

Biosecurity in Post-Covid-19 Dental Care: An Integrative Review

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Abstract: After the emergence of Coronavirus 2019 (COVID-19), biosafety measures in dentistry had to be intensified to provide more safety for professionals and patients, given that dental care requires close contact, thus exposing the professional to contaminated fluids such as saliva and blood, increasing the chances of cross-infection. The objective of this study is to conduct an integrative review on the established biosafety in dental care after the emergence of COVID-19. A bibliographic search was conducted until November 1, 2021, through the Regional Portal of the Virtual Health Library (VHL) and PubMed, using the terms "COVID-19," "Biosafety," and "Dentistry," with no filters or limits applied. After reading and applying inclusion and exclusion criteria, 11 studies were selected. A manual search was then conducted among the already selected studies, where two more studies were included, totaling 13 studies. Biosafety measures that should be carried out before, during, and after dental care following the emergence of COVID-19 were identified. Among the main measures are pre-screening, organization of the waiting room, increased frequency of hand hygiene, use of Personal Protective Equipment (PPE) previously not widely used, such as face shields, mouthwashes that reduce viral dissemination, and rubber dams to reduce contaminated aerosols, knowledge about the types of procedures that should be avoided or performed with restrictions, and cleaning and disinfection of environments. In conclusion, biosafety measures should be employed in all dental environments to strengthen the protection of professionals and patients, thus minimizing the risk of contagion.

Keywords: COVID-19; Biosafety; Dentistry.



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1. Introduction

In December 2019, the first cases of coronavirus (COVID-19) emerged in Wuhan, Hubei Province, China. This disease, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), quickly became a serious public health issue, concerning not only China but all countries worldwide, leading to its declaration as a pandemic by the World Health Organization (WHO) in March 2020 [1-3]. It is noteworthy that SARS-CoV-2 has an average incubation period of 14 days, which is also the recommended quarantine period for individuals who have had contact with infected people, even if they do not show symptoms [4].

Infected individuals may present symptoms such as cough, fever, shortness of breath, among others, and in more severe cases, it can lead to kidney failure, respiratory failure, and even death [5]. It is understood that the coronavirus prefers the respiratory tract, thus placing oral health professionals at a high risk of infection due to their constant proximity to nasal and oral secretions such as saliva and blood, and because they are exposed to aerosols and droplets generated during some dental procedures [4, 5].

Oral health professionals work directly in the oral cavity, which is a highly contaminated environment, frequently exposing them to a wide variety of bacteria, viruses, fungi, and other infectious pathogens [6, 7]. However, contact with these pathogens does not necessarily result in the transmission of an infectious disease to the professional. This is because the risk of infection depends on several factors, such as the virulence of the microorganism or its pathogenicity class, the amount of microorganism transmitted, the frequency of exposure [8], and the immunological condition of the contaminated individual [9]. Therefore, it is important to note that there are several ways of cross-contamination in the dental environment [10]. This contamination can occur through different routes, such as direct contact with blood, saliva, oral fluids, or contaminated materials; indirect contact via instruments, surfaces, infected equipment; contact of the ocular, nasal, or oral region with droplets; inhalation of aerosols [11, 12]; or through the water from the dental unit water lines [8].

It should be noted that the water used in dental units is distilled, not sterile, and can contain a high number of bacteria and opportunistic pathogens such as *Legionella pneumophila*, *Mycobacterium* spp., *Pseudomonas aeruginosa*, and *Candida* spp [13]. Although it is a means of pathogen transmission for both the professional and the patient, water is of utmost importance for viable dental care [8]. In addition to infectious microorganisms, aerosols can be composed of blood, saliva, dental biofilm, among other residues, and their infection capacity will depend on the characteristics of these fluids and the presence or absence of any type of oral infection [6, 7]. Thus, the composition of aerosols varies from patient to patient, according to the oral cavity microflora and the type of procedure being performed [10]. Procedures using high or low-speed handpieces, air/water spray syringes, ultrasonic instruments, lasers, among others, are considered aerosol-generating procedures [14, 15].

Effectively, aerosols can travel a distance of one to three meters from their source [6, 14]. They also have the capacity to remain suspended in the air for a long period until they settle on a surface or are inhaled by someone [10, 14]. Aerosols result in the transmission of various pathogens from the dental unit water [6], and from the patient's oral cavity [10]. It is worth noting that several infectious diseases can be acquired through the ocular region, via contact with blood splashes, respiratory droplets, or aerosols containing infectious pathogens. Therefore, the American Centers for Disease Control and Prevention (CDC) advises that professionals working in environments where such contamination may occur, such as oral health professionals, use eye protection, such as goggles or face shields. This creates a barrier between the eye and these infectious agents [16].

