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Effects of Occupational Ultrasonic Noise Exposure on Hearing of Dental Hygienists: A Pilot Study

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Introduction

More than 30 million Americans are exposed on a regular basis to hazardous noise levels.¹ Occupational noise exposure contributes to overstimulation of the hearing, which in turn, can lead to permanent hearing loss. Persons can differ in their host susceptibility to noise damage. Unfortunately, once the damage occurs, hearing problems are irreversible. In private dental offices, dental hygienists continually use low-speed handpieces, sonic and piezoelectric scalers, and ultrasonic cleaners and scalers in the process of care. Ultrasonic devices are the biggest potential noise hazard affecting hearing in dental hygienists.² Ultrasonic scalers can produce 68 to 75 dBA when used. Although this decibel range does not fall into the category of damaging, with the repeated use of an instrument emitting these decibel levels, hearing damage may be caused.³ Moreover, the literature supports the expanded use of ultrasonic instrumentation to treat periodontal disease nonsurgically and to minimize cumulative trauma disorders of the skeletal-muscular system in practitioners. Therefore, the use of ultrasonic scalers is expected to escalate. In large group oral health care practices, multiple practitioners use these instruments, further increasing occupational noise levels and the risk for hearing loss among workers in this environment. Little research has been conducted on hearing loss in dental hygienists and results have been mixed.

Abstract

Purpose. The purpose of this case-control study was to determine whether long-term ultrasonic noise exposure via the dental office environment is related to dental hygienists' hearing status.

Methods. Registered dental hygienists (N = 698) who live in the Hampton Roads areas of Virginia were mailed a *Dental Hygiene Work History Questionnaire* to determine who would meet the inclusion criteria and would be willing to participate in the study. Consenting subjects were categorized into one of two groups, according to ultrasonic scaler usage rate, and matched on age. Persons with known hearing loss due to infection, disease, or congenital defect were excluded from the study. The final sample consisted of 20 dental hygienists with a high ultrasonic usage rate and a matched group of 20 dental hygienists who had a low ultrasonic usage rate. Once the groups were formed, a certified audiologist tested subjects' hearing in each ear via the pure-tone audiometer. Audiometric data were analyzed using the analysis of variance for repeated measures procedure to determine if degree of ultrasonic scaler noise exposure in the dental office environment was significantly related to hearing status in these dental hygienists.

Results. Results revealed that the right and left ears were not statistically different in the hearing threshold levels, regardless of group status. However, there was a significant difference in the high ultrasonic usage group and the low ultrasonic usage group at the 3000 Hz. No differences were found at the frequencies of 500, 1000, 2000, 4000, 6000, and 8000 Hz.

Conclusions. Based on these outcomes, the ultrasonic scaler is not considered to have a negative effect on the hearing of dental hygienists at 500, 1000, 2000, 4000, 6000, and 8000 Hz, but may be related to hearing loss at 3000 Hz. Ultrasonic noise may in fact be affecting dental hygienists' hearing at 3000 Hz, but loss of hearing observed at the higher frequencies may be attributed to other unidentified factors present in both groups.

Keywords. Ultrasonic noise, hearing loss, occupational hazards.

Significance of the Problem

Occupational noise exposure is the most common occupational disease in the United States.¹ People are unaware of their hearing loss until they have lost 28%, or 30

dBHL, of hearing ability.⁴ In addition to unrecognized hearing loss, problems created by occupational hearing loss include 1) reduced quality of life because of social isolation and unrelenting ringing in the ears (tinnitus); 2) impaired communication with family members, the

public, and co-workers; 3) diminished ability to monitor the work environment such as warning signs or equipment sounds; 4) lost productivity and increased accidents resulting from impaired communication and isolation; and 5) expenses for workers' compensation and hearing aids.¹ Oral health care professionals need to be aware of the potential dangers of occupational noise exposure, the leading cause of noise-induced hearing loss in the country.

Review of the Literature

Effects of Occupational Noise on Oral Health Care Professionals' Hearing Status

Moller, Grevstad, and Kristoffersen studied ultrasonic scaling of the maxillary teeth to determine if it caused tinnitus and temporary hearing shifts.⁵ Many oral health care professionals reported experiencing tinnitus or a ringing in the ear. Tinnitus is frequently associated with noise induced hearing loss, and is nature's warning that noise levels are dangerously high.² Moller, Grevstad, and Kristoffersen⁵ found that half of the subjects in the study experienced² temporary hearing shift and tinnitus when their maxillary teeth were scaled with the ultrasonic scaler.

