

COVID 19: ENDO-CARE

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ABSTRACT

A novel disease emerged in Wuhan, China, in late 2019. The disease was designated by the World Health Organization (WHO) on 12 February 2020, as Coronavirus disease (COVID-19). The disease is caused by Severe Acute Respiratory Syndrome Corona Virus-2 (SARS CoV-2) Virus. The outbreak of COVID-19 has evolved rapidly into a public health crisis and has spread exponentially to other parts of the world. Given the widespread transmission of SARS-CoV-2 and reports of its spread to health care providers, dental professionals are at high risk for nosocomial infection and can become potential carriers of the disease. The endodontic treatment is complex, requires a longer time compared to other dental procedures and includes aerosol generation, handling of sharp instruments, and proximity of the clinician to the patient's oropharyngeal region. Long-term assessment of treatment outcomes is usually required. The goal is to provide emergency and urgent dental care to patients, to prevent cross-contamination, and to protect dental care providers during the provision of care. Human-to-human transmission has been described mainly through respiratory droplets and contaminated hands or surfaces. The virus remained viable in aerosols under experimental conditions for at least 3 hours. Coronavirus can persist on inanimate surfaces like metal, glass or plastic for up to 9 days, depending on type of surface, the temperature, and the humidity of the environment. This paper aims at addressing the urgent need to develop a protocol that includes guidelines for dental care and infection control during the COVID-19 outbreak.

KEYWORDS: Covid- 19, Endodontics, Infection control, Sterilization.

INTRODUCTION

A novel disease emerged in Wuhan, China, in late 2019. The disease was designated by the World Health Organization (WHO) on 12 February 2020, as Coronavirus disease (COVID-19).^[1]

The disease is caused by Severe Acute Respiratory Syndrome Corona Virus-2 (SARS CoV-2) Virus. The novel coronavirus belongs to a family of single-stranded RNA viruses known as Coronaviridae.

Coronavirus can persist on inanimate surfaces like metal, glass or plastic for up to 9 days, depending on type of surface, the temperature, and the humidity of the environment. The outbreak of COVID-19 has evolved rapidly into a public health crisis and has spread exponentially to other parts of the world.^[2] The typical clinical symptoms of the patients who suffered from the novel viral pneumonia were fever, cough, and myalgia or fatigue with abnormal chest CT, and the less common symptoms were sputum production, headache, hemoptysis, and diarrhea. This new infectious agent is

more likely to affect older males to cause severe respiratory diseases.

Given the widespread transmission of SARS-CoV-2 and reports of its spread to health care providers^[3] dental professionals are at high risk for nosocomial infection and can become potential carriers of the disease. These risks can be attributed to the unique nature of dental interventions, which include aerosol generation, handling of sharp instruments, and proximity of the provider to the patient's oropharyngeal region.^[2]

The endodontic emergency procedure presents unique challenges, requires a longer time compared to other dental procedures, and involves special equipment, such as microscopes and ultrasonic devices.^[1] Endodontists are in a unique situation as they may be called upon for the assessment and management of odontogenic pain, swelling, and dental alveolar trauma in suspected or known COVID-19 patients. It is worth noting that case presentations can be dynamic, and there is a good chance that dental practices might treat some of the patients with

asymptomatic COVID-19 infections since the incubation period can range from 0 to 24 days and most patients only develop mild symptoms.

Thus, every patient should be considered as potentially infected by this virus, and all dental practices need to review their infection control policies, engineering controls, and supplies. This article aims at addressing the possible routes of transmission in dental clinics and the urgent need to develop a protocol that includes guidelines for endodontic treatment and infection control during the COVID-19 outbreak.

The possible transmission routes of COVID-19 in dental clinics

Dental professionals should be familiar with modes of transmission of COVID-19, signs and symptoms of COVID-19 so as to identify the patients with COVID-19 infection, and what extra-protective measures should be adopted during the practice, in order to prevent the transmission of 2019-nCoV.^[5]

To et al. reported that live viruses were present in the saliva of infected individuals by viral culture method.^[6]

• Airborne spread

It was found that many dental procedures produce aerosols and droplets that are contaminated with virus.⁷ It is hard to avoid the generation of large amounts of aerosol and droplet mixed with patient's saliva and even blood during dental practice.^[8]

