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Is there a Risk of Hearing Loss in Dental Technicians? A Case Control Study

Diş Teknisyenlerinde İşitme Kaybı Riski Var mıdır? Bir Vaka Kontrol Çalışması

Gülin Gökçen KESİCİ[1]
0000-0003-0409-6225
İlhan ÜNLÜ[2]
0000-0002-5649-2257
Arzu BAŞTÜRK[3]
0000-0001-7567-1448
Engin TUTKUN[4]
0000-0003-2215-0424

[1]Ankara Bilkent City Hospital Department of Otorhinolaryngology, Ankara

[2]Duzce University Medical Faculty Department of Otorhinolaryngology, Duzce

[3]Pendik State Hospital Otorhinolaryngology Clinic, Istanbul

[4]Bozok University Medical Faculty Department of Public Health, Yozgat

Sorumlu Yazar
Corresponding Author
Gülin Gökçen KESİCİ
gulingokcenmd@gmail.com

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ABSTRACT

Aim: Dental technicians are exposed to noise and chemical hazards that may lead to hearing loss in workplace. The aim of this study is to investigate the hearing loss risk of dental technicians working in dental laboratories.
Material and Methods: A hundred and five dental laboratory technicians who applied to Ankara Occupational Diseases Hospital for periodic check and 120 control subjects were included in the study. All of the subjects in both the dental technician and control groups were male. Audiograms of dental laboratory technicians was compared with audiograms of control subjects. Mann Whitney-U test and Spearman correlation analysis were used for statistical analysis of data.
Results: The hearing threshold values of the dental technicians at all frequency in both ears were found to be significantly higher than the control group. There were statistically significant correlation between age and hearing thresholds at all frequencies (except at 250 Hz and 1000 Hz) in dental technician group. There were statistically significant correlation between age and hearing thresholds at only 4000 Hz and 8000 Hz in control group. It was found that there were statistically significant correlations between exposure time and hearing thresholds at 2, 4 and 8 kHz frequencies in dental technician group.
Conclusion: Results of this study indicate that hearing loss is a serious occupational health problem in dental technicians. Dental technicians are exposed to noise and chemical hazards that may constitute a risk for hearing loss. Dental technicians must take preventive measures for hearing loss during working.
Keywords: Hearing loss; noise; dental technician; audiometry.

ÖZ

Amaç: Diş teknisyenleri iş yerlerinde işitme kaybına neden olabilecek gürültü ve kimyasal tehlikelere maruz kalmaktadırlar. Bu çalışmanın amacı dental laboratuvarlarda çalışan diş teknisyenlerinin mesleki işitme kaybı gelişme riskini araştırmaktır.
Gereç ve Yöntemler: Çalışmaya periyodik kontrol için Ankara Meslek Hastalıkları Hastanesi'ne başvuran 105 diş teknisyeni ve 120 kontrol birey dahil edildi. Hem diş teknisyenleri grubunda hem de kontrol grubundaki deneklerin tümü erkekti. Diş teknisyenlerinin odyogramları kontrol grubu bireylerinin odyogramları ile karşılaştırıldı. Verilerin istatistiksel analizi için Mann Whitney U testi ve Spearman korelasyon analizi kullanıldı.
Bulgular: Diş teknisyenlerinin her iki kulakta tüm frekanslarda işitme eşik ortalamaları kontrol grubundan istatistiksel olarak anlamlı şekilde yüksek bulundu. Diş teknisyenleri grubunda tüm frekanslarda (250 Hz ve 1000 Hz hariç) işitme eşikleri ve yaş arasında istatistiksel olarak anlamlı bir korelasyon vardı. Kontrol grubunda yalnızca 4000 Hz ve 8000 Hz frekanslarda işitme eşikleri ve yaş arasında istatistiksel olarak anlamlı korelasyon vardı. Diş teknisyenleri grubunda 2, 4 ve 8 kHz frekanslarında maruz kalma süresi ile işitme eşikleri arasında istatistiksel olarak anlamlı korelasyon olduğu saptandı.
Sonuç: Bu çalışmanın bulguları işitme kaybının diş teknisyenleri için ciddi bir sağlık sorunu olduğunu göstermektedir. Diş teknisyenleri iş yerlerinde işitme kaybı için risk oluşturabilecek gürültü ve kimyasal tehlikelere maruz kalmaktadırlar. Diş teknisyenleri işitme kaybı açısından çalışma sırasında mutlaka koruyucu önlemler almalıdırlar.
Anahtar kelimeler: İşitme kaybı; gürültü; diş teknisyeni; odyometri.

