

Dental Evacuation Lines: Function, Backflow, and Maintenance

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Dental unit waterlines (DUWLs) and evacuation lines provide important aqueous functions in dental practices, and both can be colonized by microbial organisms. Although they are distinct systems that serve different purposes, both are typically unseen by clinical personnel and patients alike and these personnel may be confused as to the systems' functions. DUWLs contain lengths of narrow-bore plastic tubing and unused/capped-off lengths of tubing (e.g., dead legs, stagnant water) that deliver water and compressed air to handpieces, air/water syringes, and ultrasonic scalers to cool and irrigate operative sites. This maze of tubing offers an optimal environment for the proliferation of complex waterborne microbial communities called biofilms. In contrast, evacuation lines are used to **remove** fluids and debris from a patient's mouth during dental treatment. A saliva ejector is used at the same time as other (high-volume) evacuation equipment. These suction lines can also become contaminated with saliva, blood, and other fluids during provision of patient care.

Although the important functions of DUWLs and evacuation lines during dental procedures cannot be overstated, the research timeline investigating their potential for microbial colonization and cross-contamination has historically been one-sided toward DUWLs. For example, a 1963 study published in the British Dental Journal documented high concentrations of bacteria in coolant water from high-speed handpieces. That publication is generally credited with leading to later investigations showing that bacterial biofilms in dental unit tubing rapidly proliferate in lines that are not cleaned and maintained properly.¹ In contrast, it wasn't until the early 1990s when studies began considering saliva ejector systems as possible cross-contamination risks in dental practices.^{2,3} Much has been learned in this area since those initial studies. The following discussion will use a question/answer format to briefly discuss information reported since the study conducted at the University of Alberta.²

Q: What is a dental evacuation system, and how can it contribute to maintaining a clean, safe clinical environment?

A: An evacuation (i.e., suction) line system typically utilizes a saliva ejector and a high-volume evacuation line. Both have unique characteristics that require specific maintenance protocols, including using cleaning/disinfectant solutions for evacuation lines and anti-retraction devices for saliva ejectors as effective infection prevention precautions.

A saliva ejector is a narrow tubular device attached to a dental unit's evacuation lines. This device provides suction to draw saliva, blood, and debris from the mouth of a dental patient to maintain a clear operative field. One problem that has been documented during the clinical use of low-volume saliva ejectors occurs when the pressure in the patient's mouth is less than that in the evacuator, which can result in previously suctioned fluids in the suction tubing then flowing back into the patient's mouth. The resultant fluid retraction, termed **backflow**, can occur when:

- There is pressure in a patient's mouth (a result of closing their lips and forming a seal around the tip of the ejector) that is less than in the saliva ejector (similar to how liquid flows back into a cup after drinking through a straw).
- The suction tubing attached to the ejector is positioned above the patient's mouth.
- There is the simultaneous use of other evacuation equipment (like a saliva ejector).
- The cheek, the tongue, or another oral mucosal surface blocks the tip of the saliva ejector.

A published report from the University of Alberta in 1993 used red dye to show that backflow in low-volume suction lines can occur and fluid can be retracted into a patient's mouth when a seal around the saliva ejector is created (e.g., by a patient closing their lips around the tip of the ejector, creating a partial vacuum). Furthermore, studies have demonstrated that gravity pulls fluid back toward the patient's mouth whenever a length of the suction tubing holding the tip is positioned above the patient's mouth, or during simultaneous use of other evacuation (high-volume) equipment.³⁻⁵ These and other studies suggest a potential source of cross-contamination, although this occurrence is variable. An important factor for this possibility is related to the seal pressure applied by patients.

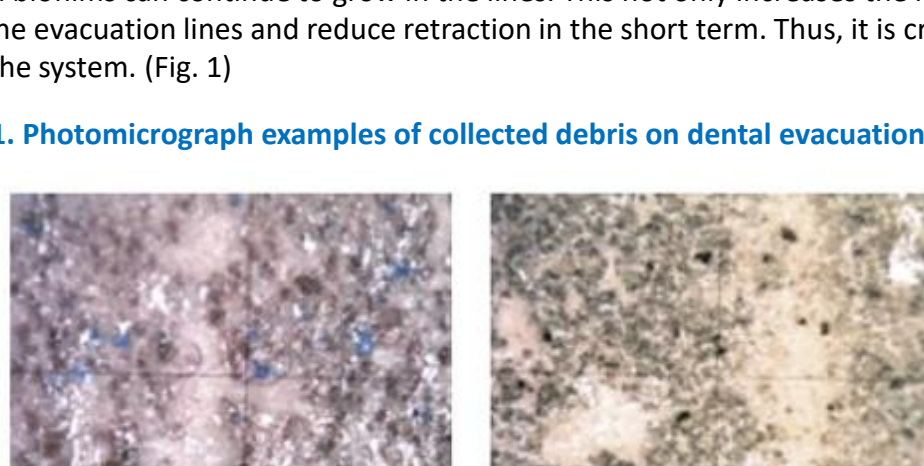
Q: Is there a potential risk of bacterial cross-contamination from evacuation lines if backflow occurs?

