

Review Article

Aerosol Suction Device: Mandatory Armamentarium in Dentistry Post Lock Down

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ABSTRACT:

Since its emergence in December 2019, corona virus disease 2019 (COVID-19) has impacted several countries, affecting more than 90 thousand patients and making it a global public threat. The routes of transmission are direct contact, and droplet and possible aerosol transmissions. Due to the unique nature of dentistry, most dental procedures generate significant amounts of droplets and aerosols, posing potential risks of infection transmission. Understanding the significance of aerosol transmission and its implications in dentistry can facilitate the identification and correction of negligence in daily dental practice especially after the lockdown period ends after the containment of this pandemic so that in future such infection spread should be averted.

Keywords: Corona virus disease 2019 (COVID-19), Aerosol, Infection control, High-Volume Evacuator.

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INTRODUCTION

Coronavirus (nCoV) is a novel virus that is considered to be a recent strain that has not been previously identified in humans. Coronavirus mainly causes illness that varies from the common cold to more Severe Acute Respiratory Syndrome. Coronaviruses are characteristically transmitted between animals and people. Common clinical signs of the infection include respiratory symptoms in the form of fever,

cough, shortness of breath and breathing difficulties. In more critical cases, infection results in pneumonia, severe acute respiratory syndrome, kidney failure and even death.¹

AEROSOLS

Aerosols were defined as particles less than 50 µm in diameter. Particles of this size are minor enough to stay airborne for a lengthy period before they settle on environmental surfaces or enter the respiratory tract.

The minor particles of an aerosol (0.5 to 10 µm in diameter) have the potential to enter and lodge in the smaller passages of the lungs and are thought to carry the utmost potential for transmitting infections. Splatter was defined by Micik and colleagues, as airborne particles larger than 50 µm in diameter. They specified that these particles behaved in a ballistic manner. This shows that these particles or droplets are ejected by force from the operating site and arc in a trajectory comparable to that of a bullet until they contact a surface or fall to the floor. These particles are too big to become suspended in the air and are airborne only temporarily.²

CORONA VIRUS & DENTISTRY

The virus is thought to spread via airborne transmission. Since that numerous kinds of dental equipment's are used in the clinical practice in the form of handpieces, air-water syringes and ultrasonic scalers substantial amounts of aerosols are produced. So, the potential for the spread of infections from patients to dentists or dental assistants is high.³ Dentists working in routine dental procedures involving ultrasonic scalers, high-speed hand pieces in endodontic procedures and prophylaxis cup-polishing, get exposed to hazardous airborne particles like aerosols, splatter, droplet nuclei and particulate matter. Aerosols are generated when air, water spray and air turbine hand pieces are used; they may contain up to 100,000 bacteria per cubic foot of air and remain airborne for long time. Aerosol and splatter composed of blood, bacteria, saliva and tissue fluid cause exposure to blood-borne pathogens. Accidental inhalation is responsible for dissemination of pathogenic microorganisms which eventually have caused diseases tuberculosis, hepatitis-B, HIV and Severe Acute Respiratory syndrome (SARS) and most recent Coronavirus, among dentists and dental hygienists.⁴ Centre for Disease Control & American Dental Association Infection Control Guidelines have been mandating universal precautions such as gloves, protective eyewear with solid-side shields, face masks/chin-length plastic face shields, protective clothing to minimize the contact with aerosols in dentists.⁴ Pre-procedural rinse with 0.2% chlorhexidine before ultrasonic scaling, using isolation devices (rubber dams), saliva ejectors & high-volume evacuator (HVEs) have been tested in controlling aerosol production in dental settings and studies have shown promising results with HVEs causing 90% to 98% reduction of aerosols irrespective of source.⁶

ARMAMENTERIUM

Increased use of ultrasonic scalers and turbine hand pieces is responsible for decreased air quality in the dental office due to increased aerosol contamination. Reducing the aerosol production, microbial load in the water tubing, container will reduce the chances of cross-contamination in the dental surgery.⁷ HVE is a

