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Transmission Routes of SARS-CoV-2 in Dentistry: A Literature Review

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ABSTRACT

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) might be transferred from animals to humans and then escalated into transmission from human to human. Since dentists are regarded as the greatest risk category of healthcare workers in getting COVID-19, this article summarizes the transmission routes of SARS-CoV-2, particularly in dentistry, to gather all the relevant details for dental professionals and healthcare workers. SARS-CoV-2 can be spread through four main ways in dental clinics: inhalation, direct contact, indirect contact, and mucosal interaction. SARS-CoV-2 can be transmitted through saliva, fecal-oral, and surgical smoke in an operating room.

1. Introduction

There was a pneumonia pandemic with unknown origin in Wuhan, China, in late 2019. Many reports were connected to a local seafood market, which sold live animals, indicating that the pathogens might be transferred from animals to humans and then escalated into transmission from human to human. The pathogen was identified and called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), while the disease was named Coronavirus Disease 2019 (COVID-19).^[1, 2] Coronavirus particles vary from 0.06 to 0.14µm, with a mean of 0.125, and have recognizable nine to 12 nm spikes.^[3] The spike protein is the glycoprotein enabling connection, fusion, entry, and transmission of SARS-CoV-2 into host cells by attaching to human Angiotensin-Converting Enzyme 2 (hACE2) receptors, conveyed by epithelial cells of the lung, kidney, intestine, blood vessels, and oral mucosa.^[4] Existing articles suggest that prevalent respiratory symptoms of COVID-19 are fatigue, fever, dry cough, and shortness of breath. In susceptible patients may progress to serious viral pneumonia and failure of several organs. Other clinical signs have also been found, such as smell and taste loss, dizziness, headache, sore throat, chest pain, nausea, diarrhea, rhinorrhea, and vomiting.^[4, 5] Approximately 80% of those infected have mild respiratory infections, among which around half will have pneumonia. Another 15% of patients develop serious sickness, whereas 5% require urgent care treatment. COVID-19 can, in rare circumstances, lead to serious respiratory complications, kidney failure, or even death. However, virus spread may

occur in the absence of clinical symptoms.^[6] Dentists are regarded as the greatest risk category of healthcare workers in getting COVID-19. This is possibly attributable to their job's nature involving aerosol-generating procedures and operating in close distance to the patients during dental treatment.^[7] This article summarizes the transmission routes of SARS-CoV-2, particularly in dentistry, to gather all the relevant details for dental professionals and healthcare workers.

2. Clinical presentations

Transmission Routes in Dentistry

SARS-CoV-2 can be spread through four main ways in dental clinics:

1. Inhaling the airborne microorganisms suspended in the air for a long Time.
2. Direct contact with oral fluids, blood, or any other patient's substances.
3. Indirect contact with contaminated equipment and environmental area. Conjunctival, nasal, or oral mucosa interaction with droplets and aerosols, including microorganisms produced by an infected person, is driven by talking and coughing without a mask.

Since surfaces in dental settings act as hotbeds for droplets and aerosols combined with patients' saliva and blood, they can readily cause spread infection.^[8] The most widely confirmed ways of SARS-CoV-2 transmission include inhalation of respiratory aerosols and droplets from the infected people that might happen within a one-meter radius of the individual.^[6]

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Coronaviruses can hold their virulence active from two hours up to nine days at room temperature. The activity at 50% humidity is significantly greater than when the humidity is 30%. SARS-CoV-2 can remain viable up to 24 hours on cardboards and 72 hours on stainless steel or plastic surfaces. Hence, it appears that keeping surfaces clean and dry in dental clinics is crucial in preventing the transmission of SARS-CoV-2.^[9, 10] Besides, the oropharynx of infected patients and asymptomatic individuals contains significant viral loads. Thus, the oral cavity is specifically correlated with the developmental process of SARS-CoV-2 in inhalation of surrounding particles in the air and expectorations.^[11]

