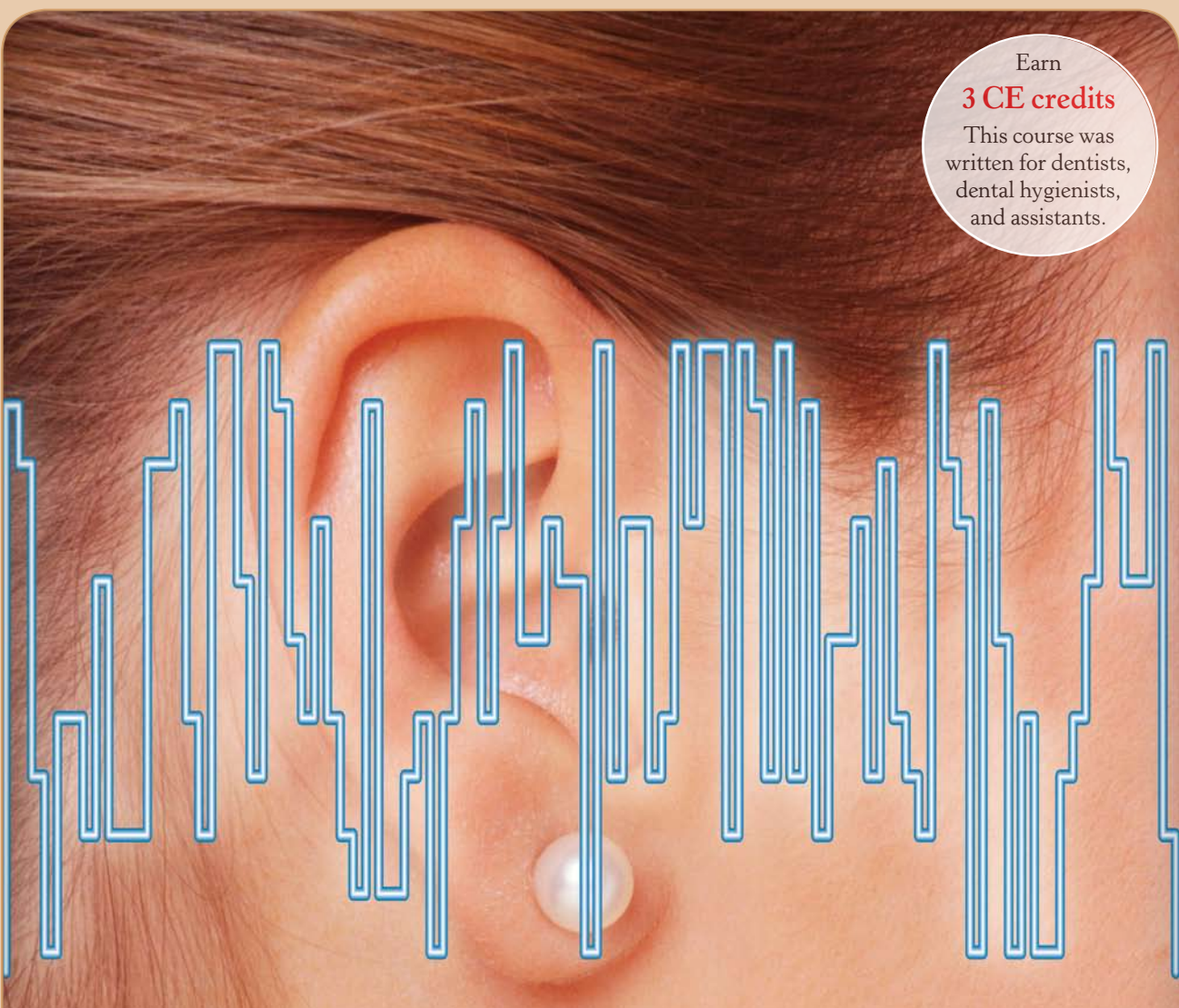


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# Noise-Induced Hearing Loss in Dental Offices

A Peer-Reviewed Publication  
Written by Rebecca Mervine, AuD, MA, CCC-A

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## Educational Objectives

Upon completion of this course, the clinician will be able to do the following:

1. Understand how noise affects hearing over a long period of time.
2. Understand the hearing loss that may occur as a result of occupational exposure to noise in a dental office.
3. Know the precautions and methods that can be employed to help prevent hearing loss.

