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| REVIEW

Consequences of the pandemic on dental practices: a literature review

Consequências da pandemia nas práticas odontológicas: revisão de literatura

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ABSTRACT

SARS-CoV-2 is caused by an RNA virus responsible for the disease known as COVID-19. First diagnosed in 2019, in a human being in the city of Wuhan, China, this disease is classified as a severe respiratory disease. Propagation occurs through coughing, sneezing, inhalation of droplets, or even indirect contact with the nasal, oral, and ocular mucous membranes. Preventive measures involving social distancing, quarantine, and mask use were implemented to prevent its spread. Such measures challenge dental practices, since they depend on proximity and do not allow the use of personal protective equipment, which cover the patient's oral cavity. This integrative literature review sought to identify articles discussing preventive measures of adequate use in current dental practices, reducing the risk of COVID-19 contamination and spread. Results showed the importance of dentists acting on the disease transmission routes, following care protocols, implementing new dental clinic management practices, such as avoiding crowds, longer time between appointments, use of teledentistry, and adopting preventive measures inside the dental office like hand washing, use of N95 mask, face shield, and air filters. However, oral health professionals must be prepared to face any imminent challenge imposed by infectious diseases in dental practice, following protocol before, during, and after dental care.

Indexing terms: Coronavirus. COVID-19. Dentistry. Pandemics. SARS-CoV-2.

RESUMO

O SARS-CoV-2 é causado por um vírus RNA responsável pela doença conhecida como COVID-19. Essa doença foi diagnosticada pela primeira vez em 2019, em um humano na cidade de Wuhan, na China, sendo classificada como uma doença respiratória grave. A propagação da mesma se dá através da tosse, espirros, inalação de gotículas ou, então, contato indireto com as mucosas nasal, oral e ocular. Para evitar o avanço da doença, medidas preventivas foram implantadas, envolvendo o distanciamento social, quarentena e a utilização de máscaras. Tais medidas desafiam as práticas odontológicas, uma vez que os cirurgiões-dentistas dependem da proximidade; além do que a prática odontológica não permite o uso de equipamentos de proteção individuais que cubram a cavidade

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oral do paciente, obviamente. Este trabalho teve como objetivo reunir, através de uma revisão integrativa de literatura, artigos com medidas preventivas que possam ser utilizadas nas práticas odontológicas atuais, diminuindo o risco de contaminação e disseminação da COVID-19. Pôde-se observar a importância do cirurgião-dentista em atuar nas rotas de transmissão da doença, seguindo protocolos de atendimento, fazendo novo gerenciamento da clínica odontológica como por exemplo; evitando aglomerações, maior tempo entre uma consulta e outra, uso da teleodontologia e também medidas preventivas dentro do consultório, como: lavagem das mãos, uso de máscara N95, protetor facial e filtros de ar. Com tudo, os profissionais da saúde bucal devem estar preparados para enfrentar qualquer desafio iminente, imposto pelas doenças infecciosas na prática odontológica, seguindo protocolo, antes, durante e depois dos atendimentos odontológicos.

Termos de indexação: *Coronavírus. COVID-19. Odontologia. Pandemias. SARS-CoV-2.*

INTRODUCTION

The Severe Acute Coronavirus Respiratory Syndrome (SARS-CoV-2) is caused by an RNA virus responsible for the disease popularly known as COVID-19. First diagnosed in December 2019 in a human being in the city of Wuhan, China, this disease is classified as a serious respiratory disease. Since its emergence, scientists and researchers worldwide have sought to collect data on COVID-19, analyzing several aspects of the disease and its possible cures or control, through medications or vaccines [1,2].

As it is a virus, the World Health Organization (WHO) classified the spread of SARS-CoV-2 as a public international health emergency on January 30, 2020 [3], reclassifying it into a pandemic on March 11, 2020 [4]. COVID-19 propagation occurs through coughing, sneezing, inhalation of droplets, or even indirect contact with the nasal, oral, and ocular mucous membranes [5-7]. To prevent its spread, preventive measures such as social distancing, quarantine, and mask use were implemented [1]. Such measures challenge dental practices, since they depend on proximity and do not allow the use of personal protective equipment (PPE), which covers the oral cavity [1].

Establishments were declared temporarily closed during quarantine, including dental offices, as aerosol-generating procedures (AGP) are performed, with the use of a high-rotation instrument or triple syringe [4,8] as well as the handling of biological materials. Such characteristics, in fact, provide dental surgeons with a crucial role in preventing COVID-19 transmission. The oral cavity is the place in the human body with the highest concentration of microorganisms, which increases the biological risk of a dental office [7]. According to Gurgel et al. [1], coronavirus can survive in aerosols for hours and on surfaces for days. Presymptomatic and asymptomatic patients also spread the disease, thus facilitating its transmission.

Due to dental procedures, which may lead to cross-infections among dental staff and/or patients, and to the characteristics of COVID-19, all dental care, including emergency and urgent care, was limited during quarantine, posing challenges for dentists [3,4-6]. Moreover, dental offices must be a reliable environment with control and prevention measures not only against COVID-19, but also against all microbiological infections. Dentists, who have always been required to adopt biosafety measures compatible with their practice, including cleaning and disinfecting devices after each appointment, always seeking to follow biosafety standards, during the pandemic, were forced to modify their office management [4,7,9]. Therefore, dental surgeons are responsible for implementing preventive measures against coronavirus.

In this literature review, we sough to identify articles containing preventive measures that can be used in current dental practices, reducing the risk of COVID-19 contamination and spread.

