

Review Article

Recommendations for Control of Infection with Novel Coronavirus in Dentistry

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The country's president reported the first case of coronavirus (COVID-19) in Perú, on Friday, March 6, 2020; Soon after, on March 11, 2020, the WHO recognized it as a global pandemic. Perú has adopted strict and severe measures to protect our population from the spread of this infection; Despite these measures, the number of infected is growing with a significant number of patients developing the effects of COVID-19. The dentist cannot be oblivious to this problem due to the nature of his profession; therefore, it may be subject to a significant risk of cross contamination and spread of this respiratory disease, with strict prevention measures being very important. The purpose of this narrative review is to establish recommendations for infection control in dentistry, with a specific focus on personal protection should be implemented to prevent further spread of COVID-19, both from dentists and from patients.

Keywords: Coronavirus; COVID-19; Control; Prevention; Infection; Dentistry; Dental; Perú

Introduction

Coronaviruses cause respiratory, enteric, liver, and neurological diseases; such as the coronavirus of the severe acute respiratory syndrome (SARS-CoV) in 2003 and the coronavirus of the respiratory syndrome of the Middle East (MERS-CoV) in 2012 that have caused epidemics in humans [1] Chen et al. [2] describe that SARS-CoV-2 is a coronavirus and belongs to the group of β -coronaviruses, being the third known zoonotic coronavirus disease. Zhu et al [3]. they isolated a new coronavirus, called 2019-nCoV, that formed a clan within the subgenus sarbecovirus, subfamily of Orthocoronavirinae, from human respiratory tract epithelial cells. Recent research reported that SARS-CoV-2 likely originated in bats, based on the similarity of their genetic sequence with that of other coronaviruses [4].

The first unexplained case of new pneumonia was detected on December 12, 2019, and was later determined by the Chinese Center for Disease Control and Prevention (CDC) as a new coronavirus [5]. From there, a unexplained case series of pneumonia in Wuhan, China. On January 12, 2020, the World Health Organization (WHO) tentatively named this virus as the new coronavirus 2019 (2019-nCoV). On January 30, 2020, the WHO announced a public health emergency of international concern. On February 11, 2020, the WHO formally named the 2019-nCoV-triggered disease as the 2019 coronavirus disease (COVID-19) [6,7].

The first case of COVID-19 disease in Peru was reported by the country's president Martín Vizcarra, on Friday, March 6, 2020 [8]. The WHO recognized it as a global pandemic on March 11, 2020 [9].

Common symptoms include fever (98.6%), fatigue (69.6%), and dry cough [59.4%], [10] another study found fever (43.8% on admission and 88.7% during hospitalization), cough (67.8%). Nausea or vomiting (5%) and diarrhea (3.8%) were rare [11] Hui et al, [12] indicated that fever and respiratory symptoms predominate,

and diarrhea is common. Chen et al, [13] found fever (83%), cough (82%), shortness of breath (31%), muscle pain (11%), confusion (9% patients), headache (8%), sore throat (5%), runny nose (4%), chest pain (2%), diarrhea (2%), and nausea and vomiting (1%). Huang et al, [14] described fever (98%), cough (76%) and myalgia or fatigue (44%) as common symptoms at the beginning of the disease; Less common symptoms were sputum production (28%), headache (8%), hemoptysis (5%), and diarrhea (3%). Dyspnea developed in 22 (55%) of 40 patients. And Ding et al, [15] described in their study, fever (100%), cough (100%), difficulty breathing (100%), nasal tampon (60%), pharyngalgia (60%), myalgia (40%), fatigue (40%), headache (40%) and expectoration (40%).

The median estimated virus incubation period is approximately 5,5 days with a range of 0 to 14 days, and according to the Centers for Disease Control and Prevention (CDC) is within 2 to 14 days [16,17]. Guan et al, [11] mention that the median incubation period was 4 days (interquartile range, 2 to 7 days). Another study mentions that the median incubation period was 3 days, although the incubation period could be from 0 to 24 days in exceptional cases; [18] and finally, Backer et al, [19] mentioned an average incubation period of COVID-19 of 6.4 days that varies from 2,1 to 11,1 days

Transmission of infectious diseases is based on three conditions: sources of infection, routes of transmission, and susceptible hosts. Human-to-human transmission was considered a primary mode of transmission for COVID-19. According to the sixth version of the guide for the diagnosis and treatments for COVID-19 issued by the Chinese National Health Commission, COVID-19 is transmitted through respiratory aspirates, droplets, faeces, and, quite possibly, transmission by aerosols [20]. In the absence of vaccines or antiviral drugs for the treatment of COVID-19, hygiene measures (hand washing) and non-pharmaceutical interventions, such as social distancing and movement restrictions (which are the basic strategies

available to mitigate the spread of disease in the population) [21].

