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Impact of SARS-CoV-2 on dentistry: a review of literature

M. BASILICATA[1], F. ZARONE[2], R. LEONE[2], C. GUERRIERO[3], M. DI LAURO[3], R. FRANCO[4], S. BERNARDINI[5], A. NOCE[3], P. BOLLERO[6], R. SORRENTINO[2]

[1]Department of Experimental Medicine and Surgery, University of Rome "Tor Vergata", Rome, Italy
[2]Department of Neurosciences, Reproductive and Odontostomatological Sciences, University "Federico II" of Naples, Naples, Italy
[3]Department of Systems Medicine, UOC of Internal Medicine-Center of Hypertension and Nephrology Unit, University of Rome "Tor Vergata", Rome, Italy
[4]Department of Biomedicine and Prevention, University of Rome "Tor Vergata", Rome, Italy
[5]Department of Experimental Medicine, Clinical Biochemistry, University of Rome "Tor Vergata", Rome, Italy
[6]Department of Systems Medicine, University of Rome "Tor Vergata", Rome, Italy

Abstract. – OBJECTIVE: SARS-CoV-2 is a new Coronavirus identified as the cause of Coronavirus disease in 2019 (COVID-19). The epidemic spread in China and beyond its borders, involving 114 countries with more than 5 million dead. On March 11, the WHO declared the spread of SARS-CoV-2 to be a pandemic and encouraged nations to adopt harsh restrictive measures. Therefore, patients more and more often turn to dental offices only for emergencies. Healthcare professionals, including dentists, are at high infectious risk. In fact, the closeness to the oral cavity and nasopharynx and the use of drills or ultrasonic devices that cause aerosol release, make dental professions at high risk of bacterial and viral infections. The way patients are treated has changed. In fact, it should be mandatory to carry out a pre-treatment telephone triage and the use of mouthwashes to reduce bacterial load. In the current pandemic, it is necessary to adopt specific safety protocols that can protect dental operators as well as limit the spread of the virus. The purpose of this review is to present an overview on ways to reduce the risk of SARS-CoV-2 contagion in dentistry by focusing on the immediate situation as well as by looking towards the future.

MATERIALS AND METHODS: To reach the review purpose, we selected a series of studies using keywords "COVID-19" OR "SARS-CoV-2" in association with "dentistry" AND "safety protocols" AND "healthcare procedures" AND "individual protection dispositive" AND "air transmission" AND "droplet". We selected papers exclusively in English language, up to 1st January 2022.

RESULTS: During future phases of the pandemic, everywhere in the World, it is necessary to impose all dentistry team both a serological screening and the vaccination, as already established for all health staff in Italy.

CONCLUSIONS: For own safety, it is an important for the whole dentistry category constantly update the devices and the protocols adopted, as well as monitoring the real infectious threats, which may occur.

Key Words:
COVID-19, SARS-CoV-2, Coronavirus, Dentistry, Infection.

Abbreviation
ARD: Aerosol reduction devices; ARDS: Acute Respiratory Distress Syndrome; BAL: Broncho-alveolar lavage fluid; CCDC: Cambridge Crystallographic Data Centre; DIC: Disseminated intravascular coagulation; COVID-19: Coronavirus disease-19; CSG: Coronaviridae Study Group; ICU: Intensive Care Unit; LMWH: Low-molecular-weight heparins; NCP: Novel Coronavirus pneumonia; NPS: Nasopharyngeal swabs; OPS: Oropharyngeal; PAPRs: Powered air-purifying respirators; PPE: Personal protective equipment; WHO: World Health Organization.

Introduction

In the last two millennia, humans have been affected several times by infectious agents causing pandemics[1]. In 2019, a new global epidemic spread from the city of Wuhan in China, due to a pathogen named SARS-CoV-2, which has been identified as the cause of Coronavirus disease-19 (COVID-19)[2]. On 30th of December 2019, the World Health Or-

Corresponding Authors: Michele Basilicata, MD; e-mail: michele.basilicata@ptvonline.it
Annalisa Noce, MD, Ph.D; e-mail: annalisa.noce@uniroma2.it

ganization (WHO) declared the 2019-nCoV virus, subsequently renamed as SARS-CoV-2 in February 2020, to be a Public Health Emergency[3]. Then, according to taxonomic and genomic studies, the Coronaviridae Study Group (CSG) finally named the virus SARS-CoV-2, inserting it in the category of "severe acute respiratory syndrome-related Coronavirus"[4].

