

Gadgets and Armamentarium of Maxillofacial Surgeons during Coronavirus Pandemic

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Abstract

Introduction: We all know about the grave situation caused by the novel coronavirus in recent times. Although the maxillofacial surgeons are not at forefront of dealing with the coronavirus directly, they are at increased risk due to their working area on face, mouth, and oral cavity. There is an urgent need to upgrade the already set guidelines and follow them stringently. Any procedure done within the oral cavity is a high-risk procedure and this upgradation is necessary because present means are insufficient to prevent infection from this deadly virus. This article aims to review and discuss all the new gadgets and armamentarium required to deal with patients during and post coronavirus pandemic. **Materials and Methods:** The authors performed a thorough literature search on various armamentarium and new gadgets introduced into the field of dentistry during the coronavirus pandemic worldwide. The relevant armamentarium is discussed under three broad headings, namely, those required before, during and after the procedures for easy understanding. **Results:** A total of 15 gadgets and armamentarium related to oral and maxillofacial surgical practice are named and discussed in the literature review. **Discussion:** We are particularly vulnerable to the transmission of diseases easily both due to the field of interest of work and type of instrumentation. Thus, we need to be extremely cautious about the procedure. Since, the literature is scarce about the sequelae of the coronavirus disease; shift to the automated, contactless gadgets is the way to look forward to a healthy dental practice. **Conclusion:** These gadgets are user friendly for any small dental set-up as well. The choice of these upgraded instruments are prerogative of the individual professionals according to their exclusive practice. Yet, the authors encourage all health care professionals to focus on better training in infection control and cross-contamination.

Keywords: Anti-reflux device, armamentarium of maxillofacial surgery, autoclave, automatic hand sanitizer dispenser, contactless thermometer, coronavirus pandemic, extraoral high volume suction apparatus, fogger machine, gadgets, high-efficiency particulate air filters, high-efficiency particulate air filters, needle-free system for multidose vials, personal protective equipment, plasma air sterilizers, pulse oximeter, safety box for trauma care, tip irrigation system

INTRODUCTION

We all know about the situation caused by the novel coronavirus in recent times. A virus that started from Wuhan City in Hubei Province of China and expanded to most parts of the world, affecting more than 185 countries. While the World Health Organization (WHO) declared the disease as pandemic on January 30, 2020, the health-care professionals are busy saving lives of those getting affected. There are already 21,026,758 confirmed cases of novel coronavirus (COVID-19) globally including 755,786 deaths reported by dated August 15, 2020 at 10:00 CEST.^[1] Millions of lives are affected already and so much is at stake. This virus has exposed many vulnerabilities

of our community and health-care system. Since it is a new type of coronavirus, highly infectious, fast transmission, there is no available vaccine or any proven medical management.

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In the absence of any definitive therapy, we depend majorly on its prevention.

Although the maxillofacial surgeons are not at forefront of dealing with the coronavirus directly, they are at increased risk due to their working area on face, mouth, and oral cavity. The risk can be to themselves as well as transmission to other patients. That is why Standard Operating Protocols (SOP) have to be set to keep the virus at bay. A two-tiered approach should be implemented to interrupt the mode of transmission of infectious agents: Standard precautions and transmission-based precautions. Since, the field of dentistry is well aware of standard universal precautions and prevention of cross-contamination and maxillofacial surgeons are also trained with triage protocols in mass disaster scenario. We need to upgrade the already set guidelines and follow them stringently. We also need to upgrade our armamentarium to fight the war against coronavirus and have safe practice postcoronavirus pandemic too.

Keeping up with the pace of the current information, the authors reviewed various armamentarium options available to deal during and post pandemic. This article aims to present all the gadgets and armamentarium required to deal with maxillofacial patients during and post coronavirus. This upgradation is necessary because present means are insufficient to prevent infection from this deadly virus. Any procedure done within the oral cavity is a high-risk procedure and all the patients should be treated as corona-positive patients unless proven otherwise.^[2]

MATERIALS AND METHODS

The authors conducted a thorough literature search on various armamentarium and new gadgets introduced during the coronavirus pandemic and discuss each that is relevant to the maxillofacial practice. All the selected instrumentations are categorized into three main headings based on their timing of use.

RESULTS

A total of 15 gadgets and armamentarium related to oral and maxillofacial surgical practice are named and discussed in the following review.

Preparation before procedure

Contactless thermometers

They are digital, battery operated, Food and Drug Administration approved infrared thermal devices^[3] with a display screen used to measure the surface body temperature [Figure 1].

