Integrated Infection Control in the Maxillofacial Operation Theatre Considering COVID-19 Pandemic

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Introduction

Coronavirus disease-2019 (COVID-19) is a recently emerged new virus that is assumed to originate from Wuhan, China. It is a unique virus that has not been antecedently known in humans. It has emerged from the zoonotic cycle and transmitted into the human cycle.¹ Within a short period of time, it has rapidly spread all around the world by human transmission via air flights into different countries. In December 2019, the outbreak of this virus occurred in China. As the outbreak progressed, it involved over 110 countries and the sustained risk of further global spread. The World Health Organization declared COVID-19 as an

Abstract

The pandemic of coronavirus disease 2019 (COVID-19) has influenced all services of life, including dentistry and oral and maxillofacial surgery. COVID-19 is primarily spread through contact with infected person, mucosal/respiratory droplets, fomites/contaminated surfaces/objects, and aerosol. Oral and maxillofacial surgeons are particularly at a high risk of transmission of COVID-19 due to proximity with patient during treatment. All cases should be assumed COVID-19 positive till proven otherwise because now asymptomatic patients also report to be COVID-19 positive. Such patients act as a carrier, shedding virus to expose the oral and maxillofacial surgeons. All elective procedures can be postponed. Only emergency cases that require immediate treatment should be done with proper standard precautions and sound infection control practice. During surgery, we require a maxillofacial operation theater (OT), which is divergent from other OTs due to the use of high-powered aerosol-generating instruments during surgery that increase the chances of spreading infection in the OTs. The aim of this paper is to integrate infection control in the OT for the management of confirmed or suspected COVID-19 patients throughout emergency treatment in oral and maxillofacial surgery.

Keywords

➤ COVID-19
➤ maxillofacial operation theater
➤ infection control

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outbreak or pandemic on March 11, 2020. The novel coronavirus is highly contagious and responsible for outbreak of the pandemic.

The transmission of COVID-19 among humans happens via shut contact with an infected person who generates metastasis droplets and fomites while coughing, during instinctive reflex, or speaking. Droplets do not travel more than two meters or six feet,2 hence social distancing is maintained. Infection can occur through nose, eyes, or mouth after touching the infected surface. Dental professionals are at high risk because they work in oral cavity, which contains high viral load, and are in close contact with the patient. COVID-19 can also be transmitted through saliva, inadequate sterilization, contaminated instrument, infected environmental surfaces, and poor respiratory hygiene and etiquettes.

The pandemic of coronavirus has posed significant challenges in providing health care service by the various specialties. In this scenario, we can postpone the elective dental care, but dental emergency must be provided. As oral and maxillofacial surgeons, there are specific recommendations for urgent care of patients during the pandemic for treatments related to craniomaxillofacial trauma, space infection (Ludwig angina), bleeding, severe pain in tooth, and oncology surgery. Emergency surgical procedures necessitate setting up of dedicated COVID operation theater (COVID OT). In maxillofacial COVID OT, we use various types of dental rotary handpieces for cutting the bone and tooth, surgical instruments, and water syringes for irrigation. Maxillofacial COVID OT is different from other operation theaters (OT) because maxillofacial procedures generate aerosol and splatter, which are contaminated with viruses, bacteria, fungi, blood, and saliva and increase the chance of COVID-19 spread at an alarming rate.

A multidisciplinary teamwork approach is necessary to prevent cross-infections in the maxillofacial OT. The OT team includes surgical staff, anesthesiologists, operating theater assistants, infection management personnel, supporting staff, and waste handlers. All direct health care staff ought to be educated regarding the risks of infection and preventive actions. In this paper, we discuss the integrated infection control in the maxillofacial OT in COVID-19 pandemic during emergency management. It has various aspects, which includes preoperative, intraoperative, and postoperative measures. Infection prevention in the maxillofacial operating room is achieved through prudent use of aseptic techniques.