METHODS

An integrative review aims to develop a comprehensive analysis of the existing literature, creating a basis for further discussions and analyses on a given topic. The idea for the study emerged after the first year of the COVID-19 pandemic, in which researchers pondered about changes undergone by dental practices during the pandemic.

Thus, this study focused on what has already been available in the specialized literature, as it is a recent topic.

Bibliographic search was conducted on the PubMed, VHL Regional Portal - VHL, Google Scholar, Embase, and Scopus databases, using the following terminologies: in Portuguese, ["Pandemia" OR "Coronavírus" AND "COVID-19" OR "SARS-CoV-2" AND "práticas odontológicas" OR "odontologia"]; in English, Dentist OR Dentistry AND Practice guideline AND Coronavirus disease 2019.

A total of 230,751 articles were identified from 2020 to 2021. Inclusion criterion for article selection consisted of titles which addressed the relationship between the COVID-19 pandemic and Dentistry (or Odontologia, in Portuguese), published in Portuguese, Spanish, and English.

As a result, 349 articles were identified. After reading their abstract, all those in which no changes in the preventive and biosafety methods used during dental practices were cited or mentioned were excluded, resulting in 130 articles.

After fully reading each of these articles, 34 publications reported or discussed changes in biosafety measures during dental practices as well as studies that discussed new practices (e.g., teledentistry).

Thus, seven stages were determined for developing the present study:

(1) elaboration of the study purpose;

(2) search for articles published between 2020 and 2021 (which was conducted from August to November 2021);

(3) organization of articles in a database created in the Microsoft Excel software;

(4) analysis of the title of the articles based on the first inclusion criterion (title);

(5) analysis of articles based on the second inclusion criterion (abstract);

(6) analysis of articles based on the third inclusion criterion (full reading of each article);

(7) discussion of results and synthesis of knowledge.

As a result of the bibliographic search and selection of scientific articles that meet the purpose of this research, 34 studies were identified (chart 1).

Chart 1. Characterization of studies included in the present article, according to title, objective, and country of origin.

1 of 3

Title	Objective	Country
COVID-19: perspectives for the management of dental care and education	List the challenges and perspectives in dental management in services and schools.	Brazil
Use of mouthwashes against COVID-19 in dentistry	Provide a comprehensive review of current recommendations on the use of mouthwashes during the COVID-19 pandemic and analyze their advantages and disadvantages.	Peru
Precautions in dentistry against the outbreak of corona virus disease 2019	Introduce basic knowledge of COVID-19 and protective measures for dentists.	China
The impact of the COVID-19 pandemic on dentistry	Discuss the impact of the COVID-19 pandemic on dentistry.	United Kingdom
COVID-19: a new turning point for dental practice	Discuss the impact of the spread of COVID-19 during dental practice.	Brazil
Recommendations for a safety dental care management during SARS-CoV-2 pandemic	Describe measures that can be adopted by oral health professionals to minimize the risk of cross-infection in dental practice during the COVID-19 pandemic.	Brazil
The efficacy of bio-aerosol reducing procedures used in dentistry: a systematic review	Assess the available data on three main measures: application of absolute isolation with a rubber dam, use of mouthwash before the dental procedure, and use of a saliva ejector during the procedure.	China

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Title	Objective	Country
Infection control in dentistry during COVID-19 pandemic: what has changed?	Review aspects of infection control in dentistry during the COVID-19 pandemic.	South Africa
COVID-19 Outbreak and Dentistry: Guidelines and Recommendations for the Provision of Dental Healthcare Services	Inform professionals in the area of oral health about the guidelines and recommendations that must be followed during dental practice.	Pakistan
Clinical experience, knowledge, attitudes and practice of turkish pediatric dentists during the COVID-19 pandemic	Assess the current knowledge, attitudes, and practices of Turkish pediatric dentists who provided dental care during the COVID-19 pandemic and compare and interpret the results with other studies.	Türkiye
COVID-19 and Dentistry – Safety issues regarding doctor and patient situation in time of vaccine availability	Present, based on the performed research, an overview of the situation during the COVID-19 pandemic in relation to patients and dentists as well as dentist supporting personal protection.	Poland
Knowledge, Attitude, Fear, and Practice towards Coronavirus Disease-2019 Preventive Measures among Iranian Dentists	Determine the relationship between knowledge, attitude, fear, and practice with COVID-19 preventive measures among Iranian dentists.	Iran
The clinical practice of Pediatric Dentistry post-COVID-19: The current evidences	Conduct a literature review of available evidence on the pediatric dental practice related to biosafety and clinical recommendations, aiming to guide pediatric dentists regarding dental approaches post-COVID-19 still without the vaccine.	United Kingdom
Reopening dentistry after COVID-19: Complete suppression of aerosolization in dental procedures by viscoelastic Medusa Gorgo	Introduce ways to control aerosol production during dental practice.	USA
Preprocedural Pool Testing Strategy for Dentistry during the COVID-19 Pandemic	Assess the results and usefulness of incorporating the COVID-19 testing protocol before dental procedures.	Pakistan
Dentistry and the COVID-19 Outbreak	Review current literature and introduce essential knowledge of COVID-19, recommend adequate prevention and protection protocols for dentists during the pandemic.	United Kingdom
The impact of the COVID-19 infection in dentistry	Provide measures to decrease COVID-19 transmission in dental practice by a review of current literature.	Italy and USA
Dentist Related Factors Associated with Implementation of COVID-19 Protective Measures: A National Survey	(1) Assess the implementation of improved international and national guidelines for infection control in daily practice and (2) investigate factors related to dentists that influence its implementation, more specifically the status of dentists' infection and their perceived risk of cross-infection in the dental environment.	Belgium
COVID-19's impact on private practice and academic dentistry in North America	Discuss measures implemented to minimize the risks of disease transmission, challenges in emergency dental care, impact on patients and the life of the dental team during the COVID-19 pandemic.	North America
COVID-19 outbreak and dental health care provision in Nigeria: a national survey	Assess the knowledge of professionals of oral health in Nigeria concerning the disease and their responses to preventivemeasures required by COVID-19.	Nigeria
Preventing the suspension of dental clinics by minimizing the risk of SARSCoV2 transmission during dental treatment	Present current knowledge of COVID-19 and propose methods to reduce the spread of the virus.	Poland
Delivery of Health Care by Spanish Dental Hygienists in Private and Public Dental Services during the COVID-19 De-Escalation Phase (June 2020): A Cross-Sectional Study	Describe the employment status ofdental hygienists caused by the COVID-19 pandemic in Spain during deconfinement (June 2020) to analyze knowledge patterns and the use of PPE, as well as limitations of dental activity or changes in the forms of provision of services, both in public and private healthcare services.	Spain

