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Research Article

The COVID-19 Pandemic Shut Down Did Not Adversely Affect Outcomes of Arthroscopic Rotator Cuff Repair

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Conflicts of Interest Statement for Akshar Patel

b Andrew Stevens is currently a third-year medical student at The Ohio State University with an interest in orthopedics and management of arthritis. I love sports and staying active, and am passionate about helping others manage their arthritis so that they can live the life they want.

Conflicts of Interest Statement for Andrew Stevens

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i Dr. Rauck an orthopedic surgeon with a subspecialty in sports medicine and shoulder surgery. He takes the time to understand each patient's concerns, goals and expectations while providing a clear explanation of the diagnosis and treatment options, which can range from non-operative solutions to minimally invasive arthroscopic or open surgeries for patients of all ages. He is passionate about helping his patients alleviate their pain and improving their function to get them back to doing the things that they enjoy.

He developed a focus on patient care, research and education while training at the world-renowned Hospital for Special Surgery in New York City. However, as someone who was born and raised in Columbus, The Ohio State University Wexner Medical Center has always been a special place to him. The team-based approach and willingness to address any problem, no matter how complex, set Ohio State apart for providing the best care possible to patients and made it the ideal place to continue his career.

Dr. Rauck has served as a team physician and taken care of athletes at all levels of competition, including providing care as an assistant team physician with the New York Giants. He also enjoys taking care of the athletes at Ohio State. His research interests include enhancing our understanding of shoulder instability and available treatment options as well as patient expectations and clinical outcomes for shoulder replacements and rotator cuff repairs.

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Introduction

We investigated whether patients who received an arthroscopic rotator cuff repair (RCR) in January-March 2020 had a difference in outcomes compared to patients who received it the previous year.

Materials and Methods

Institutional records were queried to identify patients who underwent an arthroscopic RCR between 1/1/19 to 3/17/19 and 1/1/20 to 3/17/20. The 2020 patients were contacted by phone in October 2022 for follow-up. Patients were divided into cohorts based on year of surgery. Demographic information, range of motion (ROM), and physical therapy were analyzed using inferential statistics.

Results

This study identified 50 and 51 patients in 2020 and 2019, who had a minimum of 1 year follow-up. Rotator cuff repairs done in 2019 had improvements in forward elevation (FE) (135º to 161º; p<0.01) and internal rotation (IR) (L4 to L1; p-value<0.01) whereas those done in 2020 did not improve their forward elevation (146º to 151º; p=0.42) or internal rotation (L3 to L2; p=0.29). Patients in 2019 completed more physical therapy sessions (2019: 25.0; 2020: 16.7; p<0.01). Patients in 2020 also experienced a significant delay from date of surgery to date of first physical therapy session (2019: 28.5 ± 11.9 days; 2020: 35.0 ± 16.5 days; p-value=0.03). Of the 2020 patients, 8% (4/50) patients did not initiate physical therapy after RCR, 16% (8/50) reported a delay in physical therapy while 44% (22/50) reported that the COVID-19 pandemic affected their recovery following RCR. At final follow up, patients reported a SANE score of 78.2 ± 12.1 on the affected shoulder, 91.3 ± 10.4 on the unaffected shoulder, a mean VAS pain score of 2.3 ± 1.8.

Discussion

Patients who underwent arthroscopic RCR in early 2020 had a longer delay to starting PT, did less PT overall, but still had comparable range of motion and strength at final follow-up.

INTRODUCTION

The incidence of arthroscopic rotator cuff repair has risen significantly over the last two decades (Colvin et al. 2012). This is in part due to an aging population in addition to previous studies demonstrating the benefit of treating small rotator cuff tears early (Kim et al. 2009; Yamaguchi et al. 2006; Fu et al. 2020; Yamamoto et al. 2010). The large rise in the number of RCRs performed annually has led to significant research on postoperative management following surgery (Thigpen et al. 2016; Gallagher et al. 2015; Longo et al. 2020). Current rehabilitation protocols recommend early immobilization, followed by the reintroduction of passive ROM, and then the restoration of active ROM and emphasis on strength (Thigpen et al. 2016). Physical therapy is utilized to help patients attain sufficient rotator cuff strength and active ROM following RCR.

The COVID-19 pandemic led to unprecedented changes in postoperative management for patients undergoing arthroscopic RCR. Due to a shift towards emergent orthopedic care, many patients were unable to be seen for their routine follow-up visits following surgery. There is a paucity of literature that evaluates the effect of COVID-19 on postoperative care following arthroscopic RCR. Previous studies have demonstrated that patients who underwent shoulder surgery after March 2020 had delays in postoper-

ative visits compared to historical controls, but there were no other differences in postoperative range of motion and complication rates (Wang et al. 2022, 2023). In a prospective study conducted during the pandemic, Smith et al did not find a significant difference in patient-reported outcome scores between patients who experienced a two-month delay in arthroscopic RCR versus patients who had no delay (Smith et al. 2022). Thus, the literature to date suggests that the limited availability of care due to the pandemic did not adversely affect outcomes in rotator cuff patients.