### Preoperative Measures
Preoperative measures include clinical sorting as well as early recognition, immediate placement of patients at separate locations, and care of patients with suspected COVID-19 infection. Early recognition process includes history, screening questionnaire, and any foreign travel. Suspected COVID-19 patients ought to be placed in isolation ward and patient beds should be at least 1 metre apart. It is advised to patients and family members to maintain hand and respiratory hygiene. Standard precautions among health care professionals help in prevention of contact and droplet infection. Standard precaution includes use of personal protective equipment (PPE), which is explained in Tables 1 and 2.

All the items should be certified and indicating conformity to standards. To check the proper wearing of PPE kit, there should be a mirror in the donning room. There must be proper donning sequence for wearing the PPE kit, to prevent from any hazard.

### Table 1 Personal protection equipment

<table>
<thead>
<tr>
<th><strong>Personal protective equipment (PPE):</strong> PPE plays a vital role in preventing infection so all operation team and other health care staff must receive adequate training to use them effectively and efficiently. PPE includes gloves, coverall/gowns, masks/respirators, eye goggles, face shields, shoe cover, and waste collection bag.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gloves:</strong> There are two pairs of surgical gloves.</td>
</tr>
<tr>
<td><strong>Cover all/gown:</strong> Single piece wearable coverall with head hood cap, impermeable to blood and body fluids. Blood and body fluids of all patients must be considered potentially hazardous for corona viruses.</td>
</tr>
<tr>
<td><strong>Mask/respirators:</strong> Wearing a mask is therefore an especially important mode of preventing the spread of COVID-19. Surgical masks defend mucous membranes of the mouth and nose from drop spatter; however, they do not offer complete protection against inhalation of windborne infectious agents. COVID-19 is a respiratory infection whose main source of transmission is droplet method. While treating COVID-19 suspected or positive patients, N95 or FFP23 masks and face shield ought to be used as a minimum demand, throughout aerosol and surgical smoke-generating procedures (like the utilization of hand pieces, thermocautery, and supersonic instruments). Used mask should be certified as NIOSH N95, EU FFP2, or equivalent. When wearing the respirator, always perform the seal check; facial beard prevents a proper respirator fit. Various types of masks recommended for COVID-19 are described in Table 2.</td>
</tr>
<tr>
<td><strong>Eye goggles:</strong> Larger transparent glasses with zero power but can accommodate prescription glasses. They are held by an elastic band behind the head and contact the face completely around the eyes; they offer better protection against splashes of blood and body secretions.</td>
</tr>
<tr>
<td><strong>Face shield:</strong> Usually made of clear plastic that is mounted on a forehead with adjustable elastic band and has the advantage of completely protecting the whole face. May be disposable or reusable (made of material that can be cleaned and disinfected).</td>
</tr>
<tr>
<td><strong>Shoe cover:</strong> Should be long enough to cover the entire shoe up to mid-calf and made of same material as coverall.</td>
</tr>
<tr>
<td><strong>Waste collection bag</strong></td>
</tr>
</tbody>
</table>

Abbreviations: COVID-19, coronavirus disease-2019; EU, European Union; FFP, filtering face piece, NIOSH, National Institute for Occupational Safety and Health (USA).
Integrated infection management in maxillofacial OT includes hand and ventilatory hygiene, use of PPE, hindrance to needle-stick or sharp injuries, safe waste management, environmental cleanup, and sterilization of patient-care instruments and linen.

If patient transport is required, ensure that health care workers (HCWs) of the area unit who are transporting patients wear applicable PPE and patients also wear appropriate respirators. Prefer to use short and predetermined transport routes to attenuate exposures to workers and alternative patients. Before the patient’s arrival, inform the receiving area for necessary precautions. Patient contact surfaces should be cleaned and disinfected routinely. Limit the quantity of HCWs, relations, and guests in touch with a patient with suspected COVID-19 infection. Only in medical necessity, patient can move or transport out of the room or isolation ward. Use portable designated X-ray and other important diagnostic equipment. We oral and maxillofacial surgeons should avoid intraoral radiographs (intraoral, periapical, or occlusal views) because this technique can induce coughing, stimulate saliva secretion, and gag reflexes. Extraoral techniques are preferred like orthopantomogram and cone beam computed tomography during the outbreak of COVID-19.