SARS-CoV-2 is a positive-sense RNA virus, tied to nucleoprotein and surrounded by a capsid composed of matrix protein. The SARS-CoV-2 virus belongs to the family of Coronaviridae, suborder of Cornidovirineae, order of Nidovirales[5]. Similarly, to SARS-CoV-1 and MERS-CoV, the SARS-CoV-2 virus transmission is conveyed in the human species by an intermediary animal, sold in the Wuhan Wet Market[6]. Studies are being conducted to find out whether the actual vehicles were bats or pangolins, the only mammals to be infected by the SARS-CoV-2 virus and, therefore, the most probable reservoirs of the infection[7,8]. Globalization and free market era have made it possible to speed up the process of human infection, with the virus quickly reaching Europe in the mid of January 2020[9].

The aim of this review is to investigate how common clinical practice in dentistry changed during the COVID-19 pandemic and describe all specific security strategies and protocols that can protect dental professionals from the SARS-CoV-2 infection.

Epidemiology

The epidemic spread in China and beyond its borders, involving 114 countries with more than 5 million deaths. On 11th March 2020, the WHO declared the spread of SARS-CoV-2 to be a pandemic and encouraged nations to adopt harsh restrictive measures[10].

Epidemiological data collected in recent retrospective studies confirm that the presence of severe symptoms, which can even lead to death, is closely correlated to age and to the presence of underlying systemic diseases[11]. In fact, the average age of patients who died positive for SARS-CoV-2 is at least 15 years higher than that of patients who contracted the infection. Furthermore, men are affected in greater numbers, while women account for 35.8%[12]. Smoking habits have been associated, in an early systematic review, as well as an increased likelihood of experiencing severe symptoms and requiring Intensive Care Unit (ICU) hospitalization[13].

In preliminary sample studies, 4 out of 99 patients experiencing severe symptoms, had coinfections of bacteria and fungi[14]. The pediatric population (i.e., under the age of 18) has an excellent respiratory system that is not contaminated by smoke and pollution and has a stronger immune system. Data corroborates that this is the reason why the pathology shows a mild course in pediatric patients, often without fever or pneumonia[15,16].

Chinese data calculated an average mortality rate of 2.4 %[17]; the subsequent adjustments report that Italy has the highest mortality rate of 6.22%, followed by Spain and France, respectively, 6.16% and 4.21%[18]. Nowadays, according to the epidemiologic data reported by the Italian National Institute of Health, the mortality rate in Italy is 5.4 %[19]. Today, globally, there have been more than 300 million confirmed cases of COVID-19, including more than 5 million deaths, as reported by the WHO. Among these, the infection rates between clinicians and nurses remain high due to the lack of early operating protocols and adequate personal protective equipment[20].

Clinical Signs

A study conducted by Cao et al[21] highlighted that the main symptoms of Novel Coronavirus Pneumonia (NCP) were fever (87.3%) and cough (58.1%)[22,23]. Less frequently clinical manifestations were dyspnea (38.3%), myalgia or weakness (35.5%), chest tightness (31.2%) while some patients showed other symptoms such as chills, cough, conjunctival discomfort, headache, "shortness of breath" and joint pain. Instead, others presented nausea, vomit, diarrhea, and other gastrointestinal symptoms, whereas a few patients displayed hemoptysis symptoms[24,25].

A report from the Cambridge Crystallographic Data Centre (CCDC)[26] assessed that only 5% of patients was critically ill, while 14% of patients showed severe pneumonia. Moreover, 81% of patients presented mild pneumonia.

The incubation period and clinical course of SARS-CoV-2 infection are probably similar to that of SARS-CoV-1. An average incubation period of 5.2 days was first reported by Li et al[27]. However, recent reports have found that the incubation period might be as long as 24 days[28,29]. Lower respiratory symptoms often develop about one week from the onset of initial symptoms[30].

Treatment

In the absence of specific therapy, various types of pharmacological treatments have been used to treat SARS-CoV-2. These include a variety of antibiotics, such as the macrolide azithromycin, to treat presumptively known bacterial agents of atypical pneumonia. In early cases, therapy involved the use of antiretroviral agents such as lopinavir, ritonavir or protease inhibitors. On the other hand, in cases of severe acute respiratory distress syndrome (ARDS) and disseminated intravascular coagulation (DIC), the efficacy of low-molecular-weight heparins (LMWH) has been demonstrated[31].

However, an effective standard protocol remains to be validated. Besides rapid and reliable diagnostic tests as well as effective vaccines and antiviral drugs, the control of the epidemic depends on the early identification of the suspect cases, on the quarantine of patients (and their close contacts) and on effective infection control measures (i.e., digital apps).