The objective of this study is to investigate whether arthroscopic RCR outcomes were affected at a tertiary care medical center during the pandemic. We hypothesize that patients completed less physical therapy following surgery, and consequently, had lower range of motion and worse strength at final follow-up.

METHODS

PATIENT COHORT

The institutional review board approved this study. Current Procedural Terminology (CPT) code 29827 was queried to identify patients who had undergone arthroscopic rotator cuff repair between 1/1/19-3/17/19 and 1/1/20-3/17/20. These procedures were performed at a single tertiary care medical center by four fellowship-trained orthopedic surgeons. All rotator cuff repairs were performed using a double row technique.

DATA COLLECTION

Patients' medical records were reviewed for demographic, range of motion, strength testing, and physical therapy data. Range of motion included preoperative and postoperative forward elevation, external rotation, and internal rotation. Strength testing was investigated for each rotator cuff muscle. Physical therapy (PT) data was evaluated both preoperatively and postoperatively. Charts were reviewed to see if patients had undergone PT before surgery,

Patient operative reports were reviewed to document the specific rotator cuff muscle affected, type of rotator cuff repair performed, and to confirm a rotator cuff repair was performed. Patients who were originally coded for a rotator cuff repair but were deemed to have an intact rotator cuff were excluded from the study.

In addition to reviewing medical records, all patients who received surgery in 2020 were contacted by phone in October 2022. Patients were surveyed about their VAS pain score, SANE score, and whether the COVID-19 pandemic led to unanticipated delays in their postoperative physical therapy, and whether it adversely affected their recovery. The decision to use the SANE score was made based on its previously reported inter-rater reliability with the ASES and WORC scores (Wickman et al. 2020).

STATISTICAL ANALYSIS

Data were compared between 2019 and 2020 cohorts. Descriptive and comparative statistics for patient demographics as well as preoperative, perioperative, and postoperative data were analyzed for all patients. Univariate analysis of categorical data was performed using a Chi-square test or Fisher's Exact test when appropriate. Continuous data was analyzed using a 2-sample t-test or a Mann Whitney U test dependent on normality of sample. Normality was determined using a Kolmogorov-Smirnov test. To compare variance between the two groups, an F-test for equality of variance was used.

RESULTS

PATIENT DEMOGRAPHIC DATA

There were 101 patients included in the study who had a minimum of 1 year follow-up. All patients had received a double row arthroscopic RCR. There was no significance difference in follow-up between the groups: (2020: 1.0 ± 0.59 years; 2019: 1.10 ± 0.73 years; p-value = 0.38). 51 patients in 2020 and 50 patients in 2019 underwent arthroscopic rotator cuff repair between 1/1-3/17 of each respective year. 48.0% of the 2020 cohort was male while 56.8% of the 2019 cohort was male (p-value=0.54). There was no significant difference in mean age at surgery (2020: 56.8 ± 8.6 years; 2019: 57.7 ± 10.3 years; p-value=0.79), ratio of traumatic to nontraumatic tears (2020: 43%; 2019: 54%; p-value=0.27). However, there was a significant decrease of time from onset of pain to surgery in the 2020 cohort (2020: 236 ± 225 days; 2019: 475 days ± 671 days; p-value=0.05) (Table 1). There was a similar distribution of surgeries performed by the four surgeons in 2019 and 2020. In 2019, surgeon one performed 15 surgeries, surgeon two performed 14 surgeries, surgeon three performed 11 surgeries, and surgeon four performed 10 surgeries. In 2020, surgeon one performed 16 surgeries, surgeon two performed 14 surgeries, surgeon three performed 11 surgeries, and surgeon four performed 10 surgeries.

68.0% of patients in 2020 received surgery on their right shoulder while 69.7% did so in 2019 (p-value=0.97). 9 patients (18.0%) in 2020 had a history of prior shoulder surgery on the affected shoulder while only 3 (5.9%) patients in 2019 had prior shoulder surgery (p-value=0.08). 82.0% of patients had a full thickness supraspinatus tendon tear in 2020 while 82.3% reported the same finding in 2019 (p-value=0.98).

