

# CHAPTER 13

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## INFECTION CONTROL PREVENTIONS IN DENTISTRY DURING THE COVID-19 PANDEMIC PROCESS

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### INTRODUCTION

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In December 2019, it was announced to the world that the cause of pneumonia cases of unknown etiology in Wuhan city of People's Republic of China, is coronavirus (SARS-CoV-2) that has not been detected in humans before. World Health Organization (WHO) has identified the disease caused by this virus as coronavirus disease (COVID-19) and declared as pandemic disease. The social and economic devastating effects of this virus, which has spread to many countries in a short time, continue.

SARS-CoV-2 is mainly transmitted by the inhalation of droplets scattered by sick individuals into the environment through speech, coughing, sneezing, or by hand contact with contaminated surfaces and the transmission of the agent to the oral, nasal and eye mucosa. Studies have revealed that COVID-19

positive patients have a large amount of viable virus particles in the oral mucosa, epithelial surfaces, and dorsum of the tongue. It is also stated that although the incubation period of SARS-CoV-2 is between 5-14 days on average.

Due to the aerosols formed during dental treatments and long-term face-to-face work with the patient, dentistry is among the risky occupational groups with a high probability virus transmission. The preliminary problem regarding COVID-19 in dentistry is related to the swift spread of viral agents during dental procedures to the air. Therefore, as the main source of transmission of COVID-19, aerosol forms the first step of the risk exposure scale of dentists and assistant health personnel.

The second problem concerns the permanence of bio-aerosols in dental treatment rooms. Aerosols produced by high-round rotary instruments and ultra-sonic devices can stay in air and on surfaces for many hours. Although dentists and assistant staff take protective measures during dental treatments, contaminated air may pose a risk to the dentist and assistant staff after removal of personal protective equipment (PPE) and subsequent patients.

Due to direct exposure to pathogens of patients and indirect contact with microorganisms present on both surfaces and air of the dental office after aerosol generation procedures (AGP's), dental offices can be a dangerous source of SARS-CoV-2 transmission if appropriate infection control measures are not applied. Therefore, it is required to use strict and assertive treatment protocols that can classify dental treatments according to risks. In this study, the protocols recommended in the literature to protect dentists, auxiliary staff and patients from the risk of SARS-CoV-2 transmission throughout the dental treatments that were examined.

## **COVID-19 TRANSMISSION SOURCES**

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The most common transmission of respiratory system diseases occurs through inhalation of droplets ( $>5$  to  $10\ \mu\text{m}$ ) and aerosols ( $\leq 5\ \mu\text{m}$ ) resulting from coughs and sneezes of patients who are infected or direct contact of these droplets with the mucous membranes of the mouth, nose and eyes. The air-borne spread of aerosols generated by people during inhalation and speech plays a major role in the spread of COVID-19. The major forms of SARS-CoV-2 spread are by droplet transmission and fomites (objects or materials likely to carry infection). Santarpia et al. detected viral contamination in all samples in their study in which they gathered air and surface samples to study

viral contamination from isolated people. It has also been stated that there is a prevalent environmental contamination of SARS-CoV-2 surround the COVID-19 patients and there may be a potential risk of airborne contamination.

The large number of cells expressing angiotensin-converting enzyme 2 (ACE2) receptor in SARS-CoV-2 transmission is considered to be potential high risk. It has been shown that epithelial cells in the oral cavity (tongue, buccal mucosa, gingiva and salivary gland ducts) also express high levels of ACE2. It has been stated that SARS-CoV-2 is present in the saliva of infected patients. Given the main transmission mode of COVID-19 disease, airborne release of saliva particles during dental treatments will increase the likelihood of contamination. Therefore, it should be taken into account that the patient's saliva may be a strong focus of infection in dental procedures that generate aerosol.

