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Effect of the COVID-19 Pandemic on Otolaryngology Trainee Surgical Case Numbers: A Multi-institutional Review

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Abstract

Objective. To determine the effect of the initiation of COVID-19–related restrictions on the volume of surgical cases performed by otolaryngology trainees.

Study Design. Multi-institutional retrospective analysis of resident surgical case logs.

Setting. Accredited residency training programs in otolaryngology head and neck surgery.

Methods. Resident surgical case logs were combined from 6 residency training programs from different regions of the United States. Case volumes were compared between the calendar year before March 1, 2020, and the year afterward. Subgroup analyses were performed for the type of hospital (university, pediatric, veteran, county) and the key index cases by subspecialty.

Results. All 6 participating residency programs had a decrease in resident operative case volume. Surgical volume decreased from a mean of 6014 to 4161 ($P < .05$). There were decreases observed in key index cases in every subspecialty ($P < .01$), without statistical differences seen among subspecialties. There were decreases observed in every hospital type (university, pediatric, veteran, county) without statistical differences among types. Postgraduate year 5 residents were the most affected by volume reductions (51.6%), and postgraduate year 3 residents were the least affected (1.4%).

Conclusion. In the year following initiation of COVID-19–related restrictions, there was a significant decrease in trainee surgical case volumes within residencies for otolaryngology–head and neck surgery. There were no statistical differences in the volume decreases seen at different institutions, among hospital types, or within various subspecialties.

Keywords

COVID-19, residency, medical education, surgical education

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The emergence of the 2019 novel coronavirus disease (COVID-19) has caused unprecedented disruptions to health care delivery. The first case of COVID-19 in the United States was reported in Seattle, Washington, on January 20, 2020, followed by the first mortality on February 26, 2020.¹ The World Health Organization deemed COVID-19 a global pandemic on March 11, 2020. At the time of writing, there have been >37.5 million cases and >625,000 deaths from COVID-19 in the United States.²

Following the World Health Organization's declaration of a global pandemic, health authorities and hospital systems began implementing aggressive steps to mitigate the spread of COVID-19 and prepare hospitals for an influx of critically ill patients. These preparations included a recommendation by the American Academy of Otolaryngology–Head and Neck Surgery to delay all nonemergent operations and to postpone all nonessential face-to-face clinic encounters.³ Many institutions

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Table 1. Otolaryngology–Head and Neck Surgery Residency Characteristics.

Institution	No. of residents: academic year ^a		Region	State/district	COVID-19 cases per capita ^b
	2019-2020	2020-2021			
Harvard University	25	25	Northeast	Massachusetts	8431.6
Georgetown University	14	14	Mid-Atlantic	District of Columbia	5752.5
University of California San Francisco	19	20	Pacific Coast	California	9237.0
University of Colorado	17	18	Mountain West	Colorado	7422.8
University of Kansas	20	20	Midwest	Kansas	10,080.0
Louisiana State University	18	19	Southeast	Louisiana	9219.4

^aResidents on dedicated research years are excluded.

^bCumulative number of confirmed COVID-19 cases per 100,000 people in the state/district on February 28, 2021. Cumulative cases per capita for the entire United States at this time was 8667.2.

moved to limited operating room models and reduced the number of trainees allowed to participate in surgical cases. This even resulted in restricted head and neck cancer services, including the temporary cessation of free-flap surgery at some institutions.⁴

Surgical educators were faced with the challenge of adapting to these precautions and resultant disruptions to training. Still, the true effects on resident education are poorly understood, specifically whether training for competency can be maintained despite loss of experiential volume. Some preliminary studies have examined other surgical specialties that demonstrated significant reductions in resident surgical case volumes. These studies reported reductions in case volume of 49% to 80% following the implementation of COVID-19 precautions. However, these data were primarily limited to the months immediately following the declaration of a global pandemic and did not report on subsequent months of recovery or additional periods of precautions during later surges in infections.⁵⁻⁹

The field of otolaryngology–head and neck surgery (OHNS) faces a uniquely high risk of COVID-19 transmission, given the frequency of aerosolized procedures in routine clinical examinations and surgical intervention.³ There has yet to be a study evaluating the long-term effects of COVID-19 restrictions on OHNS resident surgical case volume. Herein, we present a multi-institutional analysis comparing the resident case numbers before the pandemic with the year following implementation of COVID-19 precautions.

Method

Resident surgical case data were examined from OHNS residency programs at 6 participating institutions: Harvard University, Georgetown University, Louisiana State University, University of California San Francisco, University of Colorado, and University of Kansas. Characteristics of the residency programs are presented in **Table 1**.