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Title	Objective	Country
Paediatric dental care during and post-COVID-19 era: Changes and challenges ahead	Review available literature and information on the provision of pediatric dental care during and after the pandemic and provide specific recommendations on the safe provision of dental pediatric care.	
Dentistry in a COVID-19 environment. Adaptation of the Oral Health Units in the health centers of the Community of Madrid.	Summarize the available scientific evidence on such adaptation.	Spain
A Review of Aerosol Generation Mitigation in International Dental Guidance	Assess how dental AGPs were defined in international dental guidelines, which mitigation processes were advised, and whether they were linked to the epidemiology of COVID-19.	United Kingdom
Dental practice during covid-19 pandemic: An observational study	Narrate the experience of the Department of Dentistry on how to perform dentistry in a safe and effective way, which would guide the dental professional without major environmental changes and requirement for capital items.	India
Remote management of dental problems in children during and post the covid-19 pandemic outbreak: A teledentistry approach	Draw special attention to the model of teledentistry in pediatric dentistry and to guide the management of children with dental problems during the COVID-19 pandemic.	Poland
A Risk-Based Approach to the COVID-19 Pandemic: The Experience in National Dental Centre Singapore	Provide an overview of the routes of transmission and share a risk-based approach to the new coronavirus disease (COVID-19) in a specialized tertiary center. Evaluation and mitigation of risks focused on the safety of the team and the patient, adopting a wide margin of safety, and dynamically respond to the level of risk at the work environment.	Singapore
COVID-19 and Dentistry: Prevention in Dental Practice, a Literature Review	Investigate preventive measures in dental practice, evaluating the health protection of professionals and patients during the new COVID-19 emergency.	Italy
Teledentistry and COVID-19: Be Mindful of Bogus "Good" Ideas!	Remind those who implement teledentistry about its importance and shortcomings.	France
Can Teledentistry Improve the Monitoring of Patients during the Covid-19 Dissemination? A Descriptive Pilot Study	Describe the advantages of teledentistry during the COVID-19 pandemic.	Italy
How to use laser safely in times of COVID-19: Systematic review	Conduct a literature review on the use of lasers in biosafety during the COVID-19 pandemic.	Brazil
COVID-19 pandemic and its impact on pediatric dentistry in austria: Knowledge, perception and attitude among pediatric dentists in a cross-sectional survey	Assess the knowledge, perception, and attitude towards COVID-19 among pediatric dentists in Austria.	Austria
Dental patient management in the context of the covid-19 pandemic: Current literature mini-review	Shed light on the concerns of dentists attending children and adults during the COVID-19 pandemic.	Ukraine

RESULTS

According to Mattos and Pordeus [5], any pandemic has a devastating and transformative effect on society, especially on the economy and health systems. It was only with the outbreak of the AIDS pandemic in the early 1980s that the world started discussing biosafety measures for medical and dental care. However, an existing trend against preventive measures lasted for several years, claiming that the use of PPE, such as masks and gloves, was unnecessary in dental practices, reflected in professional actions and scientific studies of the time. In 1985, for example, an article published in the New York Times stated that mask use hampered the relationship between healthcare providers and their

patients. Conversely, in early 1990, the American Dental Association (ADA) filed a lawsuit against the mandatory use of PPE, justifying it with data stating that no dental surgeon had contracted an infectious disease while working. Currently, after several studies and knowledge gathered since the AIDS outbreak, the stance against PPE use no longer exists.

As AIDS changed the view of healthcare providers regarding PPE, COVID-19 also follows the same pattern, increasing the awareness of healthcare providers regarding the disease and the biosafety measures used in the dental office [5,10]. During the coronavirus pandemic, several countries modified their restrictive measures and actions to reduce close contact between people, seeking to prevent COVID-19 spread and limit contagion. To this end, social distancing and quarantine were decreed, which poses a challenge to healthcare providers, especially dentists, as they had to reduce their working hours and adapt to biosafety conduct and measures such as increasing the level of protection with the use of face shield, protective glasses, disposable plastic apron, N95 respirator to ensure greater respiratory protection for dentists and their team, blocking at least 95% of extremely small particles (0.3 microns), suitable methods for disinfecting the air – such as HEPA air filter and germicidal lamps – and observe hand hygiene before and after changing gloves [1,3,11-14].

Some countries limited dental treatment to emergency care only, that is, dental conditions that can be fatal [14]. Dental associations and regulatory councils also published several guidelines for dental surgeons, recommending the suspension of non-emergency dental treatment to focus only on emergency and urgent care [5,6]. But despite the suspension of dental practices contributing to reducing possible COVID-19 infections, the need and search for urgent and emergency dental care in hospitals has increased. This demonstrated the need for dental care even during the coronavirus pandemic, which led several countries to resume consultations [1].

