Hearing Loss and Tinnitus Among Dentists

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When compared with the general population, the rates of hearing loss and tinnitus among dentists are doubled.[1] This is a result of noise exposure from the dental high-speed handpiece (HP)—the drill (Fig. 1a).

In the 1970s, Canadian and American governments mandated workplace safety legislation, which included sections prescribing limits for noise exposure. Building upon that momentum, surveys were also carried out in professions that were generally not associated with excessive noise; notwithstanding initial doubt, that curiosity bore fruit as dental clinics and universities' dental practical labs were subsequently earmarked for concern.[2] A correlation has since been confirmed between the use of the HP and elevated rates of noise-induced hearing loss (NIHL) and tinnitus within dentistry. Since the 1960s, regardless of the engineering improvements in all HP types, the noise intensities have not decreased in any appreciable way.[3,4]

To address the concerns of workplace NIHL, dentists have the option to either wear hearing protection or subtract/reduce the use of the HP. Drawing from that short list, the easiest option is the use of custom-made high-fidelity musicians' earplugs since they are discrete, comfortable, and will not affect communication nor hinder technique any more than other standard protective measures, such as gloves, masks, and eyewear. Since the removal of the HP would hobble any dental practice, dental lasers are, at present, the only instruments that ensure the provision of the same services without excess noise. Regardless of type (hard- or soft-tissue), wavelength, duration of use, settings, or proximity to either the main unit or the unique handpiece (Fig. 1b), their quiet operation does not pose any risk to aural health.[5]

NIHL is well documented in many trades, such as in construction workers and auto mechanics, but at an elementary level, a dentist can be likened to a mechanic using the HP for construction. Although the HP produces considerably less noise than large-scale machinery, the risk is not negated when considering the law of inverse square level for sound.[6] Simply put, to halve the distance is to double the subjective level of sound, or 6 dBA. This effect can be demonstrated using a hairdryer, which when at arm's length is loud yet tolerable but becomes less so as it approaches the ear. Moreover, the lack of sound-absorbing and disinfection-conscious surfaces of operatory acts to exacerbate the effects of this law.

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Figure. 1a. High-speed dental handpiece.

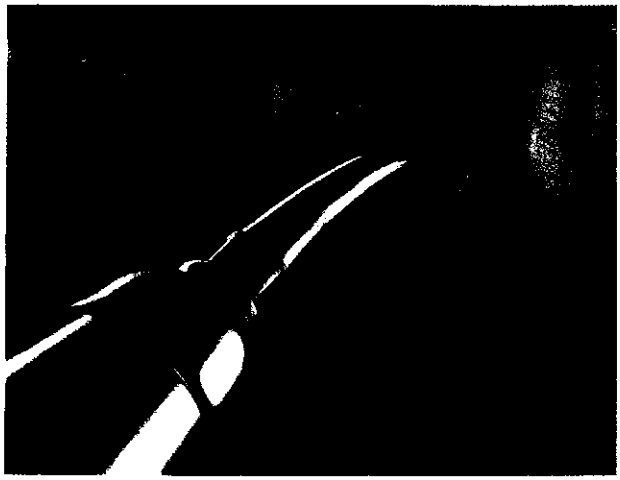

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Figure 1b. Dental laser and handpiece.

Years of clinical practice have the same effect of acclimatizing the dentist to these intensities as it does in other occupational settings, whereby workers eventually become accustomed to elevated noise levels. Although there is much redundancy and resiliency within the cochlea, long-term exposure to the HP can lead to permanent hearing loss.

NEURAL/MECHANICAL ASPECTS OF HEARING

Age-related and noise-induced hearing loss are known to affect the higher-pitched frequencies before all others, and even a mild loss in this speech discrimination-critical region will impact communication, more so with competing noise.