To minimize or avoid cross-contamination during dental procedures, it is essential that the team uses personal protective equipment (PPE), such as masks, N95 respirators, caps, gloves, protective goggles, or face shields, among others. This equipment aims to reduce the exposure of the dentist and their assistants to aerosols, blood droplets, saliva, among other oral substances and possible pathogens contained in them [17-19]. Due to the COVID-19 pandemic, the techniques for using PPE and biosafety in healthcare were reconsidered, with some PPE, such as face shields and respirators, becoming necessary during clinical practices. Similarly, some biosafety measures were implemented in dentistry to protect professionals from possible contamination [18, 20].

Among these newly established biosafety measures are pre-screening of the patient, which should be conducted before the patient arrives at the dental clinic or office, through phone calls or messaging apps. Dental appointments should be scheduled with a set time, with a certain interval between each one. Additionally, patients should be instructed to come alone, with an accompanying person permitted only when necessary [20]. Upon arrival at the clinic, the patient's temperature should be taken. Only people wearing masks should be allowed entry, the reception chairs should be spaced out to prevent people from sitting too close together, and 70% alcohol should be made available on-site. It is also important to conduct another screening when the patient arrives at the clinic, before the appointment, to investigate possible symptoms again [4, 5]. It is assumed that in addition to all these additional biosafety measures, aerosol-generating procedures

should be avoided (when possible), only being performed if truly necessary for the patient, with extra care taken before, during, and after the procedure [4, 5, 20].

2. Methodology

The bibliographic search methodology was conducted using the Regional Portal of the Virtual Health Library (VHL), which includes Lilacs, SciELO, Medline, as well as PubMed. The search was carried out until November 1, 2021, using the descriptors COVID-19, Biosafety, and Dentistry. No filters or restrictions were applied regarding date or language. Articles present in more than one database were considered only once. Additionally, a manual search was conducted through the articles identified in the previously mentioned databases.

The bibliographic search included articles that addressed biosafety measures adopted by dental clinics after the onset of the COVID-19 pandemic. Articles not aligned with the established methodological criteria, such as brief communications, abstracts, opinions, preprints, and studies that did not address the theme in question, were excluded from this review.

Initially, the search resulted in 59 studies in the mentioned databases, of which 29 were excluded after reading titles and abstracts. Another 15 texts were eliminated due to duplication across databases. After a thorough analysis of the studies and application of the exclusion and inclusion criteria, 11 articles were selected for review. Subsequently, a manual search added two more studies, totaling 13 articles included in the final review. A detailed and comprehensive analysis was conducted on the selected articles. The flowchart of the bibliographic search is presented in Figure 1.

3. Discussion and Conclusion

Table 1 (below) shows the articles selected in the review, categorized by article title, objectives and methods, results and conclusions, and biosafety measures during dental care post-COVID-19. These data guided the description and discussion of the results of this integrative review.

Since the emergence of COVID-19, many professions, including dentistry, have had to adapt to new measures. Regarding the transmission routes of SARS-CoV-2, there is consensus among the authors that the virus spreads from one individual to another through respiratory droplets and direct contact. The disease exhibits low morbidity but a high dissemination and evolution rate [21, 22, 23, 24]. COVID-19 is also present in saliva, and transmission can occur via airborne route during aerosol-generating procedures such as those involving high-speed handpieces, triple syringe, or ultrasonic devices [25]. There was divergence among authors regarding the virus's incubation period; some mention it ranges from 5 to 14 days, while others indicate it could vary from 1 to 14 days. Due to the potential for disease transmission during the asymptomatic period, it is essential to adopt additional precautions in dental care for all patients, regardless of symptoms [5, 22, 23, 26, 27].

The COVID-19 pandemic has brought significant changes to dental practice. Dentists are considered at high risk of contamination due to close and direct contact with patients' oral cavities, frequent exposure to saliva, blood, and other oral fluids, as well as aerosol generation. In light of this reality, biosafety measures in dental care must be stringent to prevent cross-infections. Biosafety standards have been reviewed, and new measures implemented, including adequate physical barriers, rigorous screening, and necessary procedures, aimed at preventing virus spread [21, 22, 23, 28].