A: Currently there haven't been any reported infections in dental patients traced to the backflow of evacuation lines, yet the possibility of cross-contamination exists. Not only do retraction fluids contain residual blood, saliva, and a variety of potentially infectious microorganisms, but patient practices during treatment can also increase the potential for backflow. Early published dental practice surveys indicated:

- Backflow can occur in 1 out of 5 patient appointments.
- 91% of dental offices ask patients to close their lips around the saliva ejector.
- 27% of questioned dental offices admitted to flushing or disinfecting their evacuation lines only once a week.^{2,4}

As a result, microbial biofilms can continue to grow in the lines. This not only increases the risk of transmission, but it can also clog the evacuation lines and reduce retraction in the short term. Thus, it is critical to properly clean and maintain the system. (Fig. 1)

Figure 1. Photomicrograph examples of collected debris on dental evacuation surfaces



[Courtesy of Molinari and Nelson, The Dental Advisor (2015)]

Q: What infection control devices and practices can maximize system efficiency and contribute to maintaining a clean and safe clinical environment?

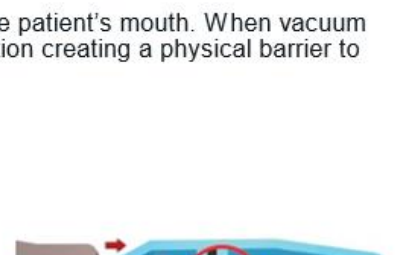
A: **Saliva ejectors** remove saliva and pooling water during treatment procedures. The use of saliva ejectors with anti-retraction valves along with effective line cleaners and disinfectants are important devices in helping keep lines clean. It has been difficult to determine what, if any, adverse health effects can develop from the improper use of these devices; however, because of the potential for cross-contamination, the CDC issued a cautionary statement in its 2003 comprehensive infection control guides for dentistry:

"...dental health care personnel (DHCP) should be aware that backflow could occur when they use a saliva ejector. DHCP should not advise patients to close their lips tightly around the tip of the saliva ejector to evacuate oral fluids. DHCP should contact the manufacturer of the dental unit to review proper use and maintenance procedures, including appropriate cleaning and disinfection methods."⁶

The use of saliva ejectors with a built-in backflow prevention mechanism (e.g., anti-retraction valve), and effective line cleaners and disinfectants are important devices in maximizing system efficiency. An example of this type of product includes the Safety Saliva Ejector from Hu-Friedy Group. (Fig. 2)

Figure 2. Safe-Flo Backflow Prevention Device

- What is Safe-Flo™
 - A unique one-way valve that provides a physical barrier that prevents backflow
- How does it work
 - The one-way valve opens and allows the evacuation of fluids from the patient's mouth. When vacuum pressure changes, the valve immediately snaps into the closed position creating a physical barrier to prevent backflow.



In contrast to saliva ejectors, which are low-volume evacuation devices (LVEs), high-volume evacuators (HVEs) have been shown in clinical use to reduce aerosol contamination arising from the operative site by more than 90%.⁷ Because of their ability to dramatically reduce aerosol production, HVEs are necessary during more extensive dental work because of their ability to quickly remove the build up of liquids and larger solids that the saliva ejector can't evacuate. Criteria for effective HVE devices include:

1. Minimal 8 mm opening (one large or multiple openings)
2. Ability to remove large amounts of air
3. Attached to an evacuation system that will remove up to 100 cubic feet of air per minute.

The challenges the dental industry has faced due to the COVID-19 pandemic required practices to make a number of infection control adaptations, including the modification of HVE technology. One of the newer innovative devices for evacuation has been the HVEsolo™ by Palmero Healthcare. The following is a portion of the device's evaluation published in Dental Product Shopper:

"Uniquely designed for dental professionals performing power instrumentation procedures without an assistant, HVEsolo's lightweight design and short 2.5-inch shaft allows solo practitioners to evacuate fluids, debris, and contaminated aerosols with their non-dominant hand, according to Palmero. With a shaft length 50% shorter than other tips, there is less tension and drag from the hose, which allows a more neutral wrist position for the user."⁸

Similar principles used for maintaining clean dental water lines are employed with **cleaning and disinfecting evacuation lines**. Minimizing the accumulation of organic debris in these lines requires the daily use of special chemical agents. Remember, the basis infection control principle is to **clean it first**, so you must clean suction lines every day to using an evacuation system cleaner to remove saliva, blood, and other debris. In addition, a system-compatible disinfectant must be run through any tubing. Unfortunately, selecting effective and safe line cleaners and disinfectants can be confusing for those responsible for maintaining practice suction lines. The following factors should be considered in the selection:^{9,10}

1. **Non-corrosive:** Do not use bleach or bleach-containing products. Chlorine is corrosive and can corrode metal components.
2. **Non-oxidizing:** Oxidizers can cause mercury to be released from amalgam particles, which can cause water contamination.
3. **Non-foaming.**
4. **Contains enzymes:** To promote the break-up of organic material.
5. **pH neutral:** Acidic or alkaline cleaners can damage pipes, causing corrosion or leaks.
6. **Easy to prepare:** Consider the use of tablets vs. liquids. Tablets are ready-to-use without any mixing.
7. **Scent:** Product that can eliminate odors from line contaminants.
8. **Ease of dispensing system:** Can streamline the cleaning process and reduce the risk of error.

An example of a strategy that incorporates features for both cleaning and disinfection is represented by **Vacuum Shock™ & Vacuum Clean™** by Palmero Healthcare. The reader is referred to a recent review of this effective two-step product combination.¹¹

We want to thank Dr. Molinari, and we invite you to evaluate our wide range of products designed to protect clinicians, patients, and the practice during dental procedures. For more information, visit palmerohealth.com, call 800-344-6424 or email customerservice@palmerohealth.com.

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