**Journal: Otolaryngology Head and Neck Surgery**

**Article Type: Original Research**

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**Title Page**

**Abstract (up to 250 words with the headings: Objective, Study Design, Setting, Methods, Results, and Conclusion.)**

**Introduction**

**Methods**

**Results**

**Discussion**

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**Title: 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 six 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's, county) and subspecialty of key index cases.

**Results:** All six participating residency programs had a decrease in resident operative case volume. Surgical volume decreased from a mean of 5,564 to 3,749 (p<0.01). There were decreases observed in key index cases in every subspecialty (p<0.01), without statistical differences seen between subspecialties. There were decreases observed in every hospital type (university, pediatric, veterans', county) without statistical differences.

**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 significant differences between the volume decreases seen at different hospital types, or within various subspecialties.

**Introduction:**

The emergence of the 2019 novel coronavirus disease (COVID-19) has caused unprecedented disruptions to healthcare 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, 20201. The World Health Organization deemed COVID-19 a global pandemic on March 11, 2020. At the time of writing, there have been close to 34 million cases and over 600,000 deaths from COVID-19 in the United States2.

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 (AAO-HNS) to delay all non-emergent operations and to postpone all nonessential face-to-face clinic encounters.(CITATION NEEDED) Many institutions moved to limited operating room models and reduced the number of trainees allowed to participate in surgical cases3. This even resulted in restricted head and neck cancer services, including the temporary cessation of free-flap surgeries at some institutions4.

Surgical educators throughout the field of otolaryngology-head and neck surgery 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. Some preliminary studies have examined other surgical specialties that demonstrated significant reductions in resident surgical case volumes. These studies reported 49-80% reductions in case volume following the implementation of COVID-19 precautions. However, these data are 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 infections6-9.

The specialty of otolaryngology head and neck surgery faces a uniquely high risk of COVID-19 transmission, given the frequency of aerosolized procedures in routine clinical examinations and surgical intervention3. There has yet to be a study evaluating the long-term effects of COVID-19 restrictions on otolaryngology head and neck surgery resident surgical case volume. Herein, we present a multi-institutional analysis comparing the resident case numbers before the pandemic, to the year following implementation of COVID-19 precautions.

**Methods:**

Resident surgical case data was examined from otolaryngology head and neck surgery residency programs at six participating institutions. These institutions included Harvard University, Georgetown University, Louisiana State University, University of California San Francisco, University of Colorado, and University of Kansas. Characteristics of the residency programs can be found in **Table 1**.

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Key index cases were defined per…

Key index cases for the specialty of Head and Neck included parotidectomy, neck dissection, oral cavity resection, thyroid or parathyroidectomy. Key index cases for the specialty of Otology and Audiology included tympanoplasty, mastoidectomy, and stapedectomy or ossiculoplasty. Key index cases for the specialty of Facial Plastics and Reconstructive Surgery included rhinoplasty, mandible or midface fractures, and flaps or grafts. Key index cases for the General and Pediatric subspecialties included congenital neck mass removal and bronchoscopy. Of note, airway cases (pediatric and adult) and ethmoidectomy were not included as key index cases because…

Data were collected from one year following the beginning of pandemic-related restrictions within United States medical centers. This period was defined as March 1, 2020, to February 28, 2021. A comparison pre-pandemic data set was also collected from the one 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.10 Cumulative number of cases per capita on February 28, 2021, were obtained for each state containing a residency included in the study and for the United States as a whole. No data included personal health information and had been de-identified before collection. All study methods were performed with the approval of the Colorado Multiple Institutional Review Board.

Data distribution was evaluated using the Shapiro-Wilk normality test. Normally distributed data were analyzed with Welch's two-sample t-test. Non-parametric data were analyzed with a two-sided Wilcox test. Multivariate analysis was performed using a two-way ANOVA test with corrections for multiple comparisons. All statistical analysis was done using R (version 4.1.0, www.r-project.org).

**Results:**

Records from a total of 61,053 resident surgical cases were included. In the year before COVID-19 restrictions, the six 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. All individual residency programs had a decrease in total cases reported (p<0.01, Figure 1). Comparison of before and after revealed a decrease from a mean of 5,564 (SD+/- 1,337) to 3,749 (SD+/- 764, p<0.01) **(Figure 1).** There was not a statistically significant difference in the number of cases done before (mean = 1452) and after covid at the individual residency level (mean = 978, p = 0.24).

Subgroup analysis of key index subspecialties demonstrated decreases in volumes in every subspecialty **(Table 2).** However, there were no statistically significant differences between the subspecialties. Similarly, the subgroup analysis of the type of hospital demonstrated decreases in each type but without any significant differences between the various hospital types (p = 0.12, Table 2).

(Given we are presenting much of the data in table form, this section is not very substantial. Anything else we should include here?)

**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. Though there were no statistical differences seen, certainly there are anecdotal differences in how each residency program was affected. Given the variability in local COVID-19 prevalence, regulations, hospital and university policies, it is likely that each residency program faced further interruptions and challenges as they were forced to adapt to the pandemic. However, 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 timeframe, meaning that more residents were performing the reduced case totals. Interestingly, no statistical differences were found between the different training programs, different subspecialties as measured by key index cases, and between different hospital types. This also suggests that the reduction of surgical case volume was consistent across otolaryngology training programs.