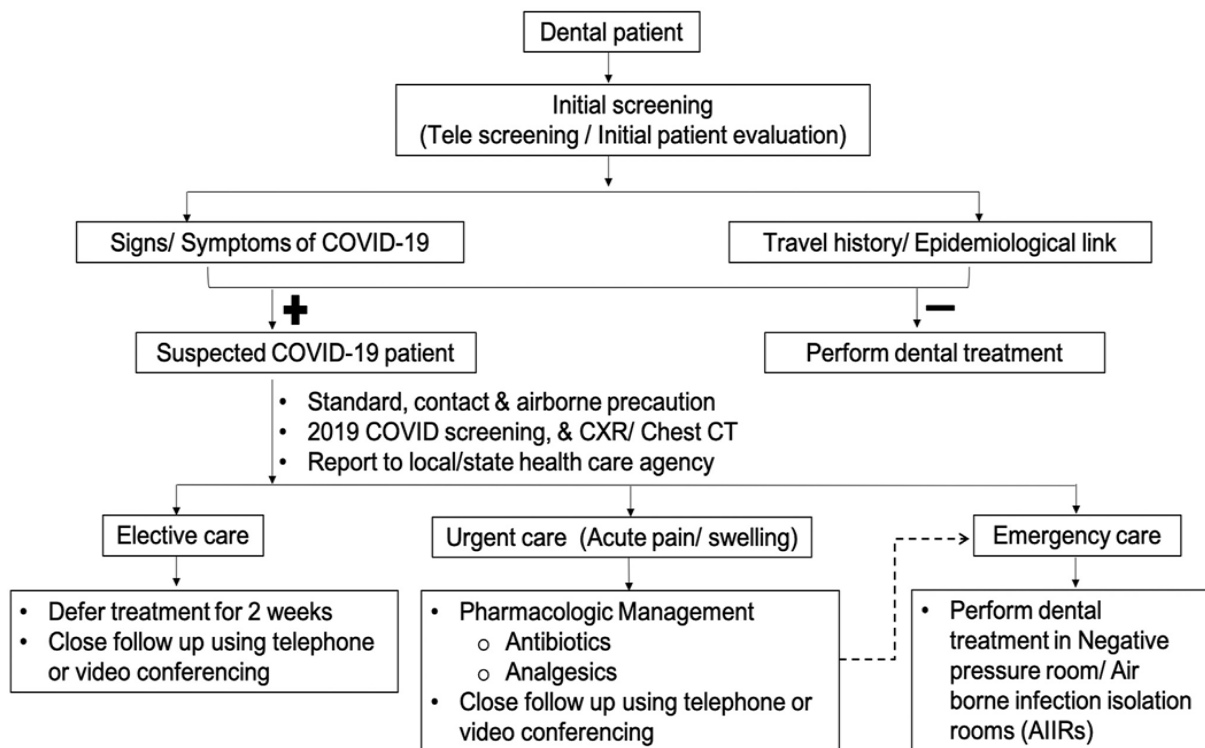
Particles of droplets and aerosols are small enough to stay airborne for an extended period before they settle on environmental surfaces or enter the respiratory tract. Thus, COVID-19 has the potential to spread through droplets and aerosols from infected individuals in dental clinics and hospitals.^[5]

• Contact spread

A dental professional's frequent direct or indirect contact with human fluids, materials, and contaminated dental instruments or environmental surfaces makes a possible route to the spread of virus.^[8]

General dental considerations

These guidelines are based on current known modes of transmission and severity of COVID-19 and the implications for dental practice.



λ Telephonic prescreening protocol

Assess the patient's dental condition over the phone and determine whether the patient needs to be seen in the dental clinic.^[9]

If dental treatment can be delayed, provide patients with detailed instructions about self-care and options of medication they may use. If urgent treatment is necessary pharmacological management with antibiotics and analgesics can be instituted.^[9]

Prioritize urgent, emergency visits and procedures and postpone elective procedures, surgeries which include scaling and follow up, non-urgent dental visits.^[9]

Enquire about the COVID-19 risk by asking about the following:

- History of travel to an area with local spread of corona virus infection in the past 14 days
- History of respiratory symptoms in the past 14 days including the following:

- a. Dry cough
- b. Difficulty in breathing
- c. Throat pain
- **History of other symptoms in the past 14 days including the following**
 - a. High body temperature (38 degrees Celsius and above)
 - b. Muscle aches
 - c. Abdominal disturbances
 - d. Date of onset of symptoms
 - e. Loss of taste
 - f. Loss of smell
 - g. Body ache
 - h. Lethargy
 - i. Severe headache
 - j. History of being detected with covid-19
 - d. Being in contact with a covid-19 positive person or a person showing any of these symptoms.

If the patient answers no to all the questions, proceed and see the patient. If they say yes to any of the above questions, investigate further so that treatment can be deferred or the patient referred to seek medical advice/ care through the nearest COVID-19 treatment facility.^[9]

Telephone triage of all patients in need of emergency dental care

- Fix appointments through phone only.^[10]
- Hot Spot Matching & Medical Symptoms Assessment.^[10]
- Dental needs assessment.^[10]
- Disclosure/ Consent Form to be sent to patient electronically (If possible)^[10]
- Ask patient to wear mask and preferably come alone.^[10]

After the patient has been scheduled for physical visit,

λ Reception/ waiting area protocol

- Receptionist / Staff: One person.^[10]
- Discourage footwear within clinic interiors/ provide disposable foot cover.^[10]
- Record patient temperature using digital non-contact infrared thermometer.^[10]
- Mandatory use of alcohol based hand rub (ABHR) & provide mask for every patient.^[10]
- Signs showing proper handwashing technique should be placed close to soap dispensers.^[10]
- Shared items such as magazines, toys, and pens, should not be placed in waiting areas.^[10]
- Waiting time should be as short as possible to minimize the number of people present.^[10]
- Seating arrangement with minimum 3 feet physical distancing.^[10]
- Display patient education material on hand & cough hygiene.^[10]
- Patient to submit signed disclosure/ consent form.^[10]

