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Odontogenic Infections: Disease Burden During COVID-19 at a Single Institution

Robert E. Johnson, III, DMD,* Trayvon E. Foy, BA, Taylor A. Ellingsen, BS, J. Luke Nelson, BS, and Jasjit K. Dillon, DDS, MBBS, FDSRCS

Purpose: The purpose of this study was to document the effect of coronavirus disease 2019 (COVID-19) on patients presenting to the University of Washington Oral and Maxillofacial Surgery (UW OMS) with an odontogenic infection.

Materials and Methods: The investigators designed a retrospective cohort study and enrolled a sample of 889 subjects who presented for an odontogenic infection from March 19 to June 18 in the years 2017, 2018, 2019, and 2020. The primary predictor variable was OMS consultation for an odontogenic infection during a non-COVID-19 (2017, 2018, and 2019) year (control) or during the COVID-19 pandemic in 2020 (experimental). The primary outcome variable was treatment rendered. Appropriate univariate and bivariate statistics were computed, and the level of significance was set at .05 for all tests.

Results: There was no significant difference in the incidence of OMS consults in the 2 cohorts ($P > .05$). The number of patients presenting to the UW emergency department (ED) for an odontogenic infection decreased from an average of 246 in non-COVID years to 151 in 2020. Patients in the experimental cohort were more likely (55 vs 30.0%; $P = .04$) to present primarily to UW than a dentist and were less likely to undergo an incision and drainage (70.0 vs 88.8%; $P = .04$), aerosol-generating procedure (70.0 vs 88.8%; $P = .04$), and incision and drainage in the ED (15.0 vs 41.3%; $P = .03$).

Conclusions: The investigators did not find evidence of increased hospital or ED burden by odontogenic infections during the COVID-19 pandemic.

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Odontogenic infections can present as low grade and localize to severe and life-threatening. Their management is a critical function of an oral and maxillofacial surgeon (OMS). Treatment of odontogenic infections by general dentists and specialists in the community is preferred to prevent disease progression; however, symptoms and signs, such as dysphagia, dyspnea, extension beyond alveolus, fever, trismus, and systemic features, warrant referral to an OMS and potential management within a hospital facility.

In response to the coronavirus disease 2019 (COVID-19) pandemic in the state of Washington (WA), Governor Jay Inslee issued Proclamation 20 to 24 on March 19, 2020, prohibiting dentists from...
Materials and Methods

STUDY DESIGN AND SAMPLE

The researchers designed and implemented a retrospective cohort study. The study sample was composed of patients presenting with an odontogenic infection to Harborview Medical Center (HMC) and the University of Washington Medical Center (UWMC) in Seattle, WA during March 19 to June 18 in 2017, 2018, and 2019 to be included in the control cohort, and during March 19 to June 18, 2020 in the experimental cohort. Subjects were excluded from the study if the infection was not odontogenic or their chart was incomplete.

VARIABLES

The primary predictor variable was oral-maxillofacial surgery consultation for odontogenic infection during the indicated 3 months of the COVID-19 response in 2020, or in one of same time frames in the 3 years previous (2017, 2018, or 2019). The primary outcome variable was treatment rendered.

Other variables included the number of patients presenting for dental infections to the emergency department (ED); demographics: gender, age, county of residence; and, potential risk factors for COVID-19 morbidity: advanced age (65 years and older), long-term care facility, chronic lung disease other than asthma, asthma, cardiac disease, immunocompromise, severe obesity (body mass index ≥40), diabetes mellitus, chronic kidney disease with dialysis, liver disease, angiotensin-converting enzyme inhibitor I or angiotensin II receptor blocker, nonsteroidal anti-inflammatory drugs, and corticosteroids; and COVID-19 positive (International Classification of Diseases, Tenth Revision [ICD-10] U07.1), whether tested for COVID, and whether AGP was performed.

Further variables describing infection of interest included the ICD-10, Clinical Modification code, location of infection (submental, submandibular, etc.), source/tooth number, and initial presentation setting (UW, outside hospital, urgent care clinic, primary care physician, or dental office).

Treatment variables included date of presentation, date of discharge, antibiotics, incision and drainage (I&D), I&D in ED, I&D in clinic, I&D in operating room (OR), extraction(s), intensive care unit stay, and hospital length of stay.