For 30 years, noise in dental offices has been suspected of contributing to hearing loss.⁶ If a noise is intense enough, or if one is exposed to it long enough, and/or if one's hearing mechanism is susceptible enough, any noise can cause hearing loss. Given these conditions, hair cells in the cochlea will be damaged and cause hearing loss. Noise causes unwanted masking of sounds, interference with speech and communication, pain and injury, and temporary or permanent loss of hearing. Physiologically, noise increases blood pressure, quickens pulse, and constricts blood vessels. Researchers have documented that

hand-reflex time to stimuli was lengthened after human subjects had been exposed to noise and that precision movements of hands and arms were also affected.⁴ Noise has also been found to cause emotional problems, nervousness, indigestion, headache, decreased overall efficiency, and decreased ability to perform complex or multiple tasks. These findings suggest that significant noise levels in the oral health care environment might affect skill performance of dentists and dental hygienists, thereby, affecting the quality of care rendered.

Zubick and Tolentino conducted research on the hearing differences among 137 dentists and 80 physicians.⁷ In pure tone air conduction evaluations, physicians had better hearing threshold levels than dentists, especially around the frequency of 4000 Hz. Zubick and Tolentino also discovered that right-handed dentists showed greater hearing loss in their left ear, probably related to their positioning and proximity to the noise. Those dentists working in a specialty area also showed hearing loss in the same pattern as general practice dentists. Zubick and Tolentino concluded that there may be a cause and effect relationship between hearing loss and the use of the high-speed dental handpiece.⁷ In work on minimizing health hazards in the dental workplace, Baratz also stated that repetitive handpiece noise produces permanent high-frequency hearing loss.⁸

Although sound exposures potentially hazardous to hearing are usually defined in terms of sound levels, frequency bandwidths, and duration, hearing experts agree that other exposures may be hazardous. For example, if the sound is appreciably louder than conversational levels for a sufficient period of time, it is potentially harmful. Furthermore, noise may be hazardous if the listener experiences difficulty communicating while "in" the sound, has tinnitus after exposure to the sound, or if sound seems muffled after leaving the exposure area.

Noise Levels Produced by Ultrasonic Scaler

The term ultrasonic describes a range of acoustical vibrations that cannot be heard by the human ear. In dentistry, the ultrasonic frequencies range from approximately 20,000 vibrations per second to 50,000 vibrations per second. These ultrasonic vibrations are a unit of frequency often referred to as cycles per second (cps) or Hertz (Hz). Some ultrasonic units are already preset for these different levels, while other units are adjustable.

Some of the frequencies that the ultrasonic produces may reach the patient's inner ear by bone or air conduction. Moller, Gravstad, and Kristoffersen set out to measure ultrasonic scaling effects of maxillary teeth on the inner ears of healthy young adults by means of audiometry.⁵ Twenty healthy subjects with at least 13 erupted maxillary teeth participated in the study; ages ranged from 22 to 36 with 9 females and 11 males. Results showed a shift in patients' hearing thresholds after ultrasonic scaling in eight participants (40%). The threshold shifts ranged from 10 to 20 decibels and persisted for as long as 30 minutes after the ultrasonic scaling was terminated. Five of the participants had a threshold shift in the right ear and two showed shifts in the left ear. Seven participants showed a threshold shift at 7000 Hz or at 8000 Hz or both; three participants showed a shift for several frequencies. Moller, Grevstad, and Kristoffersen concluded that the effects of the ultrasonic scaler were temporary, and should not prevent the use of ultrasonic instruments.⁵ However, it should be noted that in the 1970s, ultrasonic instrumentation was less frequently used than in the 21st century. The rate of ultrasonic instrument usage today demands a more critical attitude towards their frequent and repeated application and their potential effects on hearing.

