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REVIEW ARTICLE

Disinfection Measures during COVID-19 for Dental Operatories

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Abstract:

Background:

In the dental health-care setups, the environmental object and surfaces are expected to be infected by the COVID virus wherein definite procedures are performed. Consequently, these objects and surfaces, particularly where COVID-19 patients are being treated, must be appropriately cleaned and sanitized to stop further spread.

Objective:

The present article is intended for providing protocols about the cleaning and disinfection of objects and surfaces in the circumstances of COVID-19 for Dental operatories.

Methods:

Studies evaluating the surface characteristics of the virus as well as effective disinfection measures have been documented.

Results:

Various chemicals in different concentrations have a virocidal effect. The devices introduced include used UV radiation and ozone.

Conclusion:

These changes in dental clinical practice are needed to save humanity by preventing further transmission of disease.

Keywords: COVID-19, Disinfection, Disinfection protocol, NaOCl, Hydrogen peroxide, Dental operatories.

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1. INTRODUCTION

The coronavirus epidemic outbreak started in China and had spread rapidly to other parts of the world. It has led to public health crises and it was declared a pandemic in early 2020 [1]. Covid -19, a novel acute respiratory disease, is a spherical or elliptical enveloped RNA virus with a diameter of 60–140 nanometers [2, 3]. It belongs to the family of viruses known as Coronaviridae. It is currently designated as a severe acute respiratory syndrome (SARS)-CoV-2 and has affected more than 74,299,042 people with a mortality rate of 2.24% (WHO Report – 19th Dec, 2020). With the high transmission

rate from direct contact between the people, the general public and healthcare providers are at risk for contracting the infection and thus becoming the carrier of the disease [4]. As per the OSHO, the dental health care providers are categorized into ‘very high-risk group’ as they work very near to the oral cavity [5]. The dental procedures involve aerosol-generating procedures, which further contribute to the spread of the infection [6].

1.1. Transmission Modes

According to current research, transmission modes of the COVID-19 virus are mainly respiratory droplets and contact routes [7]. Contact routes mainly include Direct and Indirect [8]. Direct spread mainly includes contact with the infected person and indirect spread is *via* the surfaces in the close vicinity or with objects utilized for the infected person [9].

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Direct contact includes contact with the eye, oral, nasal and mucous membrane, whereas indirect contact includes airborne droplets, contact with contaminated surfaces/objects/instruments [10]. Dental professionals are in frequent contact with aerosols containing micro-organisms from infected patients [11]. Possible transmission routes in dental clinic/institution include from dental healthcare personnel to patient, from patient to dental healthcare personnel, from patient to patient, from patient to the environment, and from environment to the patient [5].

1.2. Surface Disinfection in Dental Clinics

Surface disinfection can be defined as “chemical disinfection of a solid surface, excluding those of certain instruments, by the application of a product with or without mechanical action.” Various methods of application include immersion, spraying, wiping, flooding, circulation, *etc.* These different ways of application can be targeted for varying objects in clinics.

The Centers for Disease Control and Prevention have recommendations for infection control in the dental office. The purpose of the disinfection of the environmental surface is to inactivate the virus to an extent that it prevents subsequent transmission of infection [12]. Frequency of disinfection for various surfaces in different areas should be at least twice daily. According to various studies, the virus remains active for various periods, as shown in Table 1 [13].

Table 1. Life span of the virus.

Objects	Life Span
Air	3 hours
Copper	4 hours
Cardboard	1 day
Glass	2 days
Stainless steel	3 days
Plastics	3 days
Medical mask	7days

The factors affecting the existence of the virus include the humidity and temperature of the environment as well as the resistance of micro-organisms. Kampf *et al.* evaluated coronavirus persistence on inanimate objects and its inactivation using biocidal agents. They found that human coronaviruses can remain contagious at room temperature for up to 9 days. The degree of persistence is shorter if the temperature is 30 degrees or more [14]. However, at 4 °C temperature, the persistence could be greater than or equal to 28 days. It was seen that after 5 minutes, raising the temperature to 70 °C, the virus was no longer evident. Therefore the persistence was longer with higher inocula. Warnes *et al.* showed that surfaces with a higher percentage of copper lead to the antiviral effect. This deactivation of the virus was due to the formation of reactive oxygen [15].

2. LITERATURE REVIEW

The exclusive nature of dental operatory, its procedures and instruments, and care of the patient are aimed to avoid the spread of diseases amongst the dentist, their assistants, and the

patients. Disinfection must be performed in the following susceptible areas of the clinic, such as highly touched surfaces (chair handles, door handles, table tops, pens, appointment diary, keyboards, mouse, printer, scanner, instrument trolley, dental chair, operator stool, X-ray unit), noticeable contaminated surfaces (with blood, pus), and waiting areas or rooms where infected patients have been treated [16]. Before any appointment, the classification of the patient is required and is done through preventive triage, which includes evaluation of epidemiological data (travel history) and then the clinical presentation. The general health assessment can be carried out through telecommunications. The use of smart applications such as DOCTOROral® may be considered for quick assessment [17].