One study detected the presence of SARS-CoV-2 RNA in the saliva of twelve infected patients in Hong Kong. Although detection does not necessarily mean an infectious virus, some positive viral cultures showed the presence of live viruses, proving that saliva can transmit COVID-19 in both symptomatic and asymptomatic patients, even during normal breathing [1,5,6,9]. According to Patel [9], there are three COVID-19 transmission routes through saliva. The first consists of the direct exchange of secretions from the upper and lower respiratory tract and the oral cavity, the latter being considered the most important. The second route is gingival fluid, which is rich in blood components and may contain the virus and, thus, can be added to the saliva. The larger or smaller salivary glands are considered the third route and are a target of SARS-CoV-2 infection.

Although SARS-CoV-2 is a new virus, there were two epidemics involving coronavirus a few years ago: SARS-CoV and MERS-CoV. This allowed scientists to rely on the protocols develop at the time, using them at the beginning of the pandemic seeking to control COVID-19 spread. Currently, we know that patients themselves are the main source of COVID-19 infection, as they transmit the virus through respiratory droplets or aerosols generated by coughs, sneezes (up to one meter away), or close personal contact (such as talking very close to someone or kissing) [6]. Mattos and Pordeus [5] proposed four COVID-19 infection routes.

The first is by symptomatic transmission, where the symptomatic individual directly transmits the virus to another. The second is presymptomatic transmission, in which the infected person transmits the disease before presenting symptoms. The third route is asymptomatic transmission, whose asymptomatic infected individual transmits the virus but does not develop symptoms. The fourth and final route is environmental transmission, in which the contaminated environment transmits COVID-19, requiring no interpersonal contact. Contemporary studies indicate that most of COVID-19 transmission occurs from symptomatic people to those who use PPE incorrectly and remain in close contact. The coronavirus incubation period ranges from 0 to 14 days and the average period is 5 to 6 days. However, a 24-day incubation period was reported by a Chinese study, and samples obtained from patients recovered from COVID-19 constantly show positive RT-PCR results, something never seen in other infectious diseases. In short, the major challenge of coronavirus lies with asymptomatic patients [5,9].

Due to these factors, COVID-19 transmission in dental clinics must be considered given the high risk [6], as these are difficult environments to avoid the generation, in large quantities, of aerosols and droplets of both saliva and blood during dental procedures. The potential for the spread of a pathogen through aerosol must be minimized as

much as possible or eliminated within a dental office, as infected droplets can remain suspended in the air for up to 30 minutes. Hence, the mask should not be removed before this time, thus reducing the risk of contamination [6,9]. Due to these factors, the standard control of cross-transmission between patients-patients or professionals-patients is unable to eliminate the entire virus and prevent COVID-19 spread, which makes dentists responsible for disinfecting their work environment and implementing preventive measures against COVID-19 [1,5,15].

ADA proposed three measures that serve as guidelines to assist dentists and dental clinics during patient screening. The first selects patients who require urgent or emergency treatment. The second determines whether or not these screened patients may have COVID-19, which defines whether dental treatment can be performed or not. The last guideline assesses the patient's risk of contamination. Another ADA recommendation is that dentists apply a screening questionnaire to patients with questions specific to COVID-19, such as: whether they have contacted someone who tested positive for the disease in the last 14 days, whether they presented any of the symptoms in the last 14 days, among others. To select patients, the dental team must interview them before the appointment, whether by telephone, text messages, images, or video conference [1]. According to Mattos and Pordeus [5], there are two types of preventive measures that can be adopted during the pandemic: pharmacological and non-pharmacological, and the latter can be used by dentists. Non-pharmacological measures involve greater watchfulness when leaving home and greater hygiene (constantly washing hands), immediate identification and isolation of infected people, and implementation of blockades in establishments.

As a way to reduce the COVID-19 spread, Umer and Arif [16] advise dentists to test all patients 48 hours before the appointment, and that patients must remain in isolation until the time of care. To provide reliable and cost-effective testing for healthcare providers, the study used pooled testing, which can be used before dental care in asymptomatic low-risk patients and reduce the risk of spreading COVID-19.

The ideal dental treatment should be performed in individual rooms [5,17]. If not possible, specific guidelines should be followed for collective dental practices. For the latter cases, dental facilities with open floor plans (such as the undergraduate clinic at the Piracicaba Dental School, State University of Campinas) must place easy-to-clean barriers between chairs. Dental rooms must be at least 97 feet and the space between one chair and another, 6 feet [5]. The entire dental team must be up to date with vaccination. If one of the employees is experiencing COVID-19 symptoms, they should not attend the service. It is recommended that everyone on the team check the temperature twice and respect the correct use of PPE [1,3,17].

Dentists must avoid overcrowding their offices in circulation areas and waiting rooms, and a distance of 1.8 to 2 meters should be maintained between one patient and another [1,6,17]. For greater distance control, marks should be placed on the waiting room floor and all patients advised not to bring companions, except in case of need such as children, patients with special needs, or older adults. Glass or plastic physical barriers can also be installed at the reception, protecting both patients and employees and helping to avoid cross-infections [1,17]. The deep-seated idea that dental care is provided on a first-come first-served basis must be banned, thus avoiding crowds. It is essential that patients have a previously scheduled appointment, leaving a safe period between one appointment and another, reducing contact or proximity between patients. For cases in which the patient shows signs of COVID-19 symptoms, especially cough and fever, the appointment should be delayed, and health authorities notified [1,6,17,18].