3.1 Hand Hygiene

Frequent hand hygiene is highlighted by the authors in this review as a crucial measure for infection control, recommended for both professionals and patients. Proper hand-washing can break the cycle of respiratory disease transmission and reduce transmission risk by 6 to 14%. Hands should be washed with soap and water for 20 to 30 seconds or with 70% alcohol. Patients should perform hand hygiene upon arrival and before leaving

the dental office, while professionals should do so before and after patient care, with additional instances during gowning and degowning processes [24, 28].

Figure 1: Flowchart of article selection for this integrative literature review on biosafety in post-COVID-19 dental care.

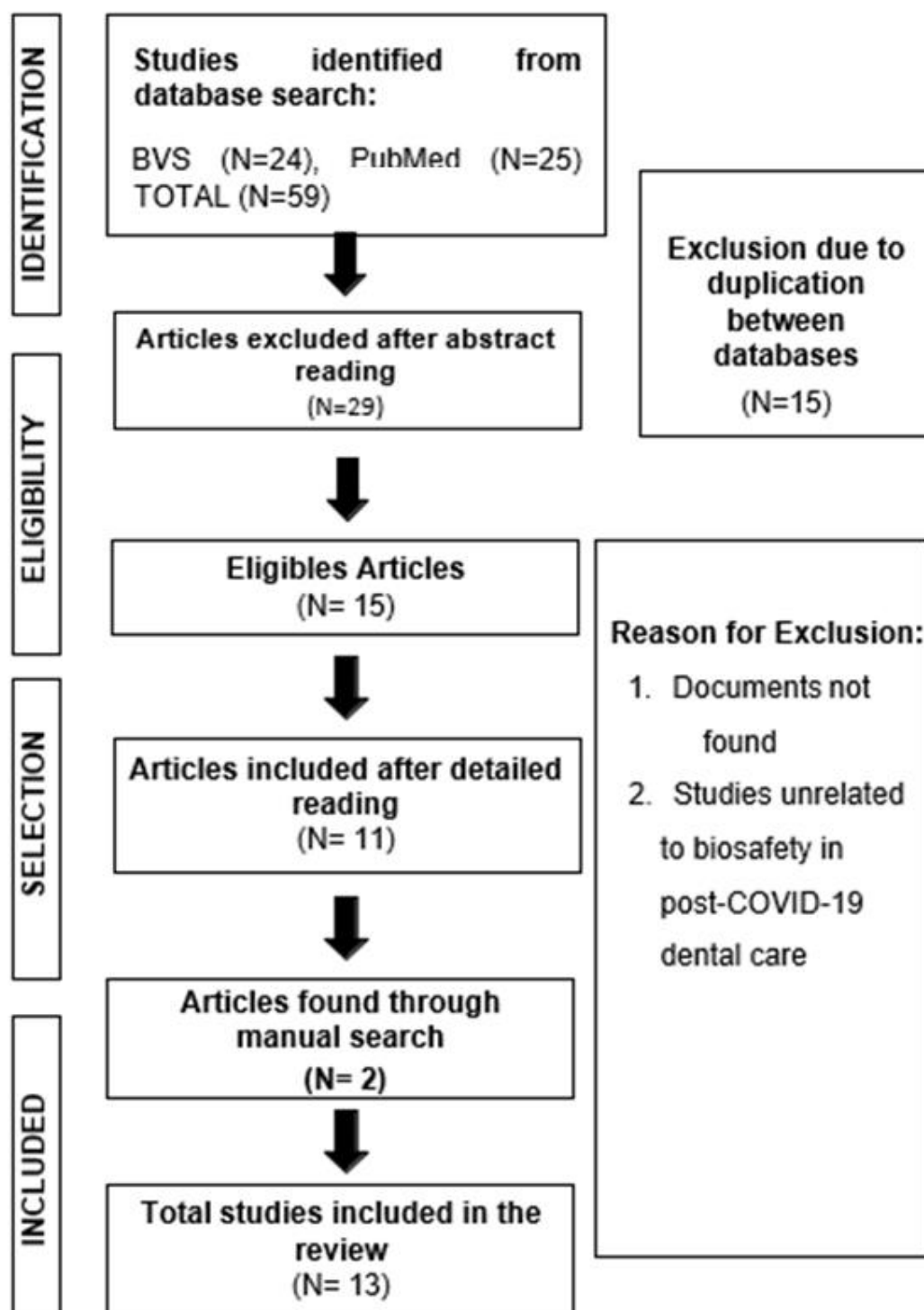


Table 1: Articles selected in the review, according to articles, objectives and methods, results and conclusion and biosafety measures during dental care after COVID - 19.