INTRODUCTION

Dental technicians are exposed to many chemical and biological hazards and risks in dental laboratories. These hazards include solvents, mineral acids, gases, vapors, dust coming from plaster, metal alloys, ceramics and acrylic resins. Many chemicals have been found in laboratories such as silica, butylene glycol, hexane, ethyl acetate, nitrocellulose, glutaraldehyde, benzoyl peroxide, hydroquinone, corundum, bisphenol-A, kaolin, oxides of titanium, iron, boron, methyl methacrylate (MMA), triethyleneglycol di-methacrylate (TEGDMA), ethyleneglycol di-methacrylate (EGDMA), 2-hydroxy-ethyl-methacrylate (HEMA), vitallium, wisil, duralium, and vironite (1). There is a risk of developing pneumoconiosis because of exposure to dust with high silica concentrations and cobalt, chromium and molybdenum (2). Also there is noise hazard in dental laboratories. The noise in the dental laboratories is mostly caused by grinding, cutting, polishing operations. The literature data about the issue whether the noise in dental laboratories is exceeding the critical harmful level or not is insufficient and inconsistent (3-5). It is known that the risk of hearing loss is increased with vibrations (6). Dental technicians are exposed to hand/arm vibrations while working with various hand pieces. Usual suspects that causing hearing loss in dental technicians are the noise, vibration, and chemical hazards.

In this article, we aimed to determine the risk of hearing loss in dental technicians.

MATERIAL AND METHODS

This research is a retrospective case control study and was approved by ethics review board of Keçiören Education and Research Hospital (date: 22.02.2012 and number: 20). The study was carried out in accordance in the Declaration of Helsinki. The study was conducted in Ankara Occupational Diseases Hospital. In this hospital different occupational groups are routinely examined at certain times. A hundred and five dental technicians and 120 workers as control group were included in this study. The workers in control group were selected from 4 different occupations (office workers, secretaries, cook and meal servers) that were exposed to neither noise nor chemicals. Medical records of subjects including physical examinations, otorhinolaryngological examinations, personal data, such as smoking habits, detailed history of current and previous occupational jobs, history of chronic drug intake, and any previous ear operations, pus discharge or hearing problems were obtained from periodic examination files. Subjects with a history of chronic illness, such as diabetes mellitus or hypertension, were excluded from study. The age and number of working years of the participants were recorded. All of the subjects in both the study and control groups were male. All of the subjects were examined by two otolaryngologists and had normal tympanic membrane examinations. Two subjects with tympanic membrane perforation and one subject with otosclerosis were excluded from this study.

Audiometric test was done using a pure tone manual diagnostic audiometer (Model GSI 61, Grason-Stadler, Inc) by a single audiologist at the Audiology Laboratory, Ankara Occupational Disease Hospital. The subjects were tested in a sound-isolated chamber. Pure tone audiometry was conducted with the subjects at frequencies of 0.5, 1, 2, 3, 4, 6, and 8 kHz using both air and bone conduction. Subjects should try to discriminate low sound levels of different frequency pure tones and respond by pressing a button. The lowest tone heard at each frequency was considered as the hearing threshold level. The thresholds in the frequency range of 0.5-2 kHz were averaged, and average hearing threshold was determined.

Statistical Analysis

Data were analyzed using the SPSS version 21.0 software program (Statistical Package for Social Sciences v.21, IBM, Chicago, IL). As descriptive statistics, the mean, standard deviation, median, minimum and maximum values for hearing levels and ages were given. The data were checked by the Kolmogorow-Smirnow test for normal distributions. Mann Whitney-U test was used to compare hearing levels and ages between two groups because values were not normally distributed. Spearman correlation analysis was applied to investigate correlation between hearing levels and age, and noise exposure time. A p value <0.05 was considered statistically significant.

