Are Ultrasonic Aerosols an Infection Control Risk?

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By Stephen K. Harrel, DDS

All dental health care providers have dealt with the aerosols and splatter produced during dental treatment. For the dental hygienist, the most common source of aerosol and splatter is the ultrasonic scaler. All ultrasonic scalers produce clinically significant aerosol and splatter no matter what the tip design or the power source.

The ultrasonic scaler produces the greatest amount of airborne contamination,[1] which is demonstrated by the amount of airborne bacteria that can be cultured from the air of a treatment room during the use of various instruments.[2] When compared to all other dental instruments, the number of bacteria in the air is the greatest following the use of an ultrasonic scaler.[3] Two questions naturally arise concerning the presence of airborne bacteria resulting from the use of an ultrasonic scaler:

1. Where do these bacteria come from?
2. Do they represent a danger to dental health care workers or other patients?

WHERE DO THE BACTERIA COME FROM?

Dental unit water lines and patients are the two main sources of bacteria that are forced into the air during use of an ultrasonic scaler. Some bacteria are present in the water that is used to cool the ultrasonic tip. Bacteria from dental unit water lines (DUWL) become airborne through the coolant water that is needed for an ultrasonic scaler. If the DUWL is well maintained, comes from an independent reservoir, and/or has a bacterial filter in the water line, the number of bacteria from the DUWL should be small. If, however, the ultrasonic scaler is directly attached to an older style, poorly maintained source of water, such as a water connection on a dental unit, the coolant water may contain a large number of bacteria that will, in turn, become airborne during treatment. This source of bacteria is easily controlled by proper design and maintenance of the DUWL. All water used in dental hygiene treatment should come from a well-maintained source of water.[4] The patient is the other source of airborne bacteria created by ultrasonic scalers. The ultrasonic scaler tip is placed into the mouth, which is filled with bacteria. When used in the presence of periodontal diseases, the scaler tip is placed into areas of active infection. Studies show that an ultrasonic scaler placed into a small amount of liquid, representing saliva or crevicular fluid, produces copious airborne splatter and aerosols even when coolant water is not used.[5] Most of the

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airborne bacteria produced by the use of an ultrasonic scaler comes from the patient, ie, the treatment site, rather than the DUWL. The bacteria coming from the patient is more likely to be dangerous to dental professionals and other patients than the bacteria present in even a poorly maintained DUWL. However,

neither the source nor pathogenicity of airborne bacteria created by an ultrasonic scaler has been clearly demonstrated.

A DANGER OF JUST A NUISANCE?

Most studies of airborne bacteria look at aerobic bacteria, such as streptococci, that can be easily grown on simple growth media such as blood agar. While aerobic bacteria in the mouth, such as staphylococci, can be extremely pathogenic, most represent a relatively low risk for the spread of infection. Given these facts, many have dismissed the results of most classic studies of airborne bacteria as showing no proof that there is danger from contaminated aerosols produced by the ultrasonic scaler. If the bacteria grown on simple aerobic media were the only bacteria present in the aerosols and splatter originating from the use of an ultrasonic scaler, the infection control risk would be relatively small. However, the relatively benign aerobic bacteria cultured from the air are an indicator or surrogate marker for the presence of other, more dangerous organisms that may be present in saliva and crevicular fluid. Unfortunately, these more pathogenic organisms, such as viruses and anaerobic bacteria, are very difficult to culture and, as a result, no studies have tested for them.

Given the difficulty of testing for the more pathogenic bacteria and viruses, is there another way to evaluate for other potentially dangerous substances or organisms present in the aerosol and splatter from ultrasonic scalers? A single study has looked at the presence of blood in the aerosols produced by ultrasonic scalers.[6] In this study, the liquid captured by a high volume evacuator tip held outside the mouth was evaluated for the presence of blood. Blood was present in 100% of the aerosol samples collected during root planing. This showed that material from the treatment site is routinely aerosolized during ultrasonic scaler use. Blood in aerosol and splatter, just as was the case with aerobic bacteria, may represent a surrogate marker for pathogenic organisms and thus create an infection control risk.

THE EVIDENCE

In evaluating studies published to date, is there clear evidence that aerosol and splatter arising from the use of an ultrasonic scaler are an infection control risk? The unequivocal epidemiologic answer must be no. Aerobic bacteria and blood do not represent absolute risks for the spread of disease. However, other potentially pathogenic organisms may be present in the aerosol and splatter. We know that viruses of the herpes simplex group, hepatitis viruses, and methicillin resistant staphylococcus (MRSA) can be present in the mouth. So are these pathogenic organisms present in the aerosol and splatter from an ultrasonic scaler? This has not been proven because the organisms have not been directly cultured from the aerosol but logic indicates that if they are present at the treatment site, they will probably be forced into the resulting aerosol and splatter resulting from the use of an ultrasonic scaler.

Another way to quantify the potential risk from dental aerosols and splatter is to look at other situations where there is some evidence of the aerosol spread of disease. There is documented evidence of exposure and subsequent seroconversion, indicating exposure but not necessary transmission of disease, of individuals sitting close to a known tuberculosis patient in an airplane.[7] Evidence also suggests that SARS was transmitted via air currents from roof top sewer vent pipes.[8]

In my own experience as an infection control officer in a large teaching hospital, two instances were documented where fatalities were linked to aerosol disease transmission. One was staphylococcus transmitted via nebulizers in a neo-natal intensive care unit and the other resulted from a poorly maintained humidifier system in an operating room suite. Does this evidence for the aerosol transmission of disease in nondental settings have any bearing on the risk of disease transmission by aerosols and splatter arising from the use of an ultrasonic scaler? Once again, these events give further surrogate evidence of the risk of disease transmission from dental aerosol and splatter but they do not represent proof.

WHAT'S THE RISK?

Is the aerosol and splatter arising during use of an ultrasonic scaler an infection control hazard or is it just a patient management nuisance? All dental professionals who treat patients know that aerosol and splatter are a patient management problem that is a nuisance and messy. The question of an infection control risk is more difficult. The only answer currently available is that ultrasonic aerosols and splatter have the potential to cause the spread of infectious diseases. Questions of risk can only be answered by an epidemiologic study of the number of infections caused by dental treatment. Unless there is a major outbreak of disease linked to a dental setting, this study will probably never be completed. Without evidence from an epidemiologic study and given the existing data, ample evidence suggests that aerosol and splatter from an ultrasonic scaler should be considered a potential infection control risk.

Practical clinical infection control must be based on a realistic assessment of risk and the application of reasonable control measures. Dental aerosols and splatter represent a real risk for disease transmission but the potential for transmission appears relatively low.

In recognition of the risk, the Centers for Disease Control and Prevention (CDC) have indicated that aerosols should be controlled to the greatest extent possible.[9] A high volume evacuator (HVE) should be routinely used with an ultrasonic scaler to control aerosols and splatter. A saliva ejector alone is not adequate to control aerosol and splatter.[10] The lack of epidemiologically detectable disease spread resulting from the use of an ultrasonic scaler with only a saliva ejector may speak to the low potential for disease transmission. However, the risk of disease transmission appears real and the methods for reducing the risk are simple and inexpensive. The current nearly universal disregard for the risk associated with ultrasonic aerosols and splatter may be short sighted. Dental personnel working in the presence of aerosols and splatter resulting from dental treatment should implement the CDC recommendations to routinely limit aerosols and splatter to the greatest extent possible.

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From *Dimensions of Dental Hygiene*. June;6(6): 20, 24, 26.