Case volume data from 2019 to 2021 were obtained from the ACGME resident case logs (Accreditation Council for Graduate Medical Education) provided by the program director from each institution. For active residents, case-detailed ACGME reports were analyzed from the pre- and postpandemic periods. For graduated residents, archived ACGME

reports were analyzed for the pre- and postpandemic periods. For each case log, surgery type and training site were identified. In all but 1 institution's data, the postgraduate year (PGY) level was also identified for each case log.

Key index procedures (KIPs) are defined by the ACGME Otolaryngology–Head and Neck Surgery Review Committee as the “required minimum number of key indicator procedures for graduating residents.”¹⁰ KIPs serve as a proxy for overall resident surgical experience within surgical programs. Within OHNS, KIPs are grouped within 4 subspecialty areas. Within the head and neck subspecialty area, cases include parotidectomy, neck dissection, oral cavity resection, and thyroidectomy or parathyroidectomy. KIPs within the subspecialty of otology and audiology include tympanoplasty, mastoidectomy, and stapedectomy or ossiculoplasty. KIPs within the subspecialty of facial plastics and reconstructive surgery include rhinoplasty, mandible/midface fractures, and flaps and grafts. KIPs within the general and pediatric subspecialty include congenital neck mass removal and bronchoscopy. Of note, airway cases (pediatric and adult) and ethmoidectomy were not included as key index cases for the purposes of this study, because they were not explicitly coded for in the archived case data obtained for graduated residents. This precluded an accurate comparison between the pre- and post-COVID-19 periods for these cases.

Data were collected from 1 year following the beginning of pandemic-related restrictions within US medical centers. This period was defined as March 1, 2020, to February 28, 2021. A comparison prepandemic data set was collected from the 1 year prior (March 1, 2019, to February 28, 2020).

Epidemiologic data for COVID-19 cases were obtained from the Centers for Disease Control and Prevention's publicly available data.¹¹ The cumulative number of cases per capita on February 28, 2021, was obtained for each state containing a residency in the study and for the United States as a whole. Data included no personal health information and had been deidentified before collection. All study methods were performed with the approval of the Colorado Multiple Institutional Review Board.

Data distribution was evaluated via the Shapiro-Wilk normality test. Normally distributed data were analyzed with a

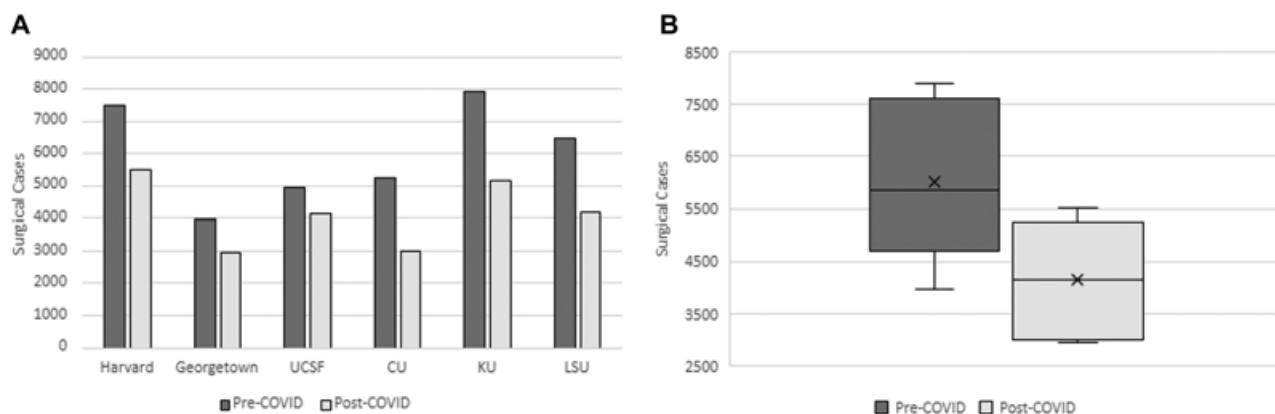


Figure 1. Surgical cases decreased for residents in otolaryngology the year following the initiation of COVID-19 restrictions at the 6 residency programs examined (**A**), from a mean of 6012 to 4159 ($P < .05$) (**B**). CU, University of Colorado; KU, University of Kansas; LSU, Louisiana State University; UCSF, University of California San Francisco. ×, mean; line, median; box, interquartile range; error bars, 95% CI.

Welch 2-sample *t* test. Nonparametric data were analyzed with a 2-sided Wilcoxon test. Multivariate analysis was performed through 2-way analysis of variance with corrections for multiple comparisons. All statistical analysis was done with R (version 4.1.0).