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Table 1. Noise Levels for Dental Lab and Oratory Instruments[11]

Studied equipment	Studied process	N	Mean	Standard deviation	Standard error	Minimum	Maximum
Noise levels [dB(A)], clinical equipments							
Ultrasonic scaler	Without suction pump	6	[illegible]	12.20	4.98	51.7	77.4
	With suction pump	6	76.70	6.35	2.59	69.1	83
Turbine (brand new)	Only turned on	6	68.20	1.20	0.49	66.9	69.6
	Cutting on tooth	6	[illegible]	3.61	1.49	69.7	78.8
Turbine (used)	Only turned on	6	70.27	2.12	0.86	68.1	72.7
	Cutting on tooth	6	89.72	1.55	0.63	87.4	91.9
Contra-angle handpiece (brand new)	Only turned on	6	69.72	1.73	0.71	67.6	71.7
	Cutting on tooth	6	68.22	2.97	1.21	65.6	72.4
Contra-angle handpiece (used)	Only turned on	6	67.13	1.74	0.71	64.9	69.2
	Cutting on tooth	6	68.17	2.01	0.82	66.1	70.9
Micro motor handpiece	Only turned on	6	77.70	1.97	0.80	74.9	80.7
	Cutting on tooth	6	82.87	8.32	3.40	74.4	92.2
Suction pump (low volume)	Running free	6	77.85	7.19	2.94	70.3	87.2
	Touch mocusa	6	72.40	4.29	1.75	66.3	78.1
Suction pump (high volume)	Running free	6	76.12	6.37	2.60	68.9	81.7
	Touch mocusa	6	77.47	6.76	2.76	69.3	84.4

While little can be done about the process of aging, reducing workplace NIHL is quite manageable. With respect to the HP, transmission of sound to the cochlea via bone conduction is immaterial when the use of hearing protection is adopted.

It is typical for those in the early stages of hearing loss to believe that their impairment is either negligible or may disproportionally fault such variables as competing noise, distance, or poor elocution–the ubiquitous claim that people mumble. This blame-shifting can be somewhat excused since no individual can appreciate the full extent of their own loss: It is impossible to know which normally heard sounds have gone undetected if elevated thresholds obscure what would have been normal to hear in the first place. This circular argument corralling a mix of facts and accountability is yet another frustration when dealing with hearing loss. Moreover, since it is customary in the early stages that the lower-pitched frequencies remain within or close to normal limits, the ability to minimize hearing loss gains traction.

NOISE LEVELS IN OPERATORIES & UNIVERSITY LABS

Regardless of engineering advances in both the micromotor and pneumatic HPs, their noise output, since the 1960s, has remained unchanged at 70 to 82 dBA, with peaks reaching 105 dBA.[7] Add the noise produced by ultrasonic scalers (80-92 dBA) and suction (74-80 dBA), and it becomes apparent that an operatory exposes the dentist to remarkable levels of noise. (Sound surveys are "A"-weighted since this scale is mindful of the reduced low-frequency sensitivity of human hearing.)

It is an established fact that dental students are also exposed to harmful intensities within practical labs. Fully one-quarter of students experience an average 15-minute temporary threshold shift (TTS) following hands-on HP practice.[8] A TTS is defined as a 10 dB HL or greater increase in thresholds at 2, 3, and 4 kHz. Repeated enough, TTS leads to permanent hearing loss.[9]

While only mild variables exist between specialties, a few pediatric surveys recorded some impressive figures–equal in intensity to a chainsaw–with peaks reaching 112.9 dBA. The source of these outliers was eventually discovered to be the vocalized protests of some very anxious young patients (with very big lungs), and not from any differences in equipment.[10]

SOUND DOSIMETRY

The methods used for sound dosimetry, or the documenting of sound intensities, were purposely designed to capture sound from the perspective of the working dentist. With this in mind, microphone placement was purposely affixed on shirt collars or in chest-level pockets since it reflects chair-time, proximity to the HP, and the inverse square law (Table 1).[11] The greatest loss was found on the dominant, usually right-handed side, an expected result considering a greater degree of exposure to the HP (Fig. 2).[12]