Patients considered to be at high risk (e.g., older adults or immunosuppressed individuals) must be scheduled early. Patients should wait until appointment time in a personal vehicle or outside the dental establishment and should be called only when it is their turn to be treated. All objects or products that may contain the virus must be removed from the office such as magazines, vases, and toys. Pens used to complete the screening questionnaire must be constantly sanitized [17].

Dental surgeons must offer patients a surgical mask while awaiting their appointment, asking them to sanitize their hands when entering the office. This procedure can be done with 70% alcohol for 20-30 seconds or with soap and water for 40 to 60 seconds. Patients must be using protective measures correctly and must not leave the masks under the nose or on the chin. Dentists must instruct their entire team to observe the patients who are in the waiting room

[1,10,17].

Healthcare providers are aware of the importance of hand hygiene, whose main role is in preventing diseases during clinical practice. Hand sanitization is considered the most effective measure to minimize pathogen transmission in dental offices. Due to the COVID-19 transmission routes, hand hygiene is considered a prerequisite for the clinical routine of dentists. To this end, hand sanitizers or antiseptics should be used in the dental office, preferably activated by sensors or by foot, thus avoiding contact between the packaging and professionals or patients. It is recommended to perform hand hygiene by rubbing both hands with 60-95% alcohol or soap and water for at least 20 seconds, especially before wearing the PPE [17].

The reception, waiting room, and clinical environment must be properly cleaned and disinfected [1,10]. Disinfecting surfaces is extremely important for oral health care, as the virus can remain for up to 3 hours in aerosols, up to 72 hours on plastic surfaces, up to 48 hours on stainless steel surfaces, up to 4 hours on copper, and up to 24 hours on cardboard.

Sodium hypochlorite (0.1%) and alcohol (62-71%) are used worldwide for surface disinfection, both significantly reducing the degree of coronavirus infection on surfaces within a one-minute period of exposure time [5,6]. To clean the clinical environment, the exclusive use of a hospital disinfectant (70% alcohol) is recommended. As a substitute, disinfection can be achieved with a neutral detergent followed by 0.1% sodium hypochlorite, despite its not fully proven efficacy against COVID-19 [17]. All devices and equipment, including door handles, monitors, chairs, keyboards, telephones, among others, must be frequently sanitized, every day, following the protocols [1,17].

Despite the use of a questionnaire and prior patient selection, dentists must confirm the health status of each patient by checking their temperature before dental care [1,17] using a forehead thermometer or infrared cameras. If the temperature is higher than 37.5°C or there are signs of respiratory diseases, the appointment should be delayed for 14 days and patients should be informed, take appropriate precautions, and isolate themselves for 14 days. If the appointment cannot be delayed, the procedure should take place at the end of the working day and follow all protective measures [1,18].

Carvalho et al. [19] observed that with limited access to dental care during lockdown, prescription of antibiotics and anti-inflammatory drugs/analgesics by dentists increased by 18% and 23%, respectively. For COVID-19 infected patients who have toothaches and/or swelling in the orofacial region, dentists may prescribe pain relievers, such as Acetaminophen (Paracetamol). Despite the hypothesis of a potential interaction between Ibuprofen and coronavirus, the WHO exempted itself from contraindications for this medication, as no current scientific evidence proves that Ibuprofen aggravated the COVID-19 infection in patients of any age group. When urgent oral treatment is necessary in patients with suspected or confirmed COVID-19, especially those whose procedures will generate aerosols, they should be performed at the end of the appointment, followed immediately by cleaning of the site, avoiding self-contamination and cross-infections [1,6].

According to Wu et al. [20], patients experienced more serious oral diseases, such as odontogenic infections, extensive swellings, and trismus, during the pandemic, and demands for tooth extractions increased. On average, 8 out of 10 patients required tooth extraction, whereas before the pandemic only 4 out of 10 patients demanded the procedure, which indicates that over half of dental patients had teeth with unfavorable prognoses such as class III mobility and extensive carious lesions. Moreover, endodontic treatments were refused due to financial reasons, with the patient opting for tooth removal rather than conservative treatment during the COVID-19 pandemic. It was also observed that 15 to 30% of patients received antibiotic prescriptions made by dentists through teledentistry. Some of the prescriptions were not intended for patients according to the ADA clinical guidelines.

As preventive measures against COVID-19, dentists should use their knowledge, attitude and practice to control infections, limit the generation of aerosols, make use of minimally invasive approaches and atraumatic restorative treatment (ART), use manual instrumentation to reduce the risk of transmission, such as dentin curette for caries removal. When high rotation is necessary, it is recommended to rinse the mouth beforehand for at least 30 seconds or to clean the oral cavity of children who do not know how to spit with substances capable of reducing the infectious burden of SARS-

CoV-2. It is also important to use the rubber dam for absolute isolation during procedures, thus reducing the amount of aerosol and saliva generated by up to 70% over a distance of up to 1 meter, as well as to perform the work with four hands, reducing the contamination of the clinical environment during consultation [8,11-17,21-26]. If using a rubber dam is not possible, manual methods for performing the procedures are preferable, as the particles scattered by aerosols can travel at least 20 cm from the generating site [1,6,17].

When the use of high rotation is necessary, professionals must always use a saliva ejector as well, reducing aerosol generation. All handpieces must be sterilized as they can aspirate and expel fluids and debris during treatment, increasing the risk of cross-infections. To avoid or reduce such risks, professionals can choose to use handpieces with anti-retraction or anti-reflux valves. It is recommended that patients wear a face protector (e.g., disposable sheet or dental bib) and protective glasses during consultation [1,8,10,17].