In humans, the incubation time of SARS-CoV-2 has been reported to range from approximately 2 to 14 days (possible extreme values: 0–27 days). Virus transmission starts 2–3 days prior to the onset of symptoms, therefore asymptomatic individuals have an important role in the transmission of SARS-CoV-2. Considering that most of the dental instruments are made of metals and polymers, the virus spreading from asymptomatic individuals can be permanent on these surfaces for a long time. Therefore, if these instruments used in patient treatments are not sufficiently decontaminated, they may pose a risk of virus transmission.

It is important to know that dental procedures produce aerosols that can carry the virus to help identify the level of risk posed by these procedures. The risk level has a significant effect on the suitability of the PPE to be selected.

### **Measures of COVID-19 in dentistry**

It is very important to develop effective prevention strategies in dentistry, especially for dentists, to prevent COVID-19 and alleviate the transmission risk. The main challenge in dental care during the pandemic period is the need for both a suitable diagnostic model (test swabs) and the presence of asymptomatic patients, patients whose infections cannot be identified exactly. Therefore, in order to avoid the risk of contamination, all of the patients must be treated as if they were infected. To date, it has not been proven that a patient with COVID-19 history has acquired an absolute and persistent immunity for the disease. However, reactivation of the disease and even reinfection has been reported.

## **Triage and categorizing patients**

Dentists carry high risk of infection of coronavirus, due to face-to-face interaction with patients and exposure to aerosol containing saliva and blood during dental treatment. Therefore, in both safety and dental treatment procedures that should be followed during the COVID-19 pandemic period, the use of tele-consultations is emphasized first. This method helps patients to reduce their screening and clinic visits. Secondly, it encourages the triage development to investigate the present health status of patients and the risk factor presence for COVID-19 before performing a dental examination.

The triage review is recommended to be based on a standardized survey to be able to identify patients who may have had any kind of contact with COVID-19 or have a history of travel to an area effected by COVID-19. In the triage process, patients with flu-like symptoms, taste and smell loss should be identified. In addition, patients' fever should be measured. It is suggested that as a preventive measure of COVID-19, there should be no companions (except minors and disabled patients) at dental clinics to comply with social distancing norms. It is also recommended that reception areas have a mandatory seating plan with patients separated by 2 meters. For the disinfection of hands in waiting areas, a solution containing at least 60% ethanol should always be available.

### **Patient categories in triage applications**

- COVID-19 symptomatic patient
- Asymptomatic COVID-19 positive patient
- Formerly symptomatic and recovered patient
- Formerly asymptomatic recovered patient
- Negative patient

It is stated that, as a result of triage, dental facilities can provide dental treatment for COVID-19 negative patients. However, for the category of COVID-19 positive patients or patients showing symptoms, the treatment plan of the patients must be made through medical consultation, taking into account the patient's physical condition and findings. It is also recommended to postpone even emergency procedures and use pharmacological agents for symptomatic relief in case of unstable respiratory symptoms. Dental treatment can be performed after it is confirmed by PCR test that the patient, who has been diagnosed with COVID-19 and recovered symptomatically or asymptotically, is negative.

## **Preparation of the patient registration, waiting and treatment rooms**

It is recommended to leave at least 1 meter of a safe distance from the patient in the registration of patients scheduled for a dental treatment appointment and, whenever possible, to use isolation type of transparent Plexiglas from the patient. All unnecessary objects (magazines, mouse pads, children's play corners, etc.) should be removed from the dentist office and registration table, including the tools that are not utilized during the dental procedure.

During dental treatments, a large amount of droplets and aerosols containing blood, saliva and microorganisms quickly travel a short range and reach all surfaces in the treatment room. Therefore, all non-disposable surfaces and tools utilized during treatment should be sanitized and disinfected after each patient. Any part that may be more difficult to sanitize should be wrapped with cling film and changed after each patient. Kampf et al. found that coronaviruses were effectively inactivated with 0.5% hydrogen peroxide, 62-71% ethanol, or 0.1% sodium hypochlorite, but they stated that biocidal agents such as 0.05-0.2% benzalkonium chloride or 0.02% chlorhexidine gluconate were less effective.