CLINICAL CHARACTERISTICS

Patients in 2019 had significant changes in range of motion following arthroscopic RCR. Forward elevation improved from 135° ± 43° to 161° ± 16° (p-value<0.01), while external rotation increased from 54° ± 17 to 56° ± 12° (p-value=0.40) and internal rotation improved significantly from L4 to L1 (p-value<0.01). Patients experienced significant improvements in strength for forward elevation (4+/5 to 5/5; p-value<0.01), external rotation (5-/5 to 5/5; p-value<0.01)

Table 1. Comparison of Patient Demographic Information

Cohort	2019 (n=51)	2020 (n=50)	p-value
Age (years)	56.8 ± 8.6	57.7 ± 10.3	0.79
Follow-Up (years)	1.10 ± 0.73	1.0 ± 0.59	0.38
% Male	56.8%	48.0%	0.54
% Traumatic RC tears	54%	43%	0.27
Time from Onset of Pain to RCR (days)	475 ± 671	236 ± 225	**0.05**

All significant p-values (p<0.05) are bolded.

Table 2. Comparison of Postoperative Clinical Outcomes

Cohort	2019 (n=51)	2020 (n=50)	p-value
Forward Elevation (°)	161° ± 16°	151° ± 29°	0.05
External Rotation (°)	56° ± 12°	48° ± 18°	0.01
Internal Rotation	L1	L2	0.38
Strength – Forward Elevation	5/5	5/5	0.21
Strength – External Rotation	5/5	5/5	0.20
Strength – Internal Rotation	5/5	5/5	0.09

All significant p-values (p<0.05) are bolded.

and internal rotation (5-/5 to 5/5; p-value<0.01). The interval from date of MRI to date of surgery was 116.0 ± 181.7 days. The mean time from date of surgery to date of first postoperative visit was 15.4 ± 8.3 days.

Patients in 2020 did not have significant improvements in range of motion. Forward elevation improved 146° ± 37° to 151° ± 29° (p-value=0.42), while external rotation decreased (51° ± 16° to 48° ± 18°; p-value=0.44) and internal rotation (L3 to L2; p-value=0.29) did not improve significantly following surgery. Patients experience significant improvements in strength for forward elevation (4+/5 to 5/5; p-value<0.01), external rotation (5-/5 to 5/5; p-value<0.01) and internal rotation (5-/5 to 5/5; p-value<0.01). The interval from date of MRI to date of surgery was 57.7 ± 72.1 days. The mean time from date of surgery to date of first postoperative visit was 13.7 ± 9.8 days.

There were significant differences in postoperative forward elevation and external rotation between the two cohorts, while there was no significant difference in internal rotation and strength (Table 2).

Patients in 2020 experienced a significant delay in starting physical therapy after RCR (2019: 28.5 ± 11.9 days; 2020: 35.0 ± 16.5 days; p-value=0.03). Patients in 2019 completed more physical therapy sessions (2019: 25.0; 2020: 16.7; p<0.01). Patients in 2020 also terminated physical therapy more quickly (2019: 139.2 days; 2020: 128.7 days; p-value=0.62).

PATIENT REPORTED OUTCOMES AND COVID-RELATED DELAYS

8% (4/50) patients did not initiate physical therapy after RCR. 16% (8/50) of patients reported a delay in physical therapy while 44% (22/50) reported that the COVID-19 pandemic affected their recovery following RCR. By phone in October 2022, patients reported a SANE score of 78.2 ± 12.1 on the affected shoulder, 91.3 ± 10.4 on the unaffected shoulder, a mean VAS pain score of 2.3 ± 1.8.

COMPLICATIONS AND REVISIONS

There were zero complications in the 2019 cohort, and two surgically revised complications in the 2020 cohort (p-value=0.11). One patient had a broken anchor and underwent revision RCR 6.5 months after the index procedure. One patient re-tore his rotator cuff 1.7 years after the initial surgery, and underwent a revision rotator cuff repair.

DISCUSSION

Postoperative management and expected outcomes following rotator cuff repair have been well-documented previously (Thigpen et al. 2016; Keener et al. 2014; Sheps et al. 2019). Patients who follow the standard of care protocol for their respective cuff tear size can have predictable outcomes after RCR. This often involves a combination of immobilization followed by physical therapy. In 2020, the standard of care protocol following RCR was interrupted for many patients due to the COVID-19 pandemic. Due to a shift in focus on emergent care, physical therapy became much less accessible for many patients. Previous studies reporting on this have suggested that the delays in care did not lead to significant differences in range of motion or patient-reported outcomes (Wang et al. 2022; Smith et al. 2022). We sought to investigate delays or interruptions in physical therapy that led to adverse outcomes at our tertiary care medical center.