Articles	Objectives and Methods	Results and Conclusion	Biosafety measures during post-COVID-19 dental care
5	Case report. Provide management protocols for students and dentists in highly affected areas based on lived experiences with COVID-19.	Dental offices can pose a threat to infection control. In Wuhan, 29% of the infected population were healthcare professionals.	Cleaning and disinfecting the room. Ventilating the treatment room. Pre-screening. Performing only urgent and emergency treatments. Use of PPE. Antiseptic mouthwash before the procedure. Checking body temperature. Proper hand hygiene. Use of rubber dam. Four-handed dentistry. Use of absorbable suture thread. Avoid aerosol-generating procedures whenever possible.
20	Systematic review. Determining biosafety measures in dental offices following the emergence of COVID-19.	A Strict adherence to biosafety protocols effectively reduces the risk of COVID-19 infection for both dentists and patients through measures implemented before, during, and after dental appointments.	Conducting pre-screening by phone in advance. Scheduling appointments in an orderly manner. Measuring temperature. Providing masks and alcohol. Frequent hand hygiene. Use of all PPE. Covering dental units and worktables with disposable plastic film, changing it after each patient. Asking the patient to rinse their mouth with hydrogen peroxide + distilled water at 1% before the procedure. If X-rays are needed, opt for panoramic or CT scans whenever possible. Use of rubber dam. Handpieces, micro motors, and ultrasonic tips should be disinfected with 96% alcohol or sodium hypochlorite and sterilized like other instruments.

		Surfaces such as door handles, chairs, elevators, etc., should be cleaned and disinfected frequently.
21	Cross-sectional study. Assess the behavior and perceptions of Brazilian dentists about the COVID-19 pandemic and verify its impact on dental care routine.	Of the interviewed dentists, 78.3% work in private clinics, 8.8% tested positive for COVID-19. During the period the questionnaire was applied, 73.9% of respondents were treating routine and emergency patients. Only 54.7% felt safe using PPE. 54.7% said they had no financial reserves for work stoppage. The COVID-19 pandemic had a significant impact on dentistry, better financial planning is essential, and biosafety measures are continuously strengthened to protect professionals. Not addressed
22	Literature review. Guide professionals on the risks involved in dental care, both adult and pediatric, for patients with restorative needs during the pandemic, and discuss strategies to optimize care, reducing the risks of contamination and virus transmission.	In addition to biosafety, measures related to spacing between patients and reducing aerosols should be applied, increasing the implementation of minimally invasive dentistry procedures. Dentistry has always been based on and focused on hygiene procedures and cross-contamination control. The emergence of other Pre-screening through teleconsultation. Use of PPE. Use of rubber dam whenever possible in aerosol-generating procedures. Avoid aerosol-generating procedures. Opt for manual instruments and use rotary instruments only as a last resort. Do not use the triple syringe in spray form (Water/Air). Avoid intraoral radiographic exams. Proper cleaning and disinfection of contaminated environments.

viruses in the past also changed our sanitation and disinfection procedures. However, it is certain that improvements in biosafety will be permanently incorporated, and patients may define this situation as a prerequisite for choosing a professional.

Literature review. Review the literature on biosafety practices, especially in the context of restorative dental procedures during COVID-19.

More stringent biosafety measures need to be implemented in dental offices before, during, and after appointments to reduce contamination and cross-infection.

Perform only urgent and emergency care.

Conduct a telephone screening before the appointment.

Measure body temperature.

Schedule appointments with time intervals between patients.

Wash hands with soap and water and disinfect with 70% alcohol gel.

Maintain a minimum distance of at least one meter between patients in the waiting room.

Use mouthwashes and PPE.

Avoid aerosol-generating procedures.

Whenever possible, use a rubber dam and high-power suction devices.

Avoid performing intraoral X-rays.

Clean and disinfect all contaminated surfaces.

Literature review. Report the main protective measures and recommendations that should exist in environments where dental activities are performed.

Protective measures should be implemented in the dental environment to reduce the risk of virus transmission. Stricter protocols should be followed to keep environments such as the office and

Conduct a pre-screening.

Measure temperature.

Use of PPE.

Hand hygiene.

Cleaning and disinfection of the entire dental environment, with replacement of protective barriers.