They work on the principle of emissivity, i.e., by focusing the light that is coming from the surface of the forehead in the form of infrared rays and tunnelling that light into a detector, known as a thermopile. This thermopile turns the infrared radiation into heat, which then is converted into electricity, which is then measured and displayed on the screen of the thermometer. This process takes seconds to measure. They are noninvasive and easy to use for mass screening. It should

be held in palm, directly perpendicular to the forehead and at a distance of 3–15 cm.

One disadvantage is the readings vary depending on the distance to spot ratio i.e., the distance of the device from the surface to the area of the surface being measured.

Pulse oximeter

It is a battery operated hand-held device that provides real-time information on blood oxygen saturation and heart rate. It comprises of a monitor with light emitting diodes (LED) and a photo sensor. The device works on the principle of spectrophotometry, i.e., the relative absorption of red (absorbed by deoxygenated blood, 660 nm) and infrared (absorbed by oxygenated blood, 940 nm) light wavelengths in blood. It is used for early screening for coronavirus disease in asymptomatic patients by detection of early development of hypoxia. The patients with oxygen saturation below 92% are referred for further evaluation by the specialist. They are easy to use, noninvasive, low cost and effective devices that every maxillofacial practice should possess.

Automatic hand sanitizer dispensers

Touch free, quick and easy to use with refill system. They can be wall mounted or portable [Figure 2]. Alcohol-based hand rubs or sanitizers^[4] are effective in reducing the viral load on surfaces like hands. The manual operating push style dispensers allow contact of fingers that could be contaminated and leave the surface potentially infectious.

Similarly, soap bars should be replaced by liquid soap gels to keep the contact as minimum as possible.

Autoclave

The nondisposable items should be double autoclaved in a type B autoclaving machine [Figure 3]. Instruments should be autoclaved in two cycles. Preheating and preventing the existing air inside the autoclave chamber is important before new cycle is started. The WHO recommends Sterrad advanced sterilization system^[5] that allows for the sterilization of the medical and dental instruments using hydrogen peroxide and low temperature gas plasma to destroy microorganisms. It does not leave any toxic residue after completion of the cycle of 1 h.

Personal protective equipment

Components of PPE are goggles, face-shield, mask, gloves, coverall/gowns (with or without aprons), head cover, and shoe cover [Figure 4].

Face shields and goggles

The protection of mucus membrane of eyes, nose, and mouth using face shields and goggles is an integral part of standard and contact precautions. Face shield should extend from the forehead, extend until below the chin, covering the entire face and wrap around the sides of the face. The goggle should snugly fit around the eyes and should have anti-fog properties.

Masks

Coronavirus is a respiratory virus that spreads through droplets



Figure 1: Infrared thermometer



Figure 2: Automated hand sanitizer dispensing machine



Figure 3: Type B autoclaving machine

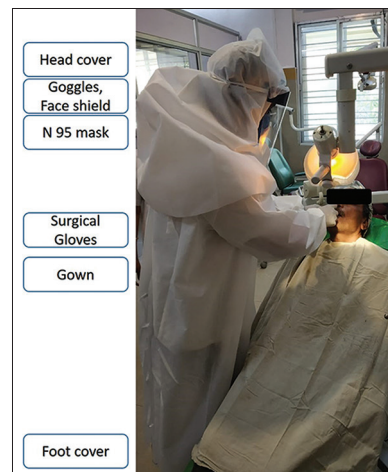


Figure 4: Components of personal protective equipment



Figure 5: Valveless N95 respirator mask



Figure 6: Respiratory mask with expiratory valves

contact. It targets upper and lower respiratory system. Thus, it is our duty to protect our airway from the particulate matter generated during the surgical procedure by wearing a well-fitted triple layered surgical mask.

There are two types of masks relating to the profile of the health care personnel and his/her work.

- Triple layered surgical mask – A disposable, fluid-resistant mask protects the wearer from infectious material emitted during coughing, sneezing, and talking. The innermost layer is the absorbent layer that absorbs the nasal secretions of the wearer. The middle layer is the filter layer that forms



Figure 7: Components of powered air-purifying respirator

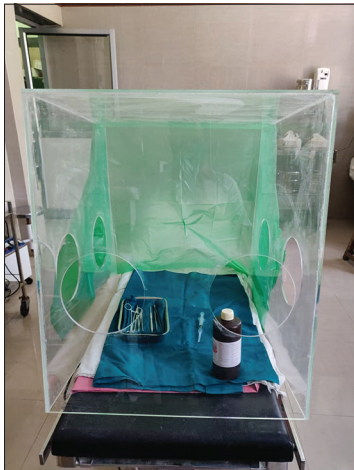


Figure 9: A modified (SAAS) trauma box



Figure 11: Puncture proof closed lid sharp container with biohazard sign

the barrier between the inner and outer environments. The outermost layer is the repeller or reflector layer