DATA COLLECTION AND ANALYSIS

After institutional review board approval (STUDY00010091), a retrospective search was conducted to identify patients treated for odontogenic infections at HMC and UWMC during March 19 to June 18 in the years 2017, 2018, 2019, and 2020. The International Classification of Diseases, Tenth Revision, Clinical Modification codes were used to identify study subjects. Refer to Supplementary Data for ICD-10 codes included.

Once subjects were identified by ICD-10 codes and date range queries, individual chart reviews were conducted by calibrated members of the research team to ensure satisfaction of inclusion and exclusion criteria and facilitate collection of the variables. All data were deidentified and kept in a secure Excel (Microsoft, Redmond, WA) spreadsheet accessible to the investigators only. After data collection, the primary author (R.E.J.) randomized 25 charts to crosscheck for consistency. Descriptive statistics were stratified by non-COVID-19 (control) and COVID-19...
Results

The study sample was composed of 889 subjects whom presented to UW ED with an odontogenic infection during March 19 to June 18 in the years 2017, 2018, 2019, and 2020. The number of patients presenting to the UW ED (Table 1) for an odontogenic infection decreased from an average of 246 in non-COVID years (2017, n = 255; 2018, n = 264; 2019, n = 219) to 151 in 2020. In the 3 years before COVID-19 (2017, 2018, and 2019), 738 patients presented, and 80 (10.8%) were consulted by an OMS. During COVID-19 (2020), 151 patients presented, and 20 (13.3%) were consulted by an OMS. The 80 subjects (mean age, 45.7 ± 20.6 years; 47.5% females) treated before COVID-19 were enrolled in the control cohort, and the 20 subjects (mean age, 41.1 ± 12.9 years; 30.0% females) treated during COVID-19 were enrolled in the experimental cohort.

Table 2 describes patient demographics. Most (61.3%) of all subjects resided in King county, where both HMC and UWMC are located. A total of 8 (8.0%) patients in the sample were 65 years and older at time of treatment, all of whom presented in a year other than 2020 ($P > .05$). No statistical difference was found in demographics of subjects between the 2 cohorts. The 3 patients whom did not receive treatment did not have a COVID-19 comorbidity.

Table 1. INCIDENCE OF OMS CONSULTATION FOR ODONTOGENIC INFECTION

| Year   | OMS Consultations, n (%) |
|--------|--------------------------|
| 2017   | 29 of 255 (11.4)         |
| 2018   | 30 of 264 (11.4)         |
| 2019   | 21 of 219 (9.6)          |
| 2020   | 20 of 151 (13.3)         |

Abbreviation: OMS, oral and maxillofacial surgery.

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Table 2. BIVARIATE ANALYSIS OF PATIENT DEMOGRAPHICS

| Descriptor                           | Non-COVID-19 | COVID-19 | $P$     |
|--------------------------------------|--------------|----------|---------|
| Sample size, N                       | 80           | 20       | .16     |
| Female, N (%)                        | 38 (47.5)    | 6 (30.0) | .16     |
| Age (yr)                             | 45.7 ± 20.6  | 41.1 ± 12.9 | .22 |
| 95% CI                               | 41.19-50.21  | 35.45-46.75 |       |
| County of residence, N (%)           |              |          | .47     |
| King county                          | 51 (63.8)    | 11 (55.0) |         |
| Not King County                      | 29 (36.3)    | 9 (45.0)  |         |
| Potential COVID-19 comorbidities—yes, N (%) |          |          | >.05    |
| 65 year and older                    | 8 (10.0)     | 0 (0.0)  |         |
| Care facility                        | 0 (0.0)      | 0 (0.0)  |         |
| Chronic lung disease                 | 3 (3.8)      | 2 (10.0) |         |
| Asthma                               | 9 (11.3)     | 1 (5.0)  |         |
| Cardiac disease                      | 19 (23.8)    | 2 (10.0) |         |
| Immunocompromised                    | 3 (3.8)      | 3 (15.0) |         |
| Severe obesity (BMI ≥40)             | 6 (7.5)      | 0 (0.0)  |         |
| Diabetes                             | 8 (10.0)     | 3 (15.0) |         |
| CKD with dialysis                    | 0 (0.0)      | 0 (0.0)  |         |
| Liver disease                        | 6 (7.5)      | 1 (5.0)  |         |
| ACE-I/ARBs                           | 9 (11.3)     | 0 (0.0)  |         |
| NSAIDs                               | 9 (11.3)     | 1 (5.0)  |         |
| Corticosteroids                      | 4 (5.0)      | 1 (5.0)  |         |
| Tested for COVID-19                  | N/A          | 17 (85.0)|         |
| COVID-19 positive                    | N/A          | 0 (0.0)  |         |