RESULTS

Total 225 subjects, 105 subjects in dental technician group and 120 subjects in the control group were included in the study. Dental technicians have been working an average of 8 hours a day for 5-28 years in dental laboratory. The mean age of dental technician group was 37.00±8.22 years. The mean age of control group was 35.88±7.79 years. There was no difference in terms of age between groups ($p=0.281$). The hearing threshold values of the dental technicians at all frequency in both ears were found to be significantly higher than the control group (Table 1).

For determining effect of age on hearing, Spearman correlation analysis was applied between hearing levels and age in both groups (Table 2). In dental technician group there were statistically significant correlation between age and hearing thresholds at all frequencies (except at 250 Hz and 1000 Hz). In control group there were statistically significant correlation between age and hearing thresholds at only 4000 and 8000 Hz.

For determining effect of noise exposure time on hearing in dental technician group, Spearman correlation analysis was applied between hearing levels and exposure time. It was found that there were statistically significant correlations between exposure time and hearing thresholds at 2, 4 and 8 kHz frequencies (Table 3).

DISCUSSION

Hearing loss is one of the common occupational health disorders. Beside noise exposure, daily life noise exposure, ototoxic chemical exposure, use of tool with vibration, aging, smoking, hyperlipidemia, hypertension, diabetes mellitus and ototoxic medication also contribute to occupational hearing loss (6-9). Noise-induced hearing loss is one of the most important causes of hearing loss in the adult population worldwide (10). After noise damage, reactive oxygen levels in the cochlea increase, and cochlear blood flow is disturbed (11). Noise induced hearing loss starts when the level of noise is significantly high enough. The Occupational Safety and Health Administration accepted noise level of 90 dB (A) for 8 hours in a day as safe in terms of hearing loss (12). Dental

Table 1. Comparison of audiogram findings (dB) of dental technician group and control group

		Dental Technician (n=105)	Control (n=120)	p
PTA	R	10.44±7.81 8 (5-65)	6.47±2.15 5 (5-18)	**<0.001**
	L	11.41±9.67 8 (5-68)	6.89±2.60 5 (5-17)	**<0.001**
250 Hz	R	10.72±6.58 10 (5-45)	8.23±4.14 5 (5-20)	**<0.001**
	L	12.59±8.97 10 (5-60)	8.69±4.34 10 (5-20)	**<0.001**
500 Hz	R	8.65±6.58 5 (5-55)	5.96±2.28 5 (5-15)	**<0.001**
	L	9.66±8.25 5 (5-60)	6.38±3.04 5 (5-20)	**<0.001**
1000 Hz	R	10.24±8.79 5 (5-70)	5.96±1.98 5 (5-10)	**<0.001**
	L	9.81±8.24 5 (5-65)	6.21±2.83 5 (5-25)	**<0.001**
2000 Hz	R	11.53±11.32 5 (5-70)	6.34±3.36 5 (5-20)	**<0.001**
	L	12.88±13.12 10 (5-90)	6.68±3.92 5 (5-25)	**<0.001**
4000 Hz	R	33.60±19.63 30 (5-110)	10.08±8.15 5 (5-50)	**<0.001**
	L	36.97±20.24 33 (5-90)	9.85±6.09 10 (5-30)	**<0.001**
8000 Hz	R	35.04±20.93 30 (5-105)	11.51±6.99 10 (5-40)	**<0.001**
	L	38.79±23.48 35 (5-110)	11.72±6.52 10 (5-30)	**<0.001**

PTA: Pure Tone Average, Hz: Hertz, R: Right ear, L: Left ear, values are presented as mean±standard deviation and median (minimum-maximum)

Table 2. Correlation analysis between hearing levels and age in both groups

		Dental Technician (n=105)		Control (n=120)	
		r	p	r	p
PTA	R	0.271	**0.005**	0.043	0.644
	L	0.254	**0.009**	0.055	0.556
250 Hz	R	0.570	0.568	0.072	0.436
	L	0.163	0.098	0.096	0.298
500 Hz	R	0.226	**0.021**	-0.042	0.646
	L	0.215	**0.029**	-0.038	0.685
1000 Hz	R	0.250	**0.011**	0.033	0.723
	L	0.144	0.145	0.020	0.833
2000 Hz	R	0.225	**0.021**	0.076	0.412
	L	0.248	**0.011**	0.118	0.203
4000 Hz	R	0.278	**0.004**	0.176	0.055
	L	0.291	**0.003**	0.242	**0.008**
8000 Hz	R	0.237	**0.015**	0.172	0.061
	L	0.313	**0.001**	0.223	**0.015**