Figure 8: Needle-free vial adapter



Figure 10: Tip irrigating surgical handpiece

- N 95 respirator mask – It is a respiratory protective device with high filtration efficiency to airborne particles. In 1972, 3 M introduced the first, single use, N 95 masks for industrial coal and oil workers. They added an electrostatic charge to the material in order to block very small particles. N 95 means mask can filter at least 95% of particles $>0.3 \mu$. ‘N’ stands for NOT Resistant to oil [Figure 5].

The recent modified version is N99 masks. Its filter is made up of millions of microfibers of polypropylene in a layered fashion that is permanently electrocharged. This electrostatic charge is necessary to retain its ability to filter microorganisms. It can filter up to 99% of the particles of up to 0.3μ . The 0.3μ is considered as the cut off size as this is the filtration capacity of lungs.

They are further valved (filtering respirators) and valveless (insulating respirators). The valved respiratory masks [Figure 6] are not to be used by the patients as they can exhale the virus particles into the environment. To check the fit of the mask: It should collapse on inhalation and check for any air leak on exhalation. Ideally, the mask should be air tight fitted.

Filtering facepiece particles (FFP2) mask is a European standard respiratory mask equivalent to N 95 mask which is a US standardized respiratory mask. They are easy and comfortable to use, re-usable, and easily available in the market.^[6]

Powered air-purifying respirator (PAPR)^[7] are a type of respirator used to safeguard the healthcare workers against contaminated air. They are also known as positive pressure masks. A PAPR consists of a headgear, a battery operated fan to force the incoming air into the device and a filter to deliver the purified oxygen [Figure 7].

One basic version being used by various healthcare professionals is "Gas-mask respirator" which is a easy to use and disinfect, non powered, face-piece with filters used to protect the wearer from inhaling any harmful gas, particulate matter, infectious splatter, fumes or vapours commonly generated during various medical and dental procedures. Hence, it can be used during anesthetic procedures like bronchoscopy, tracheostomy and routine dental procedures like Surgical extractions, Root canal preparations, ultrasonic scaling and other such procedures.

Gloves

Nitrile gloves preferred over latex gloves because they are resistant to chemicals and less chances of allergy. Non powdered gloves preferred over powdered ones. Double gloves should be worn at all times so that the outer pair can be changed after each patient.

Gowns

To provide a 360° protection to cover the torso, clothing, back, legs, and arms. Triple layered surgical gowns and head caps are recommended when doing any procedure within 1 meter distance of the infected patient.

The CDC has discussed proper donning and doffing technique and their sequence in detail in order to limit the transmission of virus.^[8]

Hazmat Suit – (Hazardous material suit) – is a piece of personal protective equipment (PPE) that consists of an impermeable whole body garment. They are worn by fire fighters, toxic laboratory researchers, emergency medical technicians, paramedics, and workers in toxic environment. These days the frontline medical care professionals also use it while dealing with corona positive patients. If an oral and maxillofacial surgeon is required for his/her services near such patients, this suit becomes paramount.

Shoe covers

Should be made of impermeable material to be used over shoes to facilitate personnel protection and decontamination.

Head covers

Covers the head and neck area. Hair extensions should fit inside the head cover.

Further rationale use of using PPEs is discussed in the guidelines provided by MoHFW.^[9]

Needle free system for multi-dose vials

In dentistry, we use multi-dose vials for local anesthesia. This leads to multiple punctures on the vial septum and increased chances of contamination. The vented needle-free vial adapter [Figure 8] is an important tool to fix over the vial septum to facilitate rapid and multiple withdrawal of local anesthetic agent from the vial. It reduces spray back potential because of its pressure equalization technique. It has a spike, nozzle, PTFE hydrophobic air filter, and a cap that prevents contamination of the solution inside the vial. It would also prevent needle stick injuries at this crucial time.

During the procedure

High-efficiency particulate air filters

It removes 99.95% of particles from the air passed through it. It is composed of a mat of randomly arranged fiberglass particles that work as a sieve to filter the suspended air particles. They would work best in the dental operator where air rotor or drilling procedures are performed.

Safety box for trauma care

It is a transparent plastic box that is used to cover up the head and neck region of the patient. It has arm slots through which the surgeon can access the target region on patient. It can be used for emergency procedures such as intubation, bronchoscopies, treatment of facial trauma, incision, and drainage of space infections. It provides an effective additional barrier between the patient and the surgeon. It can later be sterilized using sodium hypochlorite solution and detergent [Figure 9].