## Abstract

Dental professionals are at risk for noise-induced hearing loss. Often, individuals are not aware that they have hearing loss — their first complaint and the reason they seek a hearing evaluation may in fact be tinnitus. The dental office environment subjects dental professionals to noises associated with handpieces and ultrasonics as well as other dental equipment. Handpieces must be well maintained to reduce the level of noise emanating from them. Hearing protection devices can be used to help prevent hearing loss. Several types are available, and musician's earplugs may be particularly useful as they reduce noise while still enabling the individual to hear and communicate with others.

## Introduction

As a dental professional, you may encounter occupational hazards everyday. Hearing loss might be one of them. Your hearing might be at risk due to the noises encountered in your dental practice that may make you susceptible to the development of permanent hearing loss. Hearing loss caused by noise is referred to as noise-induced hearing loss. According to the National Institute for Occupational Safety and Health, noise-induced hearing loss is the most common occupational injury.<sup>1</sup>

## Noise

So what makes noise hazardous to your hearing? The level of risk and type of noise can determine whether or not specific noise is hazardous to your hearing. There are three properties of noise that can be examined to determine the level of risk: intensity, duration, and spectrum of the sound.<sup>2</sup> These three elements of sound, which include time characteristics and the physical make-up of the noise, interact to put an individual at risk for hearing loss.<sup>3</sup>

### Intensity of sound

The intensity of sound is measured in decibels (dB). The greater the intensity of the sound (or the higher the dB level), the greater the risk of hearing damage. The level of the sound and the impact it makes are influenced greatly by the temporal patterns of exposure.<sup>4</sup> Temporal patterns of sound include “steady-state,” where the

sound is continuous and does not vary; “fluctuating,” where the sound is continuous but varies over time; “intermittent,” where a noise may be hazardous for some amount of time but is combined with time periods of non-hazardous sound levels; and “impulse,” which is intense and short.<sup>5</sup> In a dental practice, dental professionals will likely be exposed to intermittent noise.

### Duration of sound

The duration of the sound is measured in time. The longer the period of time during which an individual is exposed to a sound, the greater the risk of developing hearing loss. Feuerstein has reported that “long-term exposure studies have shown a clear link between the number of years of daily exposure and hearing loss.”<sup>6</sup>

### Spectrum of sound

The final element of noise is the spectrum. Feuerstein has observed that “most noise exposures are due to complex, variable, broadband signals.”<sup>7</sup>

## Noise-Induced Hearing Loss (NIHL)

The effects of noise on hearing have been reported to fit into three general categories: acoustic trauma, temporary threshold shift, and permanent threshold shift.<sup>8</sup>

Acoustic trauma describes the effect of one or few exposures to very intense sound levels such as an explosion. Typically, the loss of hearing with an acoustic trauma is noted immediately. The second category, temporary threshold shift, refers to a temporary change in hearing thresholds that follows an exposure to noise. Feuerstein has reported that the symptoms of a noise-induced temporary threshold shift may be a reduction in hearing sensitivity, tinnitus, or a possible feeling of subjective fullness in the ears. The amount of the hearing threshold shift and the recovery time are related to the intensity and duration of exposure to the noise.<sup>9</sup> Permanent threshold shifts, the third category, refer to a change in hearing that, once it occurs, is permanent and irreversible. This may be a common occurrence as small amounts of permanent damage result from many noise-induced temporary threshold shifts.<sup>10</sup> Permanent threshold shifts are the consequence of an accumulation of noise exposures that are repeated over a period of many years.<sup>11</sup>

### Types of Noise-Induced Hearing Loss

Acoustic trauma	few exposures, intense sound level
Temporary threshold shift	temporary hearing change following exposure to noise
Permanent threshold shift	result of accumulation of exposure to noise; irreversible

