

# Impact of COVID-19 on the Reported Case Volume of Orthopaedic Sports Medicine Fellows in the United States

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*Investigation was performed at Howard University Hospital, Washington DC, USA*

**Background:** The impact of the coronavirus 2019 (COVID-19) pandemic on reported case volume during orthopaedic sports medicine fellowship training remains poorly understood from a national perspective.

**Hypothesis:** It was hypothesized that reported case volume during orthopaedic sports medicine fellowship training would decrease during the 2019-2020 academic year, which corresponded to the COVID-19 outbreak. It was also hypothesized that there would be a subsequent rebound in case volume during the 2020-2021 academic year.

**Study Design:** Cohort study.

**Methods:** Reported mean case volumes were extracted for 4 academic years (2017-2018, 2018-2019, 2019-2020, and 2020-2021), and year-over-year percentage changes were calculated. Parametric tests were used for interyear comparisons.

**Results:** There was a 7% decrease in mean  $\pm$  SD case volume between the 2018-2019 and 2019-2020 academic years ( $339 \pm 123$  vs  $316 \pm 108$ ;  $P = .042$ ). Case categories with the greatest percentage declines were foot and ankle ( $-20\%$ ), knee instability ( $-11\%$ ), meniscus ( $-8\%$ ), and glenohumeral instability ( $-7\%$ ). There was a 13% year-over-year increase in case volume between the 2019-2020 and 2020-2021 academic years ( $316 \pm 108$  vs  $357 \pm 117$ ;  $P < .001$ ).

**Conclusion:** There was a slight decrease in total orthopaedic sports medicine case volume during the 2019-2020 academic year, corresponding to widespread lockdowns during the COVID-19 outbreak. Certain case categories experienced the greatest negative impact. Results from this study may inform accrediting bodies and surgical educators on the impact of future disruptions to health care delivery.

**Keywords:** sports; medicine; surgery; fellowship; COVID-19

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The first documented cases of viral pneumonia caused by the SARS-CoV-2 were reported in Wuhan, China, in December 2019.<sup>1,2</sup> This viral illness was subsequently called COVID-19. By March 2020, the World Health Organization declared COVID-19 a global pandemic, and surgical societies such as the American College of Surgeons recommended the cessation of nonessential surgical procedures in accordance with government guidelines.<sup>18,23</sup> In an unprecedented fashion, COVID-19 created significant strains on health care delivery and surgical education.<sup>5,7,19</sup>

The impact of COVID-19 on orthopaedic surgery education manifested in 2 primary ways. Starting first in major metropolitan areas and then cascading to cities throughout the United States, orthopaedic surgery residents and fellows were repurposed to provide health care coverage for patients with COVID-19.<sup>25</sup> Second, nonessential surgical cases were largely discontinued between March and June 2020 owing to federal, state, and local government mandates.<sup>14</sup> The disruption to nonessential surgery was exacerbated by patient fears of contracting COVID-19 in the health care setting.<sup>24,28</sup>

Anecdotally, these shutdowns resulted in several changes in orthopaedic surgery education, including the adoption of virtual platforms for didactics, grand rounds, and academic conferences.<sup>3,9,31</sup> Previous studies of COVID-19 in orthopaedic sports medicine training have been limited to qualitative insights from surveys and single-institution reports.<sup>11,22,29,32</sup> Collectively, these studies generated concerns on the adequate exposure to cases during fellowship training owing to COVID-19. Given the ongoing nature of COVID-19 and its variants, it is important to understand the impact of widespread lockdowns on orthopaedic sports medicine fellowship training for future generations of trainees. Currently, however, objective data are lacking on the national impact of COVID-19 on orthopaedic sports medicine fellowship training.

We hypothesized that orthopaedic sports medicine fellows would report fewer cases during the 2019-2020 academic year resulting from the initial outbreak of COVID-19. Furthermore, we hypothesized there would be a rebound in cases during the 2020-2021 academic year. We provide national data on the impact of widespread lockdowns in response to the COVID-19 outbreak to inform the orthopaedic sports medicine community on the potential impact of future national emergencies such as viral pandemic outbreaks.

## METHODS

This was a retrospective cohort study of orthopaedic sports medicine fellows from 4 academic years (2017-2018, 2018-2019, 2019-2020, and 2020-2021). The Accreditation Council for Graduate Medical Education (ACGME) provided national case logs for orthopaedic sports medicine fellows who completed accredited fellowship training during the 4 academic years. An academic year was defined as August 1 of the preceding year to July 31 of the subsequent year. The COVID-19 outbreak occurred in March 2020, which corresponded to the last 4.5 months of fellowship training for the 2019-2020 academic year. Thus, the graduating class of 2019-2020 was the primary cohort of interest. This study received formal review exemption from our institutional review board.