Plasma air sterilizers

It is an air purification technology that uses bipolar ionization technology to pro-actively purify indoor air at the source of contamination. This technology produces a natural bio-climate rich in positive and negative oxygen ions. These polarized ions effectively neutralize the particulate matter, aerosols, bacteria, and virus cells. These devices can be efficiently used in dental setup, operating theatres and waiting areas.

Surgical handpieces with tip irrigation system or anti-reflux device attached to them. They should be used at as low rpm as possible. The tip irrigation system [Figure 10] eliminates the need for separate irrigation device. Since the working end of the handpiece is closely and continuously irrigated with antiseptic solution, it reduces generation of aerosols during the procedure. Aspirating handpieces are expected to be available in the market that would evacuate all the aerosols as soon as they are produced.

Irrigation system

The longer irrigation needles to be used instead of short ones. They should be held close to the oral cavity and should not be directed over the rotating bur directly. The speed of irrigation should be as slow as possible to avoid aerosolization. Avoid acute bends in the irrigating needles.

High volume suction

Extra high-volume suction^[10] (300l/min) with large bore suction cannula is necessary while performing any aerosol generating procedure to minimize the spread of splatter and aerosols into the environment. The suction tip should be avoided in posterior part of the oral cavity to prevent gagging and coughing.

Various modifications to the existing suction apparatus like addition of plastic barriers extraorally are discussed during the pandemic time. Extraoral high volume suction apparatus with filter has been recently introduced to cater all the mist and aerosols in the immediate dental operator environment. The next patient can be taken with less interval time as all the

environmental mist is suctioned immediately and thus limits any cross contamination. It can also be attached with the UV light unit to act as added disinfectant.

After the procedure is complete

Closed lid dustbins

Foot operated touch-free closed lid dustbins with inner layer of color-coded biomedical waste plastic bags to be used instead of the open ones. The biomedical waste, used PPE and gloves should be discarded in the yellow bin.

Puncture proof containers

Sharps should be handled with extreme caution and immediately discarded into the puncture proof containers labeled with a biohazard symbol [Figure 11]. Single-dose vials, needles, and syringes should be preferred in such scenarios.

Fogger machine

A device that emits dense vapors used for OT fumigation. 40% formalin solution is used to fumigate the operation theatre after the patient is shifted from the theatre and the dental clinic after the end of the day. Since the formalin fumes from fumigation machines are reported to cause damage to the interstitial cells of lungs, the fogger machine is used with Sodium hypochlorite disinfectant to create a dense fog for sterilizing contact surfaces such as door knobs, dental chairs, tables, and cloths. Chlorine-based products (e.g., hypochlorite) at 0.1% (1000 ppm) for general environmental disinfection or 0.5% (5000 ppm) for blood and body fluids large spills with minimum contact time of 1 min.^[11] It can be used two–three times a day in clinic to reduce the transmission of coronavirus in dental clinic.

While many upgradations are discussed in the previous part, there are few instances that need shift to conventional form.

1. Biometric system used to record the attendance of the working staff should be immediately suspended as it requires touching the finger/thumb to the sensor and shifted back to paper system where staff uses their own pens. The face recognition technology is also very little help during this time as the staff are covered with masks and face shields when they enter the hospital premises
2. The use of surgical burs or drills for minor oral surgical procedures should be discouraged as much as possible. Shifting back to chisel and mallet to extract any difficult tooth or other hand instruments to be preferred at this time instead of surgical aerosol generating drills and burs. In addition, depending on intermaxillary fixation and closed reduction whenever possible will save us a lot of exposure of unwanted aerosols
3. Limit the use of three-way syringes. Limit or eliminate irrigation during drilling. It causes aerosolization of the saliva
4. Staircases should be used instead of elevators to reduce the contact of multiple individuals to the buttons of lifts
5. Doors to be kept open during working hours to reduce frequent contact on the door knobs

6. Conventional ventilators, exhaust fans to be used, and air conditioners to be discouraged. If air conditioners were used, they should be disinfected regularly. The temperature to be kept at 24°–30°
7. Scalpels should be encouraged over cautery. If at all cautery are necessary, bipolar cautery should be preferred over monopolar with as low power voltage setting as possible.

