the pandemic telehealth was rapidly expanded. This facilitated post-discharge care of patients who underwent surgery immediately before March 15, 2020, when elective surgery was halted in our hospital for 7 weeks. In March 2020, CMS began to provide payment for telehealth visits and allowed for a variety of communication platforms to deliver these services. Orthopedic surgeons became early adopters of telehealth services, with over 80% of orthopedic surgery departments implementing and utilizing these telehealth services (20), which had previously accounted for less than 1% of all patient visits in the United States pre-pandemic (21). In a recent study by Bini et al., telehealth services peaked during the height of the early pandemic and were more likely to be utilized for postoperative follow-up visits (22). The increased utilization of telehealth services for postoperative visits is likely multifactorial and may be explained by its widespread adoption, the sudden ability to receive reimbursement for the telehealth visit, and increased necessity for management of postoperative issues and rehabilitation during a time when social distancing was paramount. These findings explain the minimal number of unscheduled in-person follow up visits seen in this study.

The rate of ER visits, hospital readmissions, and complications was low and comparable between the study and control cohorts. This finding has also been corroborated in several studies that reported a low number of ER visits, and complication, readmission, and reoperation rates when ambulatory and fast-track protocols are employed after THR and TKR (23-25). A recent study by Husted et al. highlighted similar findings in that patients undergoing fast-track (DOS) discharge had similar postoperative contacts with the healthcare system when compared with patients not discharged on the DOS (26). Our findings further mitigate concerns regarding the safety of fast-track THR.

Regarding PROMs, we observed that patients undergoing fast-track THR in the study period experienced similar satisfaction and functional gains (Δ), as indicated by similar HOOS Jr and VR-12 scores from baseline scores. Our findings support previously published results of patients experiencing similar improvements in PROMs after early (e.g., ambulatory) discharge versus inpatient THR (27,28). Interestingly, in our study the preoperative PROMs trended towards being lower for the study cohort. This may potentially be due to the potential deterioration in the quality of life and health status of the study patients during the peak of the pandemic when access to arthroplasty surgeons was limited and elective THR was halted. Nevertheless, the improvement in satisfaction and function converged with that of the pre-pandemic cohort, further validating the utilization of fast-track THR.

There are limitations to our study. First, this is a retrospective single-institution study, which may limit its generalizability. Second, our institution is a tertiary orthopedic specialty hospital in a large metropolitan city, which may further limit the generalizability of our observations. Third, the time to first PT visit is likely guided by discharge plan. Because the percentage of outpatient procedures increased, it is likely to have influenced the decrease in average time to first PT visit. Fourth, while a decrease in hospital readmission rate from 4.0% to 2.8% in the study cohort may not be statistically significant, it is possible that the study is not powered enough to detect a difference of this magnitude. Fifth, while we noted that there were similar postoperative in-person office contacts between the cohorts, we were unable to study the effect of the increased telehealth utilization on primary care provider (PCP) visits, as highlighted in the Husted et al. study (26). This is the result of our institution being a tertiary orthopedic hospital with an EMR that does not capture PCP visits, and it is unlikely that there would be a correlation here as it is our standard practice for surgical patients to follow up with their index surgeons, with PCP visits discouraged. Lastly, we assumed that the outcomes observed were directly related to the COVID-19 pandemic, though there may be several other confounders at play not analyzed in the present study. Nonetheless, our study is unique given our location in a large metropolitan city, which was considered an epicenter of COVID-19, and is a realistic representation of the return-to-normalcy period and resumption of elective THR, which is lacking in the literature.

In conclusion, our analysis demonstrates that hospital LOS was lower with the return of elective THR following the peak of the COVID-19 pandemic in mid-2020. The decrease in LOS was likely multi-factorial including the utilization of shorter-acting neuraxial anesthesia with more predictable return of motor function, earlier and more-intensive in-hospital rehabilitation, and general fear by patients of being admitted to the hospital in the pandemic. However, the LOS reduction did not substantially influence the rate of unscheduled postoperative visits, complications, readmissions, and PROMs. Our findings lend further support for the utilization of fast-track or early-discharge arthroplasty and the use of tele-medicine and tele-rehabilitation after elective THR. The findings may also be useful should new waves of COVID-19 or other pandemics develop in the future. A follow-up study will compare costs in these reported cohorts using the TDABC method.

NS, ADV, FB, ES, and JR planned the study. EVK and CO participated in data collection. YFC performed statistical analysis. All authors contributed to data analysis and writing the manuscript.

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