Routes of Transmission

According to current evidence, the SARS-CoV-2 virus is primarily transmitted between people through respiratory droplets and by direct contact. Airborne transmission refers to the presence of microbes within droplet nuclei (i.e., particles <5 micron in diameter) and can remain in the air for a long period of time and be transmitted to others over distances greater than 1 meter. Airborne transmission may be possible when procedures or support treatments that generated aerosol are performed[32].

Droplets of different sizes might potentially transmit respiratory infections. The droplet particles, with diameter of more than 5-10 micron, are known as respiratory droplets while, the ones with diameter less than 5 micron are called droplet nuclei[33]. This kind of transmission happens when a person is in close contact (i.e., within 1 meter) with someone who shows respiratory symptoms.

Furthermore, an indirect contact, mediated by surfaces or with objects used on infected patients (i.e., thermometer or stethoscope), can cause SARS-CoV-2 virus transmission[30]. SARS-CoV-2 is more persistent on plastic and stainless-steel surfaces until 72 hours later, with a decreasing viral titer on copper surfaces. SARS-CoV-2 was not found there after 4 hours, and it was not found on cardboard after 24 hours. Just like SARS-CoV-1, there is a stunning decay of viral titer in all experimental circumstances[34].

In analyzed nasopharyngeal and rectal samples in 8 children who tested positive for SARS-CoV-2, the results confirmed the persistence of SARS-CoV-2 presence in the rectal samples, even when the nasopharyngeal swab turned to negative. It might be speculated that the virus excretion is longer and more persistent throughout the digestive system than throughout the respiratory system. Notably, a report of one case of SARS-CoV-2 infection in Germany indicates that transmission of the virus may also occur through contact with asymptomatic patients[35].

The analysis of conjunctival samples from confirmed and suspected cases of SARS-CoV-2 suggests that eye exposure represents an effective way of virus inoculation inside the body. Whether or not it is possible to detect the SARS-CoV-2 virus in air samples from patients' rooms, where no procedures or support treatment that generate aerosol are implemented, still needs to be investigated.

Laboratory Diagnosis: Swab and Serological Test

Performing a correct diagnosis depends on the sensitivity and the accuracy of the method and on the timeliness of the collection. The nasopharyngeal swabs (NPS) are more sensitive than oropharyngeal (OPS) ones[32]. Other respiratory samples, such as broncho-alveolar lavage fluid (BAL) are recommended, even if this method, *via* bronchoscopy, is more invasive and increases the risk of aerosol creation for operators[36]. This highly technical procedure requires trained staff and higher costs, whereas upper and lower respiratory specimens are easier to be detected and can be performed in limited settings[37].

Another crucial aspect is the time of specimen collection. RNA positive rates peaked in the upper respiratory tract specimens at 7-10 days after symptoms and then declined, while RNA positive rates in the lower respiratory tract remained higher throughout 3 weeks after onset. However, both specimens miss to diagnose early infection that can be detected only by bronchoscopy[38]. Serology can also be used as a supplementary tool, particularly when the NPS swab was not collected properly[39,40].

In addition to traditional methods, the analysis of saliva has also been studied as an effective mean to diagnose SARS-CoV-2. It was observed that salivary analysis also gives a good index on the course of the disease. Furthermore, the salivary test is much faster and does not require spe-

cialized personnel to be performed. However, this method is still under development, and it needs to be validated[41].

Search Methods

The aim of this paper is to review a collection of scientific studies that show the possible impact of SARS-CoV-2 pandemic on dentistry activity. A literature search was performed by six databases (PubMed, Web of Science, Cochrane, Scopus, Google Scholar, and Embase). The search was limited to peer-reviewed journals written in the English language and the search terms were "COVID-19" OR "SARS-CoV-2" in association with "dentistry" AND "safety protocols" AND "healthcare procedures" AND "individual protection dispositive" AND "air transmission" AND "droplet". We selected manually the papers from to 1st January 1980 up to 1st January 2022.

Dental Management

Impact on Dentistry

Dental practitioners are exposed at a high level to bacterial and viral infections[39]. Several European countries have reduced dental activities to emergencies only and even dental associations in the United States recently have also adopted these restrictions. At the same time, the role of dental clinics in oral care is crucial for preventing overcrowding in hospitals[42]. Closeness to the oral cavity and nasopharynx (which constitute niches with high viral loads) and the use of drills or ultrasonic devices that cause aerosol release, make dental professions at high risk of infection. In the current pandemic, it is necessary to adopt specific safety protocols that can protect dental operators as well as limit the spread of the virus[43]. Performing preventive telephone triage with simple questions can help operators identifying confirmed or potentially infected cases. Patients are questioned about their state of health in the past 15-20 days, asked if they have travelled to high-risk areas or had direct contact with infected or possibly infected subjects. The guidelines from American and Italian Dental Associations recommend postponing appointments with patients showing fever or severe coughing. In fact, a study shows that people with severe symptoms have a higher viral load than those with mild symptoms[44] and hopefully this correlation is also true for asymptomatic people. Through telephone triage, it is possible to categorize patients in confirmed and suspected cases, which helps evaluate the level of risk involved in treating them[45]. In cases of SARS-CoV-2 positive triage, it can be faced with multiple high-risk situations, which should be resolved by implementing the necessary precautions. If the patient is in absence of dental pain, it would be advisable to follow through telephone check-ups as he/she remains in isolated quarantine for at least 15 days[46].

