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## DISCUSSION

# DENTAL AEROSOLS SHOULD NOT BE IGNORED DURING THE COVID-19 PANDEMIC UNTIL PROVEN OTHERWISE



**PURPOSE/QUESTION:** Are aerosol-generating dental procedures (AGDPs) linked to significant aerosol distribution, and subsequent SARS-CoV-2 transmission?

## REVIEWERS

PORAMATE PITAK-ARNNOP, PRIM AUYPCHAI, AND ANDREAS NEFF

## Article Title and Bibliographic Information

Meethil AP, Saraswat S, Chaudhary PP, Dabdoub SM, Kumar PS. Sources of SARS-CoV-2 and other microorganisms in dental aerosols. *J Dent Res* 2021;100(8):817–23. doi: 10.1177/00220345211015948.

## SUMMARY

### Subject Selection

This was an experimental research in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for human observational investigations. Meethil et al. enrolled a sample of 28 dental patients and 5 dental personnel between May 4, and July 10, 2020 at the College of Dentistry of the Ohio State University. Inclusion criteria were not mentioned. The subjects for dental treatments were excluded, if they were <18 years, currently pregnant, previously treated with antibiotics, or self-reported about HIV infection or COVID-19, or COVID-19-like symptoms since January 2020 (ie all symptomatic cases were excluded). The investigators calculated the sample size based on in vitro and clinical non-SARS-CoV-2-related studies.

### Key Exposure/Study Factor

The aerosol-generating dental procedures (AGDPs) were performed under high-power suctioning by 5 dentists and dental assistants wearing N95 masks in 2 enclosed operatories measuring 10.5 × 10 × 12 feet, with 6-exchange/min ventilation. All except 5 scaling patients (82.1%) rinsed 1% H<sub>2</sub>O<sub>2</sub> 30 mL for 1 minute before treatment began.

The predictor variables included 1) timing in relation to dental treatments (before vs after [30 minutes after treatment end]), 2) location of specimen collecting (operator [dentist's face shield] vs assistant [assistant's face shield] vs patient [patient's chest] vs environment [an area of 6 feet from the site of operation]), 3) source of specimen (saliva vs aerosol), 4) type of AGDPs (dental implant placement vs restorative procedures with high-speed handpieces vs ultrasonic scaling; there was no control group without an AGDP), and 5) type of microorganisms (SARS-CoV-2 vs other [over 1250 microorganisms other than SARS-CoV-2; the sizes of these microorganisms were not reported]).

## SORT SCORE

A	B	C	N/A
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SORT, Strength of Recommendation Taxonomy.

## LEVEL OF EVIDENCE

1	2	3
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See article 101482 for complete details regarding SORT and LEVEL OF EVIDENCE grading system.

## SOURCE OF FUNDING

The authors reported that no external funding sources directly supported this study.

## TYPE OF STUDY/DESIGN

Experimental research.

Corresponding author: Poramate

Pitak-Arnnop Tel.: +49 6421 586 3239.

## KEYWORDS

COVID-19, SARS-CoV-2, Dental aerosol

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## Main Outcome Measure

The main outcome variable was the frequency of identifiable microorganisms, which was measured by microbiologic-genetic techniques for microbial DNA sequences, and an RNA extraction-free dualplexed reverse transcriptase quantitative polymerase chain reaction (qRT-PCR) for SARS-CoV-2 detection (SalivaDirect version 5).

## Main Results

There were statistical significances between postoperative salivary and aerosol microbiota, regardless of type of AGDPs and location of sample collecting ( $P < .001$ , Dunn method for joint ranking of Bray-Curtis dissimilarity distances). *Vulcaniibacteria* was identifiable in 70% of microbial abundance. The aerosolized microbial abundance was 8.3-10 times more than saliva bacteria, which were found in 8 (or 28.6%) patients [5 of those did not rinse H<sub>2</sub>O<sub>2</sub>]. However, the source of 0%-90% of the microbiota (mean, 20%) was unknown. The patient's chest was the most frequent site of germ deposition ( $P < .05$ , chi-square test), despite in 8 patients only. On the contrary, SARS-CoV-2 was detected in saliva of 19 participants (viral load, 27-912 copies/mL). No aerosol with SARS-CoV-2 in any location was found.

## CONCLUSIONS

The investigators concluded that with appropriate infection control measures, that is, preoperative mouth rinses and intraoral high-volume suction, dental treatment in asymptomatic patients does not decrease the risk of SARS-CoV-2 transmission. Standard infection control is sufficient to protect personnel and patients from exposure to potential pathogens.