## Effects of Permanent Noise-Induced Hearing Loss

Once noise-induced hearing loss becomes permanent, recovery of hearing is impossible. Initially, the affected individual may not perceive a change in hearing sensitivity. Eventually, however, these small changes in hearing sensitivity accumulate, causing a greater degree of hearing loss. As the hearing loss progresses, one may unknowingly develop compensatory strategies to help with communication. As a result, the hearing loss may go unnoticed until significant difficulties are experienced.<sup>12</sup> Hyson states that “noise-induced hearing loss generally went unnoticed because it was gradual, progressive, and painless.”<sup>13</sup> Garner et al. observed that “since noise-induced hearing loss typically affects high frequencies first, individuals who experience this kind of hearing loss may have very little difficulty hearing in quiet, face-to-face situations but may begin to experience difficulty hearing women and children’s voices.”<sup>14</sup> Other factors, such as age, add to the noise-induced hearing loss, and other frequencies will be affected.<sup>15</sup> As the hearing loss progresses, an individual may experience added difficulties hearing in the presence of background noise, when sounds are at a distance, or in rooms with poor acoustics. Should the hearing loss affect the speech frequencies, individuals will have difficulty hearing in many different types of situations.

Anyone may be at risk for hearing loss if exposed to noise. Merrell and Claggett observed that “all noise, regardless of its source, will cause hearing loss if it is loud enough or if one is exposed to it long enough, and/or if one’s hearing mechanism is susceptible enough.”<sup>16</sup>

## Noise in the Dental Office

Several studies and surveys have been completed to determine the effects of noise in the workplace for dentists. Many of these studies have examined whether the noise found in a dental practice exceeds the Occupational Safety and Health Act (OSHA) standards. OSHA regulations for industry limit a worker’s exposure to steady-state noise levels of 90 dB in an eight-hour time period.<sup>17</sup> The National Institute for Safety and Health (NIOSH) recommends that the time spent exposed to noise should be reduced by half as the sound level doubles.<sup>18</sup>

Dental professionals are exposed to equipment that emits differing levels of noise. Garner et al. have reported that common types of exposure in a dental office can include: angled-design turbine handpieces, low-speed angled-design handpieces, lab electromotor handpieces, high-speed turbine handpieces, low-speed handpieces, stone mixers, lab machines, ultrasonic scalers, and ultrasonic cleaners. These pieces of equipment can emit sounds ranging from 66 dB to 91 dB.<sup>19</sup> The instruments may differ slightly, and some researchers

have reported that noise levels can reach 100 dB with the use of air turbines.<sup>20</sup>

The noises to which dental professionals are exposed are intermittent. The amount of noise to which the dental professional is exposed may depend on the type of treatments that are scheduled and the type of equipment used. Furthermore, older equipment may result in an increased exposure to noise. Older drills may produce louder sounds of 100 dB.<sup>21</sup> The higher intensity reduces the allowable exposure time to two hours per day. Based on the findings of Fabry and Hyson, a typical dental office does not appear to exceed the limits set by OSHA and proposed by NIOSH. However, damage to hearing may still occur. Garner et al. stated that “the authors have clinical experience suggesting there is sufficient anecdotal evidence to warrant a more active approach to hearing conservation by the dental team.”<sup>22</sup>

## The Dental Professional’s Hearing-Loss Risk

Lehto, Laurikainen, et al. reported that “some authors have found losses of hearing in dentists possibly attributable to the drill noise, while others have not.”<sup>23</sup> A recent review of the literature by Hyson found the results to be inconclusive and concluded that future research is indicated. Merrell and Claggett reported that even though it cannot be clearly demonstrated that noise in the dental practice environment will cause hearing loss, they feel a case has been made to show that dental professionals have hearing loss.<sup>24,25</sup>

Even if noise exposure in the office is minimal, the potential for noise-induced hearing loss exists. According to Lehto et al., some individuals may be more susceptible to hearing loss, and even with a “low-risk exposure, such as the dental drill noise,” a gradual loss of hearing may occur. They also concluded that it is currently not possible to determine which individuals are more susceptible.<sup>26</sup> Some report that an individual may be at risk when the effects of different noises encountered are combined. Fabry stated that “if you are working with noisy drills all day, the simple fact is it may make you more susceptible to hearing loss than someone who has a quiet desk job and the same hobby as you do.”<sup>27</sup> Others agree and have reported that the noise in a dental office may have an additive effect together with other 24-hour noise exposures and that this could explain the hearing loss experienced by a significant number of dental professionals.<sup>28</sup>

