



# Effect of COVID-19 on Shoulder Arthroplasty at a Tertiary Care Medical Center in New York City

## *Efeito da COVID-19 na artroplastia de ombro em um centro médico terciário na cidade de Nova York*

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### Abstract

**Objective** The COVID-19 pandemic led to an unprecedented pause in elective surgeries, including shoulder arthroplasty. We sought to determine whether clinical and/or demographic differences would be seen between patients who presented for shoulder arthroplasty during the pandemic compared with the previous year (2019). **Methods** Institutional records were queried for patients who underwent shoulder replacement between March 1 and July 1 of 2019 and 2020. Demographics, range of motion, surgical duration, hospitalization time, discharge disposition, and postoperative management were analyzed.

**Results** The mean duration of surgery was  $160 \pm 50$  minutes in 2020 and  $179 \pm 54$  minutes in 2019 ( $p = 0.13$ ). The mean hospitalization time was  $36 \pm 13$  hours in 2020 and  $51 \pm 40$  hours in 2019 ( $p = 0.04$ ). In 2019, 96% of the patients participated in physical therapy, while 71% did it in 2020 ( $p = 0.003$ ). A total of 100% of the 2019 patients and 86% of the 2020 patients participated in an in-person postoperative follow-up ( $p = 0.006$ ). The 2019 patients reported for an office visit on average  $14 \pm 11$  days after surgery; the 2020 patients waited  $25 \pm 25$  days to return for a follow-up ( $p = 0.10$ ). Range of motion, age, American Society of Anesthesiologists (ASA) scores, and complication rates did not differ between the cohorts.

**Conclusion** Patients presenting for surgery during the initial phase of the pandemic were demographically and clinically similar to 2019 patients. However, the length of stay was significantly reduced during the COVID-19 pandemic. Postoperative follow-up and physical therapy were delayed in 2020, but this did not lead to differences in complication or readmission rates compared with those of the 2019 cohort.

**Level of Evidence** III.

### Keywords

- ▶ arthroplasty, replacement, shoulder
- ▶ COVID-19
- ▶ coronavirus infections
- ▶ elective surgical procedures
- ▶ perioperative period
- ▶ postoperative period

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**Resumo**

**Objetivo** A pandemia de COVID-19 causou uma pausa sem precedentes em cirurgias eletivas, inclusive artroplastia de ombro. Procuramos determinar as possíveis diferenças clínicas e/ou demográficas entre os pacientes que realizaram artroplastia de ombro durante a pandemia em comparação com o ano anterior (2019).

**Métodos** Os registros institucionais foram consultados para obtenção de informações sobre pacientes submetidos a artroplastia de ombro entre 1° de março a 1° de julho de 2019 e 2020. Dados demográficos, amplitude de movimento, duração da cirurgia, tempo de hospitalização, condições à alta e manejo pós-operatório foram analisados.

**Resultados** O tempo médio de cirurgia foi de  $160 \pm 50$  minutos em 2020 e de  $179 \pm 54$  minutos em 2019 ( $p = 0,13$ ). O tempo médio de internação foi de  $36 \pm 13$  horas em 2020 e de  $51 \pm 40$  horas em 2019 ( $p = 0,04$ ). Em 2019, 96% dos pacientes fizeram fisioterapia, enquanto 71% o fizeram em 2020 ( $p = 0,003$ ). Todos os pacientes de 2019 e 86% dos pacientes de 2020 participaram do acompanhamento pós-operatório presencial ( $p = 0,006$ ). Os pacientes de 2019 retornaram para a consulta médica em média  $14 \pm 11$  dias após a cirurgia; os pacientes de 2020 retornaram para o acompanhamento em  $25 \pm 25$  dias ( $p = 0,10$ ). A amplitude de movimento, a idade, a pontuação da American Society of Anesthesiologists (ASA, na sigla em inglês) e as taxas de complicações não diferiram entre as coortes.

**Conclusão** Os pacientes submetidos a cirurgia na fase inicial da pandemia eram demográfica e clinicamente semelhantes aos pacientes de 2019. No entanto, o tempo de internação diminuiu de forma significativa durante a pandemia de COVID-19. O acompanhamento pós-operatório e a fisioterapia foram adiados em 2020, mas isso não levou a diferenças nas taxas de complicações ou de reinternações em comparação às da coorte de 2019.