Disinfection procedures for objects and flat surfaces should be carried out in an order as follows: first, cleaning with disinfectant moistened disposable wipes as not to raise the spray, and secondly, spray the surface and wipe once again. Solution containing 0.5% hydrogen peroxide, 62-71% ethanol or 0.1% sodium hypochlorite should be applied for at least 1 minute to eliminate the virus.

In addition to chemical disinfection of treatment rooms, an ultraviolet irradiation lamp (UV-C) can also be used. The effectiveness of UV-C disinfectant lamps depends on the radiation intensity, air movement, the amount of aerosol passes from the device per unit time, the duration of action, the particle size and the moisture of the penetration barrier.

Treatment rooms should be ventilated for a minimum of 20-30 minutes between patients. In addition, high volume filters (HVE) and high efficiency particulate air (HEPA) filters are widely used to remove/filter contaminated air.

To prevent the formation of pathogenic biofilms, dental unit water lines should be cleaned with a specific disinfectant agent for 2 minutes at the start and end of each day and 20-30 seconds between patients. All contaminated surfaces such as pipes of high-volume aspirators and saliva ejectors, etc. should

be disinfected with 70% alcohol and 0.1% sodium hypochlorite after each patient.

Adequate sterilization of instruments is essential to prevent cross infection. Rotary instruments (aerotors, contra-angle, etc.) must be sterilized after each patient in the DAC device (Dentsply sirona, Germany) or in the autoclave (Statim5000, SciCan).

Dental treatment rooms working with aerosol should be separate and their doors should be closed during the procedure. Only the materials to be used in the treatment of the patient should be included in this room. If the dental treatment room is used for all dental procedures, the room should be adequately ventilated (minimum 20-30 minutes) after the procedures containing aerosol. In these treatments, disposable materials should be preferred whenever possible.

The risk of cross-infection from dental treatments in an open-plan clinic seems small with a distance of  $\geq 5$  meter between compartments. Most settled aerosol is detected within 10 min indicating environmental cleaning may be appropriate after this. Also, even low volume suction (40 L/min air, with a wide bore suction nozzle) provides a significant benefit.

### **Personal Protective Equipment (PPE)**

The choice of effective PPE should be determined by the risk assessment and the dental treatment to be performed. Hand hygiene has a critical importance to reduce SARS-CoV-2 transmission. It is stated that the first step of PPE should be hand washing for hand hygiene before and after dental procedures, and then 60% hydroalcoholic solution should be used before and after treatment.

Most useful PPE in dentistry:

1. A filter mask should be used to prevent airborne contamination of particles. Wearing a face mask reduces the risk of airborne infections in healthy individuals, therefore, WHO recommends the use of masks. Particle masks used in various countries (by percentage of filtration) include: (a) European Union: CE certified Filtration Facepiece class 1 (FFP1) (80%), class 2 (FFP2) (95%) or class 3 (FFP3) (99.7%); (b) United States: National Institute for Occupational Safety and Health (NIOSH) certified N95 (95%), N99 (99%), N100 (99.7%).
2. The powered air-purifying respirator can be considered a standard component of PPE in certain situations, including aerosol generation

procedures in high-risk environments.

3. Goggles and face shields should be used.
4. Disposable protective gowns and coveralls are not considered PPE over dental uniforms.
5. Disposable gloves should be used for each patient. Gloves protect the dental operator from direct contact with mucous membranes and saliva. Prolonged use of gloves, washing with soap, chlorhexidine, or alcohol can cause micro-holes to form, with increased biological risk. The simultaneous use of double gloves significantly reduces the passage of pathogens through these micro perforations.
6. Head and hair should be protected with a disposable or sterilizable (autoclave) bonnet.
7. Disposable protection should be worn on shoes.

Measures for infection control should be chosen based on direct contact with the patient's body fluids and risk assessment (Table 1).