## Tinnitus

In addition to hearing loss, several articles reported on the presence of tinnitus in dentists.<sup>29,30,31,32</sup> Tinnitus is a condition in which one hears what is often described as a ringing, whistling, or buzzing sound that is perceived only by the affected person. The individual may perceive

tinnitus as constant or intermittent; it may be extremely noticeable or barely detectable. Individuals suffering from tinnitus may experience annoyance, anxiety, difficulty with concentration, sleep disturbances, depression, or difficulty with spoken communication.<sup>33</sup>

As many as 90 percent of people who experience tinnitus have had some noise-induced hearing loss, although it has been observed that an individual may notice the tinnitus before he or she notices any hearing difficulties. As a result, tinnitus is often the precipitating cause for an individual to pursue a hearing evaluation.<sup>34,35</sup>

One survey found that a significant number of dentists reported having tinnitus, and the researcher concluded that the noise that dentists were exposed to (specifically an air turbine handpiece) may have been a contributing factor in their hearing loss.<sup>36</sup>

### Methods to Prevent Hearing Loss

Since noise-induced hearing loss is not medically treatable, preventing the effects of noise is important. Methods to reduce noise exposure in the dental office, and to protect hearing, can be implemented to prevent noise-induced hearing loss. The work environment can be modified to decrease the effects of noise. Methods used to reduce noise exposure can include having the dental professional maintain good posture while a handpiece is being run as well as keeping an appropriate maximum distance between the dental professional and the patient.<sup>37</sup> Maintaining dental equipment appropriately is important — insufficient lubrication contributes to noise, together with the resultant bearing wear and turbine failure, and these are associated with an increased level of noise production from air turbine handpieces.<sup>38</sup>

While these modifications are helpful, they are not sufficient in themselves, and dental professionals should consider wearing hearing protective devices. It has been found that if you cannot or will not avoid hazardous noise, the use of ear protectors is a simple, effective, and under-utilized way to reduce noise exposure. There are several types of hearing protection devices that can be worn over the ears as a headset or in the ear as an earplug. Hearing protection devices can be disposable or custom made. The amount of protection a hearing protection device offers depends on its design.<sup>39</sup> There are advantages and disadvantages to each design, and these should be considered when choosing which type of devices to use in a dental office.

### Methods to Prevent Hearing Loss

- Maintain good posture
- Keep an appropriate distance from patients
- Maintain dental equipment
- Use hearing protection devices

The hearing requirements of dental professionals are unique. Hearing protection devices, if used, must protect the dental professional from potential noise damage induced by handpieces as well as other equipment. At the same time, the dental professional must be able to hear sufficiently to communicate with the patient. One option is to purchase custom earplugs, the same type of hearing protection device used by many musicians for protection from occupationally induced hearing loss. Garner et al. found that “the musician’s style earplug is perfectly suited to the dental environment and is an affordable and comfortable solution — voices sound softer but are still audible. A definite decrease in the noise from dental equipment will be observed.”<sup>40</sup> If custom products are not used, other hearing protection devices such as generic insert earplugs (foam plugs or flanged plastic plugs) and headsets are possible alternatives.

### Conclusions

In 1959, the American Dental Association Council on Dental Research advised that dentists using high-speed drills should have periodic hearing tests to monitor their hearing. Further recommendations include minimizing non-occupational noise exposure and using a hearing protection device when exposed to loud sounds.<sup>41</sup> Dental professionals can protect their hearing while at work by monitoring and/or changing the environment to decrease the effects of noise. To ensure that the effects of noise are diminished, using a hearing protection device when exposed to noisy dental equipment may prevent the occurrence of noise-induced hearing loss.

### Endnotes

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## Author Profile

Rebecca Mervine is currently a senior clinical audiologist at Rochester Hearing and Speech Center in Rochester NY. After completing an undergraduate degree in speech and hearing from Miami University she received an MA from the State University of New York at Geneseo. She completed her clinical Doctorate in Audiology (AuD) from Central Michigan University in 2005.