Holmberg, Landstrom, and Nordstrom set out to evaluate the sensa-

tion of annoyance as well as the sensation of discomfort during exposure to the high-frequency sound and ultrasound from an ultrasonic washer.⁹ The study included 10 subjects and consisted of five men, aged 23 to 38, and five women, aged 23 to 44. Based on a pre-study audiometric evaluation, none of the subjects presented with hearing loss. The subjects were exposed to the noise while proof reading a text, simulating the work in an office. Afterwards they were asked to rate their sensation of annoyance (mental effect) and discomfort (effect located at the ear) on a 100 mm scale with verbal labels. The related levels of annoyance were high at all amounts of exposure. The group average for the noise level of 96 dBA was 63 mm, which corresponds to "rather annoying" and "quite annoying." Holmberg, Landstrom, and Nordstrom concluded that the ratings of annoyance and discomfort among participants in the investigation must be considered high enough to recommend an avoidance of even the lowest level of noise from the washer at 70 dBA.⁹

Methods

The protocol was reviewed and approved by the Old Dominion University Institutional Review Board for the Protection of Human Subjects. A prescreening instrument, titled the *Dental Hygiene Work History Questionnaire*, was mailed to all registered dental hygienists in the Hampton Roads area of Virginia (N = 698) to determine those meeting the inclusion/exclusion criteria (Figure 1). Inclusion criteria stated that the subject must be 21 years of age and a registered dental hygienist. This included both practicing and nonpracticing dental hygienists from the list of registered dental hygienists obtained through the Virginia Board of Dentistry Web site in February 2001 (<http://www.vbd.org>). If the subjects had a history of hearing loss due to infection, disease, or congenital defects, they were

excluded from the study. The dental hygienists that agreed to participate were matched on age. The final sample consisted of 20 matched pairs of dental hygienists. All participants were female. The overall sample had a mean age of 42.7 and a mean

of 15.2 years in practice. Twenty dental hygienists that had a high ultrasonic scaler usage score were matched with 20 dental hygienists who had a low ultrasonic scaler usage score. The high ultrasonic usage group had a mean age of

Directions: Please complete the following 11 questions by filling in the blank or circling the response that best reflects your characteristics and experiences. This information will be used to identify dental hygienists for a hearing loss study. Your cooperation is appreciated and may contribute to improvement in occupational safety for dental hygienists. Please return the questionnaire by March 1, 2001.

1. What is your age at the time of your last birthday? _____
2. How many days a week do you work in a dental office providing client care? (circle one response)

0 days	1 day	2 days	3 days
4 days	5 days	6 days	
3. How long have you worked in a dental office providing direct client care? (circle one response)

<3 years	>5-10 years	>15-20 years
3-5 years	>10-15 years	>20 years
4. In your total dental hygiene practice career, how many years have you practiced?

Full time (defined as 4 or more days per week) _____
Part time (defined as less than 4 days per week) _____
5. On how many patients per day, on average, do you use the ultrasonic scaler? _____ (specify)
6. On the average, how many years have you used or been using the ultrasonic scaler on patients? _____ (specify)
7. Have you had any previous hearing problems that have been diagnosed by a physician or audiologist?

Yes (If yes, answer item 8 on back)
No (If no, go directly to item 9 on back)
8. What is the cause of your hearing loss? (check all that apply)

Infection	Congenital defect	Other _____
Disease	Loud noise exposure	(specify)
9. Do you have a family history of hearing loss?

Yes (If Yes, please answer item 10)
No (If No, please go directly to item 11)
10. Who in your family has had a history of hearing loss? (circle all that apply)

Mother	Siblings
Father	Other _____
11. Are you exposed to any loud noises outside of the dental office? (i.e., concerts, noise at home) Yes (please specify source of noise) _____
No _____

If you would like to participate in this study, please sign below and fill in your telephone number. If you meet the requirements for the study, you will be called to schedule a free hearing test appointment at Old Dominion University. Thank you.

No, I am not interested (no need to sign your name, just return the questionnaire)

Yes, I am interested, please contact me based on the information provided below.

Print name: _____ Telephone number: _____

Preferred time for hearing test: days/time _____ evenings time _____

Signature: _____ Date: _____

Please return this form in the stamped envelope provided to:

School of Dental Hygiene
Old Dominion University
Technology Bldg.
47th Street and Hampton Blvd.
Norfolk, VA 23529-0499
Attn. Jennifer Dunning, BSDH

Figure 1. Dental hygiene work history questionnaire

42.75 and a mean of 18.65 years in practice; the low ultrasonic usage group had a mean age of 42.65 and mean of 11.8 years in practice.