What remains to be seen is what implications these reductions in surgical volumes have in the ability of residency programs to prepare trainees for practice. Further study is needed to identify whether this decreased surgical volume will affect resident competency. It would seem intuitive that a decrease in surgical experience would lead to less competent residency graduates. One limitation of this study was the absence of post-graduate year data for each resident who performed cases. A decrease in surgical patients likely has a different effect based on the trainees' prior experience level. Also, the more experienced residents may have performed a larger share of the available cases at some institutions because of the relative scarcity of surgical experiences. Will the impact of the decreased surgical volumes be apparent in current graduates, or will the graduates demonstrate more considerable training deficiencies in the years to come?

There are several other limitations to this study. The data collection and analysis were retrospective. The extended timeframe (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 this was mitigated by program-specific interventions to increase resident exposure to surgical cases. Another limitation was that there were only six residency programs included in the study. However, each of the residency programs is located in a different state/district. The cumulative COVID-19 cases in those states ranged from 5,753 to 10,080 cases per 100,000 people (February 28, 2021). The cumulative number of cases per capita in the US during the same time was 8,667. Given that the six residency programs included in this study represent different regions, and the range of COVID cases per capita spans that of the entire US, we feel that the data presented herein represents residency programs elsewhere within the US.

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, and hospital type. The lack of statistical differences between 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 otolaryngology head and neck surgery. There were no significant differences between the volume decreases seen at different hospital types, or within various subspecialties. The implications of these volume reductions on resident competencies are unknown, and further study is warranted.

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**Tables:** Data appearing in tables should supplement, not duplicate, the text. Tables must be submitted in Excel or Word table format and not as images. Tables should contain at least 2 columns of data and should not list qualitative information or single-column numeric data that can be easily described in the Results section. Put tables on separate pages and number them in order of their mention in the text. Place tables before the figure legend page and after the list of references, and do not embed them throughout the text. Provide a brief title for each table (not a separate legend), and define any abbreviations in table footnotes. Tables must be no larger than 1 page (with 1-inch margins), using a minimum font size of 10. Tables larger than 1 page will count as multiple tables. Tables larger than 3 pages will be considered for publication as online-only appendices.

**Figures:** Upload each figure as its own file in Editorial Manager. Provide a legend of no more than 30 words for each figure after your reference list. Because all figures will be printed in black and white unless selected by the Editor in Chief for color reproduction, please refrain from using color descriptors in the legend. Additional figure guidelines are as follows:

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Table 1: Otolaryngology-Head and Neck Surgery Residency Characteristics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Institution | Number of Residents: 2019-2020 Academic Year\* | Number of Residents: 2020-2021 Academic Year\* | Region | State/District | COVID-19 cases per capita† |
| Harvard University | 25 | 25 | Northeast | Massachusetts | 8,431.6 |
| Georgetown University | 14 | 14 | Mid Atlantic | District of Columbia | 5,752.5 |
| University of California, San Francisco | 19 | 20 | Pacific Coast | California | 9,237.0 |
| University of Colorado | 17 | 18 | Mountain West | Colorado | 7,422.8 |
| University of Kansas | 20 | 20 | Midwest | Kansas | 10,080.0 |
| Louisiana State University, New Orleans | 18 | 19 | Southeast | Louisiana | 9,219.4 |

\*Residents on dedicated research years are excluded.

†Cumulative 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 8,667.2.

Table 2: Subgroup Analyses: Key Index Cases and Hospital Type

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Pre COVID-19** | **Post COVID-19** | **% Decrease** |
| **Key Index Cases** |  |  |  |
| **Head and Neck (total)** | **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 (total)** | **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 (total)** | **4064** | **3166** | **22.10** |
| Rhinoplasty | 833 | 493 | 40.82 |
| Mandible or Midface Fractures | 646 | 549 | 15.02 |
| Flaps or Grafts | 2585 | 2124 | 17.83 |
|  |  |  |  |
| **General and Pediatrics (total)** | **871** | **611** | **29.85** |
| Airway (Pediatric and Adult) | \* | \* |  |
| Congenital Neck Masses | 368 | 247 | 32.88 |
| Ethmoidectomy | \* | \* |  |
| Bronchoscopy | 503 | 364 | 27.63 |
|  |  |  |  |
| **Hospital Type** |  |  |  |
|  |  |  |  |
| **University** | **18876** | **13136** | **30.41** |
| **Pediatric** | **4868** | **3954** | **18.78** |
| **Veterans'** | **2102** | **1189** | **43.43** |
| **County** | **2777** | **1781** | **35.87** |
|  |  |  |  |

\*Need to put a footnote here regarding why we don't have complete data (e.g., ethmoidectomy)

**Figure 1:**

|  |  |
| --- | --- |
| **Reduction in Resident Surgical Case Volumes Associated with COVID-19 Pandemic Restrictions** | |
| A | B |
|  | C:\Users\mannc\Downloads\image.png |
|  |  |

UCSF, University of California San Fransisco; CU, University of Colorado; KU, University of Kansas; LSU, Louisiana State University

Figure 1 Legend:

Surgical case volumes decreased for residents in otolaryngology the year following the initiation of widespread COVID-19 restrictions in the US. A) Total resident surgical case volume for six residencies in Otolaryngology-Head and Neck Surgery in the one year preceding and the one year following March 1, 2020. B) Surgical case volume in six residency programs decreased from a mean of 5,564 to 3,749 (p<0.01).