Disinfection and its importance in dental unit water line: A critical review

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Abstract: Research in cross infection in dentistry has historically focused on practices operated by dentists or patients infected with hepatitis B virus (HBV) or human immunodeficiency virus (HIV). The risk of dentist-to-patient transmission of such blood-borne diseases appears to be extremely small. To rule out this small possibility, stringent sterilization protocols as stated in clinical guidelines are followed to avoid blood to blood cross contamination. Busy practices may sterilize or disinfect waterlines and, but most frequently, this is often overlooked.

Keywords: infection control, disinfection, dental unit water line.

INTRODUCTION

Infection control is well recognized in the field of medicine and dentistry. Infection control in health care continues to be a subject of intensive research and debate. Various organizations like Occupational Safety and Health Administration (OSHA), Centers for Disease Control (CDC) and American Dental Association (ADA) have laid down various infection control protocols, and act as regulatory bodies to govern infection control.1

The routes of transmission of diseases in the dental offices can be from patient to patient, dentist to patient and patient to dentist when adequate precaution is not followed. The aerosol and splatter generated during the dental procedures have the potential to spread the infection to dental personnel and other people in dental office.2 In addition, numerous environmental surfaces routinely become contaminated with saliva, blood, and exudate (i.e., bioburden) during provision of care and require surface cleaning and disinfection or placement of disposable covers between patients. These inanimate items include dental equipment, light handles, counter surfaces, doorknobs, reusable medical containers, and dental unit hose lines.

Cleaning and decontamination processes before subsequent patient treatment remain important, yet often misunderstood, components of an effective infection-control program. Some clinicians still remain unclear about potential hazards and recommendations for prevention of cross-infection.3

Critical review and discussion:

Review and discussion will be elaborated under following headings:
1. Disinfection and its importance.

2. Disinfection and its application in dental unit water line.

**Disinfection and its importance:**

Disinfection is considered to be the primary mechanism for the inactivation/destruction of pathogenic organisms to prevent the spread of waterborne diseases. With all of the disinfection processes, time is a critical factor. In fact, simply allowing the organisms’ time to die is one way to disinfect. Disinfection protocols, when implemented correctly, can be a cost-effective means of reducing pathogenic organisms and are an important step in any biological risk management program. Disinfection protocols used on a daily basis will differ from those needed to control an infectious disease outbreak. However, both have one component in common; thorough cleaning and washing prior to the application of any disinfectant is essential.

Chemical disinfectants can have various effects against microorganisms. Therefore, a basic understanding of the different chemical agents is important. Biocide or germicide refers to chemical agents that kill microorganisms. These general terms include disinfectants, antiseptics and antibiotics. When a killing action is implied, the suffix –cide (e.g. biocide, bactericide, virucide, sporicide) is used, while –static (e.g. bacteriostatic, virostatic, sporostatic) is added when an organism’s growth is merely inhibited or it is prevented from multiplying.

Disinfectant describes a product applied directly to an inanimate object. It destroys or irreversibly inactivates most pathogenic microorganisms, some viruses, but not usually spores. In comparison, antiseptics are applied to the surface of living organisms or tissues to prevent or stop the growth of microorganisms by inhibiting the organism or by destroying them. Sterilization refers to the process, either physical (i.e., extreme heat) or chemical (i.e. ethylene oxide), that destroys or eliminates all forms of life, especially microorganisms. The simplest way to approach the subject of environmental surface disinfection is to adhere to a basic premise of aseptic technique: clean it first.

As straightforward and logical as this statement appears, this procedure is not done thoroughly. Unfortunately, choosing an appropriate general-purpose surface cleaner and disinfectant may be difficult because of exaggerated claims by manufacturers and misleading assays reported in the literature. These analyses can obscure the actual performance capabilities of individual agents and also may yield information that is not clinically applicable or readily reproducible. Instead, there are choices of different, appropriate formulations, each of which has received Environmental Protection Agency (EPA) approval as a hospital-level disinfectant. If barriers are not used, surfaces should be cleaned and disinfected using an EPA-registered hospital disinfectant with a low-level (i.e., HIV and HBV label claims) to intermediate-level (i.e., tuberculocidal claim) activity after each patient. An intermediate should be used when the surface is visibly contaminated with blood or other potentially infectious materials (OPIM). The use of low-level disinfectant products with HIV and HBV label claims is supported by the scientific literature; however, selecting one appropriate product with a higher degree of potency (i.e. intermediate-level disinfectant) to cover all situations is more practical.

