"DENTAL UNIT WATERLINE DISINFECTION: A review"

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Abstract: Opportunistic and respiratory pathogens such as Legionella spp, pseudomonads and Non-tuberculous Mycobacteria are the most commonly seen pathogens that contaminate the dental unit water lines which pose a threat to public health. These pathogens are capable of growing and multiplying rapidly to infective concentration in DUWL biofilm. This is hazardous, leading to respiratory infection if inhaled and can contaminate surgical wounds. In this paper we discuss the threats in the dental practice and practical methods of waterline management to limit the spread of infection.

Keywords: Dental unit waterlines, Disinfection, Biofilms

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Introduction:

Dental clinics are built around dental units. Dental operational units are designed to provide power (water, electrical, air etc.) in addition to acting like a foundation for additional dental equipment like a dental handpiece and other dental accessories. A network of small bore plastic tubes connect the dental units to the high-speed airotor handpieces, three way syringes and ultrasonic scalers that carry air and water to cool and activate the instruments.(1)

Water quality in dental units is critical since patients, in addition to dental personnel are routinely exposed to the aerosol and water created by the dental unit (2). Multiple authors have demonstrated that microorganisms of more than 40 different species, extensively colonise the dental operatory system. These include oral streptococci, Enterobacteria, Candida albicans,

Legionella pneumophila, Pseudomonas species, and non-tuberculous Mycobacterium species (3-6), so it is critical to understand the modes of contamination and disinfection of the DUWLs.

Source of Dental Unit Water Line contamination

Water from public water supply pumped into the dental facilities, back flow of the patient's saliva and independent reservoirs are direct causes of DUWL (Dental Unit Waterline) contamination (7-9). A biofilm forming in the small-bore plastic tubing is an indirect source of pollution within the waterlines (7,10)

The majority of biofilms show a thickness of 30–50µm and are heterogeneous in species and morphology. Resistance to any agents of a chemical nature is provided by glycocalyx, which is a polysaccharide slime layer. With time they grow and colonize and eventually the cluster of microbes break off and become free floating ("planktonic") in the dental unit waterline(12).When the operator releases the water, the free-floating colonies exit the line and end up in the patient's mouth.

The bacteria in DUWL biofilm are always Gram-negative, saprophytic species that are generally non-pathogenic bacteria, but the discovery that some potentially pathogenic microorganisms, such as Legionella pneumophila and Pseudomonas aeruginosa, may be present in the water has caused some concern in the dental community (13)

Factors influencing biofilm formation in DUWL (14)

1. Long periods of stagnation and inactivity
2. Hardness of water
3. Mineral content of water
4. High surface to volume ratio
5. Low flow rate

Majority of the materials widely used to provide water to the air/water syringes and the dental handpieces provide good substrate mediums for bacterial adhesion and subsequent biofilm development. Furthermore, the majority of treated water made suitable for drinking contain minerals, primarily calcium carbonate, which are sedimented on these water bearing surfaces. Organic molecules then congregate on the surfaces, promoting the adherence of bacteria floating in municipal water supply water. (15)

Biofilm may thrive in laminar flow systems with little chance of them being dislodged. This is inadvertently one of the main reasons why flushing waterlines may remove planktonic and suspended bacteria but is ineffective at eliminating biofilms (16). Furthermore, the high surface to volume ratio (6:1) provides biofilms with lots of surface area to proliferate. (14)

Spread of infection from DUWL

Water-borne bacteria can infect a patient having dental work in at least four ways: hematogenous dissemination during major and minor surgical operations, local mucosal such as conjunctival or oral contact, inhalation and ingestion. (17)

People with a weakened resistance to opportunistic and overt infections are increasingly seeking and warranting dental care. This demographic comprises not only persons living with HIV, but also blood transfusion recipients, the elderly, organ transplant recipients, and those suffering from diabetes, cancer and other chronic diseases. These patients may be especially vulnerable to infection as a

result of their contact to water from the dental unit. (7)

According to research studies, polluted water from dental units is a health concern to practitioners and auxiliary staff since dental treatments create a high number of aerosols that can be inhaled. A fraction of dentists are exposed to a water-borne virus Legionella pneumophila, that causes Legionnaire's disease and related ailment such as Pontiac fever, on the job. According to data, dental employees have a much greater anti-Legionella antibody titres than the general population. (18-20)

Waterline management to prevent infection

Flushing of the waterlines was established as a convenient and efficient solution that can be implemented instantly as a temporary procedure in all types of dental procedures without the need for extra equipment. Unfortunately, it was discovered that it only provided a transitory decrease in bacterial load and had limited to no effect on the microbial biofilm. (21) For many years, independent bottled water systems have been provided as optional attachments to dental facilities. (22) Their biggest benefit is that they avoid using municipal water. Fluids are instead pulled from the reservoir bottle, which contains either a dilute aqueous biocide solution, or simply sterile or distilled water.

Chemical treatment methods might be employed sporadically as a "shock" therapy or continually delivered into waterlines in tiny volumes, depending on the nature of specific germicidal chemicals. This protocol necessitates the existence of an independent reservoir system from which the desired solution can be generated. Commonly used chemicals include sodium hypochlorite, glutaraldehyde,
ethylenediaminetetraacetic acid, ethanol, chlorhexidine gluconate, peroxide, phenol, and povidine iodine. (23)

Conclusion

Almost all dental procedures require the use of copious amounts of water. Water is used as a coolant during procedures such as cavity preparation, tooth preparation for crown, Endodontic access opening, Scaling and other procedures. Water helps reduce the heat generated by rotary instruments and thereby reduces the damage on the pulp tissue. Hence dental unit waterlines play a major role in day to day practice. Disinfection of these dental unit waterlines is therefore of paramount importance, as infection can spread through these waterlines by means of biofilm formation. Various methods have been proposed for management of dental unit waterlines, so as to prevent the spread of infection. The dentist should follow these protocols regularly to reduce the risk of infection to the patient through microorganisms from dental unit waterlines.

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