Many patients were unable to complete physical therapy due to suspension of elective care on March 17th, 2020

(Commins 2020). Wang et al. reported that 90.4% of patients in 2020 and 98.5% of 2019 patients underwent physical therapy after an arthroscopic RCR (Wang et al. 2022). While the trend did not approach significance, it is still noteworthy that approximately 10% of patients did not pursue the standard of care protocol following an arthroscopic RCR. Despite this difference, Wang et al. did not report a significant difference in the incidence of complications, unplanned readmissions, or revisions between their 2020 and 2019 cohorts (Wang et al. 2022). Similarly to Wang et. al, 8% of our patients did not initiate physical therapy after rotator cuff repair. In our study, patients in 2020 had significant delays in initiating physical therapy after surgery (2019: 28.5 ± 11.9 days; 2020: 35.0 ± 16.5 days; p-value=0.03). Additionally, patients in 2020 completed less physical therapy sessions overall (2019: 25.0; 2020: 16.7; p<0.01). Despite the delay and decreased physical therapy, our patients in 2020 had comparable range of motion and strength to historical controls.

Previous studies have documented the importance of physical therapy in restoration of strength and range of motion following rotator cuff repair (Colvin et al. 2012; Thigpen et al. 2016; Vo et al. 2013; Stillson et al. 2022). Despite significant differences in usage of physical therapy between the 2019 and 2020 cohorts, both groups had mean postoperative strength of 5/5 for forward elevation, external rotation, and internal rotation. However, the 2020 patients also did not report a significant improvement in range of motion; 5º improvement in forward elevation, 3º decrease in external rotation, and one vertebral level improvement in internal rotation. However, we suspect this may be due to a high ceiling effect in our 2020 cohort. The 2020 patients reported a mean preoperative forward elevation of 146º while it was 135º in the 2019 group. Thus, there was limited opportunity for significant improvement because of the higher baseline forward elevation in our 2020 cohort. Additionally, the average patient had full strength in forward elevation, external rotation, and internal rotation at final follow-up. Despite the challenges associated with COVID-19, our patients still had excellent postoperative range of motion and strength.

In this study, we also investigated patient perceptions of COVID-19 related delays in postoperative care. We found that 8% of patients did not do any physical therapy, 16% were delayed in starting PT, and 44% of patients felt the pandemic affected their recovery after RCR. Quantitatively, this corresponded with a 78.2 ± 12.1 SANE score on the affected shoulder. In a previous study, Cvetanovich et al. reported the patient acceptable symptomatic state SANE score following rotator cuff repair was 82.5 at 1 year follow-up (Cvetanovich et al. 2019). This suggests that our patients were almost at the previously established guideline for an acceptable symptomatic state SANE score. Despite 44% of patients reporting a subjective delay in postoperative care, the cohort still achieved satisfactory outcomes when contacted by phone 2.5 years later. While patients in the 2020 cohort did not have as many in-person physical therapy sessions as those in the 2019 cohort, these patients were all given a comprehensive home exercise program to follow postoperatively which may have resulted in patients achieving comparable outcomes. A randomized control study by Okoro et al demonstrated no difference between a traditional physical therapy regimen compared to a home-based physical therapy regimen following hip surgery over a two-year time period (Okoro et al. 2016). A study by Mannion et al. further reinforces the idea that home based physical therapy can yield similar results to formalized physical therapy (Mannion et al. 2007). Their study saw no differences in post-operative outcomes between randomized cohorts undergoing supervised physical therapy and those who had a home-based program. Overall, while there may have been a subjective delay and fewer in person physical therapy sessions for the 2020 cohort, patients undergoing home based physical therapy after RCR.

There are several limitations to consider with this study. The retrospective nature of the project created a bias in patient selection. Additionally, the sample sizes were small, and thus, many of the differences in results did not approach statistical significance. The main hypothesis of this study would benefit from being conducted in a multi-center study. Additionally, a randomized controlled trial evaluating the effectiveness of home physical therapy compared to traditional physical therapy should be performed before any definitive conclusions regarding postoperative rehabilitation protocols are made. Future studies could evaluate the impact of physical therapy in patients who had a traumatic tear compared to non-traumatic tears.

CONCLUSION

The COVID-19 pandemic led to unanticipated changes in patients' postoperative management of rotator cuff repair. 44% of patients reported the pandemic affected their recovery, but patients still had satisfactory outcomes. Our patients performed less physical therapy sessions over a longer period of time, but still had comparable postoperative strength, range of motion, and SANE scores when compared to historical controls. This suggests that patients who have decreased physical therapy usage rates may still go on to do well after arthroscopic rotator cuff repair.

AUTHOR CONTRIBUTION

AVP, AS, VM, and RCR designed the study. AVP, AS, AII, NT and VM performed the chart review and compiled data. AVP, AII, NT drafted the manuscript. AS, VM, GC, GJ, JYB, and RCR provided important revisions of intellectual content. RCR served as corresponding author. All authors are responsible for the accuracy of the manuscript.

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