After the patient has been guided to dental operator,

λ Dental operatory protocol

- Keep the clinical operatory clutter-free.^[10]
- Improve air circulation and avoid use of air-conditioners.^[10]
- Donning of appropriate PPE for Dental Surgeon and one dental assistant should be done in donning room.^[10]

λ Patient assesment and treatment protocol

- Pre-procedural mouth rinse: 1% hydrogen peroxide or 0.2% povidone-iodine : 1 min.^[10]
- Extra oral scrubbing of face with antiseptic wipe.^[10]
- Patient is made to wear the disposable gown and covered with a full-length drape with their hands tucked in and the mouth mask removed.^[10]
- Diagnose & plan the treatment into aerosol generating procedures (AGP) and non aerosol generating procedures (non-AGP)^[10]
- Four-handed dentistry and rubber dam application for all procedures.^[10]
- High volume suction & minimize IOPA usage^[10]

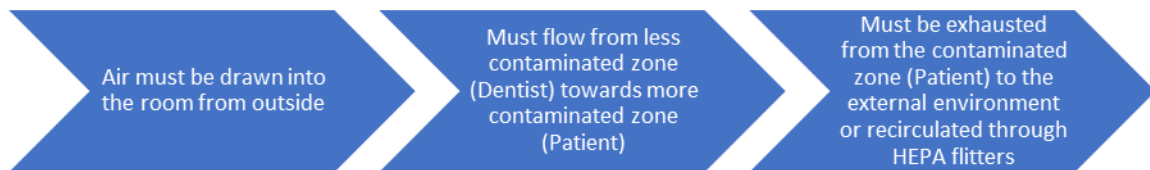
λ Aerosol generating procedures (AGP)

- Identify a closed room to perform Aerosol Generating Procedures (AGP) if available.^[10]
- Air should be filtered with High Efficiency Particulate Air (HEPA 13 or 14)- if recirculated or otherwise exhausted to the outside effectively.^[10]
- Temporary use of a strategically placed portable, industrial grade HEPA filter may expedite removal of airborne contaminants.^[10]
- Ultraviolet germicidal irradiation (UVGI) 252 nm, duct irradiation or upper-room air irradiation(30-40 Watts/100 sq feet) can be used as an adjunct air-cleaning measure but it cannot replace HEPA filtration.^[10]
- Allow adequate time for sufficient ACH(Air Changes per Hour) to remove 99% of airborne particles and to perform environmental disinfection of min 20 minutes after non-AGP and 30 minutes after AGP between patients.^[10]
- Hydrogen peroxide vapour fumigation with 30% hydrogen peroxide can be performed, Vacate the operatory during disinfection procedure.^[10]

• Air flow circulation

- The air flow must be planned in a way to facilitate clearing of the contaminated aerosol within.^[10]
- The dental operatory with adequate provision of ventilation to allow a minimum of 6 ACH.^[10]
- It is recommended to
 - a. Use a stand alone HEPA 13 or HEPA 14 air filter in the dental operatory.
 - b. Avoid air conditioners if they are not having in-built HEPA filters.
 - c. Use natural ventilation when available

- d. Introduce additional positive air flow from less contaminated to more contaminated zone by using pedestal or table top fans.
- e. Place exhaust fans to evacuate the contaminated air to the external environment.



- One or more of the following four contaminant removal techniques should be followed^[10]

HEPA air filters (min 12 ACH)	UVGI (Ultraviolet Germicidal Irradiation) + Ventilation (min 6 ACH)	Disinfectant defogging	Only natural ventilation (min 6 ACH)
20 minutes Air filtration with HEPA 13 / HEPA 14 Filters	15 minutes UV-C Irradiation of 245 nm, 40 W per 100 sq.ft	30 - 45 minutes Hydrogen Peroxide Vapor (HPV) or Chlorine Dioxide	60 Minutes Cross ventilation and additional ventilators (pedestal fans, exhaust fans)

HVE filter (high volume evacuator): It is a suction device that helps remove air at a rate of up to 2.83 cubic mm per minute. It is the easiest way to remove dental aerosols as they are generated and could effectively reduce contamination caused by the operating site by 90%.

The device should be held at a proper distance (approximately 6–15 mm) from the active ultrasonic tip.^[12]

During dental practices, the spread of oral microorganisms mostly radiates toward the dentist's face, particularly in the inner part of the eyes and around the nose, which are important areas for infection transmission (Bentley *et al.*, 1994; Nejatidanesh *et al.*, 2013). Personal protective equipment (PPE) can form an effective barrier against most hazards of aerosols generated from the operative site.

- PPE should include**

- Long sleeved disposable gown
- Face mask & respirators.
- Face shield as well as a protective eyewear.
- Gloves.
- Shoe cover.

Requirements and technical specifications of personal protective equipment (PPE)

PPE Kit: kits should be made from 70 ± 5 GSM material.

