Clinician’s Perspectives on Hearing Protection Devices

Abstract
Occupational noise-induced hearing loss is estimated to be the most common occupational disability in the United States. In addition to hearing loss, high noise levels can create stress, reduce productivity, and interfere with communication and concentration.

For this issue of the Professional Product Review, the ADA Science Institute partnered with the United States Department of Veterans Affairs (VA) to conduct a qualitative review of four different hearing protection devices (HPDs). Two electronic devices with active sound control and two physical barriers providing passive noise control were selected. Fifteen practicing VA dentists were recruited to use and review these devices. Perceptions were gathered via questionnaires and analyzed to determine mean ratings and product preferences. Qualitative assessments of the HPDs evaluated are presented, including participant preferences and recommendations. In addition to evaluation summaries for each HPD, the final ratings, battery life of electronic devices, and overall comparisons are also presented. The dentists reported that the ability to hear patients and colleagues while wearing the devices was the top priority. Other desirable attributes were comfort, appearance and the ability to accommodate various ear shapes. The two devices with active sound control evaluated by the dentists met all of these requirements, while the passive standard earplugs presented several limitations.

Introduction
More workers in the United States suffer hearing loss as a result of their jobs than any other disability. Although noise exposure in the dental office is typically broken up throughout the day, dentists and other dental care providers have been shown to be at risk of hearing loss.

The Occupational Safety and Health Administration Permissible Exposure Limit is 90 decibels per 8-hour work day. Similarly, the National Institute for Occupational Safety and Health recommends limiting noise exposure to 85 decibels per 8-hour work day.

Common equipment in the dental operatory generates cumulative noise nearing decibel levels that can damage hearing:

• Handpieces 70–92 decibels
• Ultrasonic scalers 86 decibels
• Saliva suction tubes 75 decibels.

Although noise exposure in the dental office is typically intermittent, dental professionals have been shown to be at risk of hearing loss. Signs of hearing damage include:

• Ringing in the ears;

• The sense that people are mumbling or phone conversations seem muffled;
• Difficulty hearing in crowds;
• You’ve been told that you speak or play the radio or television too loud;
• You often need to have things repeated.

Because the potential for hearing loss exists in dentistry, dental professionals might consider the use of hearing protection devices. This Professional Product Review looks at dentists’ perceptions of four different hearing protection devices. There are two main categories of HPDs available in the market: the first category is based on a power source that will modulate the sound output by reproducing it at an adjusted level, so-called active noise control.
The Problem
Exposure over time to noise generated by dental equipment like handpieces, ultrasonic scalers and saliva suction tubes has the potential to contribute to hearing loss in dental healthcare workers. Are there hearing protection devices available that would be suitable for use in dental practice?

These devices use an electronic system that captures and transmits sound at a reduced volume to the user. The second category, named passive noise control, is limited to a physical barrier and the properties of the material, with no dynamic interaction with the sound waves.

Approach
Fifteen practicing VA dentists used and rated the performance of four different hearing protection devices (Figure 1). The HPDs were purchased by the American Dental Association (ADA) from product manufacturers or distributors. The HPDs evaluated were MP 9-15 Music PRO Electronic Earplugs (Etymotic Research, Inc.); ETY Plugs High Fidelity Non-Electronic Earplugs (Etymotic Research, Inc.); Laser-Lite Earplugs (The Safety Zone, LLC distributed by Henry Schein); and DI-15 High Fidelity Electronic Earplugs (Dental Innovations, LLC). All HPDs were reusable, with the exception of the foam Laser-Lite Earplugs which were disposable. The dentists participating in this project were provided with one pair of Laser-Lite Earplugs for each day of the evaluation. The two electronic HPDs (DI-15 and Music PRO) were supplied with Rayovac #10 hearing aid batteries, with a nominal voltage of 1.45 V. Each device was used for one week or worn during 20 hours of patient treatment, depending on which condition was met first. The participants then completed a survey assessing the performance of the device and mailed the survey back to the ADA.

Dentists rated each device on:
- Ease of insertion
- Attractiveness
- Painlessness
- Comfort
- The ability to stay in place
- Whether the ear felt “open” versus “blocked”
- Whether they could hear when wearing the device while using a high-speed handpiece.

Respondents also answered Yes/No questions about the ability to hear patients and colleagues while wearing the device, whether they wore the device continuously or took it out throughout the day, and whether they would use this device themselves and/or recommend it to others.