Mouthwashes have been widely used as a gold standard before dental procedures due to their ability to reduce the number of microorganisms in the oral cavity, which impacts the spread of pathogens through aerosols. Recent studies suggest that mouthwashes may control and reduce the risk of COVID-19 transmission, but specific evidence on the subject are scarce. However, the ADA and the Center for Disease Control and Prevention (CDC) strongly recommend the use of mouthwashes before a dental appointment. Four substances can be used as a mouthwash: chlorhexidine 0.12%; hydrogen peroxide 1-1.5%; cetylpyridinium chloride 0.05-0.1%; or povidone-iodine 0.2-1% [1,2,18].

Chlorhexidine is a broad-spectrum antiseptic, acting against gram-positive and negative bacteria, facultative aerobes or anaerobes, and fungi, widely used in dentistry to reduce dental plaque and treat periodontal diseases. Studies indicate that chlorhexidine acts against lipid viruses, such as Influenza A or herpes virus, and that this substance may have a suppressor effect on coronavirus two hours after using a 15 mL mouthwash of chlorhexidine 0.12%. Nevertheless, studies proving the efficacy of chlorhexidine against SARS-CoV-2 are scarce. Hydrogen peroxide (H2O2) has been used in dentistry alone or combined with other salts. Several studies show that using a mouthwash with hydrogen peroxide 1 to 1.5% has no adverse effect on soft tissues. Although hydrogen peroxide is more effective against COVID-19 at 3%, mouthwash with this substance is only recommended at 1 to 1.5%, thus reducing the viral load of the saliva. Cetylpyridinium chloride (CPC) is a quaternary ammonia compound proven to be safe for human use. This substance has been used to reduce dental plaque and gingivitis, especially in patients allergic to chlorhexidine. CPC antiviral effects have been demonstrated in some studies with patients suffering from the flu, reducing the duration of flu symptoms. Cetylpyridinium chloride may be used against COVID-19, but studies have yet to prove this information. Povidone-iodine (PVP-I) 1% is a water-soluble iodine complex used as a skin antiseptic in pre-surgical procedures for mucositis, as a prophylaxis for oropharyngeal infections, and pneumonia prevention. Studies show that povidone-iodine has greater antiviral activity than other antiseptics, including against SARS-CoV and MERS-CoV viruses. Recent articles propose the use of PVP-I mouthwash at 0.23% for at least 15 seconds before dental procedures [1,2,17].

To reduce cross-infection, preference should be given to disposable and non-reusable materials, such as syringes, syringe tips, plastic wraps for handpieces, triple syringe, dental chair mirror, among others [1,17]. Extraoral radiographs and cone beam computed tomography are preferable to intraoral radiographs, thus preventing coughing or vomiting, and reducing aerosol generation [1,6,17]. During dental care, it is recommended to avoid stimulating areas that trigger coughing or vomiting, including base of the tongue, uvula, soft palate, and rear pharyngeal wall.

During the pandemic, according to the ADA, at the end of dental procedures, dentists must reinforce all biosafety measures such as social distancing, continuous mask use, and regular hand hygiene [1]. The team (assistant or oral technician) must disinfect and sterilize instruments by autoclave using appropriate PPE and pre-established techniques. All contaminated material must be disposed of in a separate package, which must be replaced as soon as it reaches 2/3 of its capacity or 48/48 hours. Importantly, inadequate disposal presents a greater risk to public and ecological health. Dentists must, therefore, recognize the importance of controlling COVID-19 spread and making efforts to strictly follow safety protocols, and must always reinforce these measures for the team itself [6].

Cleaning the clinical environment requires special attention and must be disinfected with the aforementioned chemicals. Reusable PPE, such as face shields and protective glasses, as well as non-disposable and non-sterile equipment (e.g., dental chair), must also be cleaned and disinfected [1,18].

Studies highlight the need for infrastructure rehabilitation, patient management to ensure safety and confidence during dental treatment; as well as a new management of dental clinics, including remote care. Thus, teledentistry began to play an important role during the pandemic in scheduling appointments, patient registration, screening prior to face-to-face dental care, virtual dental consultations, remote dental care, electronic prescriptions and even for the care of children who, due to their time, requires extra care for adequate counseling to patients and parents. Despite the great utility of teledentistry, many patients were personally contacted to be treated with medication [12,14,21-24,27-30].

Telemedicine confers greater visibility to videoconference consultations, which allows health systems to screen those infected and prevent the virus spread among patients, healthcare providers, and the community [1]. To validate a new practical activity, its benefits and technological tools must be scientifically proven. Currently, telemedicine is considered a medical activity and should be carried out with high quality. Likewise, teledentistry should not be ruled out or undermined when compared with conventional dental care. However, teledentistry cannot be promoted as a substitute for in-person care, and patients should be aware of its use and that they cannot, in any way, abandon in-person consultations. In other words, e-health must be considered as a therapeutic tool for dentists during a pandemic. When it comes to teledentistry, one must ensure that any social and economic class can access to this type of service, otherwise it will only increase the differences in healthcare access. In short, digital dental practices must be developed bearing in mind universal access and quality of care, encompassing public health [31]. Teledentistry is feasible only for certain areas of dentistry, providing remote consultations for treatment preparation, promotion, and prevention plans for oral health; but as a new activity, its effectiveness is yet to be proven [1].

Teledentistry can benefit postoperative dental surgeries, allowing remote patient monitoring during the recovery process. Digital consultation can be performed by videoconference in addition to images taken by patients themselves from the operated area. Giudice et al. [32] showed that teledentistry is a promising tool for the remote monitoring of cancer patients, mainly because it reduces patient costs and waiting time, and provides professional guidance to patients during post-surgery. During data collection, the authors noticed that teleconsultations have increased patient treatment adherence and established a link between physician and patient. In the coming years, the amount of research on the subject might dramatically increase, since the whole world will have to adapt to the new post-COVID-19 reality, even with mass vaccination.