Results

Records from 61,053 resident surgical cases were included. In the year before COVID-19 restrictions, the 6 participating residency programs reported 36,085 surgical cases performed by residents. In the year following the initiation of COVID-19 regulations, the same programs reported 24,968 surgical cases. When evaluated together, programs had a decrease in total cases reported ($P < .01$; **Figure 1**). Comparison of before and after revealed a decrease from a mean of 6014 cases (SD, 1549) to 4161 cases (SD, 1061; $P = .039$). When residency programs were compared, there was not a statistically significant difference in the number of cases done before and after initiation of pandemic restrictions ($P = .24$). The decrease in case volume for the 6 programs was as follows: Harvard University, 27%; Georgetown University, 26%; Louisiana State University, 36%; University of California San Francisco, 16%; University of Colorado, 43%; and University of Kansas, 35%. This did not correlate with the density of COVID-19 cases in the areas as measured by the cumulative per capita cases in each state or district. The largest decrease in surgical volume was at the University of Colorado (43%) despite having lower COVID-19 cases per capita (7423) than the United States as a whole (8667). The smallest decrease in surgical volume was seen at the University of California San Francisco (16%), which had more COVID-19 cases per capita (9237) than the United States overall (8667).

Subgroup analysis of key index subspecialties demonstrated decreases in volumes in every subspecialty (**Table 2**). The KIPs with the most pronounced decrease in case volume were oral cavity resection (50.89%) and rhinoplasty (40.82%). The procedures with the smallest decrease in case volume were mandible/midface fractures (15.02%) and flaps

and grafts (17.83%). However, there were no statistically significant differences among the subspecialties.

Cases performed at different hospital types were also evaluated. An overall 57,156 (93.6%) case logs contained a specific hospital designation and could be classified as university, veteran, pediatric, or county type. The hospital types with the largest and smallest percentage decreases in cases were Veterans Affairs medical centers (43.43%) and pediatric hospitals (18.78%). Subgroup analysis did not demonstrate significant differences among the hospital types ($P = .12$; **Table 2**).

PGY level was available in 54,125 (88.7%) resident cases examined. Examination of trainee seniority demonstrated reductions in all PGY levels (**Table 3**). The largest decreases were seen in the PGY4 and PGY5 levels, with the reduction in cases per resident at 42.3% and 51.6%, respectively. The PGY3 level appeared the least affected, with a reduction of 1.4%.

Discussion

The COVID-19 pandemic caused unprecedented disruptions to health care delivery worldwide, and the effects on medical education are only starting to be understood. In this study of resident surgical cases, we sought to understand the impact of COVID-19 on the volume of surgery performed by trainees in otolaryngology. This multi-institutional study demonstrated that residents' number of surgical cases decreased significantly between the year preceding and after the initiation of widespread COVID-19 restrictions among all 6 institutions. There were no significant differences among training programs, hospital types, or KIP subspecialties. A lack of statistical significance, however, does not necessarily correlate with a lack of clinical significance. Our data suggest that a reduction in trainee surgical volume was likely widespread. Every program examined had a decrease in the total case volume. Half of these programs underwent a complement increase during the same time frame, meaning that more residents were performing the reduced case totals (the University of

Table 2. Subgroup Analyses: Key Index Procedures and Hospital Type.

	No. of Cases		Decrease, %
	Pre-COVID-19	Post-COVID-19	
Key index procedure			
Head and neck	4621	3121	32.46
Parotidectomy	784	492	37.24
Neck dissection	1638	1089	33.52
Oral cavity resection	560	275	50.89
Thyroid/parathyroid surgery	1639	1265	22.82
Otology and audiology	2335	1575	32.55
Tympanoplasty	907	581	35.94
Mastoidectomy	979	709	27.58
Stapedectomy/ossiculoplasty	449	285	36.53
Facial plastics and reconstructive surgery	4064	3166	22.10
Rhinoplasty	833	493	40.82
Mandible/midface fractures	646	549	15.02
Flaps and grafts	2585	2124	17.83
General and pediatrics	871	611	29.85
Airway (pediatric and adult) ^a	—	—	
Congenital neck masses	368	247	32.88
Ethmoidectomy ^a	—	—	
Bronchoscopy	503	364	27.63
Hospital type			
University	18,876	13,136	30.41
Pediatric	4868	3954	18.78
Veteran	2102	1189	43.43
County	2777	1781	35.87

^aAirway and ethmoidectomy procedures are excluded because they were not explicitly coded in the archived case logs obtained for graduated residents.

Table 3. Mean Resident Surgical Case Volume and Percentage Decrease by PGY Level.