2.1. Disinfection Measures

2.1.1. Preoperative Measures

When dentists treat patients, they should intercept potentially contaminated persons before they arrive at the operating room, such as diagnosing those with a fever >37.5 °C and asking about the patient’s general health status in the previous 7 days, and about the possibility of having been in contact with other contaminated persons. Patients must be asked to wash their hands before entering the operative field. The washing of hands should be done underneath running tap water along with antiseptic soap solution (cetrimide soaps like Savlon, phenolic soaps like Lifebuoy, 4% chlorhexidine gluconate scrub, 10% povidone-iodine like beta scrub, *etc.*) They should be scrubbed extra orally with isopropyl alcohol before any procedure. Preoperative mouth rinsing with hydrogen peroxide 1% or povidone-iodine 0.2% is highly recommended. Preparation includes mixing one part of 3% hydrogen peroxide with 2 parts of water. The patient should be asked to tilt the head back and gargle for 30-60 seconds. This will effectively reduce the oral microbes, including bacteria, yeasts, fungi, viruses as well as spores [18 - 20].

2.1.2. Operative Measures

All the electronic devices (microscopes, motors, light curing units, apex locators) required during the procedure should be cleaned and disinfected, and rapped with barrier priorly. Measures should be adopted which minimizes the areas touched and infected each time a patient is treated. Therefore, reducing the equipment necessary during the procedure will reduce the time required for disinfecting them as well as will minimize cross-infection [21]. While viewing X-rays, one with a disposable plastic cover, the plastic cover should be disposed and the glove needs to be changed; the other one with no cover needs to be immersed in 0.1% NaOCl for 2 minutes and then rinsed. Intra-oral imaging such as IOPA’s, Radiovisiography, or placement of PSP plates should be avoided as they may cause gag or cough reflexes, whereas extra-oral imaging such as OPG’S and CBCT should be used [22].

2.1.3. Post-operative Measures

After completion of the clinical session, major disinfection protocols need to be followed. Every one of the equipment or operatories within 3 feet of the operating field needs to be

disinfected with 1% Sodium hypochlorite [23]. All instruments used in the procedure are collected immediately and cleaned under running water and dipped in disinfectant solution for 30 minutes [24]. Suction pipe needs to be backflushed with 1% NaOCl for 30 seconds using disposable cups. Other pipelines such as a 3-way syringe, handpiece waterline, and water outlets also should be disinfected for 30 seconds. A separate mop is used for the clinical area. Mopping from less soiled to more soiled and beginning from higher to the lower level is recommended. Lastly, the floor is cleaned with water followed by freshly prepared 1% NaOCl. According to WHO, in enclosed spaces, regular disinfectant application by spraying or fogging to environmental surfaces is not recommended for COVID-19 [25]. Surface disinfection with 0.1% sodium hypochlorite or 62-71% ethanol significantly reduces coronavirus infectivity on surfaces within 1 min exposure time [14]. Izzetti *et al.* established that the use of sodium hypochlorite necessitates a minimum concentration of at least 0.21% to be efficient. Hydrogen peroxide was helpful with a concentration of 0.5% and an incubation time of 1 min. A significant finding is the ineffectiveness of chlorhexidine. Within 10 min, a concentration of 0.2% showed no efficacy against coronavirus. It is a result that does not hold up some guidelines for dentistry [26].

2.1.4. Ventilation of Clinic

To assist in the prevention of airborne infections, sufficient ventilation in health-care facilities in all patient-care areas is essential. It can be natural or mechanically assisted. Proper ventilation will allow continuously removing the contaminated air. It has been established that as compared to mechanical ventilation, natural ventilation causes improved air exchange, up to 69 changes/hour when the windows are completely open. Most guidelines suggest about 12 changes/hour for isolation rooms [27].

2.1.5. No-touch Methods

UV germicidal irradiation devices provide rapid and chemical-free disinfection, and can be operated with phones or laptops, hence this is no-touch technology. No-touch devices include:

- (1) Aerosolized hydrogen peroxide and hydrogen peroxide vapors,
- (2) Ultraviolet (UV-c) light devices,
- (3) A pulsed-xenon UV light system, and
- (4) High-intensity narrow-spectrum (405 nm) light.

However, several factors affecting the effectiveness of UV irradiation include the distance from the UV gadget; the dose of irradiation, exposure time and wavelength; placement of lamp; lamp age; and duration of use. The major disadvantage of these is that they are used only when room lights are off [25]. These are mostly used as an adjunct with other protocols as combination therapy may enlarge the antimicrobial spectrum [28].

2.1.6. Laboratory Materials

Objects from the lab such as appliances, models, and impressions should be cleaned thoroughly to eliminate all evident blood and debris. Impression materials like silicone and poly sulfur can be disinfected by submerging in glutaraldehyde (2%) or sodium hypochlorite (0.1%). Alginate and polyether are disinfected by immersing in sodium hypochlorite (0.1%), and then be wrapped in a hypochlorite saturated paper towel and reserved in a closed container for the suggested disinfectant time until use.