DISCUSSION

We, as maxillofacial surgeons are particularly vulnerable to transmission of diseases easily both due to the field of interest of work and type of instrumentation. We need to be the best at our work because the slightest negligence might cost a grave infection to us and the community. It all starts from taking proper detailed case history including travel history to COVID affected areas. Written informed consent with special mention about the current situation, urgency of the treatment and risk of contamination is must. Extraoral radiographs as orthopantomogram should be preferred instead of intraoral periapical radiographs. Performing well planned procedure under all aseptic precautions with heightened caution is the need of the hour. Mouth props to be avoided. Absorbable sutures to be used to save an extra visit for suture removal. Discharge the patient as soon as the surgeon and anesthetist see fit. Day care procedure preferred over admitting the patient to the wards especially in the coronavirus pandemic scenarios.

Literature is flooded with disinfection, personal hygiene and infection prevention that need no more detailed description in this article. Few points the author would like to mention regarding adapting to the new technologies. Payment methods to be shifted to contactless. Disposable plastic barriers to be used on all the surfaces of touch such as dental chair, light handle, computers, x-ray viewers, and cabinet handles. In addition, the dental chairs should be foot operated and the light bulb should be sensor oriented. Patients should be wearing masks at all times except when an emergency procedure is being performed. Proper positioning of patient (supine or semi supine, mouth angled away from the clinician) and operator (standing or sitting with back straight, away from the oral cavity of the patient). Preoperatively, rinsing the oral cavity and painting using antiseptic solution for 30 s to 1 min. 0.5% Povidone-Iodine has proved be most effective in reducing bacterial and viral load in oral cavity.^[12] Surgical loupes, if used, to be disinfected after every patient.

Since the sequelae of this coronavirus infectious disease is not well understood, there are news reports^[13] that it is relapsing in few patients after treatment is complete. Its mechanism is not known because of its novelty and the absence of definitive care as well as absence of vaccination. We, the dental fraternity may use this opportunity to upgrade our practices and instrumentation for the future as we continue to deal with the most vital part of human body, the face and mouth.

There is a huge need of research to develop a consensus on infection control measures stringent enough to be effective against any kind of infection.

CONCLUSION

This review presents changes in the armamentarium required by maxillofacial professionals during and postcovid scenario in order to keep serving their patients with utmost care and precautions. These gadgets are user friendly for any small dental set-up as well. The choice of these upgraded instruments are left to the choice of individual professionals according to their exclusive practice. Yet, the authors encourage all health care professionals to focus on better training in infection control and cross-contamination.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200815-covid-19-sitrep-208.pdf?sfvrsn=9dc4e959_2. [Last accessed on 2020 Aug 15].
2. Available from: <http://newsonair.com/Main-News-Details.aspx?id=386422>. [Last accessed on 2020 May 01].
3. Bitar D, Goubar A, Desenclos JC. International travels and fever screening during epidemics: a literature review on the effectiveness and potential use of non-contact infrared thermometers. *Eurosurveillance*. 2009 Feb 12;14:19115.
4. Available from: https://www.drdo.gov.in/sites/default/files/whats_new_document/attach2.pdf. [Last accessed on 2020 Aug 15].
5. Jacobs P, Kowatsch R. Sterrad sterilization system: A new technology for instrument sterilization. *Endosc Surg Allied Technol* 1993;1:57-8.
6. Available from: https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Half-Facepiece-Respirator-Assembly-6291-07002-AAD-Medium-with-3M-Particulate-Filters-2091-07000-AAD-P100-24-EA-Case/?N=5002385+3294780266&rt=rud. [Last accessed on 2020 Aug 15].
7. Wong J, Goh QY, Tan Z, Lie SA, Tay YC, Ng SY, *et al.* Preparing for a COVID-19 pandemic: A review of operating room outbreak response measures in a large tertiary hospital in Singapore. *Can J Anaesth* 2020;67:732-45.
8. Centers for Disease Control and Prevention. Transmission of Coronavirus Disease 2019 (COVID-19). Available from: <https://www.cdc.gov/coronavirus/2019-ncov/about/transmission.html>. [Last accessed on 2020 Aug 15].
9. Available from: <https://www.mohfw.gov.in/pdf/GuidelinesonrationaluseofPersonalProtectiveEquipment.pdf>. [Last accessed on 2020 May 01].
10. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci* 2020;12:9.
11. World Health Organization. Cleaning and Disinfection of Environmental Surfaces in the Context of COVID-19: Interim Guidance, 15 May, 2020. World Health Organization; 2020.
12. Eggers M. Infectious disease management and control with povidone iodine. *Infectious diseases and therapy*. 2019;1:1-3.
13. Available from: <https://www.downtoearth.org.in/news/health/covid-19-relapse-three-theories-can-explain-worrying-trend-70364>. [Last accessed on 2020 Aug 15].