Preoperative measures include ensuring that the operative site is shaved, which helps in reduction in the surgical site infection. A good antimicrobial must be administered 1 hour before the initial incision, and repeat the antibiotic dose to keep therapeutic serum levels of the drug in long-lasting surgery. All routine blood investigations should be done to rule out any systemic conditions. Especially, testing of patients for COVID-19 is important to detect the infected patients at an early stage. Betadine rinse are advised preprocedural because it is highly susceptible to COVID-19 and might significantly reduce the load of coronaviruses in saliva.

No personal devices should be allowed inside the OT like mobile phones, laptops, purse, and bag. Use intercom facilities available inside the OT, which should be covered with transparent plastic and used for communicating with medical personnel and support staff outside the OT.

### Operation Theater/Complex

Dedicated OTs need to be used for all confirmed or suspected COVID-19 infected patients. These OTs should be labeled as COVID-19 OT and situated in the COVID Block/Center. The COVID-19 OT should be designed in such a way that it remains separate from the other building/operating complex within 20 m. There should be a devoted lift for the utilization of suspected or confirmed COVID-19 patients, which should be wide and capable of carrying a bed, equipment, and concomitant health care professionals. OTs should have adequate space for patient transfer onto the operating table, for all HCWs to stand up comfortably, and for instrument trolley preparation simultaneously.

Ideally, the changing rooms for doctors, nurses, and other staff should be independent along with toilet and shower facility. The doors should be such that it can be opened without touching the handles, with the help of feet or elbow. There should be a separate donning room attached to the scrub room, where enough PPE kits should be available along with hand sanitization and a chair facility. Doffing room should have facility of hand sanitization and disposing off used PPE in waste collection bins. There should be separate entry for donning area and the exit from the doffing area to avoid the risk of cross-infection among health care professionals entering and leaving the OTs.

### Table 2 Various types of mask/respirator recommended for COVID-19 pandemic

<table>
<thead>
<tr>
<th>Masks/respirators</th>
<th>N95</th>
<th>N99</th>
<th>N100</th>
<th>FFP2</th>
<th>FFP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>N for US standard; FFP for European standard</td>
<td>![N95 Mask]</td>
<td>![N99 Mask]</td>
<td>![N100 Mask]</td>
<td>![FFP2 Mask]</td>
<td>![FFP3 Mask]</td>
</tr>
<tr>
<td>Particles filtered: % of ≥0.3 μm</td>
<td>At least 95%</td>
<td>At least 99%</td>
<td>At least 99.97%</td>
<td>At least 94%</td>
<td>At least 99–99.95%</td>
</tr>
<tr>
<td>Breathing difficulty</td>
<td>Less</td>
<td>More</td>
<td>Most</td>
<td>Less</td>
<td>More to most</td>
</tr>
<tr>
<td>Permitted internal leakage rate</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>8%</td>
<td>2%</td>
</tr>
<tr>
<td>Medical use</td>
<td>Protection against viruses, bacteria, and fungi</td>
<td>Protection against viruses, bacteria, fungi, and oil (8 hours)</td>
<td>Protection against viruses, bacteria, fungi, and oil (40 hours)</td>
<td>Protection against viruses, bacteria, and fungi</td>
<td>Protection against viruses, bacteria, and fungi</td>
</tr>
<tr>
<td>Suitable for COVID-19</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: COVID-19, coronavirus disease-2019; FFP, filtering face piece.
When surgery is performed on COVID-19 patients, the OT should be maintained at negative pressure of 2.5 Pa (preferably > 5 Pa) for aerosol-generating procedures to help in controlling the spread of infections and also to protect the HCWs. Air exchange should be at least 12 times per hour. Central air conditioning must be turned off. Temperature should be between 24 and 30°C. Relative humidity should be maintained between 40 and 70%. All these settings will make the working of health care professionals during the summer months without air conditioning comfortable. The operating room must be equipped with high-efficiency particulate air (HEPA) for the treatment of exhaust air, or chemical disinfection (1% hypochlorite) is also acceptable. Ultraviolet irradiation (15 minutes) and heating (45 minutes at a temperature of 75°C) are two other options for treatment of exhaust air.