Note: Chronic lung disease not to include asthma. Fisher exact test was used for potential COVID-19 comorbidities, analysis of variance was used for age (95% CI), and $\chi^2$ test was used for all others.

Abbreviations: ACE-I, angiotensin-converting enzyme I inhibitor; ARBs, angiotensin II receptor blockers; BMI, body mass index; 95% CI, 95% confidence interval; CKD, chronic kidney disease; COVID-19, coronavirus disease 2019; N/A, not available; NSAIDs, onsteroidal anti-inflammatory drugs; SD, standard deviation.

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COVID-19 testing in 2020 were also the first 3 patients seen in that year’s cohort, before institutional testing standardization. None (0.0%) of the subjects were COVID-19 positive. Table 3 describes the infections. Supplementary Data lists all 66 ICD-10 codes that were used to query patient charts; however, only 6 ICD-10 codes resulted with subjects. It should be noted that more than 1 ICD-10 code described multiple patients. In descending order of prevalence: K12.2—cellulitis and abscess of mouth (n = 57); K02.9—dental caries, unspecified (n = 52); L02.01—cutaneous abscess of the face (n = 14); L03.211—cellulitis of face (n = 14); K01.1—impacted teeth (n = 10); and K04.1—necrosis of dental pulp (n = 6). The experimental cohort experienced more infections involving 4 or 5 spaces (25.0%) versus the control cohort (5.0%); however, the difference in number of anatomic spaces implicated was not statistically significant ($P > .05$). Submandibular space was the most commonly implicated space, involved in 48.0% of all subject infections, followed by submental space (26.0%) and buccal space (20.0%). Third molars were most likely (10.0%) to be a source of infection in the maxilla, followed by canines (9.0%) and second premolars and lateral incisors (both 6.0%). Second molars were most commonly (33.0%) identified as a source of infection in the mandible, followed by first molars (27.0%) and third molars (20.0%). Table 4 describes the treatment course of infections by cohort. Oral-maxillofacial surgery was more likely to be consulted during COVID-19 (13.3% of patients presenting to UW with an odontogenic infection versus 10.8% in non-COVID-19 years; however, this relationship was not statistically significant ($P = .39$). There was no significant difference in the distance patients had to travel for treatment, as described by percent of patients whom reside in the same county (King) as HMC and UWMC. Patients were found to be more likely to present initially to HMC or UWMC during the pandemic (55.0% vs the 3 years prior 30.0%; $P = .04$) in lieu of an outside hospital, dental office, urgent care clinic, or primary care physician. There were no differences in length of stay, rates of admission, intensive care unit stay, extraction(s), I&Ds in clinic or the OR, or antibiotics. Patients treated by an OMS for an odontogenic infection during the COVID-19 pandemic were less likely to undergo an I&D than those patients treated in the 3 years prior (70.0 vs 88.8%; $P = .04$). No patients in the sample underwent an AGP other than I&D; therefore, those same patients were less likely to undergo an AGP by the same margin (70.0 vs 88.8%; $P = .04$). Patients treated during the pandemic response had a