Sterilization of instruments after each patient.

		waiting room clean. The use of PPE is crucial as it will reduce transmission during care.	Suction system hoses should have anti-reflux valves and be cleaned with sodium hypochlorite solution after each patient. The environment should be ventilated, and aerosol-generating procedures should preferably be done in a location with a respiratory isolation unit with negative pressure and a HEPA filter.
26	Integrative review. Systematize the literature on recommendations for the use, prolonged use, reuse, and decontamination of PPE in dental care during COVID-19.	During periods of epidemiological outbreaks, certain measures should be taken for dental care, such as the use of respirators (N95, PFF2, PFF3, or equivalents), impermeable gowns, gloves, caps, and face shields.	Screening and recognition of suspected or confirmed cases. Frequent hand hygiene. Use of PPE. Cleaning the work environment, sterilizing all instruments. Proper disposal of waste.
28	Literature review. Synthesize and analyze the management of current biosafety standards for dental patients since the onset of the COVID-19 pandemic.	Given the different modes of exposure to COVID-19 among patients before dental care, it is crucial that they comply with all biosafety measures established before, during, and after the consultation, as this will reduce the chance of virus transmission.	Conduct pre-screening by phone. Measure the patient's temperature. Disinfect footwear with a 0.1% sodium hypochlorite solution. Use mouthwashes before the procedure. Perform as few aerosol-generating procedures as possible. Avoid intraoral X-ray exams. Frequent cleaning of the environment and use of 70% alcohol gel on hands. Use a negative pressure room in case of infected patients, maintain a minimum distance of 1 to 2 meters without physical contact, and use PPE.
30	Literature review. List the challenges and perspectives in managing dental care in services and schools.	Dentists must be prepared to handle any imminent challenges in clinical practice posed by infectious diseases like COVID-19. They	The professional should have received the influenza vaccine. Appointments should be scheduled with intervals between them. Pre-screening of the patient should be conducted. Rigorous cleaning and disinfection of

		should always seek specific dental regulations in their state or country for the COVID-19 pandemic.	public areas and clinical environments. Instruments and items like door handles and chairs should be cleaned frequently and according to recommended protocols. Hand hygiene. Use of PPE. Avoid aerosol-generating procedures and intraoral X-rays. Whenever possible, procedures should use a rubber dam. Cleaning and disinfection of the dental office. Disinfection of reusable PPE and non-disposable equipment that cannot be sterilized.
31	Literature review. Review the current evidence on biosafety practices. Clinical recommendations regarding the return to elective dental care in pediatric dentistry.	Pediatric dental care requires a thorough and explanatory approach. At this time, preventive measures should be used, and whenever possible, techniques without aerosol production and minimally invasive procedures should be employed. Due to continuous scientific discoveries, professionals should remain vigilant and updated based on the best scientific evidence.	Use of PPE. Schedule appointments with a longer interval between patients. Hand hygiene. Provide 70% alcohol gel. Sterilize instruments. Proper disposal of waste. Avoid treatments with aerosol production and triple syringe in spray form. Mouthwash before the procedure. Use of rubber dam whenever possible.
32	Cross-sectional study. Assess, through an online questionnaire, the impact of COVID-19 on the routine of endodontic treatment among Brazilian dentists, including possible changes in technique and/or preventive measures. 1105	Of the respondents: Over 90% recognize the high risk of COVID-19 infection for dentists and the need to change some clinical practices. 60.1% partially adhere	Greater attention to biosafety measures, duration of dental consultations. Intervals between appointments.

participants took part in the survey in Brazil.

to social isolation.

97.1% recognize the need for changes in PPE during dental appointments.

The use of minimum PPE adequate to the pandemic was related to the area of residence and marital status of the participants.

Only 30% of participants reported using minimum PPE during the pandemic.

Endodontists still need to determine the best way to perform their procedures safely during the COVID-19 pandemic.

3.2 Mouthwashes

Some studies suggest using mouthwashes before dental procedures to reduce oral cavity microbial load. However, recent research indicates that 0.12% chlorhexidine, widely used in dentistry, is not effective against SARS-CoV-2. Therefore, mouth rinses containing 1% hydrogen peroxide, 0.2% povidone, or 0.05% to 1% cetylpyridinium chloride are recommended for their oxidative antiseptic properties. These solutions effectively reduce viral load in saliva without harming oral mucosa, exploiting SARS-CoV-2's vulnerability to oxidation [23, 27, 28].

3.3 Personal Protective Equipment (PPE)

The use of PPE is a precautionary practice against potential contamination and cross-infections, which should be employed in all patient contacts regardless of their health status. It is essential for the entire dental team as well as for the patient. Recommended PPE for dental personnel includes disposable caps, surgical masks, disposable gowns, protective eyewear or face shields, disposable gloves, N95 respirators or equivalent (PFF2), and shoe covers. Patients should wear masks (before and after procedures), disposable caps, protective eyewear, and shoe covers [23, 24, 27, 29, 30, 31].