- Coverall (medium and large)**

- Impermeable to blood and body fluids
- Single use
- Avoid culturally unacceptable colors e.g. black
- Light colors are preferable to better detect possible contamination
- Quality compliant with following standard
- Meets or exceeds ISO 16603 class 3 exposure pressure, or equivalent

- N-95 Masks**

- Shape that will not collapse easily
- High filtration efficiency
- Good breathability with expiratory valve
- Quality compliant with standards for medical N95 respirator: NIOSH N95, EN 149 FFP2, or equivalent
- Fluid resistance: minimum 80 mmHg pressure based on ASTM F1862, ISO 22609, or equivalent
- Quality compliant with standards for particulate respirator that can be worn with full face shield

- Goggles**

- With transparent glasses, zero power, well fitting, covered from all sides with elastic band/or adjustable holder.
- Good seal with the skin of the face
- Flexible frame to easily fit all face contours without too much pressure
- Covers the eyes and the surrounding areas and accommodates for prescription glasses
- Fog and scratch resistant
- Adjustable band to secure firmly so as not to become loose during clinical activity
- Indirect venting to reduce fogging
- May be re-usable (provided appropriate decontamination arrangements) or disposable
- Quality compliant with the below standards, or equivalent:

EU standard directive 86/686/EEC, EN 166/2002

ANSI/SEA Z87.1-2010

- Face Shield^[11]**

- Made of clear plastic and provides good visibility
- Adjustable band to attach firmly around the head and fit snugly against the forehead
- Fog resistant (preferable)
- Completely covers the sides and length of the face
- May be re-usable (made of material which can be

- cleaned and disinfected) or disposable
- Quality compliant with the below standards, or equivalent:

EU standard directive 86/686/EEC, EN 166/2002
ANSI/SEA Z87.1-2010

e. Gloves

- Nitrile
- Non-sterile
- Powder free
- Two gloves should be used : Outer gloves preferably reach mid-forearm (minimum 280 mm total length)

- Quality compliant with the below standards, or equivalent:

EU standard directive 93/42/EEC Class I, EN 455

EU standard directive 89/686/EEC Category III, EN 374

ANSI/SEA 105-2011

ASTM D6319-10

f. Shoe Covers^[11]

- Made up of the same fabric as of coverall
- Should cover the entire shoe and reach above ankles

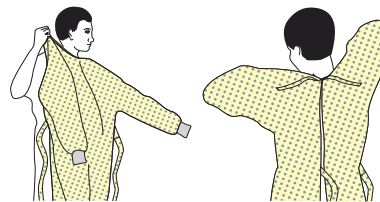
Sequence for putting on & removal of PPE is depicted in the following images:

SEQUENCE FOR PUTTING ON PERSONAL PROTECTIVE EQUIPMENT (PPE)

The type of PPE used will vary based on the level of precautions required, such as standard and contact, droplet or airborne infection isolation precautions. The procedure for putting on and removing PPE should be tailored to the specific type of PPE.

1. GOWN

- Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back
- Fasten in back of neck and waist



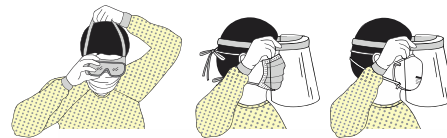
2. MASK OR RESPIRATOR

- Secure ties or elastic bands at middle of head and neck
- Fit flexible band to nose bridge
- Fit snug to face and below chin
- Fit-check respirator



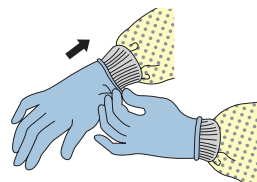
3. GOGGLES OR FACE SHIELD

- Place over face and eyes and adjust to fit



4. GLOVES

- Extend to cover wrist of isolation gown

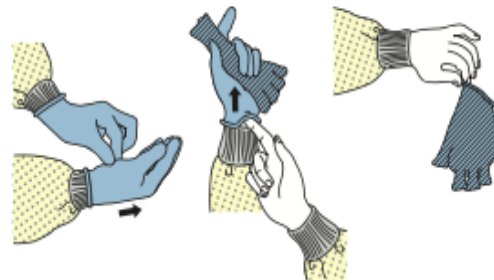


HOW TO SAFELY REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE) EXAMPLE 1

There are a variety of ways to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. Here is one example. **Remove all PPE before exiting the patient room** except a respirator, if worn. Remove the respirator **after** leaving the patient room and closing the door. Remove PPE in the following sequence:

1. GLOVES

- Outside of gloves are contaminated!
- If your hands get contaminated during glove removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Using a gloved hand, grasp the palm area of the other gloved hand and peel off first glove
- Hold removed glove in gloved hand
- Slide fingers of ungloved hand under remaining glove at wrist and peel off second glove over first glove
- Discard gloves in a waste container



2. GOGGLES OR FACE SHIELD

- Outside of goggles or face shield are contaminated!
- If your hands get contaminated during goggle or face shield removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Remove goggles or face shield from the back by lifting head band or ear pieces
- If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container



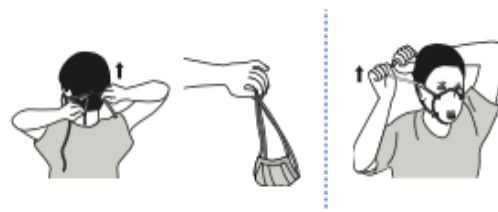
3. GOWN

- Gown front and sleeves are contaminated!
- If your hands get contaminated during gown removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Unfasten gown ties, taking care that sleeves don't contact your body when reaching for ties
- Pull gown away from neck and shoulders, touching inside of gown only
- Turn gown inside out
- Fold or roll into a bundle and discard in a waste container