	Per institution			Per resident ^a		
	Pre-COVID-19	Post-COVID-19	Decrease, %	Pre-COVID-19	Post-COVID-19	Decrease, %
PGY1	673.4	516	23.4	156.8	116.6	25.6
PGY2	1412	1169.2	17.2	354.5	272.6	23.1
PGY3	814.2	802.8	1.4	204.7	201.9	1.4
PGY4	1380.8	791.2	42.7	366.7	211.5	42.3
PGY5	2141.8	1086.2	49.3	566.8	274.3	51.6

Abbreviation: PGY, postgraduate year.

^aSome institutions were undergoing complement increases during the time studied. The mean number of active residents for each PGY level during the months of the pre- or post-COVID-19 period was used to calculate the "per resident" volumes.

California San Francisco, University of Colorado, and Louisiana State University all added a resident at the PGY2 or PGY3 level). The lack of significance among sites and specific KIPs suggests that the reduction of surgical case volume was consistent across otolaryngology training programs.

Given the variability in local COVID-19 prevalence, regulations, and hospital and university policies, it is likely that residency programs were faced with different interruptions and challenges as they were forced to adapt to the pandemic.

For example, in at least 1 training program, operative cases were diverted to outpatient surgical centers where residents are not assigned. This increased capacity for higher-acuity COVID-19-related patient care at the primary hospital sites but decreased the available cases for trainees. These types of modifications within programs will likely have continuing impacts on resident experience, especially as we see cases rise again with the delta and omicron variants. Of particular concern was the disproportionate affect that these types of

disruptions appeared to have on the more senior PGY levels. PGY4 and PGY5 residents had the largest decreases in case numbers. These reductions occurred during a pivotal portion of surgical training and likely worsened trainee anxiety regarding competency deficiencies. When programs evaluate whether a resident is ready to graduate and begin independent practice, case volumes can serve as only a proxy for competency. It seems intuitive that a decrease in surgical experience would lead to less competent residency graduates, but will programs be able to adjust education in other ways to account for this long-term problem? Further study is needed as the COVID-19 pandemic continues for longer than many anticipated at the onset.

There are several limitations to this study. The data collection and analysis were retrospective. The extended time frame (1 year for each period) was chosen to identify the long-term effects of the pandemic-related restrictions. Still, it limits the ability to examine how each viral surge, wave, or subsequent recovery affects surgical volumes within a program. Though volume reductions were seen throughout, we suspect that this was mitigated by program-specific interventions to increase resident exposure to surgical cases. One hospital-specific factor that may have influenced case volumes during the study period was the Care in the Community initiative for the Veterans Affairs sites. This initiative facilitates care outside the Veterans Affairs sites when availability is limited. Although this program was in place during the pre- and post-COVID-19 periods, it may have decreased available cases for residents, and the Veterans Affairs sites had the largest observed reductions in trainee case volumes. The effects of specific factors such as this initiative were not examined in the analysis. Another limitation was that only 6 residency programs were included in the study. However, each program is located in a different state/district. The cumulative COVID-19 cases in the focal states ranged from 5753 to 10,080 per 100,000 people (February 28, 2021). The cumulative number of cases per capita in the United States during the same time was 8667. Given that the 6 residency programs in this study represent different regions and that the range of COVID-19 cases per capita spans that of the entire United States, we feel that the data presented herein represent residency programs elsewhere within the United States.

Perhaps the most compelling aspect of these data is the consistency with which surgical volumes decreased. We observed a reduction in every residency program total, key index case, subspecialty, PGY level, and hospital type. The lack of statistical differences among subgroups further suggests that cuts in residency surgical experiences were widespread.

Conclusion

In the year following the initiation of COVID-19–related restrictions, there was a significant decrease in trainee surgical case volumes within residencies for OHNS. There were no significant differences in the volume decreases seen among hospital types and within subspecialties. The implications of these volume reductions on resident competencies are unknown, and further study is warranted.

Author Contributions

Scott Mann, project design, data collection, data analysis, data interpretation and manuscript preparation; **James Duffy**, project design, data collection, data analysis, data interpretation and manuscript preparation; **Tyler Muffly**, data analysis, data interpretation and manuscript preparation; **Keval Tilva**, data collection, data interpretation and manuscript preparation; **Stacey Gray**, data collection, data interpretation and manuscript preparation; **Laura Hetzler**, data collection, data interpretation and manuscript preparation; **Shannon Kraft**, data collection, data interpretation and manuscript preparation; **Sonya Malekzadeh**, data collection, data interpretation and manuscript preparation; **Steven Pletcher**, data collection, data interpretation and manuscript preparation; **Cristina Cabrera-Muffly**, project design, data collection, data interpretation and manuscript preparation


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