Due to the characteristics of dental settings, the risk of cross infection can be high among dentists and patients. For dental offices and clinics in countries and/or regions that are affected with COVID-19, strict and effective infection control protocols are urgently needed [22]. The American Dental Association (ADA) recommends control measures for respiratory infections, along with precautions for contact, and thus prevent transmission of COVID-19 and all flu-like illnesses in a dental care setting [23].

This work aims to establish considerations for infection control in dentistry, with a specific focus on personal protection and the equipment used in dental care, which should be implemented in the dental office to avoid further spread of COVID-19 infection, both from dentists and patients.

The dentistry as staff at risk to COVID-19

Health workers face a high risk of exposure to infectious diseases, including the new COVID-19 in China. The WHO confirmed 8098 cases and 774 deaths (9.6%) during the SARS outbreak in 2002, of which health workers accounted for 1,707 cases (21%). Recent evidence suggests that even someone who is not symptomatic can spread COVID-19 with high efficiency, and conventional protective measures, such as face masks, provide insufficient protection; suggesting that people can be infected by patients with subclinical infection, either by droplets or by direct contact with secretions from infected cases, followed by subsequent inoculation into the mucous membranes [24]. Unlike SARS-CoV, transmission of COVID-19 occurs during the prodromal period when infected people are slightly ill and carry out their usual activities, which contributes to the spread of infection [25].

The forms of contagion are defined as: (a) those who live in the same household with a confirmed infection; (b) those with direct or face-to-face contact (for any period of time) with an infected person or with their biological fluids, without having adequate protection measures; (c) those who are within 2 meters of a person with a confirmed infection for more than 15 minutes; (d) be informed by a public health institution that there has been contact with a confirmed case [17,26].

COVID-19 is highly infectious, pathogenic, and highly transmissible; person-to-person transmission occurred primarily through nosocomial transmission; This is transmitted predominantly through direct or indirect contact with the mucous membranes in the eyes, mouth or nose. The respiratory tract is probably not the only transmission route for COVID-19; therefore, exposure of unprotected eyes to COVID-19 could cause an acute respiratory infection. It is necessary that when examining suspicious cases, protective glasses should also be worn [27-29].

In dentistry we are exposed to many microorganisms by the presence of aerosols produced by the use of the high-speed handpiece. Aerosols are an important source of the emission of microorganisms, and it is essential to comply with all the biosafety regulations that protect both the operator and the patient [30]. Therefore, the ADA has issued a brochure that provides strategies to help prevent the transmission of respiratory disease in the dental health care setting, and routine cleaning and disinfection strategies [31].

Therefore, the closeness that occurs between dentists and patients during the examination and the direct treatment that is always performed in the dental chair, can represent a great infectious risk, increasing the possibility of cross infection between patients and dentists within dental offices, more than other clinical disciplines.

Strategies to prevent transmission within the dental office

Zhang et al, [32] provided the effective measures taken to reduce infection among health professionals and made suggestions to improve job security during the outbreak of the COVID-19 epidemic. This contributes to the rapid detection, the effective classification or triage and the isolation of infected health personnel. Therefore, guidelines and procedures should be established to detect infectious diseases at an early stage to timely determine pathogens, transmission routes, diagnosis, and treatment among healthcare professionals.

An epidemic can affect a large population, therefore the availability and appropriate use of personal protective equipment, such as N95 respirators, masks, gowns, and gloves, are crucial to protect the health of health professionals [33].

Patient selection

This should be the first step in reducing the risk of exposure of the dentist and uninfected people to COVID-19 disease. Trying to reduce the number of patients in the waiting room and attend to scheduled appointments.