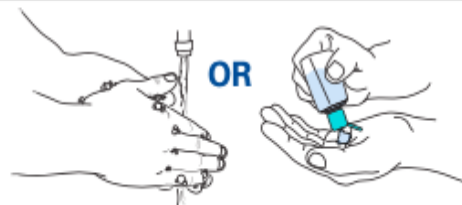


4. MASK OR RESPIRATOR

- Front of mask/respirator is contaminated — DO NOT TOUCH!
- If your hands get contaminated during mask/respirator removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Grasp bottom ties or elastics of the mask/respirator, then the ones at the top, and remove without touching the front
- Discard in a waste container



5. WASH HANDS OR USE AN ALCOHOL-BASED HAND SANITIZER IMMEDIATELY AFTER REMOVING ALL PPE



HOW TO SAFELY REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE) EXAMPLE 2

Here is another way to safely remove PPE without contaminating your clothing, skin, or mucous membranes with potentially infectious materials. **Remove all PPE before exiting the patient room** except a respirator, if worn. Remove the respirator **after** leaving the patient room and closing the door. Remove PPE in the following sequence:

1. GOWN AND GLOVES

- Gown front and sleeves and the outside of gloves are contaminated!
- If your hands get contaminated during gown or glove removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Grasp the gown in the front and pull away from your body so that the ties break, touching outside of gown only with gloved hands
- While removing the gown, fold or roll the gown inside-out into a bundle
- As you are removing the gown, peel off your gloves at the same time, only touching the inside of the gloves and gown with your bare hands. Place the gown and gloves into a waste container



2. GOGGLES OR FACE SHIELD

- Outside of goggles or face shield are contaminated!
- If your hands get contaminated during goggle or face shield removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Remove goggles or face shield from the back by lifting head band and without touching the front of the goggles or face shield
- If the item is reusable, place in designated receptacle for reprocessing. Otherwise, discard in a waste container

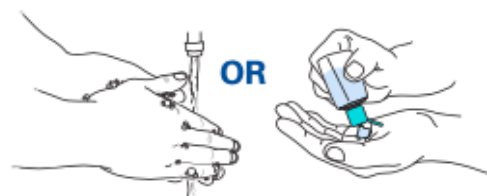


3. MASK OR RESPIRATOR

- Front of mask/respirator is contaminated — **DO NOT TOUCH!**
- If your hands get contaminated during mask/respirator removal, immediately wash your hands or use an alcohol-based hand sanitizer
- Grasp bottom ties or elastics of the mask/respirator, then the ones at the top, and remove without touching the front
- Discard in a waste container



4. WASH HANDS OR USE AN ALCOHOL-BASED HAND SANITIZER IMMEDIATELY AFTER REMOVING ALL PPE



(<https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf>)

λ Sterilization protocol for endodontic instruments and equipments

Dental radiography

1. Use of autoclavable or disposable film/receptor holders is recommended to decrease clinician's contact with saliva while placing the film/receptor.^[13]
2. The high-touch and non-critical items such as tube head, X-ray cone, control panel, exposure button, head rest and adjustment control, chair and adjustment control and countertop/working area

should be barrier-protected (plastic sheets, wraps) and the barriers should be changed after each patient.^[13]

3. Intermediate level disinfectants (70% ethyl alcohol, 70% isopropyl alcohol) can be used for disinfection of these items on a daily basis or when contaminated.^[13]
4. Digital receptors cannot be sterilized by conventional means. Manufacturers' recommendations should be followed. For digital sensors (CCD and plates) wiping with intermediate

level disinfectants after each use (70% ethyl alcohol, 70% isopropyl alcohol) is recommended.^[13]

5. Phosphor plates may also be gas sterilized with ethylene oxide.^[13]
6. Plastic sheaths must be used for all kind of intraoral films/ receptors and the integrity of sealed barrier must be verified before placement.^[13]
7. The use of double barriers for films and plates and latex finger cots in conjunction with a plastic sheath for direct digital sensors will more effectively prevent cross contamination. The risk of contamination with latex finger cots is very less compared to plastic barriers which are used to cover the sensor.^[13]

Technique

1. Use disposable, fluid-proof surface barriers to cover surfaces/objects that may be touched with contaminated hands or contaminated objects for example:

Tubehead,
X-ray cone,
Control panel,
Exposure button,
Headrest,
Chair adjustment controls,
Work surfaces,

1. Computer equipment/devices.^[14]
2. Change barriers between patients.^[14]
3. Clean the parts of radiography equipment that touch patients and which are touched with contaminated gloves at the end of the appointment (e.g. radiograph tube head and control panel).^[14]
4. Clean film-holding and positioning devices between patients.^[14]

Magnifying loupes

1. All areas of the loupe should be disinfected with a high-level disinfectant (70% isopropyl alcohol) after each patient.^[15]
2. If the lenses are water resistant, products such as Lysol Disinfectant Spray (Reckitt Benckiser Professional, Wayne, N.J.) may be sprayed into a gauze sponge and used to wipe the frames and lenses.^[15]
3. Whenever possible, clean, disinfected loupes should be in position on the clinician when the clinical procedure is started and left in place until the clinical procedure is completed, and hand contact with the loupes should be avoided during the procedure. At the completion of the clinical procedure, the lenses can be cleaned and the frames and lenses disinfected with 70% isopropyl alcohol.^[15]

Dental operating microscope

To protect the internal optics from dust, the system should never be left without the objective lens, binocular tube and eyepieces. After use, cover the system to protect it from dust. Clean the exterior surfaces of the optical

components (eyepieces, objective lenses) only when necessary:

- Do not use any chemical agents.
- Remove dust from the optical surfaces using a squeeze blower or a clean, grease-free brush.