After the dentist had used all of the devices, he or she completed a survey that compared the products against...
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Ratings of Hearing Protection Devices

![Figure 2. Ratings of Hearing Protection Devices based on qualitative assessment performed by surveyed dentists. Scale from 1 (most positive) to 5 (most negative).]

Communications Perception and Personal Preferences of Hearing Protection Devices

![Figure 3. Communications perceptions and preferences of Hearing Protection Devices evaluated. Percentage indicates a “yes” response from the dentists.]

According to the surveys, the ability to hear patients and members of the dental team while wearing the devices was the top priority. Dentists also valued comfort, attractiveness and an open (rather than blocked) feeling in the ear. They reported that all of the tested devices were comfortable and that they stayed in place (Figure 2).

The two electronic brands with active sound control — DI-15 and Music PRO — scored well for all of the rated traits (e.g., ease of insertion, comfort, open feeling in the ear, attractiveness, stays in place). Most importantly, dentists noted that they could hear patients and colleagues while wearing the devices. They said they not only would use these devices themselves, they would recommend them to others. Not surprisingly, the DI-15 and the Music PRO were the hearing protection devices this group was most likely to use, primarily because of their ability to hear when using them, comfort and appearance (Figure 3). The passive noise control devices — ETY plugs and Laser-Lite impacted the ability to hear patients and colleagues, resulting in a low acceptance rating among the dentists.

Clinical Relevance

The noise generated by some dental equipment (e.g., handpieces) approaches exposure limits put in place by the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health (90 decibels per 8-hour work day and 85 decibels per 8-hour work day, respectively). Based on this information, dentists could reasonably consider the use of hearing protection devices.

This study engaged 15 practitioners to use and review the performance of four different hearing protection devices. According to our survey, the top consideration in choosing a hearing device was the ability to hear patients and members of the dental team while wearing the devices.

Our Findings

one another. Participants ranked the devices in order of their preference and identified which device they were most and least likely to use and which traits led them to their decision.

The electronic devices were battery operated, so we conducted tests in the ADA Laboratory to get an idea of battery life (see “Boosting Battery Life”).
**Impact of Noise on Patient Experience**

Many patients report feeling anxious about visiting the dentist’s office, in part due to the noise produced during common dental procedures. A variety of equipment can contribute to the noises that create anxiety for patients, including handpieces, ultrasonic scalers or amalgamators. While the majority of dental procedures are virtually painless, many patients may associate the noises of the equipment with the idea of pain, which can keep patients away from the dentist’s office. The presence of music can alleviate the anxiety in the waiting room, but it is less effective mid-procedure. Providing patients with active hearing protection devices during their procedures may create a better clinic experience by reducing the noise-induced anxiety they may have experienced in the past, while still allowing them to communicate with the dental team.

**Boosting Battery Life**

Strategies to extend battery life include switching electronic hearing protection devices off when not in use and resealing the battery when the device is not in use.

Both electronic devices in the ADA Professional Product Review survey use standard #10 zinc-air batteries (typically used with hearing aids), which are available in many retail stores or pharmacies. The batteries enable these devices to modulate sound transmission, effectively reducing unwanted noise rather than blocking all sound, like a non-electronic earplug.

Zinc-air batteries have air vents that are covered with an adhesive strip. Once this strip is removed, the battery is activated. We measured the life of the battery in the ADA Laboratory with the vents covered and uncovered.

After running the devices 8 hours/day, 5 days/week, we found that the batteries lasted about 4 weeks when stored with the air vents uncovered (Figure 4). This time nearly doubled if the batteries were resealed when not in use. You may get different results, depending on storage conditions; extreme or fluctuating temperatures or humidity can cut into the life of your battery.