**Nível de Evidência** III.

**Palavras-chave**

- ▶ artroplastia do ombro
- ▶ COVID-19
- ▶ infecções por coronavírus
- ▶ procedimentos cirúrgicos eletivos
- ▶ período perioperatório
- ▶ período pós-operatório

**Introduction**

The first case of COVID-19 was reported in New York on March 1, 2020, and the region quickly became the global epicenter for the disease. Within 2 weeks, the Surgeon General advised hospitals to pause elective surgeries to minimize the spread of the virus and maximize existing healthcare supplies. This led to the advent of new treatment protocols and social distancing guidelines that significantly reduced the hospitalization, spread, and mortality of the illness.

The economic impact of pausing elective orthopedic surgery has been significant. Elective procedures, including major orthopedic procedures such as joint arthroplasty, have historically provided valuable income to healthcare systems.<sup>1,2</sup> As the world recovers from the widespread impact of the COVID-19 pandemic, elective surgery will play a key role in restoring economic stability to healthcare systems. However, important changes must be implemented to ensure the safety of patients and providers and the effective stewardship of healthcare resources. The American Academy of Orthopaedic Surgeons (AAOS) recognized four tiers of orthopedic procedures during the pandemic: A (emergency), B (urgent), C (urgent/somewhat elective), and D (elective).<sup>3</sup> Resumption of each tier could occur with appropriate precautions at different stages of recovery from the pandemic.

Current algorithms recommend careful consideration of the urgency of the procedure, patient risk factors (age, medical comorbidities, and other risk factors) and required resources (stay or discharge needs) with appropriate application of preoperative screening and COVID-19 testing.<sup>3,4</sup> In addition, patient willingness to undergo surgery is a key driver in the resumption of elective procedures. In a recently published investigation, 27% of the patients who responded to an online questionnaire conducted during the early pandemic in May 2020 stated that they would be willing to undergo elective procedures in the 1<sup>st</sup> month of reopening; this was despite 61% of the respondents reporting a fear of exposure to or contracting the virus.<sup>5</sup> This suggests that despite fears about COVID-19, the demand for elective surgery has begun to recover.

Total shoulder arthroplasty (TSA) is an elective procedure that, while with a lower volume than that of knee and hip arthroplasty, is growing in prevalence. It can provide patients with significant pain relief from debilitating shoulder arthritis, much of which occurs within the first 6 months following surgery.<sup>6</sup> Prior to the pandemic, the mean length of stay for TSA had already been steadily declining (decreasing by > 50% from 1993 to 2007), and growing interest had arisen for outpatient TSA in an effort to reduce costs to the patient and the healthcare system.<sup>7</sup> As a result, the incidence of ambulatory TSA has been steadily increasing, nearly doubling from

2010 to 2014 with no evidence of increased readmission or of complication rates in appropriately-selected patients, and this transition to outpatient procedures resulted in a cost savings of nearly US\$ 4,000 per procedure.<sup>8</sup> However, a significant number of these procedures continues to be performed on an inpatient basis, a fact that may hinder a return to previous capacity. A previous investigation noted increased length of stay and likelihood of discharge to a care facility in patients > 65 years old, female patients, patients with obesity or diabetes, and patients undergoing reverse total shoulder arthroplasty (rTSA).<sup>9</sup> Some of these demographic features, specifically older age and medical comorbidities, overlap with patients at higher risk of severe disease from COVID-19.

The purpose of the current investigation is to investigate the difference in demographics between patients undergoing total shoulder arthroplasty in 2020, during the COVID-19 pandemic, compared with patients undergoing the same procedure in 2019, the year prior to the pandemic. Given the current trend towards performing TSA on an outpatient basis, patient attitudes towards surgery, and the emphasis on efficient resource allocation and risk reduction to patients during the COVID-19 pandemic, we hypothesize that patients who undergo shoulder arthroplasty during the COVID-19 pandemic will be younger, healthier, have shorter length of stay, and be more likely to be discharged home rather than to a short-term care facility compared with the year preceding the pandemic.

## Materials and Methods

### Study Design and Sampling

The present study was approved by our institutional review board. This is a retrospective study of patients who underwent TSA or rTSA during the initial phase of the COVID-19 pandemic, defined as March 1 to July 1, 2020. The first case of COVID-19 was confirmed in New York City on March 1, 2020, and July 1, 2020 marked the 1<sup>st</sup> day in which < 1,000 new cases were reported. Elective surgery was paused on March 14, 2020 according to the recommendation of the Surgeon General and was resumed on June 8, 2020. A cohort of patients who underwent TSA or rTSA between March 1 and July 1, 2019 was used as a comparative group. Institutional records were queried using Current Procedural Terminology (CPT) codes 23470, 23472, 23473, and 23474.