All mechanical surfaces of the system can be cleaned by wiping them with a damp cloth. Do not use any aggressive or abrasive cleaning agents. Clean off any residue using a mixture of 50% ethyl alcohol and 50% distilled water plus a dash of household dish-washing liquid.

If the system surfaces need to be disinfected, please note the maximum concentrations are:

- a. For alcohol (tested with 2 propanol): 60%
- b. For aldehyde (tested with glutaraldehyde): 2%
- c. For quaternary compounds (tested with DDAC): 0.2%

- **Caution:** The use of unauthorized disinfectants can cause the paint on the device to become damaged.
- Use a disinfectant based on aldehyde or alcohol. The addition of quaternary compounds is acceptable.
- To avoid damaging the surfaces, do not use any disinfecting components other than those specified above.

(<https://www.zeiss.com/meditec/int/med-support-now/disinfecting-surgical-microscopes.html#quicklinks>)

Local anesthesia: Preferably disposable needles and syringes should be used for local anesthesia administration.

Single dose vials should be used.

The outer surface of the glass anesthetic cartridges should be disinfected by using Povidone- iodine solution (Betadine).

Rubber dam: Presoak the rubber dam clamps, forceps and punches in 0.5% to 0.1% sodium hypochlorite or 70% alcohol or Holding Rinse and clean immediately following the procedure. Hinged instruments should be cleaned in the open position.^[17]

- For **Dental Dam Clamps, Forceps and Punches**, steam sterilize for 15 minutes at 132°C / 270°F in a gravity autoclave or for 4 minutes at 132°C / 270°F in a pre-vacuum sterilizer. Do not heat metal based instruments above 177°C/350°F.^[17]
- For **Metal Frames**, sterilize for 4 minutes at 132°C /270°F in a pre-vacuum sterilizer. Do not heat above 140°C/ 284°F as warping may occur. Allow instrument to dry. Make sure instruments are dry before storing.^[17]
- **Rubber dam sheets** can be disinfected by using hydrogen peroxide 7.35% & paracetic acid 0.23% for 15 minutes, glutaraldehyde 2% for 20 minutes.^[17]

Endodontic Files: They must be sterilized before use.^[18] Recommendations of ANSI/ADA Specification 28 include^[18]

- Scrub the files with soap and warm water.
- Rinse thoroughly with deionized or distilled water.
- Files are allowed to air dry.
- Instruments are unwrapped and placed in the autoclave tray.
- Steam Autoclave at $136^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 20 minutes.

Recommended File Disposal: Place used files in a Biohazard Sharps container.

Hand operated endodontic files: Stainless steel endodontic hand files should be treated as single-use items in our practice and are disposed of after use.^[19]

Rotary nickel-titanium (NiTi) endodontic files Technique

1. Remove stoppers immediately after use and insert the files into a scouring sponge soaked with chlorhexidine gluconate aqueous solution Clean the files by using 10 vigorous in-and-out strokes in the sponge.^[19]
2. Place the files in a glass beaker and cover with a suitable enzymatic cleaning solution (i.e. Empower for 30 minutes).^[19]
3. Perform 15 minutes of ultrasonic cleaning with the files in the beaker still covered with the enzymatic solution.^[19]
4. Drain and rinse the files in hot running water for 20 seconds. Discard the enzymatic solution, being careful to avoid any splashing onto the skin.^[19]
5. Allow to dry then examine for debris, separations or distortions, and discard if these are found.^[19]
6. Package appropriately, label and sterilize.^[19]
7. Do not use the same rotary NiTi file if it has been through more than three cycles of reprocessing due to elevated chance of fracture in the root canal.^[19]

Ultrasonic Tips Sterilization: Temperature of 136°C (277°F) is maintained for a minimum of 20 minutes as per USP recommendations.^[18]

Ultrasonic Irrigation Needle: Wipe the needle and tubing with 70% isopropyl alcohol.^[18]

Post Decontamination: Wipe the post with alcohol and allow the post to air dry for 30 seconds before use.^[18]

Post Drills Sterilization Procedure: Using deionized or distilled water, unwrapped post drills are subjected to a pressure of 220 kPa (2.2 bar) for 20 minutes at a temperature of $(136 \pm 2)^{\circ}\text{C}$, or placed in a dry heat sterilizer at $(180 \pm 5)^{\circ}\text{C}$ for 120 minutes.^[18]

Endodontic Electric Motor Systems

- **Hand pieces:** Wipe with an alcohol gauze. Clean and lubricate handpieces with a cleaner/ lubricant after each use and before autoclaving. This ensures proper operation and a long service life for the handpiece. Cleaner/ lubricant should not be used after autoclaving and only used before sterilization.^[18]