Table 3. BIVARIATE ANALYSIS OF INFECTIONS

| Descriptor                                      | Non-COVID-19 | COVID-19 | $P$  |
|-------------------------------------------------|--------------|----------|------|
| ICD-10 implicated, N (% of subjects)            |              |          |      |
| K01.1 (impacted teeth)                          | 9 (14.3)     | 1 (5.0)  | .40  |
| K02.9 (dental caries, unspecified)              | 42 (57.1)    | 10 (50.0)| .84  |
| K04.1 (necrosis of dental pulp)                 | 5 (9.5)      | 1 (5.0)  | .83  |
| K12.2 (cellulitis and abscess of mouth)         | 47 (57.1)    | 10 (50.0)| .50  |
| L02.01 (cutaneous abscess of the face)          | 13 (14.3)    | 1 (5.0)  | .28  |
| L03.211 (cellulitis of the face)                | 11 (14.3)    | 3 (15.0) | .89  |
| Number of spaces implicated, n (% of subjects)  |              |          | .07  |
| 1                                               | 48 (60.0)    | 11 (55.0)|      |
| 2                                               | 18 (22.5)    | 3 (15.0) |      |
| 3                                               | 10 (12.5)    | 1 (5.0)  |      |
| 4                                               | 3 (3.8)      | 3 (15.0) |      |
| 5                                               | 1 (1.3)      | 2 (10.0) |      |

Note: Infections may have more than 1 associated ICD-10 code. Fisher exact test was used for ICD-10 implicated, and $\chi^2$ test was used for number of spaces implicated.

Abbreviations: COVID-19, coronavirus disease 2019; ICD-10, International Classification of Diseases, Tenth Revision.
further decreased chance of undergoing an I&D in the ED (15.0 vs 41.3%; \( P = .03 \)).

**Discussion**

The investigators designed this study with the purpose of measuring and documenting the effect of COVID-19 on patients presenting to UW for treatment of an odontogenic infection. It was hypothesized that the treatment of odontogenic infections managed by UW Department of Oral-Maxillofacial Surgery would be different during the COVID-19 pandemic response than in the 3 years previous. The aim of this study was to report and compare the disease burden of odontogenic infections in the hospital setting during the pandemic response, which included restricting elective dentistry.

Subjects in the COVID-19 cohort were less likely to undergo I&D (70.0 vs 88.8%, \( P = .04 \)), AGP (70.0 vs 88.8%, \( P = .04 \)), and I&D in the ED (15.0 vs 41.3%; \( P = .03 \)). These data represent differences in treatment between the 2 cohorts; therefore, the null hypothesis was rejected.

COVID-19 transmission occurs via aerosols; therefore, assessment of AGPs, including tracheotomy, tracheostomy care, airway suctioning, abscess drainage, wound irrigation, use of ultrasonic/piezoelectric devices, and use of high-speed handpieces, was of particular interest. AGPs also require additional PPE, of which supply was strained especially during the early months of the pandemic.

During COVID-19, 13.3% of patients presenting to UW with an odontogenic infection were consulted by oral-maxillofacial surgery versus 10.8% in non-COVID-19 years; however, this relationship was not statistically significant (\( P = .39 \)). An average of 246 patients presented to the ED with an odontogenic infection in non-COVID years versus 151 during 2020. It is unclear why fewer patients presented to the ED during COVID-19. The authors postulate that patients may have avoided UW because of its widely broadcasted involvement in the pandemic response, were treated in the community by dentists or physicians with analgesics and antibiotics, or possibly less likely to visit the ED for pain medication related to dental pain. Interestingly, although there was no difference in the incidence of oral-maxillofacial surgery consultation and an overall fewer number of patients presented to the ED in 2020, there was an increased likelihood (55.0 vs 30.0%; \( P = .04 \)) that patients would present first to HMC or UWMC in lieu of an outside hospital, dental office, urgent care clinic, or primary care physician.