## COMMENTARY AND ANALYSIS

The microbial aerosol is a stable colloidal system of microorganisms floating in the air in the state of a single cell suspension or fused with dry solid or liquid particles. Viral aerosols have a small size and have Brownian motion, causing a long-time suspension, far-distance transmission, and access to the lower respiratory tract.<sup>1</sup> Dental environment are in closed spaces, and many AGDPs intensively generate aerosols compared to normal-life activities. Since the risk of SARS-CoV-2 infection is cumulative, directly proportional to the duration of exposure (apart from the viral density), repeated inhalation of several particles, although containing smaller viral doses) can inevitably lead to an infection.<sup>2</sup>

Theoretically, aerosol particles are dry very quickly: milliseconds to seconds. Enveloped RNA viruses, for example, influenza, and coronaviruses, may be unstable in dried aerosol nuclei for extended periods, limiting the viral ability to transmit.<sup>2</sup> The SARS-CoV-2, conversely, remains viable in aerosols for 3 hours with a reduction in infectious titer from 10<sup>3.5</sup> to

10<sup>2.7</sup> mean (or 50%) tissue culture infectious dose (TCID<sub>50</sub>)/L air at 21-23°C and 65% relative humidity.<sup>1</sup> A Florida study demonstrated "viable" SARS-CoV-2 isolated from air samples collected 2 to 4.8 m (6.6-15.7 ft.) away from the patients in the absence of AGDPs. For aerosol-based transmission, measures such as physical distancing by 6 feet would not be helpful in an indoor setting, provide a false sense of security, and lead to exposures and outbreaks.<sup>3</sup> Furthermore, AGDPs increase humidity in dental environments. Airflow dispersed by human activities, ventilation, and high-power suctioning could also cause resuspension of the aerosols that are already deposited on the surfaces.<sup>1</sup> Recently, we found SARS-CoV-2 distribution in an operating theater up to 3 m during midfacial fracture repair under general anesthesia.<sup>4</sup> Hence, SARS-CoV-2 transmission from asymptomatic or mildly symptomatic patients should not be underestimated, especially in areas with an incidence of  $\geq 150$  new cases per 100,000 population per week.<sup>5</sup>

Meethil et al. enrolled a cohort of 28 dental patients with unknown inclusion criteria and appeared unrepresentative to the real-world statistics, that is, selection bias is possible. Moreover, they detected a viral load of 27-912 copies/mL, although SalivaDirect can actually detect viral loads as low as 600012,000 copies/mL.<sup>6</sup> Compared to reverse transcription-polymerase chain reaction (qRT-PCR), SalivaDirect had false-positive rates of 0.03%-0.05% ( $n = 3760$ ),<sup>6</sup> suggesting the missing of  $\geq 2$  COVID-19 patients in the Meethil et al.'s study.

A meta-analysis showed that salivary SARS-CoV-2 testing may be less sensitive (up to 16.6 times) than qRT-PCR.<sup>7</sup> SalivaDirect provides significantly lower detect rates: 61.9%-96.4%.<sup>8</sup> This could be a result of accidental collection of sputum and/or remnants from food/drinks, or even brushing teeth prior to saliva collection, which can interfere sample processing or inhibit PCR.<sup>6,8</sup> The discrepancies between salivary testing vs standard RT-PCR, amid cheaper, tend to decrease in asymptomatic or mildly symptomatic patients, and can be used "only" for screening in communities.<sup>7,8</sup>

Given sample size calculation for differences in measurements among 3 unpaired groups (ultrasonic scaling vs drilling vs implant placement) at  $\alpha = 0.05$  and power of 80%, the overall effect size (calculated from the salivary viral load: 175.73  $\pm$  235.08 vs 44.43  $\pm$  13.74 vs 29.85  $\pm$  46.49, respectively) will be 7.21, and  $\geq 29$  subjects are required in each study arm (i.e., total sample size  $\geq 87$ ). The low sample size in Meethil et al.'s study may explain the insignificance among AGDP types (i.e., the results could not escape from the  $\beta$ -error).<sup>9</sup>

Gargling with 1%-3% H<sub>2</sub>O<sub>2</sub> in the mouth and throat for 1 minute 1-3 times a day (for up to 6 months) has proven effective against SARS-CoV-2. The antiseptic action via oxidizing and mechanical removal is intensified by the induction of the

innate antiviral inflammatory response by overexpression of Toll-like receptor 3 (TLR3).<sup>10</sup>

In conclusion, several factors in the Meethil et al.'s study, for example, high probability of selection bias and non-representative samples, inappropriate use of salivary SARS-CoV-2 testing as standard in the research setting, improper analysis of dental aerosols, and the high risk of  $\beta$ -errors (i.e., false-negative errors) due to the low sample size, could altogether compromise the scientific integrity. This paper's findings may cause great confusion in dental communities during the COVID-19 pandemic, and thereby, should be interpreted cautiously. We refer interested readers to up-to-date dental management during the COVID-19 pandemic by Hegde et al.,<sup>11</sup> and our meta-narrative review of oral-maxillofacial manifestations in COVID-19 patients.<sup>12</sup>

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## REVIEWERS

### **PORAMATE PITAK-ARNNOP, MD, DDS, MSC, PHD, DSC, FEBOMFS, FICS, FRSM (LONDON),**

Department of Oral and Craniomaxillofacial Plastic Surgery, University Hospital of Giessen and Marburg, UKGM, Campus Marburg, Philipps University of Marburg, Marburg, Germany  
poramate.pitakarnnop@gmail.com.

### **PRIM AUYPCHAI, DDS, MSC, FRCDST,**

Department of Paediatric Dentistry, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand.

### **ANDREAS NEFF, MD, DMD, PHD, FEBOMFS,**

Department of Oral and Craniomaxillofacial Plastic Surgery, University Hospital of Giessen and Marburg, UKGM, Campus Marburg, Philipps University of Marburg, Marburg, Germany.