Before starting any care, screening patients should be asked questions, such as: (a) In the past 14 days, have you had a fever (> 37.5°C), cough, sore throat, or breathing problems? ; (b) Have you had close or family contact with a suspected or confirmed case of COVID-19 ?; (c) Does it come from areas with a higher risk of COVID-19 in the last 14 days? [17,26].

Based on this preliminary examination, patients can be classified as low, intermediate, and high risk, resulting in different modalities of infection control precautions (Table 1) [17].

Similarly, in afebrile patients in reception triage, a questionnaire should be carried out to detect TOCC (travel to affected areas during the incubation period, occupation, contact of a suspected or confirmed case, group of cases), proposed by the Center for Disease Control and Prevention (CDC) [34].

CDC guidelines state that in cases where a patient exhibits symptoms of respiratory infection, postponing non-emergency dental procedures may be considered until the patient is no longer contagious. If urgent dental treatment is necessary, dental care personnel and physicians should work together to determine appropriate precautions on a case-by-case basis, and all personnel should wear protective gowns, N95 masks, goggles, and face masks; to prevent the possible spread of disease among patients, visitors and staff [23].

Decontamination of instruments and equipment in the dental office

There should be a detailed plan for instrument handling and office cleaning, including the methods and agents that will be used to clean and disinfect, between patient and patient.

A study in South Korea showed that many environmental

Table 1: Characteristics of the level of potential risk of COVID-19 infection [17].

Risk level	Characteristics of the patients
Low risk	No symptoms (eg, cough, fever, dyspnea, diarrhea)
	No contact with someone positive COVID-19
	Not have been in a high risk area during the previous 14 days
Intermediate risk	Presence of symptoms with:
	No medical history for contact with someone positive for COVID-19.
	Not have been in a high risk area during the previous 14 days.
	No symptoms but:
	Contact with someone positive COVID-19
High risk *	Stay in the high risk area for the previous 14 days.
	At least one symptom + one of the following:
	Contact with someone positive SARS-CoV-2
	Stay in the high risk area for the previous 14 days.

surfaces were contaminated by COVID-19, and virus RNA was detected on the surfaces within 5 days after the last positive PCR of the patients' respiratory samples [35]. Coronaviruses can persist on surfaces such as metal, glass, or plastic for a couple of days. In dental practices, they derive droplets and aerosols from infected patients, which probably contaminate all office surfaces. Furthermore, at room temperature COVID-19 remains infectious from 2 hours to 9 days, and persists better at 50% relative humidity. Therefore, a clean and dry environment must be maintained [36].

There is still no protocol for COVID-19; therefore, the recommendations to follow are based on the provisions of the CDC, which consider as critical items those that confer a high risk of infection, such as objects that enter the tissue that could transmit diseases. Most items in this category should be purchased as sterile or steam sterilized, if possible. The ADA recommends that surgical instruments and other instruments that normally penetrate soft tissue or bone be classified as critical devices that must be sterilized after each use or discarded. Instruments that are not intended to penetrate soft tissue, but that may come into contact with oral tissue are classified as semi-critical, and disinfection is recommended after each use [37].

Sterilization methods that can be used for critical or semi-critical dental instruments and materials can be sterilized with high pressure steam (autoclave), chemical steam (formaldehyde), and dry heat (for example, 320°F for 2 hours). The CDC has divided non-critical surfaces such as clinical contact and clean surfaces. Clinical contact surfaces are surfaces that can be touched frequently with gloved hands during treatment or that can become contaminated with blood or other infectious material and, subsequently, make contact with instruments, hands, gloves or devices (for example, light, switches, dental radiography equipment, etc.). Protective barrier covers (eg, clear plastic wrap) can be used for these surfaces, particularly those that are difficult to clean. Protected surfaces should be disinfected at the end of each day or if contamination is evident and not protected by barriers, these surfaces should be disinfected between patients. Most clean surfaces should be cleaned only with water and detergent. For superficial and non-critical disinfection of patient care equipment, a 1: 100 dilution of chlorine and water is currently being

used [35]. Another alternative for the dental chair is to use a soft cloth dampened in disinfectant that contains 2000 mg/L chlorine or 75% ethanol. When using the former, the residual chlorine disinfectant should be carefully wiped clean with a soft cloth after disinfection, and when using 75% alcohol the surface of the equipment should be dried naturally or wiped with a soft dry cloth [38].