Remove all nonessential equipment and gadgets from the OT. There should be separate trolleys ready for essential items like surgical equipment, linen, and dressings. Cover all other equipment with water-resistant transparent plastic sheets. These plastic coverings should be changed between each case. We can also use high-quality heat and moisture exchange filters around operating table, which filters 0.3 microns airborne particles up to 99%, thus helping in preventing contamination of OT atmosphere.

All health care professionals should wear all component of PPE kit during aerosol-generating procedures. Only the most experienced staff with minimum number should be allowed inside the COVID-19 OT. Safe working practice should be following by the surgeon and all other HCWs to prevent occupational hazard. During surgery, there ought to be lowest movement within the OT.

**General Anesthesia**

The anesthesiologists should be advised to reach in the OT before patient arrival along with necessary drugs in a sterile disposable tray. Rapid sequences of intubating or extubating ought to be performed by a most expert specialist to limit the number of attempts the patient makes for, and in a manner that generates less coughing, because coughing produces the droplet contamination within the risk area of 2 m around the operating table. Operating theater doors should stay closed for a minimum of 10 minutes once intubating or extubating starts for the HEPA filters to get rid of 99% of the particulate air matter. The operation team ought to enter the arena once 20 minutes of intubating with applicable PPE to reduce the aerosol-based transmission.

**Intraoperative Measures**

Patient skin preparation should be done with povidone iodine because it has shown vital virucidal activity against COVID-19 for 3 hours. It should be left on skin for more than 2 minutes prior to initiating procedure. Currently, it has been counseled to coat the nasal passages and oral fissure of each patient and the operational team before the procedure.

In COVID-19 cases, always prefer closed reduction (using bridle wire stabilization, eyelet wiring, or intermaxillary fixation [IMF] screws) to open reduction because it shortens the exposure time to aerosol and is a less invasive procedure. The rate of percutaneous injuries using wires and arch bars is found to be 23%, which place the oral maxillofacial surgeons at high risk in COVID-19 pandemic. This can be prevented by a wire-free system known as Rapid IMF (Fig. 1). This system uses a disposable adjustable flexible plastic tie that wraps around a tooth to create an anchorage point. These anchorage points relate to an elastic chain for intermaxillomandibular fixation and immobilization. This really helps in reduction of such injuries and is a safer option particularly in minimally displaced fractures.

Only those cases of oral and maxillofacial trauma need to be considered for open surgery that cannot be treated by closed management. Minimize the number of assistants, trainees, and health care professionals present in the OT along with an experienced surgeon. In COVID-19 case, there are some recommendations in contrast to routine case to minimize the production of aerosol and spatter during surgery. Extraoral or transcutaneous approach should be preferred over an intraoral approach. Incision should be preferred with scalp blade over monopolar cautery. High-powered suction should be used and the repeated use of suction/irrigation should be minimized. Bipolar cautery should be used for achieving hemostasis at lowest power settings. In fracture case, self-drilling screws should be preferred for fixation. In other cases where osteotomy is essential, always prefer osteotomy instead of high-speed drill or piezo saw. Oral and maxillofacial surgeons should use absorbable sutures to eliminate the unnecessary trips for the follow-up.

**Postoperative Measures**

After the treatment of a confirmed or suspected COVID-19 case, the operating team and other health care staff must take the utmost caution while donning and disposing off the PPE to minimize the risk of self-contamination. But due to long hours in suboptimal conditions, the health care professionals become stressed and fatigue. These steps are crucial because PPE is already contaminated. Sometimes health care professionals...
breach the strict protocol of donning and disposal of PPE and become infected. Hence, observing the correct sequence for donning and doffing of PPE with the help of cameras by expert professionals is strongly recommended.