If the patient suffers from pain or swelling, two options are available: (i) a primary pharmacological treatment or (ii) performing the necessary dental procedure. However, recent mathematical models that were based on the collected data suggest that most contagions occur in the pre-symptomatic period[47] and there are patients who are totally asymptomatic but potentially contagious. It is therefore recommended to treat patients as if they are infected with SARS-CoV-2. It is important to ensure that cross-infections within the common areas do not occur, so appointments must be scheduled to ensure that a minimum-security distance of 1.5 meters is kept between patients at all times. Attention should also be paid to bathrooms, providing only disposable towels and assuring frequent disinfection[48,49].

If a patient suspected to be infected with SARS-CoV-2 needs emergency dental treatment, this should be performed as the last scheduled appointment in order to reduce environmental contamination. Furthermore, the waiting room should be subject to constant ventilation, all objects that could be potentially ntaminated should be removed and surfaces should be cleaned frequently[41].

Washing hands and wearing masks is mandatory for personnel and patients and so it is necessary to organize checkpoints where masks, shoe covers, and hand hygiene procedures are checked (Figure 1). The first checkpoint should be set up before the entrance to the waiting room and it should be equipped with a dispenser of hygienic or hydroalcoholic solutions, a contactless thermometer and all the above-mentioned safety equipment. In the waiting room, a safe distance of 1.5 m between patients should be maintained. The second checkpoint should be placed before the entrance to the clinical area, where the hands are sanitized again, and a disposable gown should be provided to the patient. Dental assistants are divided in those who operate in area at high risk of contamination and the others in area at low risk of contamination. The doors should remain closed during the treatment. Moreover, it is ideal for dental clinics to use

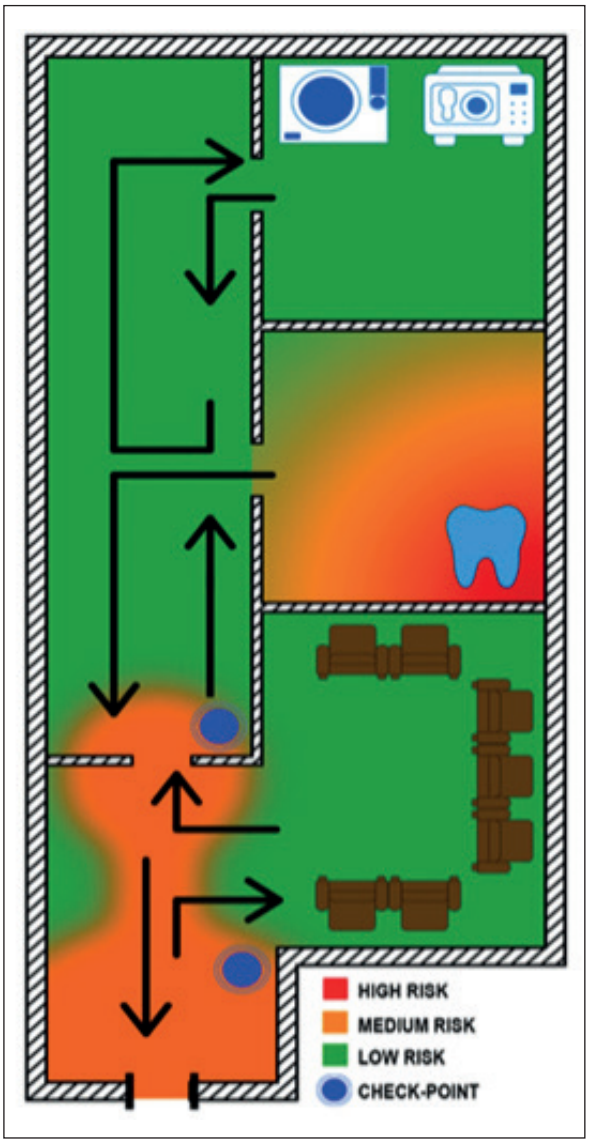

Figure 1. Checkpoints organization on high, medium, and low risk areas of dental offices.