### Statistical Analysis

All data analysis and statistical tests were conducted using R software, version 4.0.5 (R Foundation, Vienna, Austria). Categorical variables were presented as frequencies (n/N) and percentages, while continuous variables were presented as mean ( $\pm$ standard deviation [SD]). Tests of normality were performed with the Shapiro-Wilk test. Univariate analyses were performed with the  $\chi^2$  test for categorical variables, and the Student t-test or the Mann-Whitney U test (Wilcoxon rank-sum) were used for continuous variables. All p-values < 0.05 were considered statistically significant.

## Results

### Study Population

The study identified 21 patients in 2020 and 50 patients in 2019 who underwent shoulder replacement surgery. Of these patients, 50 and 62% were male in the 2019 and 2020 cohorts, respectively ( $p = 0.36$ ). The mean age in 2019 was  $69 \pm 9$  years and  $68 \pm 7$  years in 2020 ( $p = 0.71$ ). In 2020, there were 10 TSA and 11 rTSA; in 2019, there were 16 TSA, 30 rTSA, 1 hemiarthroplasty, and 3 revision surgeries ( $p = 0.16$ ) (**Table 1**).

There was not a significant difference in patient demographics between the 2019 and 2020 cohorts. The mean preoperative forward elevation was  $101^\circ \pm 41^\circ$  in 2019 and  $115^\circ \pm 36^\circ$  in 2020 ( $p = 0.19$ ). The mean preoperative external rotation was  $26^\circ \pm 19^\circ$  in 2019 and  $26^\circ \pm 15^\circ$  in 2020 ( $p = 0.92$ ). The mean ASA score for 2019 patients was  $2.4 \pm 0.70$  and  $2.5 \pm 0.59$  in 2020 ( $p = 0.74$ ). 58% of 2019 patients and 52% of 2020 patients had an ASA score of  $\leq 2$ . In 2020, 24% of the cohort used Medicaid as their primary insurance while only 8% of the 2019 cohort used it ( $p = 0.12$ ). In 2020, there were 3 urgent and 18 elective cases; in 2019, there were 43 elective cases and 7 urgent cases ( $p = 0.98$ ). 28% of patients in 2019 and 33% of 2020 patients had a prior shoulder surgery on the affected shoulder ( $p = 0.65$ ) (**Table 1**).

### Variable Outcomes

There was a difference in duration of surgery, but this was not statistically significant. In 2019, the mean duration of surgery was  $179 \pm 54$  minutes, and in 2020 was  $160 \pm 50$  minutes ( $p = 0.13$ ). The difference in length of stay between the 2 years was statistically significant. In 2019, patients spent a mean  $51 \pm 40$  hours in the hospital; however, in 2020, patients spent an average of  $36 \pm 13$  hours in the hospital ( $p = 0.04$ ). In 2019, 12% of the patients were discharged to a subacute facility and 88% were discharged home; in 2020, 9.5% of the patients were discharged to a subacute facility and 90.5% were discharged home ( $p = 0.76$ ) (**Table 2**).

Postoperative management following TSA or rTSA also varied significantly across the 2 years. In 2019, 96% of the patients participated in in-person physical therapy, while 71% did it in 2020 ( $p = 0.003$ ). In 2019, 100% of the patients ( $n = 50$ ) participated in a postoperative visit with their operating surgeon, while 86% of the patients ( $n = 21$ ) in 2020 did the same ( $p = 0.006$ ). Of the 3 patients who did not return for an office visit in 2020, the operating surgeon met the patients via telephone encounter ( $n = 1$ ) or telehealth video visit ( $n = 1$ ), while the 3<sup>rd</sup> patient did not return for any follow-up care. In 2019, patients reported for an office visit on average  $14 \pm 11$  days after the date of surgery; in 2020, patients waited  $25 \pm 25$  days to return for an office visit ( $p = 0.10$ ). In 2020, patients also utilized telehealth at increasing rates for postoperative care (**Table 3**).

## Discussion

The COVID-19 pandemic led to an unprecedented pause in elective surgery in March 2020. Based in New York, our