### **Determination of dental treatment risk level**

The high risk of transmission of COVID-19 and its rapid spread all over the world have brought with it an innovative risk scoring system that shows the risk during dental treatments. Based on the known transmission risks of SARS-CoV-2, it is stated that the risk score parameters for dental treatments for dentists, assistant staff and patients are as follows:

- Direct saliva contact (1 point),
- Direct blood contact (2 points),
- Low spray generation levels/aerosol via air-water syringes (3 points),
- High level of spray/aerosol production using rotary instruments and piezo-electric instruments (4 points),
- The procedure duration (0.25 points, 30 minutes; 0.50 points, 30-60 minutes; 0.75 points, min 60 minutes).

After this analysis of dental treatments, they are classified as: low risk (1-3 points), moderate risk (4-5 points) and high risk ( $\geq 6$  points). One procedure can accumulate multiple points. The duration of the dental treatments also plays an important role in defining the severity of the risk. Personal protective equipment (PPE) for each procedure is recommended based on the final risk score.

**Table 1** Recommendation for PPE according to the level of risk scored for typical dental procedures

Risk Level	Protective Measure
<b>Low risk</b>	Disposable or sterilizable bonnets Surgical mask Goggles or face shield Disposable or sterilizable gowns Disposable gloves
<b>Medium risk</b>	Disposable bonnet Goggles or face shield Protective respiratory mask (FFP2) Disposable suit (Gown or coverall) Disposable gloves
<b>High Risk</b>	Disposable bonnet Goggles or face shield FFP3 or Powered air-purifying respirator (PAPR) Disposable protective clothing (Coverall) Disposable gloves Shoe protector

## ADDITIONAL PROTECTIVE RECOMMENDATIONS IN DENTAL TREATMENTS

- The waiting room and treatment room should be designed to be easily disinfected.
- All clinical entrance gates should have motion sensors to reduce contamination.
- All patients in the waiting room should be separated by a distance of not less than 2 meters.
- A disinfectant should be put in waiting rooms for hand hygiene.
- Before the dental session, all patients should gargle 0.2% povidone iodine or 1% hydrogen peroxide and continue rinsing with 0.12% chlorhexidine after treatment. Yoon et al. stated that after using 15 ml of 0.12% CHX, SARS-CoV-2 was suppressed for two hours and this suppression would be beneficial for the control of COVID-19.
- Intraoral x-ray examination will induce salivation and cough, and therefore extraoral radiographs such as panoramic radiography and cone-beam CT may be alternative.
- The use of the air/water syringe, rotary/ultrasound/piezo instruments should be minimized by air polishing.
- A rubber-dam should be used in dental procedures where aerosol will occur.

- During dental treatments, disposable or autoclavable saliva absorbers with high absorption capacity should be used.
- Touching patient documents/digital registries and pens with used gloves should be avoided.
- Self-resorbable sutures are preferred in surgical procedures.
- The use of bulk-fill composite resins and self-etch adhesive systems in restorative dentistry can shorten treatment times.
- Traveling by public transport should be avoided while going for dental treatment.

## CONCLUSION

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In dentistry, instruments such as air-water syringes, rotary instruments, ultrasonic and piezo produce a large amount of droplets and aerosols containing blood, saliva and microorganisms. This splash quickly travels a short distance to the ground (near sterilized surfaces), the dental health staff or the patient. It has long been recognized that saliva may contain potential pathogens in amounts sufficient to infect individuals.

The presence of SARS-CoV-2 in saliva may cause direct transfer of infectious agents from infected individuals to healthy individuals. In addition, it has been confirmed that a person who is positive for SARS-CoV-2 can transmit the disease to other individuals in the same room. It can therefore be argued that most dental procedures that generate droplets and potentially highly contaminated microbial aerosols are extremely dangerous for anyone in the treatment room.

In dental treatments, the application of triage by phone, patient treatments by appointment, shortened treatment sessions, sterilization and ventilation of the treatment room come to the fore. In addition, the risk of SARS-CoV-2 transmission should be minimized by taking the necessary PPE measures according to the innovative COVID-19 risk classification in dental practices. However, it is considered that using all measures together instead of a single measure will be more effective in preventing SARS-CoV-2 contamination.

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