different routes for people with a confirmed infection (slight or no symptoms) or for suspected cases[51]. Telemedicine has already been used for many years in various countries and in the current emergency, we can obtain great assistance from the digital world[52]. Several countries are working on the pandemic containment, thus contact-tracing is a key element in all strategies. In Italy, an app called "Immuni" is available and contains a clinical diary and a contact-tracing function based on data exchange through bluetooth low energy (BLE)[53]. From the University of California, encouraging news comes from the development of a portal-based SARS-CoV-2 self-triage. In dental daily practice, operators might wish to follow up patients through video calls, talking face-to-face to ensure patient safety. Additionally, routine orthodontic check-ups can also be carried out digitally[54]. Moreover, if necessary, digital contacts between dentists and radiologists should be intensified to facilitate the digital preview of x-ray imaging in order to minimize repeated contacts with patients[55]. Undoubtedly, this crucial attention to the spreading of the virus must also be implemented during dental procedures and cleaning phases, including activities to educate the staff. The reasons for accessing dental services are different. Elective treatments have been abandoned by the users and the fear of contagion in the dental office is high. In fact, patients go to the office for dental treatments only in case of need and not to carry out routine care. Indeed, the main problems observed during the pandemic are dental pulpal or periapical lesions, abscesses, and bruxism. Dentists thought that in the post-COVID era there would have been an increase in dental care. Now, thanks to the operators' vaccination campaign, patient comfort and confidence in dental care could be increased. In this way, patients can carry out routine treatments that are not urgent[56].

Patients' Evaluation

Dentists should draw up a careful medical record with the relative anamnesis of each patient and update it at each appointment[56]. During the pandemic period, it was and is still necessary to integrate the questionnaire used with targeted screening questions relating to COVID-19. These questions are also very important for detecting any asymptomatic case. In particular, the telephone triage should consist of the following questions[57]:

1. Have you had fever in the last 14 days?
2. Have you had a recent onset of breathing problems, such as coughing or breathing difficulties in the last 14 days?
3. Have you traveled in the areas with a high incidence of COVID-19 contagion in the last 14 days?
4. Have you come in contact with someone showing a confirmed COVID-19 infection in the last 14 days?
5. Have you had contact with people coming from those areas with a high incidence of contagion, with fever or respiratory problems, recently documented, in the last 14 days?
6. Have people with documented fever or breathing problems been in close contact with you, in the past 14 days?

7. Have you recently attended meetings, or have you had close contact with many people you do not know well?

If a patient answers YES to the first 2 screening questions, the dentist should discuss any doubts with the patient, call a local medical facility (i.e., COVID-centers located in the area) and, if it is chosen to perform the treatment, inform the staff that they will be treating a subject with suspected infection of SARS-CoV-2"[58].

Few months ago, if the patient returned from a geographical region with a large spread of SARS-CoV-2 infection, the dentist could postpone the treatment up to 24 days, following the end of the incubation period. Dentists also had to postpone the treatment of a patient in convalescence for at least one month after hospital discharge. SARS-CoV-2 convalescent patients were asked to stay home for 15 days after discharge from the hospital and, during this period, they were required to stay at home and to limit contact with others as much as possible[59].

Surface Decontamination in Dentistry

The stability of SARS-CoV-2 and SARS-CoV-1 in aerosol and on various surfaces and their decay rate are important aspects to investigate in order to provide appropriate guidelines for surface and environment decontamination in dentistry[34].

In experimental conditions, SARS-CoV-2 seems to remain in aerosol during all the three hours of the experiment. The infection rate of SARS-CoV-2 decreases in a similar manner as reported for SARS-CoV-1[60]. The same experiment was performed on different surfaces and SARS-CoV-2 seemed to remain infective on plastic and stainless steel for four days after application, even if the virus rate was successfully lowered. On copper surfaces, SARS-CoV-2 was not found after 4 hours and on cardboard, it was not found after 24 hours. The estimated shelf life of SARS-CoV-2 was about 5.6 hours on stainless steel and 6.8 hours on plastic. SARS-CoV-2 in aerosol lasts up to 1.1-1.2 hours such as SARS-CoV-1[34].

According to the authorities of International Public Health, the procedures for SARS-CoV and MERS-CoV disinfection are the same as those normally performed in hospitals. In order to minimize the risk, Public Health England recommends preventing effective infection and establishing control measures, including transmission-based precautions with personal protective equipment (PPE). For the prevention of virus spreading, it is essential the appropriate cleaning and the decontamination of the environment[61].

Despite its high persistence on different surfaces, SARS-CoV-2 can be efficiently inactivated by good disinfection procedures. For this reason, it is essential to efficiently carry out the initial cleaning stage[62].