**Table 1** Patient demographics (2019: *n* = 50; 2020: *n* = 21)

Characteristic	2019 (SD)	2020 (SD)	<i>p</i> -value
Age at Surgery (years old)	69.3 ± 8.7	68.3 ± 7.4	0.71
Gender			
Male	25 (50.0%)	13 (61.9%)	0.36
Female	25 (50.0%)	8 (38.1%)	
ASA Score			
1	3 (6.0%)	1 (4.8%)	0.74
2	26 (52.0%)	10 (47.6%)	
3	19 (38.0%)	10 (47.6%)	
4	2 (4.0%)	0 (0.0%)	
Insurance Provider			
Medicaid	4 (8.0%)	5 (23.8%)	0.12
Medicare	25 (50.0%)	10 (47.6%)	
Medicare/Private	7 (14.0%)	0 (0.0%)	
Private	14 (28.0%)	6 (28.6%)	
Diabetes			
Yes	10 (20.0%)	3 (14.3%)	0.57
No	40 (80.0%)	18 (85.7%)	
Hypertension			
Yes	32 (64.0%)	14 (66.7%)	0.83
No	18 (36.0%)	7 (33.3%)	
Prior Shoulder Surgery			
Yes	14 (28.0%)	7 (33.3%)	0.65
No	36 (72.0%)	14 (66.7%)	
TSA Type			
Anatomic	30 (60.0%)	10 (47.6%)	0.16
Reverse	16 (32.0%)	11 (52.4%)	
Hemiarthroplasty	4 (8.0%)	0 (0.0%)	
Elective or Emergent			
Elective	43 (86.0%)	18 (85.7%)	0.98
Medically Emergent	7 (14.0%)	3 (14.3%)	
Preoperative Forward Elevation	100.7° (41.3)	114.5° (35.6)	0.19
Preoperative External Rotation	25.8° (19.1)	26.3° (15.2)	0.74

Abbreviations: ASA, American Society of Anesthesiologists; SD, standard deviation; TSA, total shoulder arthroplasty.

institution was significantly affected as a previous epicenter of the global pandemic. Elective surgery was paused in early March, and only emergent cases were initially given operating room time. After the initial shutdown period, elective procedures were slowly resumed in a phased fashion with COVID-specific testing and infection control protocols. The present study seeks to understand whether there were significant differences in demographics or early postoperative characteristics of patients undergoing shoulder arthroplasty during the first phase of the pandemic versus the previous year. We hypothesized that patients who were in

**Table 2** Patient perioperative characteristics (2019: *n* = 50; 2020: *n* = 21)

Characteristic	2019 (SD)	2020 (SD)	<i>p</i> -value
Duration of Surgery (minutes)	178.7 (54.3)	159.5 (50.1)	0.13
Length of Stay (hours)	51.3 (40.0)	36.3 (12.6)	<b>0.04</b>
Blood Transfusion			
Yes	1 (2.0%)	0 (0.0%)	0.51
No	49 (98.0%)	21 (100%)	
Surgical Complications			
Yes	4 (8.0%)	2 (9.5%)	0.83
No	46 (92.0%)	19 (90.5%)	

Abbreviation: SD, standard deviation.

lower-risk COVID cohorts and with more advanced shoulder disease would undergo surgery in the setting of the pandemic.

Public perception around the resumption of elective surgery was a significant factor in determining which patients presented for elective surgery during the pandemic. In a recent study, Moverman et al.<sup>5</sup> found that males and English speakers were significantly more comfortable with opting for elective surgery once the restrictions were lifted. However, in our investigation, there was no significant

**Table 3** Patient postoperative characteristics (2019: *n* = 50; 2020: *n* = 21)

Characteristic	2019 (SD)	2020 (SD)	<i>p</i> -value
Postoperative Destination			
Home	44 (88.0%)	19 (90.5%)	0.76
Subacute care	6 (12.0%)	2 (9.5%)	
Revision Surgery			
Yes	3 (6.0%)	2 (9.5%)	0.60
No	47 (94.0%)	19 (90.5%)	
Readmission			
Yes	6 (12.0%)	2 (9.5%)	0.76
No	44 (88.0%)	19 (90.5%)	
Postoperative Visit Method			
Telehealth Visit	0 (0.0%)	3 (14.3%)	0.006
In-person Office Visit	50 (100%)	18 (85.7%)	
Time from Surgery to Postoperative Visit (Days)	14.1 (11.4)	25.4 (24.7)	0.10
Physical Therapy			
Yes	48 (96.0%)	15 (71.4%)	0.003
No	2 (4.0%)	6 (28.6%)	

Abbreviation: SD, standard deviation.

difference in the number of males versus females electing to undergo TSA between 2019 and 2020 (2019: 50% versus 2020: 62%;  $p = 0.36$ ). There was no significant difference in the number of English-speakers in either cohort (2019: 98% versus 2020: 92%;  $p = 0.97$ ).