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## Questions

- Three properties of noise are \_\_\_\_\_.
  - Intensity, duration, spectrum
  - Intensity, duration, sound source
  - Intensity, duration, sound quality
  - Intensity, speed, level
- The intensity of the sound is measured in \_\_\_\_\_.
  - Time
  - Decibels
  - Hertz
  - Degrees
- Three categories of noise-induced hearing loss include: temporary threshold shift, permanent threshold shift, and \_\_\_\_\_.
  - Recurring threshold shift
  - Presbycusis
  - Acoustic trauma
  - Auditory sensation
- A characteristic of permanent noise-induced hearing loss is that it \_\_\_\_\_.
  - Is painful
  - Affects low frequency sounds initially
  - Is gradual
  - Is reversible
- OSHA standards for noise limit a worker's eight-hour exposure to noise levels of \_\_\_\_\_.
  - 88 dB
  - 90 dB
  - 92 dB
  - 94 dB
- NIOSH recommends that as the sound doubles, the time spent in that environment should be reduced by half.
  - True
  - False
- Typically, noise levels in a dentist's office will exceed the OSHA standards.
  - True
  - False
- According to Garner, the sound level of dental equipment can range from \_\_\_\_\_.
  - 66 to 91 dB
  - 54 to 75 dB
  - 20 to 28 dB
  - 66 to 105 dB
- Noise in the dental office when added to other noise exposures may be the cause of hearing loss according to Merrell and Claggett.
  - True
  - False
- Most noise exposure that occurs in a dental office is best described as \_\_\_\_\_.
  - Intermittent
  - Steady-state
  - Fluctuating
  - Impulse
- Tinnitus is a ringing sound noted not only by the affected person but also by those around him/her.
  - True
  - False
- Gardner et al. (2002) report that of those people who have noise-induced hearing loss, the percentage of individuals who experience tinnitus is \_\_\_\_\_.
  - 85%
  - 70%
  - 90%
  - 95%
- Noise-induced hearing loss is medically treatable.
  - True
  - False
- Ways to modify your environment to decrease noise exposure include \_\_\_\_\_.
  - Keeping an appropriate distance between dentist and patient
  - Maintaining equipment
  - Utilizing good posture
  - All of the above
- If hazardous noise cannot be avoided, wearing hearing protection will reduce noise exposure.
  - True
  - False
- Hearing protection devices include \_\_\_\_\_.
  - Custom earplugs
  - Disposable earplugs
  - Headphones
  - All of the above
- Musician's earplugs are a good choice of hearing protection for dentists as they protect from noise exposure but allow effective communication.
  - True
  - False
- Custom and disposable earplugs provide the same amount of protection.
  - True
  - False
- It is recommended that dental professionals have their hearing monitored \_\_\_\_\_.
  - Every six months
  - Never
  - After retirement
  - Periodically
- Because they are exposed to noise at work, dental professionals should not worry about recreational noise exposure.
  - True
  - False

# Noise-Induced Hearing Loss in Dental Offices

Name: \_\_\_\_\_ Title: \_\_\_\_\_ Specialty: \_\_\_\_\_

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## Educational Objectives

1. Understand how noise affects hearing over a long period of time.
2. Understand the hearing loss that may occur as a result of occupational exposure to noise in a dental office.
3. Know the precautions and methods that can be employed to help prevent hearing loss.

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Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

1. Were the individual course objectives met?	Objective #1: Yes	No	Objective #3: Yes	No		
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\_\_\_\_\_

11. Was there any subject matter you found confusing? Please describe.

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**COURSE CREDITS/COST**  
 All participants scoring at least 70% (answering 14 or more questions correctly) on the examination will receive a verification form verifying 3 CE credits. The formal continuing education program of this sponsor is accepted by the AGD for Fellowship/Mastership credit. Please contact PennWell for current term of acceptance. Participants are urged to contact their state dental boards for continuing education requirements. PennWell is a California Provider. The California Provider number is 3274. The cost for courses ranges from \$49.00 to \$110.00.

Many PennWell self-study courses have been approved by the Dental Assisting National Board, Inc. (DANB) and can be used by dental assistants who are DANB certified to meet DANB's annual continuing education requirements. To find out if this course or any other PennWell course has been approved by DANB, please contact DANB's Recertification Department at 1-800-FOR-DANB, ext. 445.

**RECORD KEEPING**  
 PennWell maintains records of your successful completion of any exam. Please contact our offices for a copy of your continuing education credits report. This report, which will list all credits earned to date, will be generated and mailed to you within five business days of receipt.

**CANCELLATION/REFUND POLICY**  
 Any participant who is not 100% satisfied with this course can request a full refund by contacting PennWell in writing.

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