ACGME case logs summarize the total surgical experience performed during fellowship training. Case volumes are self-reported by Current Procedural Terminology code and then summarized into ACGME-defined case categories (see Supplemental Table S1, available online). ACGME case logs are audited by faculty and the ACGME during the accreditation process. During the study period, virtually all orthopaedic sports medicine fellowship training programs were ACGME accredited.<sup>6</sup>

During the 2017-2018 academic year, case categories were refined from generic ones used for orthopaedic residency (ie, anatomy based) to specific ones for orthopaedic sports medicine training (ie, case based). As such, temporal analyses were limited from 2017-2018 to 2020-2021 to facilitate interyear comparisons. The independent variable was academic year, and the dependent variable was reported average case volume per fellow.

Case volume data were analyzed using D'Agostino-Pearson omnibus normality tests and are presented as

TABLE 1  
Number of Programs and Fellows in ACGME-Accredited Orthopaedic Sports Medicine Fellowship Training, 2017-2021 (N = 841 Fellows)<sup>a</sup>

Academic Year	Orthopaedic Sports Medicine Fellowships	
	No. of Programs	No. of Fellows
2017-2018	85	204
2018-2019	81	206
2019-2020 <sup>b</sup>	85	216
2020-2021	87	215

<sup>a</sup>ACGME, Accreditation Council for Graduate Medical Education.

<sup>b</sup>Affected by the COVID-19 outbreak.

means and standard deviations. Parametric tests were utilized to compare case volumes between years. Year-over-year percentage changes were calculated to understand differences in case volumes over the study period. All statistical tests were 2-tailed, and alpha was set at .05. GraphPad Prism 6 software was used for all statistical calculations.

## RESULTS

Overall, 841 orthopaedic sports medicine fellows from the 4 academic years were included in this study; the 216 fellows from the 2019-2020 academic year composed 26% of the total (Table 1). The annual number of fellows increased from 204 to 215 (5%) over the study period.

There was a 7% decrease in case volume between the 2018-2019 and 2019-2020 academic years ( $339 \pm 123$  vs  $316 \pm 108$ ;  $P = .042$ ); this decrease corresponded to the widespread lockdowns instituted during the COVID-19 outbreak (Figure 1). In addition, case volume was significantly higher in 2020-2021 versus 2019-2020 ( $357 \pm 117$  vs  $316 \pm 108$ ;  $P < .001$ ). Case volume in 2020-2021 was not significantly different from that of 2018-2019 (pre-pandemic) ( $357 \pm 117$  vs  $339 \pm 123$ ;  $P = .125$ ).

Case categories with the largest percentage decreases between 2018-2019 and 2019-2020 were foot and ankle ( $-20\%$ ;  $P = .115$ ), knee instability ( $-11\%$ ;  $P = .008$ ), meniscus ( $-8\%$ ;  $P = .077$ ), glenohumeral instability ( $-7\%$ ;  $P = .144$ ), knee articular cartilage ( $-6\%$ ;  $P = .430$ ), and rotator cuff ( $-5\%$ ;  $P = .324$ ). Hip arthroscopy increased by 9% ( $P = .642$ ) (Table 2). During the 2020-2021 academic year, there were significant year-over-year percentage increases in many case categories. Those with the greatest percentage increases were elbow instability (67%;  $P < .001$ ), acromioclavicular instability (50%;  $P < .001$ ), foot and ankle (25%;  $P = .112$ ), and knee articular cartilage (24%;  $P = .002$ ).

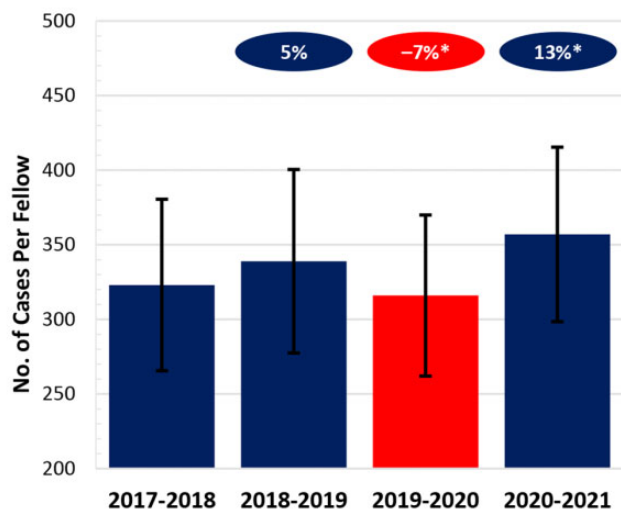
## DISCUSSION

Given the relationship between case volume and surgical outcomes,<sup>30</sup> case volume is a critical metric for orthopaedic