The usage score was determined by an equation that comprised the self-reported number of patients treated per day with the ultrasonic scaler multiplied by the number of years the dental hygienist had used the ultrasonic scaler. For example, if the dental hygienist reported using the ultrasonic scaler on five patients per day and had been in practice for 13 years, the usage score was 65.

A certified audiologist tested subjects' hearing in each ear via the pure-tone audiometer. Testing at seven frequencies took place at the Old Dominion University, Lions Child Study Center. Audiometry, at a minimum, consisted of pure-tone air-conduction threshold of each ear at 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz. The test was given in a standard sound-attenuating room. At each frequency, the hearing threshold recorded for an ear was the lowest decibel hearing level (dBHL) at which the individual responded to two of three trials. A pure-tone audiometer test uses simple vibrations of various frequencies and intensities to measure hearing. Hearing threshold levels were recorded in increments of 5 dBHL. Tympanometry followed the pure-tone testing only if the participant showed hearing loss in the lower frequencies. Only one participant in the high usage rate group was required to have a tympanogram. Upon evaluation, the participant presented with a normal tympanogram suggesting that there was no middle-ear pathology. Of the 40 participants, 10 who had thresholds 30 dBHL or higher at any frequency were asked to return for a repeated test free of charge. This was done to reevaluate the hearing thresholds for changes. Fifty percent of the subjects that needed to be re-tested were in the high frequency of ultrasonic use, and 50% of the subjects were in the low frequency of ultrasonic use. Data were analyzed using the analysis of variance for repeated measures.

Between and within group audiometric data were analyzed using the analysis of variance for repeated measures so that the main effect of ultrasonic usage, as well as the interaction effects of ultrasonic usage at the seven different frequency levels, could be determined. All hypotheses were tested at the 0.05 level. Because data were not normally distributed, data was subjected to a log transformation to ensure that analysis of variance could be used legitimately. The computerized SAS system was used for data analysis.

Results

Hypothesis One. The first hypothesis stated that there was no difference in the hearing status of matched groups of high and low ultrasonic scaler users, as measured by pure-tone audiometry. The analysis of variance for repeated

measures revealed a statistically significant difference in the hearing of dental hygienists who were high ultrasonic scaler users as compared with dental hygienists who were low ultrasonic scaler users ($F = 2.79$, $df = 6$, $P = 0.01$). High-ultrasonic users have significantly poorer hearing status than low-ultrasonic users. Therefore, hearing status appeared to be negatively affected by high-ultrasonic scaler usage in dental hygiene practice (Table I and Figure 2).

Hypothesis Two. The second hypothesis stated that there was no statistically significant difference in the hearing status of high and low of ultrasonic scaler users at the 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz as measured by pure-tone audiometry. Analysis of variance for repeated measures revealed a statistically significant difference in high and low usage groups at 3000 Hz ($F = 5.81$, $df = 1$, $P = 0.02$), but no