- **Anti-retraction handpieces:** The frequency of aerosol-generating procedures should be minimized and when necessary high-speed dental handpieces with anti-retraction valves are recommended to avoid aspiration of debris and fluids which can later be expelled.^[18]
- **Motors:** The entire motor and cord assembly supplied should be surface sterilized by autoclave. Pre vacuum sterilization at 132°C (270°F) for 3 minutes after installing the autoclaving plug into the motor and motor connector.^[18]

Handpiece Cartridge Nut: Steam autoclave for 10 minutes at 132°C .^[20]

Handpiece Delivery Plunger: Annually, Without a cartridge inserted, press the activation cuff until the gutta- percha indicator moves all the way forward. Then, push the return button and allow the indicator to completely retract.^[20]

Cartridge: Store cartridges at room temperature. Cartridges are intended for single patient use. Dispose of used cartridges in a biohazard container. Do not immerse the cartridges in any liquid.^[20]

Heat Shield: Steam autoclave for 15 minutes at 132°C .^[20]

Heat Pluggers/Thermal Response Tips: Sterilize using steam autoclave for 15 minutes at 132°C . Chemclaving is not recommended for sterilization and maintenance of the Electric Heat Pluggers or Thermal Response tips as this would cause corrosion.^[20]

Dental apex locator: Lip clip, file clip and touch probe should be disinfected and sterilized by autoclaving before the first use and between treatments. The file clip should be activated during cleaning process (pressed and released several times)^[21]

Clean the accessories with an appropriate brush or towel soaked in a disinfectant solution.

Steam sterilization at 135°C for 10 minutes in table top, N-type autoclave. Drying time after sterilization – 30 minutes.^[21]

Dental Burs: Pre-soak carbide burs in soapy water to loosen debris. Ultrasonic systems are used to loosen debris in burs. Burs are separated in a bur block during immersion to prevent damage. Burs can be protected during autoclave by keeping them submerged in a small amount of 2% sodium nitrite solution, 1cm above the burs. Preparation of solution is by adding 20gms of crystal to 1 liter of water in perforated beaker containing burs.^[18]

Curing light: Curing light tips are semi-critical pieces of equipment. The handle of the curing light and its tips are

cleaned with alcohol wipes prior to having the barriers placed, and a new barrier is used for each patient.^[19]

Gutta percha points: Gutta percha points are disinfected by immersing them into 5.25% sodium hypochlorite for 1 min which is then wiped with hydrogen peroxide before use in canal obturation. Sterile tweezers are used to handle disinfected gutta percha points.^[19]

Endoblock: The recommended chemical disinfectant for effective decontamination is a 1:5 to 1:10 dilution of sodium hypochlorite (meaning 5.25%-6.15% sodium hypochlorite providing 10,500-12,300 ppm chlorine).

Matrix bands: Matrix bands are considered single-use items and are discarded after use into the sharps container.^[19]

Matrix band retainer: Remove debris with a soft bristle brush, using a mild detergent in warm water. Steam autoclave sterilization for 15 minutes at 132°.^[22]

Wedges: These are single use, disposable items, should be disinfected using disinfectant spray only and discarded after use.^[22]

λ Patient discharge

- The patient drape should be removed by the assistant, and the patient should be asked to perform hand wash.^[10]
- Patient advised to re-mask and proceed to reception area, where he should be handed back his foot wears and belongings.^[10]
- The procedures and prescription is recorded only after doffing the PPE.^[10]
- Electronic treatment records only.^[10]
- Cashless payment preferred.^[10]

λ Post-treatment chairside disinfection protocol^[10]: (Minimum 20 mins)

- Instrument change
- Flushing of suction and spittoon drainage with 1% NaOCl.
- Disinfect 3 feet area around Chair & Mop the clinical area.

Important points to be noted

- i. Single use refers to disposal of disposable PPE or decontamination of reusable items e.g. eye protection or respirator, after each patient and/or following completion of a procedure on a patient or session.^[10]
- ii. Respirators can be used safely within their design specifications for 8 hours of continuous or intermittent use.^[10]
- iii. Discard N95 respirators following use during aerosol generating procedures or those contaminated with blood or other body fluids
- iv. Perform hand hygiene with soap and water or an alcohol-based

hand sanitizer before and after touching or adjusting the respirator.^[10]

- iv. Ensure that areas for donning and doffing are designated as separate from the patient care area (e.g., patient's room)^[10]
- v. Disinfectants spray should not be used on potentially highly contaminated areas (such as toilet bowl or spittoons) as it may create splashes which can further spread the virus.^[10]
- vi. 70% Alcohol can be used to wipe down surfaces where the use of bleach is not suitable, e.g. metal.^[10]
- vii. (Chloroxylenol (4.5-5.5%)/ Benzalkonium Chloride or any other disinfectants found to be effective against coronavirus may be used as per manufacturer's instructions)^[10]
- viii. Always use freshly prepared sodium hypochlorite solution and discard remnant diluted solution.^[10]

λ Post-treatment airborne contaminant removal protocol¹⁰:

- Vacate the operatory during disinfection procedure
- After the patient leaves the treatment room, the Assistant will collect all hand instruments immediately, rinse them in running water to remove organic matter and as per standard sterilisation protocol.
- All 3 in 1 syringe, water outlets, hand piece water pipelines, etc. should be flushed with the disinfectant solution for 30-40 seconds.
- Remove water containers and wash them thoroughly and disinfect with 1% sodium hypochlorite using clean cotton/ gauge piece and then fill with fresh 0.01% sodium hypochlorite solution and attach back to the dental chair.
- Then, disinfect the Dental Chair along with all the auxiliary parts within 3 feet of distance using 1% sodium hypochlorite and clean and sterilised cotton/gauge piece using inner to outer surface approach and leave for drying. New cotton/ gauge piece should be used for every surface.