PTA: Pure Tone Average, Hz: Hertz, R: Right ear, L: Left ear

Table 3. Correlation analysis between hearing levels and exposure time in dental technician group

		Dental Technician (n=105)	
		r	p
PTA	R	0.181	0.067
	L	0.186	0.059
250 Hz	R	0.111	0.262
	L	0.159	0.108
500 Hz	R	0.154	0.119
	L	0.160	0.105
1000 Hz	R	0.173	0.080
	L	0.085	0.391
2000 Hz	R	0.162	0.100
	L	0.218	**0.026**
4000 Hz	R	0.226	**0.021**
	L	0.206	**0.036**
8000 Hz	R	0.167	0.089
	L	0.215	**0.029**

PTA: Pure Tone Average, Hz: Hertz, R: Right ear, L: Left ear

technicians are at risk population in terms of hearing loss because of commonly use of high speed drill and dental instruments, presence of chemical and biological hazards in their clinic. There are very few studies related to occupational noise exposure and existing studies related to dental technicians are contradictory (13-16). Also these studies were including all dental professionals especially dentist not only dental technicians whereas dental technicians are most risky group among dental professionals. The purpose of this study is to investigate the presence of hearing loss in dental technicians.

The results of the current study suggest that there was a statistically significant difference in hearing sensitivity between dental technicians and the control group. Brusis et al. (5) found that noise exposure of dental technicians is below the inner ear damaging limit of 85 dB (A). Also they indicated in their study that there is no risk of permanent hearing loss among dental health care workers. In other study, it was determined that noise levels were not exceeded allowable limits in a pediatric dentistry residency clinic (17). Conversely study conducted by Choosong et al. (3) measured that the highest impulsive noise levels of the dental technicians are exposed is 137.1 dB C in the personal hearing zone. They explained these findings that the noise level of a micro-motor hand piece at the dental clinic was lower than at dental laboratory. Dentists rarely use the maximum speed of the air turbine micromotor hand piece during dental treatment while in the dental laboratory air turbine tools are always used at the higher speeds. In addition, dental technicians generally work in the same room, in this room there are multiple instruments and the other noise sources (aspirator, music, etc).

Dental technicians are exposed to many chemical and biological hazards as well as noise. These hazards may also contribute to hearing loss. Also there is a risk of developing pneumoconiosis in dental technicians and chronic pulmonary diseases may pose a potential risk in terms of hearing loss (18).

There were significant correlations between age and hearing thresholds at all frequencies (except at 250 Hz and 1000 Hz) in dental technician group, while significant correlation was found only at 4000 and 8000 Hz frequencies in the control group. In control group there were correlations at 4000 and 8000 Hz frequencies due to presbycusis. But there were correlations at almost all frequencies in dental technician group due to noise exposure. In the light of this result it can be said that noise exposure in dental technicians is affecting all along the cochlea. Significant correlations were determined between exposure time and hearing levels at 2, 4, 8 kHz frequencies. This reflects that noise exposure affects rather high frequencies (7).

In the current study, it was found that dental technicians have significantly increased risk of hearing loss. The protection of dental technicians in terms of occupational hearing loss is only possible by taking adequate protective measures, using modern equipment and raising awareness. Prevention programs as legal requirements should base on medical check-ups. Also educations, engineering controls, administrative controls should be made. Toxic materials should be replaced by less harmful alternatives, where possible. Local ventilation systems must be properly constructed in dental laboratories to prevent respiratory and skin exposure to airborne contaminants. Adequate general ventilation and enclosure systems are also important. Hearing protection devices must be worn and special anti-vibration gloves could be of some help for hearing protection.

The limitations of the study are that hearing assessment is performed only by audiometry test. Further analysis of the hearing system can be done by adding otoacoustic emission test and evoked response audiometry test.

In conclusion, our results indicate that hearing loss is a serious occupational health concern for dental technicians. Dental technicians are exposed to noise and chemical hazards that may constitute a risk factor for hearing loss. Protective measures should be taken.

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