**Disinfection and its application in dental unit water line:**

Numerous studies have been done on the contamination of dental unit water lines, while studies within the lumen and internal water lines of high speed handpieces have largely drawn contaminated sample fluid in vitro conditions and examined them. These studies found positive contamination of the dental unit water lines. Published guidelines and various literatures of such studies is discussed under following heading:

Disinfection and dental unit water line:

The presence of microbial contamination of water coming from dental units was first reported by Blake in 1963. In the years since that discovery, research
has been ongoing to identify potential bacterial human pathogens from dental unit waterlines (DUWL).8

In an era that cannot stress enough on the necessity of asepsis and total sterilization of clinical equipments as is possible, the potential contamination within Dental Unit Water Lines have not been emphasized upon enough. A closer look at the mechanism of contamination shows that in the lumen of the tubing, the flow is minimal, and progressively decreases to stasis especially when the units are not in use. Molecules precipitate from the water onto the interior wall and promote the adherence of planktonic microorganisms from the water. Once they become sessile, the microorganisms change their phenotype. After adherence, there is a so-called surface-associated lag time, and the organisms then enter a growth phase and produce exopolysaccharides that coat the organisms in a slime layer. Within the biofilm, the microorganisms can signal one another, transfer nutrients, and exchange genetic material. The insoluble exopolysaccharides shield the microorganisms from displacement and from penetration by predator organisms, antibiotics, and disinfectants. The external surface layer of microorganisms is faster growing and may detach as "swarmer" cells. Detachment of microorganisms from dental unit biofilm flushed into the oral cavity could theoretically infect the patient.9,10-15

Chemical agents in the dental unit waterlines have been investigated for their potential efficacy in controlling or eliminating biofilm formation. Common approaches to improve water quality include: self-contained water systems combined with chemical treatment (e.g., periodic or continuous chemical treatment protocols); systems designed for single chair or entire practice waterlines that purify or treat incoming water to remove or inactivate microorganisms; and combinations of these treatments.12,16-20

Former studies that analysed DUWL based on the number of colony forming units, showed that the use of water with an initial low contamination level did not prevent its increase by the time it reached the patient and the general environment of the office as indicated by the high levels of contamination of the high speed and triple syringe, because biofilm forms on solid surfaces constantly bathed by liquid where microorganisms are present. Thus besides independent reservoirs, it is necessary to develop methods to reduce or eliminate biofilm coating the internal walls of the tubules in the system. Self-contained water systems or those with an independent water reservoir, when used with a chemical treatment protocol, have demonstrated safety and efficacy. However use of independent reservoirs without use of a chemical treatment will have no effect on waterline biofilms. Therefore the primary advantage of self-contained water systems is that cleaning agents can be easily introduced into the system either periodically or continuously. Various antimicrobials like Alpron, Citrisil, Chlorhexidine etc are used as continuous DUWL antimicrobials.12,13,14,21

The center for Disease Control and prevention and British Dental Association recommend simple flushing for 1-2 minutes and can serve as the first line to decontaminate the DUWL and for 20-30s between patient treatments. A significant reduction in Cfu of pseudomonas aeruginosa was seen. Flushing will reduce bacterial contamination of the biofilm and does not look for contaminated retracted fluid. In case of failure to flush it out adequately, this fluid could be the source of cross contamination.

Stringent disinfectant protocols were followed in literatures to disinfect the DUWL from an independent water reservoir attached to the dental unit. The chemical used for disinfection of DUWL was sodium hypochlorite based disinfectant (Alpron) as chlorite based and hydroxide containing products are known to cause a 100% reduction in the total viable count and 95% reduction in biofilm coverage within dental unit water lines, the triple syringe, high speed handpiece, cup filler and surgery hand wash basin. Chlorite based disinfectant (Alpron) is known to achieve ADA recommendation of less than 200CFU/mL.15, 21

Diligent disinfection procedure of DUWL could be combined along with the recommendation
postulated by the Center for Disease Control and Prevention and the British Dental Association which states that simple flushing for 1 or 2 min can be the first line to decontaminate the DUWLs and for 20–30 s between patients’ treatments to eliminate bioburden within the internal water line of dental unit.22

Therefore, the water lines of dental unit should be treated overnight (approximately 16 hrs) on a daily basis at the end of each clinical day by introducing disinfectant and flushed with disinfectant -free sterile or deionised water for 20 minutes for complete flushing of disinfectant the following morning.23

Furthermore, dental unit water line can be rinsed with disinfectant -free deionised water for three minutes (1 or 2min recommended by the Center for Disease Control and Prevention and the British Dental Association) before the first patient was treated and between patients to prevent any cross contamination.22

CONCLUSION:

The mouth is a permanent source of microorganisms that can potentially transfer and cause infection in other people. The difficulty in sterilizing dental unit water lines is understood and accepted by most practitioners and has been object of inconsistent and despairing attention. Therefore theoretically, many community and hospital dental chairs are microbiologically unsound, but there is no documented evidence that these organisms pose a risk to patients or staff. Although documented evidence to this end is minimal, the conclusion that no cross infection is possible through this modality should not be drawn until proven otherwise. Most disinfection methods in use utilize an external wiping method with various chemical disinfectants. However, use of disinfection should be done in careful manner because vast majority of antimicrobial products may produce a window of opportunity for bacteria to evolve resistance to these disinfection products.

REFERENCES:


