

The Role of Ultraviolet Light in Keeping a Germ-Free Toothbrush



Introduction

Most people like to be clean, and also like the things they own to be clean. We are taught at a very early age to wash our hands after using the rest room, and to take showers or bathe on a regular basis.

The primary reason we don't like to be dirty is because dirty things are thought of as "germy" things. Not many of us would think of taking a used glass or fork out of the sink and pouring another drink or using the fork again without first thoroughly washing and drying them by hand or in a dishwasher. So why do we nonchalantly reuse the same toothbrush again and again, two or three times a day, simply giving it a quick rinse under the faucet and then placing it in a toothbrush holder or cup, or on a bathroom countertop, until the next time? Many of us don't realize just how "dirty" our toothbrushes are, in terms of the number and variety of potentially infectious germs that call each and every bristle their home. It's enough to make a person sick to their stomach—literally *and* figuratively!

Germs: The Good, the Bad, and the Ugly

The human mouth is host to a tremendous variety of microbes, including bacteria, viruses, fungi, and protozoa.¹ The most numerous of this group are bacteria, of which oral pathologists have identified and documented more than 600 different species, although the average person in good oral health will have between 34 and 72 species.² No matter how many species of bacteria a person hosts, there are approximately 100 million total bacteria in every milliliter (that's just a few small drops!) of saliva.¹

Not all oral bacteria are a cause of concern. As a matter of fact, some strains of bacteria that live on our teeth and gums help digest food and ward off attack by disease-causing bacteria that are also part of the normal oral flora. These are known as the "indigenous microbiota." These probiotic bacteria include *Lactobacillus acidophilus* and *Bifidobacterium* species, which help maintain a healthy digestive tract, as well as a beneficial strain of *Streptococcus*, *Streptococcus salivarius*, which has been found to promote fresh breath by competing with *Solobacterium moorei*, a strain of bacteria implicated in causing halitosis, or bad breath.^{3, 4}

Conversely, there are just as many pathogenic bacteria in the mouth as there are good. The key is maintaining a natural balance of both. When the oral flora is well-balanced between good and bad, a person with a normal, healthy immune system will likely stay well. It's when environmental pathogens—such as bacteria, germs, and mold that inhabit our homes, and especially the bathroom, where we keep our toothbrushes—are introduced into the mouth that problems arise.

The Bathroom: a Breeding Ground for Bacteria

It's interesting that the one room in the house we use to bathe and get clean is also one of the most germ-ridden. There are several reasons for this. In most homes, bathrooms are small, relatively dark, moist, and warm spaces—an ideal breeding ground for an entire spectrum of germs.⁵ Also, each time we flush a toilet, bacteria from the water in the bowl are “aerosolized” and released into the air, only to fall back down on everything that is left out in the open and on top of the sink counter— toothbrushes included.⁶ No matter how meticulous we are at keeping our bathrooms clean, it's virtually impossible to keep them 100% clean 100% of the time.

The most common disease-causing bacteria found in bathrooms are staphylococci, streptococci, *Escherichia coli*, *Salmonella*, and *Campylobacter*. It is known that an estimated 40% of the general population carries staphylococci (“staph”) bacteria in their noses and throats.⁷ Streptococci (“strep”) most commonly cause strep throat. *Escherichia coli* bacteria are part of the normal flora of the intestinal tract; but when *E coli* is introduced to the mouth or other mucous membranes, it can cause severe diarrhea and gastrointestinal distress. In infants, the elderly, and those with compromised immune systems, *E coli* infection can be fatal. *Salmonella* causes gastroenteritis with symptoms such as headache, abdominal pain, nausea, vomiting, and diarrhea. *Campylobacter*, along with *E coli*, is considered one of the most common causes of diarrhea worldwide.⁸

Knowing that these bacterial strains are present in virtually all bathrooms, and knowing that regular and thorough cleaning of the bathroom cannot entirely eliminate these pathogens, we must look at ways to reduce the opportunity for these bacteria to enter our bodies by way of our toothbrushes.

Sanitization Methods That Help Keep us Healthy

The most common way to clean and disinfect an area is through the use of liquid chemical solutions. The problem with these solutions is that they often contain harsh or caustic chemicals. Furthermore, once the chemical cleaner has dried or been wiped away, it is no longer effective, so the surface is once again subject to contamination and colonization by bacteria.

As mentioned earlier, each time a toilet is flushed, pathogen-containing water droplets are released into the air and fall back onto all surfaces in the room, and often make their way into adjacent rooms through open doors or ventilation systems. Liquid spray cleaners or powders can also present an ingestion hazard. Although we do our best to wipe away excess cleaner, a residue is inevitably left behind. This residue can be introduced onto our skin, mouths, and eyes by contact with our hands, clothes, or towels.

A relatively new way to purify water, hard surfaces, and even the air is through the use of ultraviolet radiation, or UV-C light. UV-C light has been proven bactericidal to a wide array of bacterial species, including antibiotic-resistant species, and has been extensively used in water purification systems.⁹ UV-C light is produced with commercially available low-pressure mercury-vapor lamps that emit about 86% of their light at 254 nanometers, which is a peak wavelength for germicidal effectiveness.¹⁰

How UV Light “Kills” Germs

UV light, particularly in the “C” band, which lies between 100 and 280 nanometers, is effective in killing germs.¹¹ UV-C rays destroy germs and bacteria quickly and effectively without the use of dangerous chemicals. When a UV-C light is switched on, the rays strike the various microorganisms, whether they are bacteria, viruses, yeasts, molds, or algae, and break through the outer cell membrane. The radiation reaches the “heart” of the organisms—their DNA—where it causes abrupt modifications and rearrangement of the cell’s genetic information.¹¹ This action interferes with the cell’s ability to reproduce. A cell that cannot reproduce is considered dead, since it is unable to multiply to infectious numbers within a host. Therefore, though germs are not physically removed

from the object they occupy, they are completely “inactivated” rendering them harmless and no longer able to cause infection.

In locations where exposure to pathogens is greatest, and infection control is practiced to reduce the spread of disease (such as in hospitals and clinics), illuminating the area with UV-C light instead of incandescent or fluorescent light has been proven to kill airborne pathogens and reduce the spread of infection. Similarly, in the food processing and preparation industries, UV-C lighting is directed onto the preparation surfaces to maintain a clean, germ-free environment to reduce the transmission of pathogenic germs. For water purification systems, an encapsulated UV light is submersed in the water and turned on for a specific length of time; it takes 15 minutes to completely purify a 20-liter container of water. As an added benefit, the UV light also disinfects the inside of the container.

A Germ-Free Toothbrush for a Healthy Mouth and Body

Using the proven germicidal power of UV-C light, the VIOLight toothbrush holder effectively decontaminates and kills 99.9% of all pathogens that call our toothbrushes home.^{12, 13, 14} This includes the germs that are already present in our mouths and are transferred onto the bristles every time we brush, and also the germs that are present in our homes and bathrooms, including *E coli*, *Salmonella*, *Streptococcus*, and many, many more. To date, over 100 published studies confirm the safety and efficacy of UV-C light in its ability to inactivate illness-causing pathogens, rendering them harmless and unable to cause sickness in humans.

The VIOLight is an easy-to-use, compact toothbrush holder that requires only the push of a button to operate. A toothbrush (or toothbrushes, depending on the model) is inserted into the VIOLight canister after use; the button is pressed, and the unit projects UV-C light onto the toothbrush head, bristles, and handle for 10 minutes. The unit is designed so that the UV-C rays are concentrated and focused downward onto the bristles, allowing minimal light to escape the unit and therefore preventing exposure to UV light when in use. A study conducted by an independent microbiological laboratory, as well as another conducted at the New York University College of Dentistry, revealed that after ten

minutes of exposure to the UV-C light, 99.9% of all pathogens are destroyed,¹⁴ and the toothbrush(es) is sanitized, germ-free, and ready to use again.

Conclusion

Research confirms the presence of numerous potentially harmful microorganisms on toothbrushes. These bacteria, viruses, and fungi thrive in the warm, wet conditions found in most bathrooms, and they begin to grow and multiply once they “land” on toothbrush bristles. These microorganisms are opportunistic and can enter the bloodstream via numerous routes, including canker sores, lacerations, burns, or abrasions in areas of the mouth and throat. Once in the bloodstream, pathogens can pose a health risk from a systemic standpoint, causing illness and infection ranging from common colds to influenza, gastrointestinal diseases, strep throat, and, in rare cases, infections of the heart and lungs. Although there is no way to completely shield ourselves from the environmental pathogens that bombard us every day, simple and effective measures such as using a UV-C toothbrush sanitizer can reduce our exposure and risk for infection on a daily basis.

References:

1. Laskin A, Bennett J, Gadd G, eds. *Advances in Applied Microbiology*, Volume 54 (Advances in Applied Microbiology). Illustrated ed. New York, NY: Academic Press; 2004.
2. Burnett GW, Scherp HW. *Oral Microbiology and Infectious Disease*. 2nd ed. Baltimore, MD: Williams & Wilkins; 1962.
3. Ouwehand AC, Vaughan EE, eds. *Gastrointestinal Microbiology*. Illustrated ed. New York, NY: Informa HealthCare; 2006.
4. Kazor CE. *Microbiology and Treatment of Oral Malodor*. Ann Arbor, MI: University of Michigan Press; 2003.
5. Diseases and disorders. Tarrytown, NY: Marshall Cavendish Corporation; 2007.
6. Tierno PM. *The Secret Life of Germs: What They Are, Why We Need Them, and How We Can Protect Ourselves Against Them*. New York, NY: Atria Books; 2004.
7. Vieira ER. *Elementary Food Science* (Food Science Texts Series). 4th ed. New York, NY: Springer; 1999.
8. Evans AS, Brachman PS, eds. *Bacterial Infections of Humans: Epidemiology and Control*. 3rd ed. New York, NY: Springer; 1998.
9. Tchobanoglous G, Burton FL, Stensel HD. *Wastewater Engineering: Treatment and Reuse*. 4th ed. Boston, MA: McGraw-Hill; 2003.
10. Stellman JM. *Encyclopaedia of occupational health and safety*. Geneva: International Labour Office, 1998.
11. Levinson W. *Review of Medical Microbiology and Immunology* (LANGE Basic Science). New York, NY: Lange Medical Books/McGraw-Hill; 2008.
12. Milne CT, Corbett LQ, Dubuc DL. *Wound, Ostomy and Continence Nursing Secrets*. Philadelphia, PA: Hanley & Belfus; 2002.
13. Tebbutt THY. *Principles of Water Quality Control*. 5th ed. Boston, MA: Butterworth-Heinemann; 1998.
14. Bureau Veritas Consumer Products Services, Inc. Technical Report #(5104)085-0128, March 29, 2004. Available online at http://store.cleanair4life.com/Product_PDF/VIOLight_testResults.pdf. Accessed April 28, 2009.