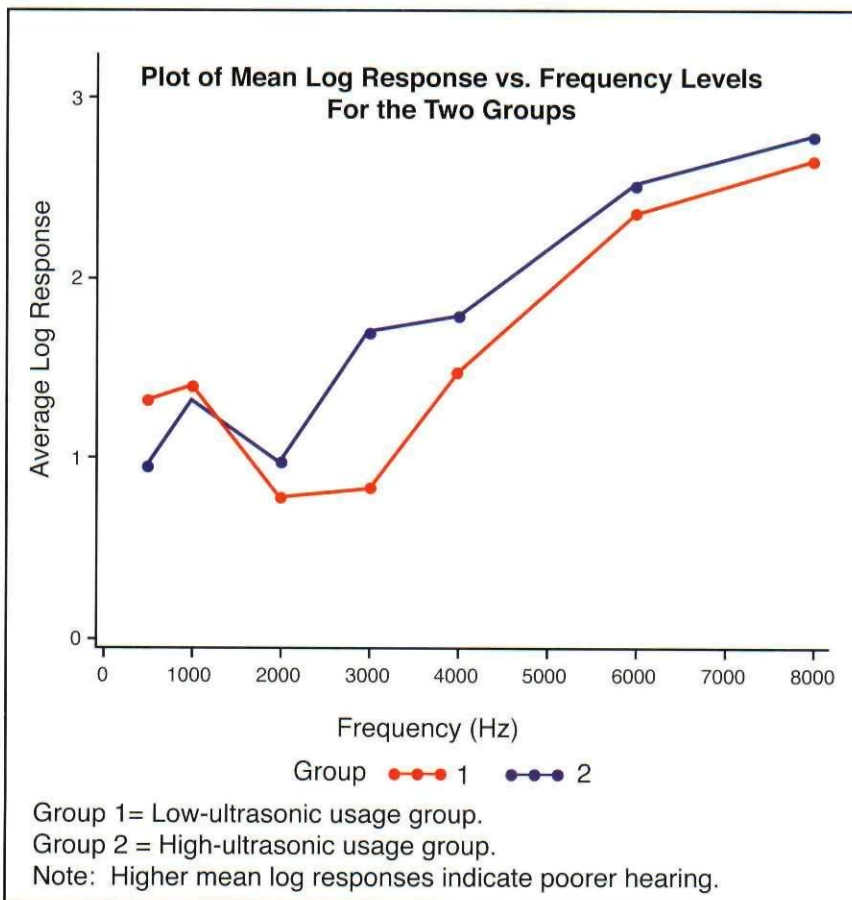


Figure 2. Change in hearing ability of two matched groups of dental hygienists (High-ultrasonic usage versus low-ultrasonic usage) at seven frequencies

statistically significant differences at 500, 1000, 2000, 4000, 6000, and 8000 Hz. Dental hygienists with high usage rates had significantly poorer hearing at 3000 Hz, while those in the low usage group had significantly better hearing at 3000 Hz. Therefore, hearing status at 3000 Hz appeared to be negatively affected by frequency of ultrasonic scaler usage (Table II).

Hypothesis Three. The third hypothesis stated that there was no interaction between usage levels of the ultrasonic scaler (high and low usage) and the frequencies (500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz). Analysis of variance for repeated measures revealed that dental hygienists with high usage levels had a higher hearing threshold level documented at 3000 Hz but not at the other frequencies ($F=37.62$, $df=6$, $P=0.0001$). Therefore, there was significant interaction between high usage rate and hearing threshold at 3000 Hz (Table III). Results revealed that as frequency increased, hearing got poorer for both groups, but this difference in hearing status between the groups was not statistically significant (Figures 2 and 3).

Hypothesis Four. The fourth hypothesis stated that there was no significant difference in the hearing status of the right and left ears of dental hygienists in either the high- or low-ultrasonic scaler usage groups. Analysis of variance for repeated measure results revealed no statistically significant difference in the hearing thresholds of the right and left ears ($F=3.61$, $df=1$, $P=0.057$), regardless of high- or low-ultrasonic usage group status. The right and left ears showed little variation in the hearing patterns as a result of ultrasonic scaler usage in dental hygienists (Table III and Figure 3).

In general, the percentages of persons in both matched groups with normal hearing and hearing deficits are presented in Table V. Although the percentages were not hypothesized, it is interesting to note the overall similarities in both

Table I. Analysis of variance comparison of high- and low-ultrasonic scaler usage levels in two matched groups of dental hygienists

Source	DF	SS	Mean Square	F value	Probability
Group	1	4.48	4.48	4.50	0.0334*
Subject	38	138.47	3.64	3.65	0.0001*
Frequency	6	226.78	37.79	37.90	0.0001*
Group and frequency	6	16.84	2.80	2.82	0.0105*

* Significance

Table II. Analysis of variance comparison of frequencies for high- and low-ultrasonic scaler usage groups of dental hygienists

Frequency	Source	DF	Type I SS	Mean Square	F value	Probability
3000Hz	Group	1	14.86	14.86	5.81	0.02*
500 Hz	Group	1	2.77	2.77	1.73	0.19
1000Hz	Group	1	0.03	0.03	0.04	0.84
2000Hz	Group	1	0.76	0.76	0.32	0.57
4000Hz	Group	1	2.03	2.03	0.90	0.34
6000Hz	Group	1	0.51	0.51	0.41	0.52
8000Hz	Group	1	0.34	0.34	0.41	0.52