The lipid envelope of SARS-CoV-2 is susceptible to a wide range of disinfectants. Surface disinfection with 62-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite, within 1 minute, can inactivate human coronavirus. Instead, 0.05-0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective[63].

Therefore, it is important to meticulously perform a daily routine surface disinfection and an additional extraordinary one, in case of visible contamination. The operator who performs the sanitation must be provided with the same PPE used for the clinical practice, including a double pair of rubber gloves. The cabinets and chairs must be disinfected with 0.5% sodium hypochlorite. It is mandatory not to vaporize disinfectants on biological materials, so as not to create aerosol[64].

Disinfection in the Patient-Care Area

Medical institutions should provide effective and strict disinfection measures in both clinical settings and public areas[65]. Operating in a negative pressure room would be ideal[66]. Alternatively, ventilate the operating rooms for at least 15 minutes between one patient and another[67].

Protocol for the Management of Surface Cleaning and Disinfection of Medical Environment (WS/T 512-2016) established by the National Health Commission of the People's Republic of China suggests the cleaning and the disinfection of the environment. These procedures have to be extended to public areas and appliances, including door handles, chairs and desks. Moreover, the lift should be regularly sanitized. Individuals should wear masks properly and should not touch buttons and other fomites with bare hands.

PPE and Healthcare

During dental practice, using high-speed drills or ultrasonic scalers could produce aerosol which contain bacteria, viruses, fungus, saliva or blood and therefore represent an important source of infection[68,69]. The use of high-speed drills or ultrasonic scalers in dental clinics can increase the spreading of infections and the personnel shoud maintain an elevated level of alert in terms of respecting safety protocols, since airborne droplets are the main vehicles of SARS-CoV-2 transmission. In order to prevent that, it is of utmost importance to carry out training and education of the dental team, which manages the use of protective equipment during the SARS-CoV-2 pandemic. Moreover, the whole staff should be

reduced to those who are absolutely necessary for the patient's safety, as well as being protected with appropriate PPE[70].

The PPE should be easily removable, avoiding any possible contamination. It is good practice to pursue all procedures in the order indicated below, as issued by various Public Health Authorities:

1. carry out a thorough hand washing for 20/30 seconds with an alcoholic solution both before and after procedures;
2. perform the correct dressing in an aseptic space, or preferably, in an antechamber;
3. wear the gloves; it is necessary that the external glove is extended to cover the wrist part of the isolation gown, also avoid attaching them together so as to ease their removal;
4. wear the FPP2-N95 filter in a correct manner;
5. protect the eyes by the use of goggles with lateral protection to avoid contact; a visor, paired with goggles, can further prevent facial contamination;
6. wear waterproof shoes that can be decontaminated; overshoes represent further good hygiene but should not be considered as a mandatory condition;
7. use a plastic polyethylene wrap to cover all surfaces exposed to contact.

The PPE should be worn step by step as follows:

1. gloves
2. gown
3. mask respirator
4. goggles and/or face shield
5. headgear
6. second pair of gloves (extended over the gown).

The undressing procedure should be performed step by step as follows:

1. wash the external gloves with alcohol and then remove them without removing the internal gloves;
2. put on new gloves;
3. remove the gown;
4. wash the external gloves with alcohol;
5. remove the goggles and/or face shield;
6. wash the external gloves with alcohol;
7. remove the headgear;
8. wash the external gloves with alcohol;
9. remove the FPP2-N95 filter from the elastic posterior bands;
10. wash the external gloves with alcohol and then remove them;
11. remove the internal gloves and immediately wash hands with alcohol solution.

All the disposable PPE used must be considered potentially infected and stored in a special waste container. Creating appropriate dental settings (the ideal setting is at negative air flow), paired with a correct dressing and undressing of the PPE, significantly reduces chances of infection[71].

Furthermore, powered air-purifying respirators (PAPRs) used in intensive care departments still show some disadvantages but provide a remarkable alternative to FPP2-N95 masks by enhancing the fit and ensuring constant air flow[72].

Discussion

Some European countries are partly reducing their restrictions so as to learn how to coexist with the virus. The flattening of the contagious curve should allow hospitals to adequately manage SARS-CoV-2 positive patients[73]. It is necessary that re-introduction of a normal way of life will be controlled through protocols that balance socio-economic needs with the necessity to avoid further waves of contagion. At an early stage, health policies have recommended to reschedule the treatment of confirmed or suspected patients. Despite this, dentists have been asked to provide support to patients, especially if they are suffering from pain or if they are experiencing an emergency. This measure is also applied so to prevent patients from going to hospital emergency rooms, which could be closed due to new restrictions[74,75].