Table 2. List of concentrations of biocides effective against Coronavirus.

Biocides	Concentration for Skin	Concentration for Aerosol
Ethyl alcohol	80% (v/v)	
Isopropyl alcohol	75% (v/v)	
Povidone iodine	5–10% (v/v)	
Quaternary ammonium	Not applicable	
Hydrogen peroxide	0.125% (v/v)	
Sodium hypochlorite	Not applicable	
Peroxyacetic acid (PAA)	Not applicable	
Chlorine dioxide		0.03 ppm
Ozone		<0.05 ppm
Ultraviolet light		200–280 nm

3. DISCUSSION

The use of chemical agents to inanimate objects will lead to the elimination of pathogenic micro-organisms. The first step in disinfection is cleaning which allows diminishing the pathogenic load on contaminated agents. It will decrease the debris accumulated, dirt as well as organic matter present on the surface. This organic matter hampers direct contact of disinfectant and surface [29].

The inappropriate selection and insufficient use of disinfectants have a noteworthy role in the cross-infection and spread of the pathogen. The critical factors taken into consideration while targeting the viruses include over-dilution of the sanitizers and inadequate contact time (Table 2) [30].

Handling and preparation of disinfectant should be done according to manufacturer’s instructions. Careful handling should be ensured by adequate PPE to check upon chemical exposure. The training in the health care setting should include training in cleaning and disinfecting. The training should include the demonstration of preparation, technique, and risk assessment of disinfectant used [31].

Concerning the persistence of the virus on various surfaces, and in particular on metals containing copper, these findings are interesting and could lead to the introduction of new surfaces with viricidal properties. Hence copper has revealed antiviral properties, so much that the virus appears damaged or altered on copper surfaces [32]. Chin *et al.* found that lesser SARS-CoV-2 survival was seen on printed and tissue papers; however, virus was observed on the surgical masks even after 7 days [33].

The hypochlorite having a broad spectrum of antimicrobial activity is used in various concentrations. It dissolves in water in hypochlorite and hypochlorous acid which leads to the degradation of amino acids and hydrolysis. Hypochlorous acid can penetrate cells disrupting their metabolism. Hence hypochlorite is proteolytic, bactericidal, and virucidal in action [34].

The recommended minimum concentration for the coronavirus is 0.1% which will inactivate the majority of micro-organisms. Nevertheless, for blood and body, a fluid spill minimum concentration of 0.5% is recommended. Regardless of the concentration used, these compounds are inactivated by the presence of organic matter; hence it is mandatory to first clean the surface with soap and water [35].

The transmission form of viruses, including droplets, aerosols, and fomites, can be eliminated using UV devices. The activity of UV light depends on its wavelength and the length of the RNA transcript. Their action increases with an increase in the length of the RNA transcript. Darnell *et al.* found that UVC with wavelength 254 nm and intensity of 4,016 $\mu\text{W}/\text{cm}^2$ was effective while UVA was ineffective. SARS-CoV-1 in an aerosolized form treated using UV light showed a greater vulnerability [36].

Another advanced biocide is Ozone. Kumar *et al.* reported that viruses such as coronavirus with lipid layer envelop are more sensitive to ozone than to non-enveloped viruses. The maximum anti-viral activity was seen at a concentration of 20-25ppm. However, periodic monitoring of ozone levels is required to prevent exposure to dental health personnel [37].

According to WHO, spraying of disinfectants is not recommended under any circumstances. Spraying is an ineffective way to treat surfaces with dirt and organic debris. Additionally spraying individual with toxic disinfectant have harmful effects on human health such as nausea, vomiting, skin and eye irritation, bronchospasm on inhalation [38, 39].

While making a choice among various disinfectants, Organization for Safety, Asepsis, and Prevention (OSAP) suggested looking for the following:

- (1) Environmental Protection Agency registration number.
- (2) Labeling of “hospital disinfectant”.
- (3) Comprehensible directions.
- (4) Lower hazard to trigger an allergic reaction.
- (5) Surfaces compatibility, directions for use, and who will apply it.
- (6) Cleaning as well as disinfection action.
- (7) Easy to use.
- (8) A rational contact time (less than 10 minutes).
- (9) Suitable storage and discarding needs.
- (10) A practical and shelf life [40].

CONCLUSION

Disinfection is key to the protection of dental health providers. Disinfection mutually benefits not only the operator

but also the patient, assistant paramedic, and the environment. The utilization of surface disinfectants is a component of an approach to shield ourselves and stop the spread of the coronavirus. Various disinfectants, such as antiseptic soap solution, hydrogen peroxide, chlorhexidine, povidone-iodine, and sodium hypochlorite, and irradiation methods can be used at different levels as precautionary steps against COVID-19.

AUTHORS' CONTRIBUTIONS

The writing of the manuscript has been done by N. Motwani. All authors have read and agreed to the published version of the manuscript.

CONSENT FOR PUBLICATION

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CONFLICT OF INTEREST

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