Promotional editorial

Contamination in dental unit water lines

Potentially pathogenic bacteria, such as: Pseudomonas aeruginosa and Legionella pneumophila, have been isolated in dental unit water lines. They are invisible enemies that are easier to eliminate with the consistent use of the right method rather than with harsh products.
The problem of contamination in dental unit water lines was first reported in 1963 by Dr. G.C.Blake, after the installation of high-speed handpieces. Checks were made easier by the fact that in those times dental units were not fed by a cooling system connected to water mains; handpieces were directly connected to a water tank that was separated from the rest of the system.
Dr.Blake's discovery was followed by numerous articles in dentistry journals and ideas for prevention systems were published. Most of the water contamination control systems for surgeries recommended: flushing, chemical treatment and filtration. In the late eighties and early nineties, it was shown that the dental unit water line (DUWL) becomes contaminated through simple use, especially by splash back inside the oral cavity as well as water retraction phenomenon on the handpiece, every time that the rotary tool or syringe was set down after use. This resulted in a set of general recommendations for prevention that in no way solved the contamination problem of dental surgeries but helped to lower the bacterial count in DUWL:

- from the eighties, dentists were advised to use only water that complied with drinking water standards;
- recommendations were made to adopt one of the options for the improvement of the quality of water used in dental treatment i.e. disinfection;
- dentists were also advised to let the rotary tool run for a little while before introducing it in the patient's mouth and before setting it down, in order to favour the release of bacteria in the last section of the water line.

Dr. Blake's theories, which showed the presence of a large number of bacteria, often pathogenic, in the water of dental unit lines and in the aerosol that was spread in the environment, made dental professionals aware of the problem. At the same time, the diffusion of the HIV virus around the world contributed to raise concern in the dental industry.

Biofilm

The biofilm is a microbial community that develops in wet environments. It grows rapidly when, in addition to humidity, it finds favourable conditions, such as temperature and anchorage. It consists mostly of heterogeneous bacteria, protected by polysaccharides, known as glycocalyx, which preserves them and defends them from chemical attack, desiccation and predation.
The water that runs in the small tubes of the dental unit water lines, very often contains mineral substances, mainly calcium and carbonate, that build up on the internal surface of the tubes, forming a rough surface to which the bacteria suspended in the mains water adhere. This forms protected biofilm scaling that the flow of water is unable to remove. Laminar flushing in the dental surgery tubes momentarily clears the fluid from suspended microorganisms, but it cannot be considered a solution to water contamination. Mature biofilm provides a favourable environment for other microbial life forms such as fungi, algae and protozoa.

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The microorganisms that pollute the dental unit water line are the same that are found in the water pipes, why does their density increase in the surgery conduits and are
considered more dangerous? The answer to this question is made up of three parts, related to biology, physics and geometry: surface colonization, laminar flow and volume/surface ratio.

Surface colonization
Many tubes, connectors and small tanks, built to supply water to the instruments have rough internal surfaces where the calcium contained in water crystallizes easily leading to the concentration of organic molecules that favour bacteria proliferation.

Laminar flow.
The water flowing through narrow tubes is practically moving only in the centre of the tube section, it slows down significantly around the walls and near the areas where it finds bacterial films it is nearly motionless, it assumes a laminar flow hydrodynamic, so the liquid around the bacterial film is not moving, due to the high density of suspended bacteria and to the stagnating liquid, the bacterial film will continue to build up.

Surface/volume ratio
The water in the dental unit is more contaminated than the water from a tap in the same room, even though they are both supplied by the same mains. The reason is biological and it is the anchorage and proliferation of the biofilm. When the fluid enter the dental unit it goes through a narrow tube, where the surface per unit of liquid contained becomes larger and open to colonization.

Risk of infection
Most of the organisms isolated in dental units are bacteria with low pathogenic potential, yet in immunocompromised patients they could still be dangerous.
Research has shown that dental health professionals experience increased exposure to legionella bacteria, increase indicated by the high rate of antibodies compared to the general population in the same area. In 1974, the researcher Clark isolated gram-negative bacteria "Pseudomonas" from dental units and the nasal flora of 14 of 30 controlled dentists, even though none of them had reported clinical symptoms.
In the light of studies, research and controls, it can be concluded that every dental unit can be colonized by bacteria and, if there are bacteria, there is also a risk of contracting diseases.

Recommendations
Considering the general situation and the risks of contracting infections, we think it is important to advise dental professionals to take every possible measure to reduce the bacterial count in DUWL. We saw how the traditional treatment (flushing) is poorly effective, because it reduces suspended bacteria only momentarily and does not eliminate the bacterial film. A more effective, long lasting treatment requires accurate, prolonged rinsing to prevent inconvenience to patients.
On the other hand, end of day procedures carried out after the last patient with a more concentrated disinfectant, provided it does not damage the surfaces it comes into contact with, may remain be left inside the water lines during the whole night. Increased concentration and duration will produce positive effects.
However, the problem of the biofilm remains; the disinfectant can disorganize the biofilm but it can never dissolve the anchorage that keeps it stuck to the surface to which it adheres.

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Promotional editorial

Continuous treatment and biofilm destruction

The solution to this problem has been offered by producers of detergents for dishwashers and washing machines by adding anti-scaling agents to detergents*. If the two products are not incompatible, the combination will normally improve the effect and provide a solution. Disinfection after disinfection, during the day (even short and diluted so that rinsing can be quicker) and more concentrated at the end of the day and before weekends and public holidays, will drastically reduce suspended bacteria and destroy the biofilm.
Will this solve the problem? It probably will, because in general all regulations and control procedures call for the reduction of bacterial density below the level that leads to pathogenic potential.

But more needs to be done; experience has taught us that a little negligence will be enough to bring back the bacterial population that so scares dental patients, surgeons and their staff.

Thank you for your attention,
Augusto Cattani

*when dental units use demineralized water, the anti-scaling agent is not indispensable; however, combined with a disinfectant it will still be of use, because it will act as an adjuvant and increase the effectiveness of the disinfectant.

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