Here are some tips that may help you get the most out of your batteries:

- Do not remove the adhesive strip from the battery until you are ready to use it. Remember, these batteries are “turned on” when the air vents are uncovered.
- Let the battery sit for a minute or so after you remove the tab. This will allow air to enter the vents and activate the battery.
- Store the batteries at room temperature, in a place where the temperature and humidity remain stable. Extreme or fluctuating temperatures or humidity can run your battery down.
- Turn off the hearing protection device when you are not using it. As long as it is on, your battery power is draining.
Concern for dentists acquiring noise-induced hearing loss (NIHL) from using dental instruments extends back at least to 1965. Whether or not dentists, as a population, are at risk for NIHL has been a controversial topic, as there is a relative paucity of published research documenting severity of hearing loss in dentists as a function of duration of exposure to instrument noise. Since dentists’ noise exposures are from instruments that have sound energy primarily at very high frequencies (8000 – 16,000 Hz) it has been posited that perhaps dentists will exhibit an atypical form of NIHL, with decreased hearing sensitivity at audible frequencies higher than the range typically tested by conventional audiometry (250 – 8000 Hz). Studies have shown a difference in hearing sensitivity in dentists with at least 10 years of experience, compared to an age-matched control group not exposed to noise occupationally.

Additionally, tinnitus (phantom ringing, buzzing or hissing noise in the ears or head in the absence of external stimuli) is a common complaint among dental professionals, and this cannot be directly measured by audiometry.

It is important to consider that risk for NIHL comes not just from the absolute sound level (measured in A-weighted decibels, or dBA). NIHL results from sound level integrated over time: it’s not just “how loud” is a noise; NIHL is due to “how loud and how long.” The level often considered to reflect the lower threshold for NIHL risk is 85 dBA. The National Institute for Occupational Safety and Health (NIOSH) recommends noise exposure levels not exceed 85 dBA for 8 hours per day. Drills, scalers, and suction exceed 85 dBA, and so could pose a risk, but only if they are used in aggregate for a long enough duration. With every 3–decibel increase in the sound level, only half the time is allowed (e.g., 88 dBA is acceptable for 4 hours; 91 dBA for 2 hours; 100 dBA for 15 minutes). Thus, the sound level integrated over time determines whether or not a noise.

In an effort to provide noise control, the following hierarchy applies: 1. Identify the source of the noise and engineer controls to reduce the level of noise to a safe level; 2. Monitor hearing annually to catch any change in hearing early; 3. Become educated about hearing and hearing loss risks; 4. Use hearing protection devices.

Consultation with an audiologist may help determine which activities contribute most significantly to noise exposure. Perhaps there is noisy equipment that can be replaced with a newer, quieter, model. An audiologist also may be able to advise if annual hearing testing is required under workplace safety regulations. Finally, the audiologist may provide specific, actionable information regarding hearing loss risk factors specific to the dentist’s office and lab.

What’s the best earplug? The one you use. This is a circular statement, but there is truth behind it. Earplugs that are too uncomfortable, bulky, or interfere with activities will not be used (and therefore will not provide any protection). Off-the-shelf foam earplugs are inexpensive and convenient, but they often block out too much sound, which interferes with understanding what a patient or coworker is saying. This communication interference not only increases your stress level, but is potentially dangerous if the dentist misunderstands something important. There may be a temptation to modify the earplug (e.g., cut it in half) or use a shallow insertion in the ear canal. The same holds true if the earplug is inserted incorrectly (something that is very easy to do with disposable earplugs). These approaches to manage “over-attenuation” can very easily lead to the earplugs offering no protection at all, and defeats the purpose of using them.

Earplugs that offer a more modest amount of attenuation are one option: there are off-the-shelf options that are roughly $20 each, and there are others that an audiologist can custom-fit to your ears using earmold impressions (typical cost $150–200). The custom-fitted earplugs reduce sound levels across the audible spectrum by the same modest amount, so speech still sounds natural but a little quieter. Another option are electronic earplugs, which allow soft- to average-level sound to come in without dampening it at all, but brings down damaging sound levels by an appropriate amount. These electronic “level-
dependent” hearing protection devices often have the highest associated cost, but have the added benefit of only attenuating the sound that is potentially damaging and letting the safe sound (like speech) through. These electronic earplugs can be used with off-the-shelf with stock eartips, or can be custom-fit by an audiologist.

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Editor’s Note: This article is intended to be an informational resource only. The views expressed are those of the author and do not necessarily reflect the opinion or policy of the ADA. The article’s contents are not a substitute for the dentist’s own judgment and dentists are encouraged to consult with other professionals, as and when appropriate, regarding the information herein.

References


Links of Interest
American Academy of Audiology Position Statement Preventing Noise-Induced Occupational Hearing Loss

American Academy of Audiology, Find an Audiologist Portal


National Institute for Occupational Safety and Health, Hearing Protector Device Compendium