### Table 4. BIVARIATE ANALYSIS OF TREATMENT COURSE

| Variables                                      | Non-COVID-19       | COVID-19          | \( P \)  |
|------------------------------------------------|--------------------|-------------------|---------|
| OMS consulted for odontogenic infection, N (%) | 80 of 738 (10.8)   | 20 of 151 (13.3)  | .39     |
| Initial presentation setting                   |                    |                   |         |
| HMC or UWMC                                    | 24 (30.0)          | 11 (55.0)         | .04     |
| Outside hospital                               | 38 (47.5)          | 6 (30.0)          | .16     |
| Dental office                                  | 13 (16.3)          | 1 (5.0)           | .19     |
| Urgent care clinic                             | 3 (3.8)            | 1 (5.0)           | .80     |
| Primary care physician                         | 2 (2.5)            | 1 (5.0)           | .56     |
| Treatment variables                            |                    |                   | .15     |
| Average LOS (days)                             | 2.97 ± 4.58        | 2.74 ± 2.00       |         |
| 95% CI                                         | 1.97-3.97          | 1.86-3.62         |         |
| Admission—yes, N (%)                          | 52 (65.0)          | 11 (55.5)         | .41     |
| ICU stay—yes, N (%)                            | 4 (5.0)            | 2 (10.0)          | .40     |
| Extraction(s)—yes, N (%)                      | 57 (71.3)          | 15 (75.0)         | .74     |
| I&D—yes, N (%)                                 | 71 (88.8)          | 14 (70.0)         | .04     |
| I&D in clinic—yes, N (%)                       | 13 (16.3)          | 3 (15.0)          | .89     |
| I&D in OR—yes, N (%)                           | 34 (42.5)          | 8 (40.0)          | .84     |
| I&D in ED—yes, N (%)                           | 33 (41.3)          | 3 (15.0)          | .03     |
| Antibiotics—yes, N (%)                         | 78 (97.5)          | 18 (90.0)         | .13     |
| AGP—yes, N (%)                                 | 71 (88.8)          | 14 (70.0)         | .04     |

*Note: Columns are mutually exclusive. Analysis of variance was used for average LOS (95% CI). All others used \( \chi^2 \) test.*

*Abbreviations: AGP, aerosol-generating procedure; 95% CI, 95% confidence interval; COVID-19, coronavirus disease 2019; ED, emergency department; HMC, Harborview Medical Center; ICU, intensive care unit; I&D, infection and drainage; LOS, length of stay; OMS, oral and maxillofacial surgery; OR, operating room; SD, standard deviation; UWMC, University of Washington Medical Center.*

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Only 1 (5.0%) patient in the experimental group presented to a dentist before HMC or UWMC, whereas 13 (16.3%) patients did so in the 3 years previous \( (P = .19) \). Strained access to COVID-19-compliant PPE, staffing difficulties, lack of government and professional organization protocols, and general pandemic-related anxieties likely hindered the ability of community dentists to provide emergent care.

A nonsignificant \( (P = .07) \) finding of more severe infections as described by the number of spaces implicated was noted during COVID-19. It is possible that limited access to emergent dental care resulted in prolonged disease course before presentation. This may also account for a decreased likelihood of undergoing an I&D in the ED as more aggressive infections require definitive treatment in a more controlled setting such as the OR.

Hospital resources and the potential to be overwhelmed was of paramount concern when preparing for the COVID-19 response, and legislative prohibition of elective dentistry had the potential to divert infections that would typically be managed in dental practices to further burden hospitals. Despite a greater likelihood of presenting primarily to the ED, this investigation did not find evidence of increased hospital burden from odontogenic infections during the studied period of the COVID-19 pandemic.

This study was intended to report and analyze the UW Department of Oral-Maxillofacial Surgery’s experience with odontogenic infections during the COVID-19 response. It was necessarily limited by drawing data from only 2 hospitals in the same city, limiting generalizability. UW is the only nonmilitary oral-maxillofacial surgery department in the state and is therefore uniquely positioned to convey data for the state of Washington. The investigators chose to evaluate a 3-month period to provide timely data to the ongoing pandemic response and to correspond with Governor Inslee’s proclamation, which defined elective dentistry as treatment of pathology not likely to cause patient harm within 3 months. This study was limited in that analysis of previous years was conducted by retrospective chart review. Follow-up studies to evaluate a longer time course of pandemic response are necessary.

At the time of preparation of this article, no studies existed to evaluate sequelae of legislative prohibition of elective dentistry in the hospital setting. The pandemic and humanity’s response are ongoing, and more data will be necessary to both evaluate the effect of actions already taken and to better inform future decisions.

As of August 17, 2020, Washington state reported 67,461 confirmed cases, 1,781 deaths, and a positive rate of 5.5%\(^8\). The United States reported 5,254,878 confirmed cases, 167,253 deaths, and a positive rate of 9%\(^9\).

**Supplementary Data**

Supplementary data associated with this article can be found in the online version, at [https://doi.org/10.1016/j.joms.2020.10.015](https://doi.org/10.1016/j.joms.2020.10.015).

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