The biological transmission risk of COVID-19 inhalation becomes exceptionally large while conducting dental procedures due to handpiece usage during irrigation, leading to the spread of aerosol particles of saliva, secretions, and blood. The aerosol generation also enables the contamination of the dental apparatuses, environment and equipment, and surfaces. Considering the direct contact transmission, the oral cavity mucosa is a possibly high-risk way of transmitting SARS-CoV-2 along with contaminated hands that might allow virus transmission to patients.^[6]

Particles of SARS-CoV-2

The nose usually filters particles in the air larger than 10 μ m. If the particle size is less than 10 μ m, it could penetrate the respiratory system. A particle less than 2.5 μ m could penetrate the alveoli. A particle smaller than 0.1 μ m (e.g., SARS-CoV-2) may enter the blood and reach organs like the brain and heart. The prevailing medical opinion is that most transmission through respiratory secretions occurs in huge respiratory droplets rather than tiny aerosols. Droplets are usually heavy enough not to fly too far and fall to the surface after moving up to six feet. Table 1. Shows how particles are categorized in terms of size.

Table 1. Different types of particles based on size.

Type of particles	Size
Coarse particles	2.5-10 μ m
Fine particles (FP)	< 2.5 μ m
UltraFine Particles (UFP)	< 0.1 μ m

The problem brings up after a sneeze, cough, or dental procedure aerosolizes the viral particles. Particles from an infected individual may fly across farther distances in such cases, even up to 20 feet, and then cause secondary infections elsewhere in the area. These aerosolized droplet nuclei may stay in the environment floating in the air, even after the emitter has left. Thus, it will infect healthcare professionals and contaminate surfaces in the clinic.^[3]

Dentists conducting aerosol-generating procedures face an incredibly high risk of inoculation of themselves, their assistants, staff, and the patients' reinoculation. Droplet transmission in periodontal treatment is more frequent than in prosthetic treatment. When performing nonsurgical treatments, the ultrasonic and sonic transmission had the greatest particle transmission rate, accompanied by air polishing, air-water syringes, and high-speed dental handpieces.^[12, 13]

SARS-CoV-2 in Saliva

SARS-CoV-2 has also been found in the saliva of infected people. It can be due to the expression of ACE-2 in salivary glands.^[5] Aerosols-generating procedures are possible to be combined with contaminated saliva of patients.^[8]

Surgical Smoke in the Operating Room (OR)

Awareness of surgical smoke in the OR, and the possible risks related to its existence is vital. The possibility of viral transmission through surgical smoke is still questionable; however, surgeons and OR staff are encouraged to minimize any chance of surgical smoke transmission by implementing safe Personal Protective Equipment (PPE) and respiratory measures during conducting open and minimally invasive surgeries.^[14]

Fecal-oral Transmission

SARS-CoV-2 also contaminates the stools of infected persons. Such results, along with the fact that ACE2 is expressed in the gastrointestinal tract and records of infected people having diarrhea appear to suggest that the fecal-oral transmission way of SARS-CoV-2 is reasonable.^[7]

What Can Dentists Do to Reduce the Likelihood of SARS-CoV-2 Transmission?

Dental professionals should use a rubber dam, hand instrumentations, atraumatic restorative procedures, or chemomechanical caries removal to reduce produced splatters. Additionally, since dentistry is in the top-risk classification, dental professionals should have negative-pressure or Airborne Infection Isolation (AII) rooms for aerosol-generating procedures. Furthermore, guidelines for dental professionals working in areas of close interaction with aerosols require wearing the following PPE masks:

1. Medical masks for a distance of less than 1 m.
2. N95 or European Standard Filtering Facepiece 2 (EU FFP2) for aerosol-generating procedures.
3. EU FFP3 for working on suspected COVID-19 cases.^[1, 3]

Using a mouth rinse and local nasal applications containing β -cyclodextrins in conjunction with flavonoid agents (e.g., Citrox) can provide useful adjunctive therapy to minimize the viral load's saliva and nasopharyngeal microbiota, including the possible transmission of SARS-CoV-2.^[9]

3. Conclusion

This study summarizes the transmission routes of SARS-CoV-2, particularly in dentistry, to gather all the relevant details for dental professionals and healthcare workers.

Conflict of Interest

The authors declared that there is no conflict of interest.

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