Our initial hypothesis was that patients who elected to undergo elective shoulder arthroplasty in 2020 would have lower ASA scores and be of a younger age. We also hypothesized that patients electing to undergo shoulder arthroplasty in 2020 would have worse preoperative range of motion. These hypotheses reflected our assumptions that patients in lower risk groups for COVID complications with worse shoulder disease or limitations would elect to undergo surgery during the pandemic. However, these preoperative variables were not significantly different between the two cohorts. In fact, we did not find significant differences in any of the preoperative patient demographic variables evaluated in the present investigation between the 2019 and 2020 cohorts. Additionally, there was a significant reduction in volume between the 2019 and 2020 cohorts (52% fewer shoulder arthroplasty procedures), which is attributable to the 3-month pause in elective procedures. This is similar to reductions in volume reported at other institutions for elective orthopedic cases.<sup>10</sup> We also saw a decline in trauma-related arthroplasty procedures (from 5 in 2019 to 1 in 2020). This also mirrored a decline in orthopedic trauma during the shutdown noted in the literature.<sup>10,11</sup>

Importantly, our investigation noted a trend towards significance in the duration of surgery (2019:  $178.7 \pm 54.3$  versus 2020:  $159.5 \pm 50.1$ ;  $p = 0.13$ ). While some of this difference could have been due to fewer revision procedures being performed during the pandemic, lower surgical volume and more efficient resource allocation could have also contributed to this difference. We saw a significant decrease in postoperative length of stay between the 2 cohorts (2019:  $51.3 \pm 40.0$  hours versus 2020:  $36.3 \pm 12.6$  hours.;  $p = 0.04$ ). In 2020, no patients stayed in the hospital for  $> 72$  hours. In 2019, 12 patients stayed  $> 72$  hours (between 72 and 100 hours,  $n = 7$ ; between 100 and 200 hours,  $n = 3$ ; between 200 and 300 hours,  $n = 1$ ; and  $> 300$  hours,  $n = 1$ ). Postoperative destination for patients was not significantly different, with 88 and 91% going home postoperatively in 2019 and 2020, respectively ( $p = 0.76$ ). In the setting of the COVID-19 pandemic, a combination of taxed hospital resources and patient desire to leave the hospital expeditiously may have contributed to the faster discharge time by aligning incentives for discharge. Previous investigations have noted improved preoperative management leading to reduced length of stay during the COVID-19 pandemic, but the present investigation is the first that we are aware of to demonstrate decreased postoperative length of stay in the orthopedic literature.<sup>12</sup>

A previous systematic review noted that length of stay and discharge disposition after TSA was influenced by a number of factors, with female gender, obesity, age  $> 65$  years, and rTSA associated with an extended length of stay or necessitating discharge to a facility.<sup>9</sup> The length of stay in our investigation improved from  $2.1 \pm 1.5$  days in 2019 to

$1.5 \pm 0.5$  days in 2020. These ranges from 2019 are comparable to those cited in the literature.<sup>13,14</sup> Notably, no increase in 30- or 90-day readmission or in complications rates were noted in our cohorts.

Postoperatively, significantly fewer patients participated in formal physical therapy in 2020 (71%) compared with 2019 (96%) ( $p = 0.003$ ). Additionally, fewer patients returned for an in-person postoperative visit, and the interval between the time of surgery and the initial postoperative visit was slightly greater during the pandemic. The literature suggests that immediate postoperative utilization of physical therapy provides short-term pain reduction and increased function, but these benefits dissipate at longer term follow-up.<sup>15</sup> There was no increased rate of early complications despite the difference in early postoperative follow-up; however, our investigation is underpowered to make any strong conclusions about postoperative complications. Taken together, these results suggest that despite similar patient demographics between 2019 and 2020, patients undergoing TSA were able to be discharged from the hospital consistently earlier in their postoperative course during the pandemic. This may be due to a variety of factors including patient motivation, aligned incentives for discharge between patients and providers, and increased available hospital resources – such as social workers – available to assist in the discharge process.

The present investigation has several limitations. It was limited by a small sample size and by the retrospective nature of the study. Additionally, all patients in our cohort were from a single, urban region – which was hard-hit by the COVID-19 pandemic – and findings may not be generalizable to other populations. Additionally, patient reported outcomes were not available.

## Conclusion

The COVID-19 pandemic led to an unprecedented pause in elective surgery beginning in the spring of 2020. Despite public perception surrounding how safe elective surgeries were during the pandemic, we note no differences in clinical features or patient demographics for those who underwent shoulder arthroplasty in the initial phase of the pandemic compared with the previous year. However, we did see reductions in operation length, albeit this did not reach significance, and in length of stay, suggesting a concerted movement towards a shorter hospitalization time during the pandemic. Furthermore, despite waiting longer to return for postoperative follow-up and reductions in physical therapy participation in 2020, the patients had no differences in readmission, revision, or complication rates in their respective years.

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### Conflict of Interests

Paul J. Cagle, MD

Stryker: Consultant  
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 Bradford O. Parsons, MD

Arthrex: Consultant

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