In dental practices, the main goal is avoiding cross-infections and transmission of SARS-CoV-2 to health professionals and other members of the dental team. Many guidelines of national and international dental associations, based on current clinical experience and on data collected from previous SARS-CoV and MERS-CoV outbreaks, have been published. Until now, few clinical trials have been conducted on actual SARS-CoV-2 transmission in dental and oral environment. The purpose of this review is to present an overview on ways to reduce the risk of SARS-CoV-2 contagion in dentistry by focusing on the immediate situation as well as by looking towards the future. This is based on guidelines or relevant scientific studies, explicating current indications and previous experience with SARS-CoV and MERS within clinical practice and ICU. It is worth emphasizing that, in a rapidly changing pandemic landscape, all members of dental teams have a professional

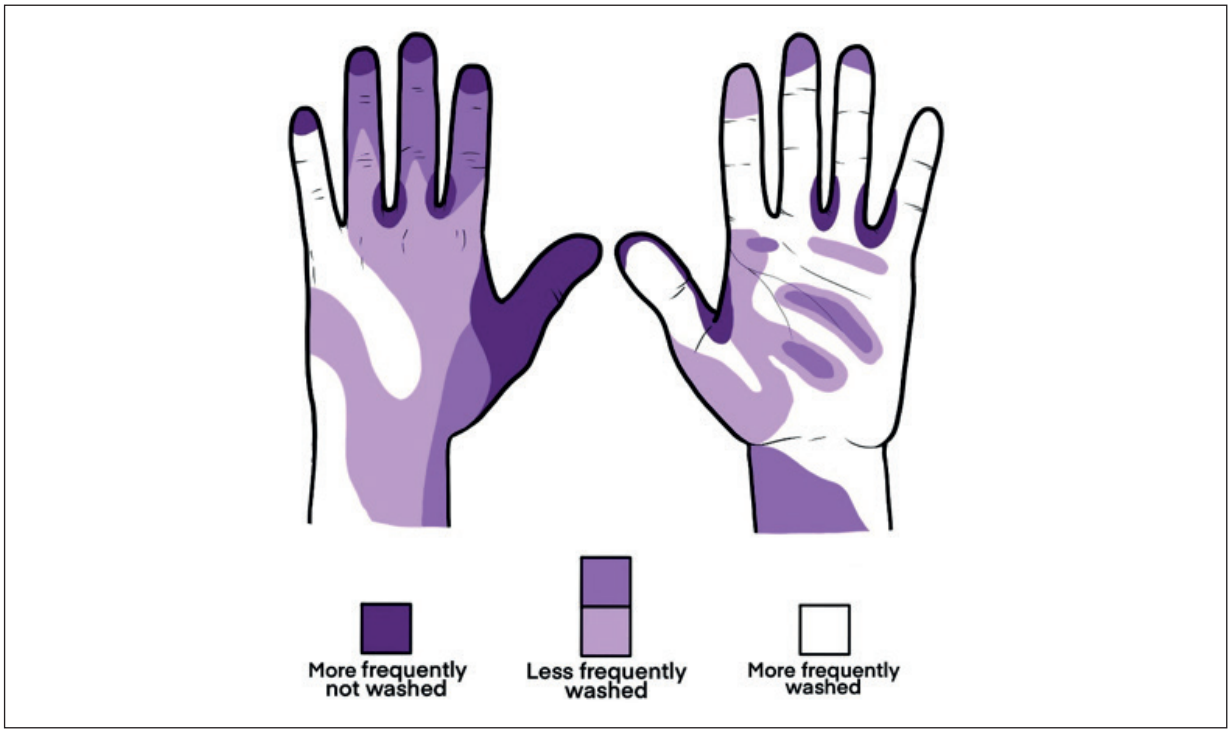

Figure 2. Areas of hand that are not properly washed owing to poor hand-washing technique.

responsibility to update themselves on national and international guidelines[76,77].

Primary Prevention

Performing proper oral hygiene procedures prevents carious diseases and warnings can be sent to patients via instant messaging applications, which are spread among people of all ages. It can be useful to communicate with patients through instant text messages or video calls as well as by sharing multimedia materials about appropriate brushing or flossing procedures[78]. Furthermore, children in quarantine spend a lot of time at home, increasing the consumption of sugary and soft food, so it is recommended to perform oral hygiene procedures more frequently[79].