* Significance

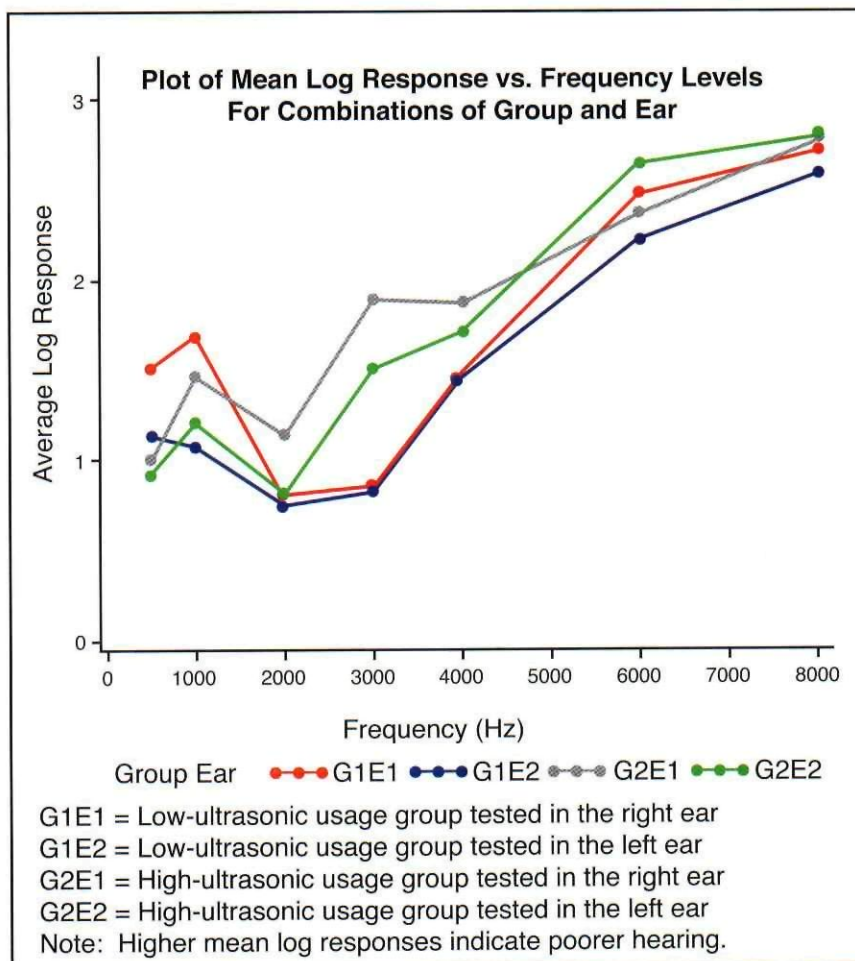


Figure 3. Change in hearing status in right and left ears of two matched groups of dental hygienists at seven frequencies

groups. These percentages were computed by calculating the percentage of the participants that presented with a hearing threshold of 25 dBHL or higher and 24 dBHL or lower. The subjects presenting with 25 dBHL or higher have a greater hearing deficit than those who tested with a threshold level less than 25 dBHL.

Discussion

Hypothesis One. The analysis of mean differences in the overall hearing evaluation revealed statistical significance between those dental hygienists who had a high frequency of ultrasonic usage as compared to those dental hygienists who had low-ultrasonic scaler usage ($P = 0.01$). Results suggest that dental hygienists with high-ultrasonic usage rates had poorer hearing than those with low-usage rates. Although there is statistical signifi-

cance, the clinical difference shows only minimal variation in dBHL levels. This implies that heavy use of the ultrasonic scaler may be contributing to noise-induced hearing loss in the oral health care work environment. The means for each group in the study are displayed in Table IV.

As compared to other dental office noises, the ultrasonic might be a source of damaging noise. As reported by Setcos and Muahyud-dan, the ultrasonic scaler was recorded as emitting some of the highest intensities of dental office noises (ranges of 75 to 88 dBA).⁴ The Hazardous and Solid Waste Amendment (HSWA) states that all workers who are exposed to sound 85 dBA or above should be given adequate information about the risk involved by their employers. The EPA has also stated that if a person in a 24-hour period is exposed to noise levels maintained at 70 dBA or below, for the most part, hearing

loss will not occur. All of the sounds recorded from the ultrasonic scaler in this study were above 70 dBA. Dental hygienists are not exposed to this noise for 24 hours, but the repeated exposure appears to be damaging. Findings of this study and that of Setcos and Mahyuddin suggest that dental hygienists that use the ultrasonic scaler frequently in practice might want to use earplugs or ear muffs to protect their hearing and prevent the accumulated trauma associated with repeated exposure to ultrasonic noise.⁴