The areas include

- Patient sitting area and armrests
- Dental chair extensions including water outlets, suction pipe, hand piece connector, 3 in 1 syringe, etc.
- Dental light and handle
- Hand washing area – slab and tap nozzle
- Clinic walls around the dental chair and switchboards
- Hand washing area – slab and tap nozzle
- Room should be well ventilated with a minimum 6 ACH (Air Changes per Hour)

λ Protocol at the end of clinical day^[10]

- Doffing of PPE in separate area.
- a) **Reception and patient waiting area^[10]**
- Avoid sweeping with broom

- Use wet moping with warm water and detergent or hospital disinfectant (eg. 1:50 dilution of 5.25-6.15% Sodium hypochlorite)
 - High touch surfaces (eg. door knobs, handles, elevator buttons) must be cleaned more frequently with hospital grade detergent/disinfectant.
 - Toilets, wash basins, sinks must be cleaned with detergent and disinfected with 1% sodium hypochlorite.
- b) Treatment area/patient care area^[10]**
- Floor - Use Wet Moping- Multi Bucket Technique – Water/Detergent/Low Level Disinfectant like 3% hydrogen peroxide, 1% sodium hypochlorite or EPA approved agents
 - High touch/clinical surfaces within 3 feet diameter of the dental chair that are difficult to clean must be covered using a physical barrier for every patient or disinfected between patients using a wipe (Eg. 0.5% to 0.1% sodium hypochlorite or 70% alcohol for sensitive surfaces)
 - Wet dust all non- critical/ non touch surfaces horizontal surfaces with freshly prepared disinfectant solution once a day unless visibly soiled (Eg. 0.5-1% Sodium hypochlorite or 3% hydrogen peroxide)
 - Walls, window blinds, frames cleaned and disinfected when visibly soiled or end of the day
 - Mop heads and cleaning cloths must be discarded in biomedical waste bins appropriate or decontaminated regularly by laundering (heat disinfection) with detergent, 1:1000 dilution of sodium hypochlorite and drying at 80 °c. Must be changed frequently
 - The house keeping staff must adorn recommended PPE.

λ Waste management

Category	Type of waste	Category	Type of waste
Category no. 1	Human anatomical waste(tissues, organs, body parts)	Category no. 6	Solid waste(items contaminated with blood and body fluids)
Category no. 2	Animal waste(tissues, body parts,fluid, blood and experimental animals used in research)	Category no. 7	Solid waste(wastes generated from disposable items)
Category no. 3	Microbiology and biotechnology waste(laboratory cultures, toxins)	Category no. 8	liquid waste(waste generated from laboratory and washing and disinfecting activities)
Category no. 4	Waste sharps(needles ,scalpels, blades)	Category no. 9	Incineration ash
Category no. 5	Discarded medicines and cytotoxic drugs	Category no. 10	Chemical waste(chemicals used in production of biological and disinfection)

Colour coding	Type of container -I Waste category	Treatment options as per schedule I
Yellow	Plastic bag cat.1, cat. 2, cat. 3, cat. 6, cat. 7	Incineration/deep burial
Red	Disinfected container/ plastic bag cat. 3, cat. 6, cat. 7	Autoclaving/microwaving/chemical treatment
Blue/ White translucent	Plastic bag/puncture proof Cat. 4, cat. 7	Autoclaving/microwaving/chemical treatment and destruction/shredding
Black	Plastic bag cat. 5, cat. 9 and cat. 10(solid)	Disposal in secured landfill

λ Waterlines management

An independent water supply can help reduce the accumulation of biofilms.

- Biofilm levels can be minimized by using a range of measures, including water treatments using ozonation or electrochemical activation, chemical dosing of water(e.g. with hydrogen peroxide, peroxy compounds, silver ions or nanoparticle silver)^[5]
- Flushing lines (e.g. triple syringe and handpieces) after each patient use, and flushing waterlines at the start of the day to reduce overnight or weekend biofilm accumulation.^[5]

- 1: 100 dilution of 5.25- 6.15% i.e., 0.01% of sodium hypochlorite for Dental Unit Waterline.^[6]

CONCLUSION

The new COVID-19 outbreak challenges current treatment protocols as well as the standards of infection control. Thus, It is important to make informed clinical decisions and educate the public to prevent panic while promoting the health and well-being of our patients during these challenging times. Each dental discipline should establish the necessary modifications in treatment protocols and should follow standard precautions of

infection control. This paper will assist endodontists to treat their patients during the COVID-19 outbreak.

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