Control of the generation of aerosols and drops in the dental office

The objective of controlling the generation of aerosols is to prevent the spread and reduce the concentration of infectious droplets in the environment; since there is the possibility of transmission when exposed to an aerosol for a long time in a relatively closed environment [3].

Aerosol is a colloidal dispersion system in which solid or liquid particles are dispersed and suspended in a gaseous medium. Microbial sprays are microorganisms, such as bacteria, viruses, and mycoplasmas, that bind to aerosol particles and are suspended in the air. Aerosols can be divided into 3 types according to the size of the suspended particles: (a) particles with a diameter of 5 µm or less can be transmitted to the alveoli through the respiratory tract; (b) particles with a diameter of 5 to 10 µm have a reduced ability to reach the alveoli, but can still reach the bronchus; (c) Particles with a diameter of 10-20 µm, their ability to reach the bronchus is significantly weakened. Cough or sneeze drops have been reported to travel up to six feet [39]. Chinese doctors recently suggested that COVID-19 is capable of being transmitted by aerosols; [40] therefore; dental practice is always considered risky, since it is a frequent generator of aerosols that contain potentially infectious agents, such as those found in the patient's blood, saliva, and oral cavity [41].

Therefore, it is necessary that to achieve good control and reduction of the generation of aerosols in the dental office, follow the following guidelines: (a) All treatment should start with the use of mouth rinses, keep in mind that rinses with chlorhexidine, they appear to be ineffective in killing the virus. However, the virus is vulnerable to oxidation, so they recommend rinsing with oxidative elements such as 1% hydrogen peroxide or 0.2% povidone-iodine. (b) Patients who have signs and symptoms of the flu or cold should wear face masks in the waiting room to reduce the discharge of pathogenic droplets and aerosols. (c) The use of rubber dam can significantly reduce airborne particles in a diameter of ~ 3 feet from the operating field by 70%; and should be used with extra high volume suction. (d) Avoid constant use of saliva suction. (e) Avoid intraoral radiographs, because they stimulate salivation and cough, prefer extraoral radiographs such as panoramic or tomography. (f) Avoid using the triple syringe in its spray form, and try to dry with cotton. (g) Use handpiece with retraction valves, to avoid aspiration and expulsion of waste and fluids during dental procedures; apart, the aerosol emitted by a high-speed piece reaches a radius of up to 2 meters. (h) Increase the distance during the treatments, reduce the operating time and instruct the patient to avoid talking as much as possible. (i) Maintain good ventilation; Air purifiers can also be used, and ultraviolet radiation can kill viruses in the air. [22,36, 39,41,42].

Zhiyong et al, [43] recommend avoiding treatments that can produce drops and/or aerosols, based on relieving the patient's pain (Table 2).

Table 2: Dental treatments prone to forming drops and/or aerosols and corresponding control measures [43].

Treatment	Control measures
Oral examination	Adjust the patient's position so that he is relaxed, if necessary use suction to aspirate.
Air/water syringe	Avoid using as much as possible, use cotton to dry.
Intraoral radiography	Use extraoral imaging techniques, including CT scans if possible.
Removal of caries or old restorations	Selective treatment; if necessary local anesthesia can be used in combination with suction and rubber dam; As much as possible, use chemical removal and dentin curette to remove cavities.
Exposed dental pulp	Local anesthesia, use rubber dam and suction to aspirate when removing caries, use dentin curettes.
Teeth grinding, occlusal adjustments	Selective treatment; if necessary, it can be done under a rubber dam and strong suction, as close as possible to the gums.
Acid etching, rinsing, adhesion and drying.	Selective treatment; Operate under rubber dam and strong suction, slow and gentle rinse; Reduce the air pressure of the triple syringe and apply it remotely from the work area.
Ultrasonic cleaning, brushing and polishing of roots	Selective treatment; if necessary, use manual scrapers, pay attention to the working angle and combine with strong suction; try to do a smooth scaling.
Tooth extraction and surgeries	Selective treatment; if necessary, lowered local anesthesia, minimally invasive extraction and as little traumatic as possible.
Drainage, irrigation and wound suturing	Slowly rinse the wound under local anesthesia; use absorbable suture.
Abscess incision	Incision and drainage, as smooth as possible to avoid splashing.