suction device that draws a large volume of air over a period of time and is fitted on to an evacuation system that is said to remove a volume of air up to 100 cubic feet per minute. HVE may address aerosol reduction but certain technical specifications are to be considered by clinicians in using HVE.⁴ The high-speed dental handpiece without anti-retraction valves may aspirate and expel the debris and fluids during the dental procedures. More importantly, the microbes, including bacteria and virus, may further contaminate the air and water tubes within the dental unit, and thus can potentially cause cross-infection. the anti-retraction high-speed dental handpiece can significantly reduce the backflow of oral bacteria and HBV into the tubes of the handpiece and dental unit as compared with the handpiece without anti-retraction function. Therefore, the use of dental handpieces without anti-retraction function should be prohibited during the epidemic period of COVID-19. Anti-retraction dental handpiece with specially designed anti-retractive valves or other anti-reflux designs are strongly recommended as an extra preventive measure for crossinfection.⁸ Application of rubber dam during cavity preparation showed a significant reduction in the spread of microorganisms by 90%. Rubber dam is applied in all aerosol-generating procedures. One disadvantage of using the rubber dam is that it is not feasible in procedures that require subgingival instrumentation, such as subgingival restoration and subgingival crown margin preparation.⁹

DISCUSSION ON PREVENTION

The potential routes for the spread of infection in a dental office are direct contact with body fluids of an infected patient, contact with environmental surfaces or instruments that have been contaminated by the patient and contact with infectious particles from the patient that have become airborne. There is a long history of infections that have been transmitted by an airborne route. Even before the discovery of specific infectious agents such as bacteria and viruses, the potential of infection by the airborne route was recognized.¹⁰ HVE filter is a suction device that helps remove air at a rate of up to 2.83 m³ 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%. However, the device should be held at a proper distance (approximately 6–15 mm) from the active ultrasonic tip. One limitation of the HVE is that without a dental assistant, clinicians might face difficulty in operating it using one hand. There are modified HVEs in the market that address this problem.¹¹ Dental health care workers, specifically dental hygienists who traditionally provide care without the aid of a dental assistant, recognize that using an HVE creates a challenge owing to the bulkiness of the high-volume suction hose and difficult-to manoeuvre disposable HVE attachment. This reality makes the saliva ejector,

which is significantly lighter and easier to manoeuvre than the HVE, the preferred device of dental hygienists for removal of excess fluids from the oral cavity.¹³ It should be emphasized that for a suction system to be classified as an HVE, it must remove a large volume of air within a short period. An evacuator that pulls a high vacuum but does not remove a large volume of air, such as is used routinely for hospital suction, is not considered an HVE. The usual HVE used in dentistry has a large opening (usually 8 millimeters or greater) and is attached to an evacuation system that will remove a large volume of air (up to 100 cubic feet of air per minute). The small opening of a saliva ejector does not remove a large enough volume of air to be classified as an HVE.¹⁴ During restorative dentistry, the HVE often will be used by an assistant who is able to guide and aim the vacuum in a manner that eliminates or greatly reduces the visible water spray produced during dental procedures. It has been shown that the number of CFUs produced during dental procedures is reduced greatly when an assistant uses an HVE. A problem arises when the operator is working without an assistant. This often is the case during delivery of periodontal treatment by a dental hygienist.¹⁵ Several options are available to operators working without an assistant. They include using the operating instrument in one hand and the HVE in the other hand, HVE devices that attach to the operating instrument and various “dry field” devices that attach to an HVE. For air polishing and air abrasion, devices are available that combine a barrier device to help contain the abrasive material and a vacuum to remove the abrasive material and the airborne particles created by the procedures. All of these instruments are available commercially from multiple sources.¹³

CLINICIANS & HVE DEVICE

Clinicians need to check the power and airflow volume of the HVE periodically. There are systems which have clean lines and show sufficient airflow but may have an extremely low static measurement of vacuum pressure (mmHg). This results in backflow. There might be, an evacuation system showing high static reading but have clogged lines, resulting in low volume. In multi-chair dental clinics where large number of dental operators are working on a suction system loop, there is reduction in volume and pressure. Predominantly suction systems are able to remove pooling water, but sometimes waterlines may get clogged, and reduce suction volume performance. Proper distance should be maintained by clinicians while holding HVE devices. The device should be held approximately 6-15mm away from the active ultrasonic tip or air polisher. Clinicians need to comfortably access the mouth when using the HVE. The angulation of HVE device into patient's mouth should be done to avoid contact with cheek/ tongue of

the patient. There are ergonomic limitations for clinicians since they might face difficulty in holding the HVE which are heavy to handle; inability to view mouth in direct vision.⁴

CONCLUSION

The aerosols and splatter generated during dental procedures have the potential to spread infection to dental personnel and other people in the dental office. While, as with all infection control procedures, it is impossible to completely eliminate the risk posed by dental aerosols, it is possible to minimize the risk with relatively simple and inexpensive precautions like universal barrier protection.

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