Hypothesis Two. Statistical analysis revealed that the ability to hear different frequencies yields unusual results when comparing the hearing of high-ultrasonic scaler users and low-ultrasonic scaler users. At 500, 1000, 2000, 4000, 6000, and 8000 Hz, there was no statistically significant difference in the hearing status of the low-frequency and high-frequency groups ($F = 1.73$, $df = 1$, $P = 0.19$); ($F = 0.04$, $df = 1$, $P = 0.84$); ($F = 0.32$, $df = 1$, $P = 0.5765$); ($F = 0.90$, $df = 1$, $P = 0.34$), ($F = 0.41$, $df = 1$, $P = 0.52$), ($F = 0.41$, $df = 1$, $P = 0.52$), respectively. In contrast, statistically significant differences were found at 3000 Hz ($F = 5.81$, $df = 1$, $P = 0.02$). The hearing threshold levels in the dental hygienists with high-ultrasonic scaler usage was found to be higher than the threshold levels in dental hygienists with a low-ultrasonic scaler usage at the same frequency. This suggests a hearing loss associated with ultrasonic usage at 3000 Hz. The reason 3000 Hz is unique cannot be explained by these data. Frequencies ranging from 3000 to 8000 Hz are most susceptible to noise-induced hearing loss.

Zubick and Tolentino looked at the differences of hearing thresholds in dentists and physicians.⁷ They found a statistically significant difference in the thresholds in dentists at 4000 Hz. Although dental office equipment noises range from 20,000 to 50,000 Hz, the frequency of the noise emitted from the ultrasonic or other dental equipment will effect the hearing thresholds around 3000

Table III. Analysis of variance of between and within group data for high- and low-ultrasonic user groups, at seven frequencies, in both ears

Source	DF	SS	Mean Square	F value	Probability
Between group subject	38	138.47	3.64	3.63	0.0001*
Within group frequency	6	226.78	37.79	37.62	0.0001*
Ear	1	3.63	3.63	3.61	0.0579

* Significance

Table IV. Sums and averages of the dBHL at the seven frequencies for both low- and high-ultrasonic user groups

	500Hz	1000Hz	2000Hz	3000Hz	4000Hz	6000Hz	8000Hz
Low usage							
Sum	205	205	120	160	290	555	720
Average	5	5.125	3	4	7.25	13.875	18
25 dBHL or greater	0	0	0	1	2	6	9
High usage							
Sum	150	210	185	310	390	675	820
Average	3.75	5.25	4.625	7.75	9.75	16.875	20.5
25 dBHL or greater	0	0	1	0	2	7	11
Difference of sums	-55	5	65	150	100	120	100

Note: Higher values denote poorer hearing.

to 8000 Hz which falls into the communication range of frequency. This finding was documented in the research by Moller, Grevstad, and Kristofferson⁵ on temporary threshold shifts after exposure to ultrasonic noise.

Hypothesis Three. Statistical analysis revealed that the dental hygienists with high-ultrasonic use had higher hearing thresholds when compared to the dental hygienists with low-levels of ultrasonic use at 3000 Hz. The finding suggests that high-ultrasonic scaler usage is related to a hearing loss detected at 3000 Hz but not at the other frequencies. This could be due to the small sample size that did not represent the total range of possible high- and low-usage scores that could occur in a larger sample or in the population of dental hygienists. When examining mean differences of the high-ultrasonic usage group compared to the low-ultrasonic usage group, the means increased in distance as the frequencies increased, except for 500 Hz (Table IV)

Hypothesis Four. Analysis revealed no statistically significant difference in the hearing when comparing the subjects' right and left ears ($F = 3.61$, $df = 1$, $P = 0.0579$). This result may have been different if more subjects participated, because the lack of significance is borderline. Perhaps the background-noise level plus the ultrasonic noise in the dental office is sufficient to effect both ears similarly. Also, Zubick and Tolentino found that in dentists, the ear closest to the noise emitted from the dental hand pieces was the ear that presented with a higher threshold change.⁷ For example, a dentist that is right-handed will have closer proximity to the sound in the left ear, and hence, greater hearing loss in the left ear. Since left- versus right-handedness of the subjects was not a variable collected on the *Dental Hygiene Work History Questionnaire*, this finding cannot be interpreted with confidence. Right- versus left-handedness may have implications for