Use of personal protective equipment

The use of personal protective equipment could further reduce the risk of exposure of dentists to infectious drops expelled from a COVID-19 patient. The first step is proper handwashing, strict hand hygiene measures are a simple and effective way to prevent the spread of any source of infection. Hand hygiene with an alcohol-based scrub is used as one of the most effective and inexpensive procedures against cross-transmission. By denaturing proteins, alcohol inactivates coronaviruses, and therefore formulations with at least 60% ethanol and/or 75% alcohol have proven effective for hand hygiene. They should be washed before contacting the patient, after contacting the patient, after exposure to body fluids, and after touching the patient's environment; Wearing gloves cannot replace hand washing, and hand washing or disinfecting is required after removing gloves [43-45].

The dentist must wear full personal protective equipment, eye protection glasses and face masks must always be used to protect the mucous membranes of the eyes, nose and mouth, during procedures that may generate splashes of blood or other body fluids. and provide patients with protective glasses; Wear isolation gown, gloves, hat, and N95 surgical mask (during aerosol-generating procedures) and masks are disposable, single use [23,30,31,42,43].

All of these means are designed to prevent the skin and mucous membranes of the eyes, mouth, nose and other parts from coming into contact with the patient's saliva, blood or other body fluids [36,43].

The proposed intervention measures for microorganisms in the dental clinic environment, namely: air purification, preoperative gargles, application of quick suction devices, ergonomic design of treatment chairs, strengthening of self-protection of personnel and protection hierarchical diagnosis and treatment processes [46].

Managed waste

After completing some treatment, all the protective elements used to avoid self-contamination must be carefully removed. Gloves are removed first because they are now considered highly contaminated. Once gloves are removed, hands should be disinfected with a disinfectant or alcohol gel; then a new pair of gloves should be worn to continue the procedure. With the new pair of gloves, the

gown should now be removed; If you wear a gown with a back zipper, the attendant should help remove it. The eye protection should be removed then, when removing the glasses or face shields, you should avoid touching the front part, which may be contaminated by drops or particles; These should be cleaned and disinfected with 75% ethanol or soaked in 500 ~ 1000 mg/L of disinfectant containing chlorine for 30 minutes, then rinsed under running water and dried. The removal of respiratory protection comes later; it is important not to touch the mask. Eventually the last pair of used gloves will be removed, which may now be contaminated. After removing the gloves, hand washing should be repeated [17,43].

The Occupational Safety and Health Administration, CDC, and WHO state that waste from COVID-19 patients is handled as standard regulated medical waste. In their COVID-19 infection prevention recommendations, the CDC says, "Management of ... medical waste must also be done according to routine procedures" [47,48]. (a) The use of a single leak-resistant bag is usually adequate for the containment of medical waste, provided the bag is resistant and the waste does not contaminate the outside of the bag. (b) Contamination or perforation of the bag requires its placement in a second biohazard bag. (c) All bags must be tightly closed for disposal. (d) A rigid container must be used for sharps. (e) For waste transportation, plastic bags are required to be contained in a rigid container, (f) Regulated medical waste is decontaminated to reduce microbial load and to make by-products safe for further handling and elimination. (g) The treatment need not render the waste "sterile". (h) Treatment processes may include autoclaving, incineration, chemical disinfection, grinding/crushing/disinfection methods, energy-based technologies (eg, microwave or radio wave treatments) and disinfection/encapsulation methods [48].

The bags containing waste can be disinfected with a solution containing chlorine at 1000 mg/L, before transport. [43] and for household waste generated by the treatment of patients, double-layer yellow bags with "gooseneck" ligation should be used [36].

Conclusion

At this time of pandemic in the world, we as dentists have a responsibility to protect our patients and ourselves. Therefore, it is of utmost importance to remain alert and start taking the necessary measures to prevent cross-transmission, and thus be able to provide

adequate treatment to our patients. Being essential to know and strictly disseminate all the considerations that have been detailed in this review.

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