sports medicine fellows who try to maximize exposure to surgical cases during fellowship training. COVID-19 offered unprecedented challenges regarding operative training of orthopaedic surgeons.<sup>26,27</sup> Results from this study demonstrated a significant impact on orthopaedic sports medicine fellowship training, as case volume dropped by 7% during the 2019-2020 academic year. Observed decreases were smallest for low-volume case categories, such as acromioclavicular instability, which may be more volatile from a percentage change basis, but they also

existed for higher-volume case categories, such as meniscus and rotator cuff. Yet, given its retrospective nature, this study could not definitively determine whether decreases in surgical volume were solely attributable to the COVID-19 pandemic. Case volume increased by 13% during the subsequent year, which reinforced the observed impact of COVID-19 on case volume. Overall, there may be a trend toward greater reporting of cases during orthopaedic sports medicine fellowship training. Importantly, this study did not demonstrate clinical significance of fewer cases on surgical competency. However, given the importance of case volume on the fellowship experience, this study may help inform accrediting bodies and faculty on future national emergencies.

The COVID-19 outbreak most affected densely populated metropolitan areas. In New York City, orthopaedic residents and fellows were largely repurposed to the emergency department and intensive care unit to care for patients with COVID-19.<sup>25</sup> However, in less densely populated areas, disruptions to health care delivery were mixed, with certain areas experiencing more acute changes because of access to fewer resources.<sup>23</sup> Thus, emergency lockdowns ranged from several weeks to several months depending on state and local governments monitoring the local prevalence of COVID-19 cases. In general, though, the discontinuation of nonessential services lasted on average 2 months in the United States, with disruptions in consumer health care behavior lasting until at least the end of 2020.<sup>5,14,15</sup> Furthermore, the delta variant of COVID-19 during the winter of 2020-2021 resulted primarily in disruptions to the delivery of inpatient care.<sup>5,20,24,31</sup> Orthopaedic sports medicine cases are typically performed in the outpatient setting, which may have preserved the number of cases in sports medicine relative to other orthopaedic specialties, such as total joint arthroplasty. We believe that the 7% decrease in



**Figure 1.** Mean number of cases per fellow during orthopaedic sports medicine training, 2017-2021. Error bars, SD; bubbles, percentage increase/decrease in reported case volume vs previous year. \* $P < .05$  vs previous year (Student  $t$  test).

**TABLE 2**  
Number of Cases Reported During Orthopaedic Sports Medicine Fellowship Training, 2017-2021<sup>a</sup>

Case Category	Reported Cases, Mean ± SD				Change, %		P Value	
	2017-2018	2018-2019	2019-2020	2020-2021	2018-2019 vs 2019-2020	2019-2020 vs 2020-2021	2018-2019 vs 2019-2020	2019-2020 vs 2020-2021
Glenohumeral instability	29 ± 14	29 ± 15	27 ± 13	30 ± 13	-7	11	.144	<b>.017</b>
Rotator cuff	93 ± 52	99 ± 54	94 ± 50	105 ± 55	-5	12	.324	<b>.031</b>
Acromioclavicular instability	2 ± 2	2 ± 2	2 ± 2	3 ± 2	0	50	>.999	<b>&lt;.001</b>
Elbow arthroscopy	3 ± 4	3 ± 4	3 ± 3	3 ± 4	0	0	>.999	>.999
Elbow instability	4 ± 7	3 ± 6	3 ± 5	5 ± 7	0	67	>.999	<b>&lt;.001</b>
Hip arthroscopy	14 ± 24	11 ± 24	12 ± 20	14 ± 25	9	17	.642	.360
Knee instability	66 ± 32	70 ± 33	62 ± 29	67 ± 27	-11	8	<b>.008</b>	.065
Knee multiligament repair and reconstruction	1 ± 2	1 ± 2	1 ± 3	1 ± 3	0	0	>.999	>.999
Knee osteotomy	2 ± 2	2 ± 2	2 ± 3	2 ± 4	0	0	>.999	>.999
Patellofemoral instability	7 ± 7	7 ± 8	7 ± 9	7 ± 9	0	0	>.999	>.999
Knee articular cartilage	19 ± 15	18 ± 13	17 ± 13	21 ± 14	-6	24	.430	<b>.002</b>
Meniscus	80 ± 36	89 ± 44	82 ± 37	94 ± 40	-8	15	.077	<b>.001</b>
Foot and ankle	4 ± 6	5 ± 7	4 ± 6	5 ± 7	-20	25	.115	.112
Total key procedures	323 ± 115	339 ± 123	316 ± 108	357 ± 117	-7	13	<b>.042</b>	<b>&lt;.001</b>

<sup>a</sup>Bold  $P$  values indicate statistically significant difference between the academic years compared ( $P < .05$ , Student  $t$  test).

surgical volume is explained in part by the geographic heterogeneity of orthopaedic sports medicine fellowships, which are distributed throughout the United States. Unfortunately, given the limitations in the underlying data, we could not perform additional analyses by individual fellowship training program characteristics, such as geographic location.