Table V. Summary of hearing status of dental hygienists in the high-usage (N=20) and low-usage (N=20) Group

	500Hz	1000Hz	2000Hz	3000Hz	4000Hz	6000Hz	8000Hz
Low-usage Group							
% of normal hearing	100%	100%	100%	95%	90%	70%	55%
% of hearing deficits	0%	0%	0%	5%	10%	30%	45%
High-usage group							
% of normal hearing	100%	100%	95%	100%	90%	65%	45%
% of hearing deficits	0%	0%	5%	0%	10%	35%	55%

differential hearing loss in dental hygienists, and this variable needs to be explored in future research.

Conclusions

Based on the results and interpretation of this investigation, the following conclusions are made:

1. Dental hygienists with a high frequency of ultrasonic scaler use have a greater chance of experiencing hearing loss than dental hygienists with a low frequency of ultrasonic scaler usage at 3000 Hz.
2. Dental hygienists need to protect their hearing if the ultrasonic is used over an extended period of time and/or if it is used frequently in practice.
3. At higher frequencies (>3000 Hz), dental hygienists show declines in hearing status, regardless of their ultrasonic scaler usage rates.
4. Both ears of dental hygienists seem to be affected similarly by noise exposure.

Considering the limitations and design of this study, future research is needed using a larger sample of dental hygienists and less than 5 dBHL increments during hearing evaluations. Also, future researchers

should screen the dental hygienists for temporary threshold changes that might occur as a result of ultrasonic scaler noise exposure, and determine hearing shifts that occur in dental hygienists immediately after ultrasonic scaler use. It would also be valuable to test the effect of noise from ultrasonic scaler use on psychomotor skills and tactile sensitivity. Other studies might include the development of a method to measure the cumulative effect of ultrasonic noise on dental hygienists that use mechanized instruments, determination of how the source of ultrasonic noise affects the hearing in the right and left ears differentially, and if wearing earplugs during ultrasonic scaler use reduces temporary threshold changes.

Based on this study's findings, ultrasonic scaler instrumentation has some effect on hearing status of dental hygienists. With increased use of ultrasonic instrumentation, more research should be conducted to determine if the ultrasonic scaler causes hearing loss and if so, at what rate. The findings in the study do not warrant the elimination of the ultrasonic scaler; the findings underscore the need for more research to understand the risk of hearing loss in dental hygienists that use mechanized instruments.

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ADHA Distance Research Student Internship/Faculty Fellowship

ADHA is pleased to announce the Distance Student Internship/Faculty Fellowship program for eligible members during the 2002-2003 academic year. The purpose of the non-compensated position is to provide an opportunity for a novice researcher to collaborate with central office staff in order to develop individual research abilities. In turn, this will increase the body of dental hygiene research and the corps of researchers.

ADHA will provide for one distance student intern/faculty fellowship during the 2002-2003 academic year. While research will be conducted off-site, ADHA will provide the selected student intern or faculty member with research tools such as SPSS 10 software and the ADHA Research Database packet. ADHA also will provide research assistance with respect to survey design and data analysis. Conversely, the student intern or faculty member will be expected to assist ADHA with survey studies, research analysis, and building/expanding the ADHA research database. Research topics are related to, but not limited to, the ADHA National Research Agenda.

Applicants for the ADHA Student Internship/Faculty Fellowship are required to have Internet access and must have taken a basic statistical course. An intern/fellow is required to complete research/educational projects using SPSS windows software and thus should be familiar with this package. The applicants should either have access to an SPSS program, or own a personal computer which meets the following requirements: Windows 98/2000 Professional or NT 4.0 Workstation (Service Pack 5 and above) and above; 586/P90 processor. For Windows 98 machines - 32 MB RAM (min, at least 64 MB are recommended); for Windows NT or 2000 - 64 MB RAM, min; 70 MB hard disk space; and SVGA monitor.

If you are interested in this unique opportunity, please contact ADHA and request an application form or download the form from the "Members Only" section of ADHA's Web site, www.adha.org. Send the completed form and a copy of your resume to: Division of Research, American Dental Hygienists' Association, 444 N. Michigan Avenue, Suite 3400, Chicago, IL 60611 or FAX to 312-467-1806.

The deadline for the application is January 2, 2003.



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