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The Need for Compliance in Waterline Maintenance

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Dental units contain lengths of plastic tubing that deliver compressed air to power handpieces and water to cool and irrigate intra-oral tissues during treatment. Investigations studying the microbial colonization and composition of dental unit waterlines (DUWL) have demonstrated that the narrow hollow bore design of the tubing promotes water stagnation and bacterial accumulation. This creates an optimal environment for proliferation of attached, complex, microbial communities known as biofilm. Potential problems of bacterial colonization in dental water delivery systems were first described in 1963, and since then numerous reports have confirmed that water flowing through dental units can contain very high bacterial concentrations. Many water samples exhibit colony counts ranging from 1,000 to 10,000 colony forming units per milliliter (CFU/mL), with concentrations greater than 1,000,000 CFU/mL also having been reported. To put these numbers in perspective, the standard established by the Environmental Protection Agency (EPA) and other agencies for potable water is 500 CFU/mL of non-coliform bacteria.

Most of the isolated DUWL microbes typically originate from the public water supply, and the overwhelming majority of the bacteria are classified as opportunistic pathogens. They do not usually pose a high risk of disease for healthy persons. However, increasing numbers of patients are coming for dental treatment with weakened immune systems, and can be exposed to microbial opportunists via colonized water. Transmission of waterborne microbes with resultant clinical infection has been documented in hospital facilities. Historically, little epidemiological evidence was available to suggest that biofilms in DUWL were responsible for clinical infections in dental patients or dental care providers. Since the majority of dental offices are located in outpatient settings, direct epidemiological links between an infection and recent exposure to contaminated dental water were difficult to establish. However that changed in 2012 when a fatal case of Legionnaires disease was described in an 82 year old dental patient with exposure to highly contaminated water during 2 treatment appointments.

Figure 1a. Slime worm released during handpiece flushing. Taken from working dental office by service representative.

DUWL Infection Control Strategies

Figure 1 summarizes a few of the infection control concerns and challenges surrounding DUWL and provision of dental treatment. Periodic flushing of dental waterlines with water can clear organisms suspended in the bulk fluid, however, the effects are transient, as bacterial counts can quickly rise to levels that equal or exceed pre-flush levels as biofilm grows or is dislodged by flowing water. The most recent CDC infection control guidelines for DUWL recommend that: 1. potable water must be used for routine dental care, and 2. sterile water should be used for surgical procedures that involve exposure of bone, the vascular system, and tissue that is normally sterile.

Figure 1. Dental Unit Waterline Infection Control Concerns and Challenges

Water coming into dental offices from city supplies contain bacteria and nutrients that support their growth	*Dental unit waterlines contain long lumens, with a high surface area for biofilms to develop*	*Biofilms thrive in moist and warm environments, making the dental unit waterline a perfect environment*
Untreated dental units cannot reliably produce water that meets drinking water standards	*Microbial counts can be > 200,000 cfu/ml within 5 days of DUWL installation*	*Dental water exiting unit can be 100's to 1000's times more contaminated than incoming tap water*
Waterline contamination consists of slime-producing bacteria, fungi and protozoans	*Immune compromised patients are at a greater risk of opportunistic infections*	*In their natural habitat, 99.9% of all bacteria live as a community and attach to surfaces as biofilms*

It is suggested to compare products under consideration with desired properties of an "ideal" dental waterline agent (Table 1).

Table 1. Properties of an Ideal DUWL Infection Control Agent

1	Rapid "cidal" (i.e. lethal) antimicrobial action
2	Exhibit broad-spectrum antimicrobial activity against bacteria, fungi, protozoa
3	Ability to disrupt/disperse accumulated biofilms
4	Exhibits "substantivity" to minimize or prevent microbial accumulation on treated surfaces
5	Non-toxic to equipment or patients
6	Non-pyrogenic
7	Non-allergic
8	Non-corrosive to metals
9	No damaging effects on rubber or synthetic materials
10	Does not interfere with performance of any dental restorative or therapeutic agents
11	"Eco-friendly" (i.e. "green")

A wide variety of products are available for dental facilities to improve dental water quality. With multiple options available, the key for accomplishing DUWL asepsis remain the same as for other infection control goals -- using basic infection control principles in the selection of a strategy, along with personnel compliance with specified protocols. Contaminated waterlines should first be cleaned (i.e. shocked) to remove accumulated microbial and extracellular material. Compliance with a manufacturer's step-by-step procedures for accomplishing this removal is essential. Minimizing subsequent DUWL colonization may require another series of protocols, some of which may be more time consuming than anticipated. Thus, the whole dental team needs to be aware of product costs, necessity for compliance, and the time required to reach recommended DUWL microbial concentrations.

One type of approved DUWL infection control device is a cartridge containing iodine which is placed in a water bottle attached to the dental unit. Flow of water through the cartridge results in the slow release of low concentrations of iodine into treatment water (i.e. ***Crosstex DentaPure® DP365B*** and ***DP365M***). Products in this category are designed to regulate CFU/mLs. THE DENTAL ADVISOR investigated the efficacy of ***Crosstex DentaPure® DP365B*** iodine-releasing cartridges, by incorporating them into dental units in busy practices and testing treatment water bi-weekly for one year. Prior to experimental exposure to released iodine in the test water systems, cultivable microbial levels were determined to be >32-100 times the recommended CDC 500 cfu/mL bacterial concentration. However, soon after installation of the ***DentaPure®*** cartridges, the decline in waterborne bacterial presence was observed to be dramatic. All self-contained waterline systems were found to be negative for microbial growth within four weeks after the installation of the ***DP365B cartridges*** (Figures 2-3).

Figure 2. Culture of 1/500 dilution of dental water prior to experimental treatment. Final bacterial concentration determined to be 3.7 x 104 cfu/mL

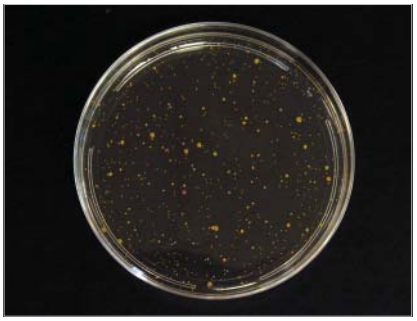
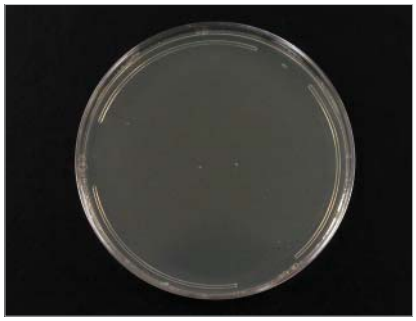


Figure 3. Culture of undiluted dental water sample after 4 weeks exposure to released iodine. Final bacterial concentration determined as <1 cfu/mL



SUMMARY

Accumulated data have shown that dental unit water lines can be rapidly colonized by organisms that thrive in aqueous environments and can form biofilms inside the lumens within days if not treated. (Figure 1b) Want proof? When you flush your lines on a Monday morning collect the water in a cup and take a look at what was collected. Are there floaters? Slime worms? (Figure 1a) We've seen it all. So remember the keys for accomplishing dental unit waterline asepsis remain the same as for other infection control goals – application of basic infection control principles and compliance with product instructions. ✚

Figure 1b. Biofilm within waterline tubing. Taken from working dental office by service representative.