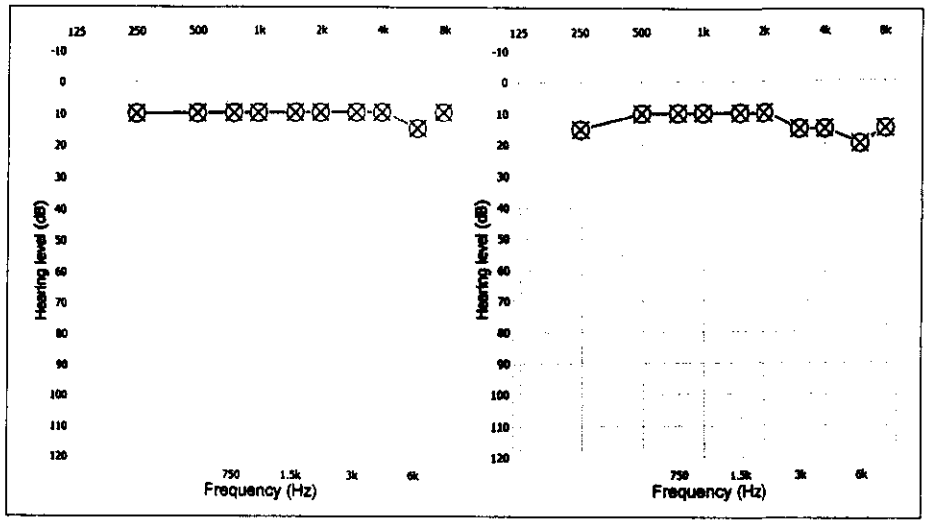

Figure 2. Hearing loss associated with long-term exposure to high-speed dental handpieces.[2] Audiometric findings: Medical doctors on the left; dentists on the right.

In the studies by Bowman, et al.,[10] and Messano, et al.,[13] the mean age of dentists was early to mid-40s, with a 60:40 male to female ratio; n = 40 to 180.[12] Dental students' mean age was mid-20s, with a 60:40 female to male ratio; n = 50.[12] All participants were subjected to standard audiological examinations.

In an attempt to ensure that other factors were not contributing to dentists' elevated rates, medical doctors acted as a control since they both share near-identical academic histories and requirements for professional office space; with comparable incomes, and made similar choices for automobiles, residences/neighborhoods, and leisure activities, etc. Except for the HP, dosimetry recorded near-identical intensities in participants' academic, professional, and private lives. Dentists' rates of hearing loss and tinnitus were double those of medical doctors.[9]

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Indeed, the most compelling evidence was discovered within the profession itself since dentists who rarely use the HP (academics and laser dentists) experience the same low rate of hearing loss as medical doctors and the general population.[12]

TINNITUS AND RELATED COMORBIDITIES

Hearing loss also effects secondary psychological, physiological and neurological changes, of which the most familiar are the ringing signals as presented with tinnitus. The etiology of this neural signal is discordant or asymmetrical damage between the cochlea's inner hair cells (IHC) and outer hair cells (OHC). While troublesome tinnitus is often found alongside NIHL, it is not absolute since 96 percent of all individuals have some form of tinnitus, though it remains essentially unnoticed by 84 percent.[13,14]

Troublesome tinnitus, however, occurs when three interconnected neural systems–the limbic system, autonomic nervous system (ANS), and aural system–respond in accordance with a misinterpretation that the tinnitus signal is a threat. Specifically, it is the limbic system's generation of negative emotions, the fight-or-flight response of the sympathetic branch of the ANS, and the initial processing of sound in the aural centers, which affects the response. The result is a mixture of stress-related physiological and psychological changes, including increased production of stress hormones, elevated blood pressure, agitation, and poor sleep quality, etc. The scale of affect it has on the individual ranges from distraction to that which is beyond tolerance, leaving the sufferer with notable decreases in mental and physical health and sense of well-being. In some cases, individuals have considered while others have carried out life-ending means for escape. The rate of tinnitus prevalence among dentists is double that of academic and laser dentists, medical doctors, and the general population.[8,12]

Moreover, unaided hearing loss has been linked to increased incidences of depression, social isolation, and hospitalization; reduced motor coordination; and impaired cognition, learning, and memory. Of recent discovery is the three-fold increase in the rates of Alzheimer's disease, which is brought about by cross-modal cortical organization: Underutilized auditory neurons are high jacked by the compensatory actions of the neuron-hungry visual centers; in turn, the auditory centers reach out to the frontal lobes in search of usable neurons, and thus the decline.[15-17]

Dentists can reduce their risks of hearing loss and tinnitus through the use of hearing protection or switching to dental lasers that, regardless of type, pose no risk to hearing health.[17] The change in hearing is often unremarkable during the initial stages and does not usually present until an appreciable amount of damage has occurred. Dentists should be mindful of the risks that their profession pose to their hearing and seek out regular audiological testing.

EDITOR'S NOTE: This article is a condensed version of a longer piece published on https://www.oralhealthgroup.com.

References for this article can be found at http://bit.ly/HJcurrent.