Another technology widely used in routine procedures in the office is the laser. High-power lasers produce aerosols, but low-power lasers do not and can be used to reduce the inflammatory process, accelerate and repair tissues, and analgesia. Thus, the use of low-power lasers should be encouraged during the pandemic to reduce COVID-19 spread and possible cross-infection. However, studies on the association between laser use and the COVID-19 pandemic are scarce [33].

According to Marcenes [4], despite all the challenges faced during the COVID-19 pandemic, if collective actions are taken and respected, opportunities emerge to resolve the flaws found in health systems. The author also recommends creating an inclusive global health system. In Brazil, we rely solely on the Unified Health System (SUS), which encompasses all the prerequisites deemed necessary: universality, equity, integrality, regionalization, decentralization, hierarchy, and social participation.

Importantly, changes in the preventive measures for dentistry ultimately have a direct impact on dental treatment costs, as the increase in the amount of PPE and cleaning products used directly reflects in expenses for dentists. Moreover, patients have not been seeking dentists since the beginning of the pandemic, which only increases the number of dental problems. The lack or loss of employment during the quarantine and decreased household income led to an overload of issues that directly affect patients' financial stability and ease in accessing dental treatment in the future [5]. Work-related stress among dental teams increased during the pandemic, and dentists are more anxious due to the high risk of COVID-19 contamination and spread among patients and among their own family members, many of them choosing to isolate themselves as a form of protection [20].

DISCUSSION

As a recent issue, which has been taking place since March 2020, the number of articles discussing and reporting changes in preventive and biosafety methods for dental practices is scarce, all focusing on similar and often identical topics. Our study reviews the contemporary literature regarding COVID-19 and dental practices.

As previously observed, people infected with SARS-CoV-2 are responsible for its transmission through respiratory droplets or aerosols generated by coughing, sneezing, or close personal contact. Other articles confirm these transmission routes, dividing personal contact between exhalation and talking, and commenting on the saliva, whose role is crucial in spreading COVID-19 through the airway and direct contact [34-36].

Coronavirus transmission can be symptomatic, presymptomatic, asymptomatic, and environmental. Its incubation period ranges from 0 to 14 days, but a 24-day period has already been verified, showing why COVID-19 is a concern: as the disease extends over a long time in infected people, it increases their risk of spreading [5,9,34]. Most infected cases are asymptomatic or have few symptoms, including night fever, sore throat, dry cough, and asthenia (feeling weak and lacking energy). In more serious cases, which occur in 15-25% of infected patients, dyspnea (shortness of breath or difficulty breathing) may occur, or a serious impairment of respiratory function, which may lead to hospitalization and subsequent assisted ventilation [34-36].

Such factors are considered in dental clinics, whose aerosol generation is high and constant [6,9]. Both the dental team and patients have always been exposed to high risks of cross-infections due to constant exposure to pathogens derived from the oral cavity and respiratory tract – a risk that, with the onset of the COVID-19 pandemic, has only been intensified. A study conducted on a mannequin equipped with jaws and seated in a dental chair, showed that the highest levels of aerosol contamination can be found 60 cm from the patient's head [34], increasing the distance found in the literature review, which indicated a 20 cm from the aerosol-generating site [1,6,17].

The foci of infection are mainly located on the right arm, the mask, and around the dental professional's eyes and nose. Moreover, the aerosol generated by ultrasound can remain suspended in the air for 30 minutes after the procedure is performed, making dental practice one of the most likely causes of SARS-CoV-2 infection. In the absence of aerosols, most coronavirus particles precipitate and settle on surfaces. In cases where aerosols are generated, SARS-CoV-2 is transmitted through the air and may persist for more than three hours [34].

Despite studies stating that infected particles remain suspended in the air for up to 30 minutes [6,9], in vitro studies have demonstrated that coronavirus maintains its viability in the air for at least three hours, with a half-life of approximately one hour. Its adhesion is persistent, remaining for a maximum of nine days on various surfaces. This indicates that all surfaces and instruments in the clinical environment of a dental office should be considered as potential sources of COVID-19 transmission and, therefore, cleaned and disinfected after each appointment [34]. At the end of procedures, the clinical environment should be cleaned with a disinfectant spray, waiting two minutes to open the door and then dismiss the patient, who must sanitize their hands and face before leaving [36].

ADA recommendations must be followed, and all patients must always be screened before the appointment, selecting those who do not show COVID-19 symptoms. Even with this precaution, Checci et al. [34] suggest that dentists should consider all patients as potentially infected, strictly following all preventive measures discussed: correct use of PPE and cleaning and disinfecting the clinical environment between one patient and another. Before dental care, the number of people in the waiting room must be controlled, avoiding overcrowding in the offices, maintaining a distance of 1.8 to 2 meters between one patient and another [1,6,17]. Checci et al. [34] and Siles-Garcia et al. [36] highlight the importance of maintaining a safe distance between patients in the waiting room.

With the onset of the COVID-19 pandemic, surgical mask supplies suffered a worldwide shortage. Many authorities, as a strategy to reserve surgical masks for healthcare providers in direct contact with those infected, began to discourage the use of masks with high filtration efficiency, but insisted on the use of facial protection (even with low efficiency) aiming to stop the virus spread and thus reduce the spread curve and unburden the health system [3].