The aerosol of COVID-19 will stay infectious for up to 3 hours to 7 days on different inanimate surfaces depending on environmental viability. Before starting the decontamination, the staff must remove the outer hand gloves. Non-disposable equipment lined by plastic cowl should be disposed of. All medical devices, contaminated surfaces, screens, anesthesia machine, and monitor cables should be wiped down within the OT and disinfected by using 1% sodium hypochlorite solution. Other disinfectant agents available are hydrogen peroxide vaporization, ultraviolet radiation, and 75% alcohol for wiping of solid surfaces of the equipment and floor, in case of liquid spills of infected secretion or excretion of body cavity on the floor. It ought to be coated with towel or newspaper and poured with 0.5% freshly ready sodium hypochlorite. Contact time stay for 20 minutes. Place all fouled sorbent material and contaminated swabs in an exceedingly yellow bag and clean with detergent water. Triple-bucket method should be used in mopping of surfaces. All floors and walls should be cleaned with 0.1% sodium hypochlorite solution for 1 minute, which has been found to be effective and sufficient procedure against coronavirus.9

All surgical dressings and linen should be discarded. All unused medicines and consumables brought into the OT ought to be assumed as contaminated and should be discarded. The histopathological specimens are to be kept in tight-fit plastic boxes that are then sealed in plastic bags. All external surfaces of plastic bags should be disinfected prior to transport. The metallic soiled instrument should be kept in 1% sodium hypochlorite solution for half an hour. They should be then washed and wiped clean, and subsequently put in instrument boxes and covered with plastic bags that should be clearly labeled and sent to Central Sterile Supply Department (CSSD) for sterilization. It is preferable to have an autoclave machine/CSSD near the COVID OT. All health care professionals involved in OT should be documented for contact purposes. Before resuming regular duties, all must take shower and change in a clean area.

In case of COVID-19, the biomedical waste should be disposed of under strict protocol. All articles like blood swab and PPE kits should be discarded in a yellow bag and all sharp equipment like syringe needles, wires, suturing needles, and blades should be discarded in puncture-proof white or blue containers. All soiled linen should be gathered without shaking and hand hygiene must be performed. These linens should be disinfected prior to transport in freshly prepared 1% bleach for a minimum of 20 minutes and then tightly packed in a labeled plastic bag.

Fig. 2 Summary of coronavirus disease-2019 (COVID-19) maxillofacial operation theater considerations for patients coming for emergency in oral maxillofacial surgeries. IMF, intermaxillary fixation; OT, operation theater; PPE: personal protective equipment.
To prevent postoperative infections in COVID-19 case, the maxillofacial OT should be free from microbes during surgery because it is unique from other OTs in terms of generated aerosol, dust particles from various tooth parts, bone, saliva, pus, and blood. In addition to these, frequent use of high-powered rotary instruments like micromotor, air-rotor, and piezo saw indicates the value of fumigation and microbiological monitoring in the maxillofacial OTs. Various considerations in COVID-19 maxillofacial OT are condensed in – Fig. 2.

**Conclusion**

In the present COVID–19 pandemic, there are various challenges in delivering health care services in an OT. As oral and maxillofacial surgeons, we cannot complete any procedure without cutting soft and hard tissues by straight hand piece or powered saw on daily basis. All these high-risk activities produce aerosol generation in the operating environment, which further spreads the cross-contamination among other HCWs.

Infection control management and prevention is key to improving care and securing safety. Infection control measures address factors related to the spread of infections within the OT complex, which include hand hygiene, PPE, sterilization, disinfection of environment, monitoring, fumigation, and vaccination. Vaccination for COVID-19 is under trial to date. The need for improving the level of infection control has increased with the rise in infectious diseases like COVID-19, and new plans are constantly being developed till the situation unfolds.

**Conflicts of interest**

There are no conflicts of interest.

**References**