3.4 Pre-Screening

Authors recommend conducting pre-screening before dental appointments to identify patients with suspected COVID-19. This measure is crucial for reducing contagion risk and protecting healthcare professionals from potential contact with infected individuals. Pre-screening involves a remote process through phone calls, video calls, or messaging apps, where a questionnaire is used to detect signs of SARS-CoV-2 infection. The

questionnaire includes questions such as: Have you had fever or respiratory symptoms in the last 14 days? Have you traveled to areas with high COVID-19 incidence in the last 14 days? Have you had close contact with people who tested positive for COVID-19 or had fever and respiratory symptoms in the last 14 days?

If the patient answers affirmatively to any of these questions, it is recommended to postpone the dental appointment for 14 days, even in the absence of respiratory symptoms. Additionally, patients should be advised to self-quarantine for 14 days at home and seek medical assistance if symptoms develop or worsen during or after this period [22, 23, 24, 27, 28].

3.5 Waiting Room

Certain biosafety measures are crucial and should be implemented in the waiting room. It is recommended to remove magazines, newspapers, decorations, or any surface where the virus could potentially be transmitted indirectly between patients [27, 28]. Upon arrival, patients should have their body temperature checked, and if it exceeds 37°C, their appointment should be rescheduled. The waiting area should have good ventilation, and patients should maintain a distance of 1 to 2 meters from each other while waiting. Ideally, appointments should be scheduled and spaced apart to avoid overcrowding and minimize the risk of disease transmission at the reception area. Patients must wear masks, and the dental office should provide 70% alcohol for hand hygiene [23, 24, 28, 30].

3.6 Rubber Dam

Some authors in this review recommend using a rubber dam for absolute isolation of the operative field, which should be used in all feasible procedures such as restorations, endodontic treatments, and post placement, to reduce aerosol spread and minimize contact with saliva and blood, especially during the use of rotary instruments. This helps reduce the risk of contamination [24, 27, 29, 31].

3.7 Dental Procedures to Avoid

According to the majority of authors in this review, aerosol-generating procedures should be avoided whenever possible. Procedures that involve rotary instruments, ultrasonic devices, triple syringe (especially in spray form), among others, should be minimized to reduce the risk of cross-infection during treatment. Alternatives such as using hand instruments instead of ultrasonic scalers for periodontal procedures like scaling and root planing are recommended. When aerosol-generating procedures are necessary, high-volume suction devices should be used to immediately eliminate infectious droplets, reducing their dispersion in the air [5, 27, 22, 24]. These procedures should be scheduled for the last appointment of the day, as aerosols can remain suspended in the air for extended periods. Intraoral radiographs should also be avoided whenever possible due to the stimulation of salivation during image acquisition; extraoral imaging such as panoramic and tomographic scans are preferred [23, 27, 28, 31].

3.8 Cleaning and Disinfection of the Dental Environment

After procedures, it is essential to immediately clean, disinfect, and/or sterilize all objects and surfaces in the dental environment that have been touched or used by the patient or professional team to prevent cross-contamination. Before opening the door, the environment should be cleaned with a disinfectant spray [28]. Non-sterilizable equipment such as X-ray machines, dental chairs, and surfaces like tables, chairs, and doorknobs should be disinfected after each patient. Recommended disinfectants include 1% sodium hypochlorite, 2% glutaraldehyde, 62% ethanol, 50% quaternary ammonium compounds, or 70% alcohol [24, 25, 27].

Disposable protective barriers used to cover surfaces should be changed for each patient due to the ability of SARS-CoV-2 to survive for up to 9 days on some surfaces [23, 25, 27]. Reusable PPE like goggles and face shields should be disinfected after use, while disposable ones should be replaced with new ones for each patient. Additionally, all instruments used should be sterilized according to manufacturer's instructions [30].

4. Conclusino

The COVID-19 pandemic has had a significant impact on dentistry, which is an area with a high risk of contamination and cross-infection during patient care. This is due to frequent exposure to droplets and aerosols, as well as close interpersonal contact between patients and professionals. Therefore, biosafety measures must be implemented in all dental settings, whether small clinics or dental schools, to reduce the risk of virus transmission. It is crucial to follow increasingly stringent protocols to maintain a clean and disinfected environment for both professionals and patients.

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