Hand Hygiene in Dentistry

The microflora present on the skin is dichotomized in the surface layer, where there are bacteria derived from environmental contamination, called transient flora, and the deeper layer is populated by an endogenous flora less associated with infections[80]. For this reason, the careful washing of the hands is the mainstay of the infection control program (Figure 2). As Peng et al[81] reported, hand washing is recommended before touching the patient, before dental procedures after having touched the patient, after contact with non-sterile surfaces and after having touched the mucosa or biological fluids. Hands should be rubbed during their washing, soap is useful for removing coarse contaminants and hydrogel containing ethanol or isopropanol (concentration above 70% v/v) as active components, are strongly effective on inactivating SARS-CoV and MERS-CoV.

Reduction of Aerosol/Droplets

The generation of aerosol and splatters is inevitable during the use of ultrasonic scalers, rotary brushes and air prophylactics[82]. High-speed dental hand pieces with anti-retraction valves and high-volume evacuator are strictly recommended for reducing droplets and contaminated aerosol as well as for preventing transmission to the air and water pipes of the dental unit[83]. The use of ultrasonic scalers can be allowed if combined with the use of extra-oral evacuation devices and special aerosol reduction devices (ARD); also in this case, completely disposable enhanced protection is necessary[84]. Otherwise, manual scaling can be performed with comparable clinical results[85]. All authors agree on minimizing the use of a 3-in-1 syringe in order to reduce risk of generating contaminated aerosol[86].

Oral Mouth Rinsing

Currently, there are no studies that have investigated the effectiveness of mouth rinses against

COVID-19. The Italian Dental Association recommended protocol is to perform a first rinsing and gargle with hydrogen peroxide at 1% and a second rinsing and gargle with chlorhexidine at 0.20%[77]. An intermediate rinse with water is not recommended. The SARS-CoV-2 virus, as reported, is susceptible to oxidative agents and the known substantivity of chlorhexidine may prolong disinfection[87,67]. Even rinses with iodine-povidone at 0.2 % have been shown to reduce the viral load of coronaviruses, but it is not recommended for pregnant women and people with thyroid diseases. Gargling is important because the tonsils and posterior oral niches have been documented to have an additional viral load[88-90].

Rubber Dam Isolation

The isolation of the operative area during restorative and endodontic procedures is already mandatory. The rubber dam is highly effective limiting the spread of aerosol and reducing its saliva component[91,92]. In this pandemic setting, isolation with the rubber dam should be considered for different procedures during endodontic emergency, prosthetic preparations, placing the supragingival margin, and bonding and debonding procedures of orthodontic brackets[93,94]. Light-cured block out resins can be a useful tool when accurate isolation cannot be achieved[95].

Impression Making

The gag reflex can be stimulated by conventional impression making, which leads the patient to an increased saliva secretion and a subsequent coughing[96]. It is recommended to strengthen the sterilization of impressions and models with alcohol solution at 70% or hypochlorite solution when moving them to and from the laboratory. Digital impression procedure is preferable, as it causes less discomfort to the patient and reduces material interactions with the laboratory[95]. Remember to perform a meticulous disinfection (i.e., soaking in hypochlorite at 1%) of the scanner tip or change it between patients.

Radiographs

Intraoral posterior radiographs can especially cause reflex gags or coughs, so they should be avoided towards orthopanoramic imaging, CT cone-beam[97] or oblique lateral views instead of bite wings[97-99].

SARS-CoV-2 has a great impact on dentistry as the disease diffusion model allows it to be widely transmitted, especially for the production of aereosol. Therefore, a review of cross-infection protocols is required while carrying out this activity. Every patient, even if asymptomatic, should be considered as potentially infected. Dental professionals should use all personal protective equipment in order to avoid cross-infections and the transmission of the virus. In fact, these patients should undergo telephone triage and scheduled appointments to avoid crowding the waiting room[100,101].

Conclusions

COVID-19 is the most important infectious disease that the global community had to face in the new millennium. Unfortunately, to date, the infections have not stopped, despite the restrictive measures in social and working life and the use of vaccine against SARS-CoV-2. To cope with this pandemic, it is certainly necessary to adopt precise infection control measures and to improve the safety measures already present in dental offices, always remaining attentive to the control of cross-infections.

In the authors' opinion, during future phases of the pandemic, everywhere in the world, it is necessary to impose all dentists, freelancers, and health services employees both a serological screening and the vaccination, as already established for all health staff in Italy. Serological screening, besides ensuring the health of the patients, would also be useful to define the epidemiological impact of COVID-19 on dentists. It is an important issue for the whole category. Until worldwide vaccination is not achieved, the dentistry will be not recognized as one of the most exposed fields to the risk of infection. It must be necessary to constantly update the devices and the protocols adopted as well as monitoring the real infectious threats, which may occur.

Conflict of Interest

The authors declare that they have no conflict of interest.

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