Regarding the PPE, there are still many doubts on which mask is suitable for daily use in the dental office. In recent decades, different types of masks have been developed, each offering a degree of protection. Surgical masks, suitable for use by both patients and oral assistants and technicians [1,3,7], have a unidirectional protection design, capturing body fluids that come out of the user, that is, they serve to protect the patient from contamination by the dental team. Moreover, studies show that the surgical mask is also capable of filtering external fluids, protecting its wearer from pathogens suspended in the air. Both existing types of surgical masks, rectangular and shell-shaped, have been tested and have proven their filtration efficiency, 92% and 96% respectively, and should not be ruled out as an option by the dental team, and their use during the COVID-19 pandemic is valid [34].

Since we are dealing with a health practice which involves high aerosol generation and risk of contamination and cross-infections, the most suitable PPE in dentistry is the FFP mask, which is also capable of blocking the passage of viruses. FFP masks are designed to protect its wearer from the external environment and are divided into three categories based on their filtration efficiency (considering pathogens with a diameter of ≥0.3 μm): FFP1, FFP2, and FFP3. According to the European Committee for Standardization, FFP1 has a total minimum filtration efficiency of 80%; the second, of 94%; and the third, of 99%. Conversely, the National Institute for Occupational Safety & Health classifies masks as: N95, N99, and N100. The N95 has a total minimum filtration efficiency of 95%; the N99, of 99%; and the N100, of 99.97%. When comparing the American and European classifications, we can state that the N95 mask is equivalent to FFP2, while the N99 mask is similar to the FFP3. As the SARS-CoV-2 particle has a 0.06-0.14 μm in diameter, the FFP2/N95, FFP3/N99, and N100 masks are considered to be the most efficient against COVID-19 transmission and contamination. Regardless of the type of mask (surgical or FFP/N) used by the dentist, it must be discarded after two continuous hours of use. [3,34].

As the ocular route is one of the most frequent forms of SARS-CoV-2 contamination, protective glasses should also be used, reducing eye contact with mechanical (e.g., foreign bodies) and biological agents (e.g., saliva or blood) [12]. The glasses must have wraparound frames and wide lenses, thus covering as much of the dentist's face as possible. Dentists can choose to use face shields instead of glasses, which confer a greater range of protection.

The face shield provided an additional barrier for the mask while performing dental procedures. Protectors are generally made of transparent plastic materials, with the purpose of protecting the eyes, nose, and mouth against direct splashes and sprays of saliva, blood, and other infected fluids and materials. Considering that most face shields do not cover the sides of the face and chin, they do not provide fully effective protection against aerosols. Moreover, protectors can impair the dentist's vision, obfuscating or blurring it. Nevertheless, face shields are recommended because, in addition to protecting the front of the face, they are durable, robust, easy to disinfect and indefinitely reusable, without hindering communication between professional and patient. In short, the face mask and disposable cap should be used together with the protectors [3].

Mouthwashes are used before procedures as a gold standard in dentistry, as they reduce the number of microorganisms in the oral cavity. No study has proven the effectiveness of mouthwashes against COVID-19, but the ADA strongly recommends continuing their use during dental visits. Four substances can be used as a mouthwash: chlorhexidine 0.12%; hydrogen peroxide 1-1.5%; cetylpyridinium chloride 0.05-0.1%; or povidone-iodine 0.2-1% [1,2,18]. However, research have reported that chlorhexidine is not effective against COVID-19, indicating instead hydrogen peroxide diluted to 1% (5 mL peroxide/10 mL of distilled water), 0.2% povidone, or 0.05-0.1% cetylpyridinium chloride. It is recommended that hydrogen peroxide be given greater relevance because SARS-CoV-2 is vulnerable to oxidation [25,36].

Besides following all the preventive and biosafety measures mentioned in the literature review, such as disinfecting the environment and devices with hospital substances [1,6,18], the air should be changed at the dental clinic after each visit, and windows should be kept open both in the clinical environment and in the waiting room. In addition to hospital substances, ozone and Ultraviolet Germicidal Irradiation (UVGI) can be used. Ozone is a natural gas and is considered one of the most effective systems for environmental sanitation due to its highly reactive free radicals that can oxidize viruses, bacteria, and organic and inorganic compounds. As a heavier molecule than oxygen, ozone is capable of precipitating into tissues and also disinfecting surfaces. Conversely, UV light can damage microbial DNA and RNA, preventing microorganism reproduction and reducing the harmful effects of pathogens [34].

Siles-Garcia et al. [35] comment on the importance of patients sanitizing their hands when they arrive at the dental office and not bring companions to appointments.

Altogether, few studies focus on changes undergone by dental practice during the COVID-19 pandemic, and all discuss the same methods to be used by dentists. On the one hand, such consistency enables dentists to follow a globally applied protocol, with no absurd or discrepant differences, intervening in the potential COVID-19 dissemination routes [37].

CONCLUSION

This literature review shows that oral health professionals must be prepared to face any imminent challenge imposed by infectious diseases in dental practice, following protocols, before, during, and after procedures to efficiently tackle possible transmission routes. Such promptness results from the fact that most dental procedures generate aerosols and, hence, increase the risk of virus contamination and spread, both among the dental team and the patient, making dentistry an area in need of greater preventive care.

The pandemic changed dentists' perspective regarding biosafety, introducing stricter cleaning and disinfection protocols to offices, in addition to influencing the constant use of PPE. Dental professionals should be aware that their participation during a pandemic is essential, not only to detect potential infected patients, but also to control the virus spread and provide comfort to the population's oral health. The preventive protocols mentioned in this study make the performance of dentistry safe and effective, even in the midst of a pandemic.

Collaborators

EGP SOUZA and EVG PERES responsible for research, methodology, writing. LM GUERRA responsible for project management. BVC GONDINHO responsible for guidance and formal analysis.

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