Several paradigm shifts occurred in orthopaedic surgery education because of the social distancing requirements during the COVID-19 pandemic. The adoption of virtual platforms for telemedicine visits<sup>15,17</sup> and academic conferences in orthopaedic surgery is well described.<sup>3,9,16</sup> In some respects, the expansion of technology in orthopaedic sports medicine training provided necessary efficiencies in the era of increasing work-hour restrictions. For example, attendance of virtual academic meetings and fellowship interviews enabled efficiencies in travel time and related costs.<sup>3,9,16</sup> While a few years away from true “prime time,” virtual simulators may help bridge perceived deficiencies in orthopaedic sports medicine training. Results from this study suggest that ankle and knee arthroscopy simulators may be the most useful. Future viral pandemic outbreaks will be easier to navigate as systems for remote communication and virtual training are widely adopted.

The completion of accredited fellowship training and subspecialty certification in orthopaedic sports medicine has become a prerequisite for credentialing privileges in many health care systems.<sup>6</sup> Increasingly, regulatory and accrediting bodies are pledging to eliminate low-volume centers.<sup>30</sup> More research is needed to understand case minimum requirements needed to achieve clinical competency during orthopaedic sports medicine training. Specifically, building off of surgical learning curves required to perform common procedures in sports medicine,<sup>8,10,12,13</sup> fellowship milestones and case minimum requirements can be designed to enable competency-based training. Importantly, this study was focused on surgical training and did not assess the impact of COVID-19 on other required competency domains, such as the acquisition of medical knowledge and scholarly productivity. COVID-19 affected all areas of orthopaedic fellowship training, including didactics, journal clubs, cadaver laboratories, and academic conferences,<sup>31,32</sup> which were not captured in this study. It would be interesting to see whether certification and board examination passage rates in orthopaedic surgery were influenced by COVID-19. Anecdotally, COVID-19 changed the distribution of available sports medicine cases owing to interruptions in organized sporting activities and redeployment of sports medicine fellows to trauma services at the height of the pandemic.<sup>20,22,25,29,32</sup> Thus, while sports medicine fellows may have performed fewer meniscal procedures in 2019-2020, the potential increase in trauma cases may have helped maintain surgical skills during fellowship.

### Limitations

There were some limitations to this study, which stemmed primarily from its data source. First, ACGME case logs are summarized by academic year, which do not allow for more

granular time-based or geographic insights. Furthermore, insights into specific procedures, such as total shoulder arthroplasty and femoroacetabular impingement surgery, were not possible and limited to ACGME-defined case categories. These common case categories were selected to have broad relevance across all 87 orthopaedic sports medicine fellowship programs in the United States. Second, all case volume data are self-reported and thus vulnerable to inaccurate reporting.<sup>4,21</sup> However, case logs are instrumental to fellowship accreditation and job placement, which places high scrutiny on these data. Third, the number of ACGME-accredited fellowship programs remains largely stable, but small changes do occur from year to year. In our sample, this amounted to a 4-program difference between the 2018-2019 and 2019-2020 academic years. Fourth, while case volume has been correlated with surgical outcomes, the clinical impact of fewer cases during orthopaedic sports medicine fellowship training remains unknown. Future studies are needed to quantify this impact, which is especially relevant in the era of competency-based training. Last, case volume was the only outcome measured in this study, but future studies should assess other fellowship training outcomes, such as publication productivity.

### CONCLUSION

COVID-19 had a negative impact on reported case volumes for orthopaedic sports medicine fellows. Certain case categories, including meniscus, experienced the greatest declines, but the clinical significance of these changes remains unknown. Surgical educators and sports medicine fellows can anticipate which case categories will need the most support through virtual reality and other methods to bridge potential deficiencies in case volume. More research is needed to define the relationship between case volume and competency in orthopaedic sports medicine fellowship training.

Supplemental Material for this article is available at <https://journals.sagepub.com/doi/full/10.1177/10.1177/23259671221149061#supplementary-materials>

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