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Screening of dental staff nurses for noise induced hearing loss

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Abstract. *Screening of dental staff nurses for noise induced hearing loss. Problems/objectives*: The effect of noise on employees of dental clinics is debatable. The purposes of this study were to determine the intensity and frequency components of dental instruments used by dental staff nurses and the prevalence of noise induced hearing loss.
Methodology: We performed a comparative, cross sectional study on a group of dental staff nurses. Participants underwent ear examination followed by pure tone audiometry. Pure tone audiometry was performed at least 48 hours after the participants were free from noise exposure. Noise induced hearing loss was defined as failed definitive threshold at a frequency of 4000 Hz greater than 20 dB. The intensity level, noise spectrum, and frequency of hand piece, saliva suction, and scaler were recorded during the dental procedure.
Results: A total of 65 dental staff nurses were included. The mean intensity of hand pieces, scalers, and saliva suctions were 88.7 (SD2.2), 87.1 (SD2.6), and 77.4 (SD6.3) dBA while their most prominent frequencies were 3880, 7997, and 3513 Hz, respectively. Three of the subjects had slightly more than 20 dB hearing loss at 4 kHz on audiogram; all were affected unilaterally. These three individuals worked as dental nurses for 11, 13, and 21 years, respectively. Therefore, the prevalence of noise induced hearing loss was 5.0% (95% CI: -1.0%, 10.0%).
Conclusions: Dental staff nurses might have an increased risk of noise induced hearing loss, depending upon individual factors influencing susceptibility and duration of noise exposure.

Introduction

Noise induced hearing loss (NIHL) has a gradual onset and progressively worsens over time. For this reason, many people are not aware of their hearing loss until it is too late to avoid permanent damage. NIHL is totally preventable. However, once acquired, hearing loss is permanent and irreversible.

Dental personnel are exposed to occupational hazards on a daily basis, including hearing loss. NIHL has been documented in certain occupations such as construction workers,[1] disc jockeys,[2] and orthopedic staff,[3] but not in oral healthcare providers. Therefore, no steps have been taken in this field to provide protection from noise exposure.

The sources of sounds in the dental office that may be harmful to hearing include high-speed turbine hand pieces, low-speed hand pieces, high-velocity suctions, ultrasonic instruments and cleaners, vibrators and other mixing devices, and model trimmers.[4] Sorainen and Rytkonen[5] reported that the noise levels of current dentistry equipment recorded in the acoustics laboratory ranged from 76-107 dB. Therefore, depending on the duration of exposure, dentistry equipment can be considered hazardous. In a study by Zubick *et al*.,[6] dentists showed a greater hearing loss at 4 kHz compared to physicians that was more pronounced on the left side.

The Occupational Safety and Health Administration (OSHA) and The National Institute for Occupational Safety and Health (NIOSH) allow exposure of 90 dBA and 85 dBA, respectively, for up to eight hours.[7,8] According to OSHA, exposure time must be reduced by half with every 5 dB increase in noise intensity. NIOSH requires this same reduction with every 3 dB increase. In Malaysia, The Factories and Machinery (Noise Exposure) Regulation (1989) is in place, which follows OSHA recommendations.[9]

Apart from assisting the dentists, dental staff nurses are also involved in delivering oral healthcare particularly for school children under the age of 17 years. Their roles range from teeth inspection to dental treatment such as filling. Therefore, they have a similar risk of NIHL compared to dentists.

Unlike industrial workers, who are protected by occupational noise regulations enforced by OSHA and NIOSH, there are no regulations concerning medical personnel, including dental staff nurses. This is likely due to the

inconclusive results of various studies. Therefore, Hyson suggested that further studies should be performed to reevaluate the hearing loss potential among dental students, faculty members, practicing dentists, and other dental staff members.[10] For this reason, we studied the noise spectra of dental equipment used by the dental staff nurses and the prevalence of noise induced hearing loss among them.

Methods

We performed a cross sectional study on a group of dental staff nurses. The source population for this study was dental staff nurses whose job involved direct patient treatment. Dental staff nurses over 55 years old or with a history of excessive noise exposure were excluded from the study to eliminate participants with presbycusis and noise induced hearing loss from other sources, respectively. Based on the number of eligible dental staff nurses in our study area, 65 were selected by a simple random sampling method. The Research Ethics Committee (Human), Universiti Sains Malaysia provided ethical approval.

Each participant completed a questionnaire which included data on sociodemographic profile (age, gender, race), exposure history (workplace, handedness, years of working, days of work per week, hours of work per day), use of dental equipment (hand piece, saliva suction, ultrasonic scaler), the used of hearing protective device, and medical status. Ear examination was conducted followed by pure tone audiometry (PTA) (A321 Twin Channel, Italy) in a sound proof room. PTA was performed at least 48 hours after noise exposure to avoid recording a temporary threshold level. Noise induced hearing loss was defined as a failed definitive threshold at 4000 Hz frequency of more than 20 dB with the loss at the two nearest frequencies amounting to at least 5 dB less.[11] Hearing impairment was defined as an average hearing threshold of more than 25 dB at 500, 1000, 2000, and 4000 Hz.[12] Data were recorded and analyzed using Statistical Package for Social Science (SPSS) version 12.0.1.

The intensity level of hand pieces, saliva suctions, and scalers were recorded during the dental procedure using a sound level meter (Quest 2900, USA) and frequency analyses were obtained using Soundforge software (version 8 by Sony, USA). The recordings were taken at 12 cm distance from the ears of the subjects.

Results

A total of 65 dental staff nurses participated in this study. Mean age was 39.0 (SD 7.47) and age range was 28-54 years. All participants were female. Sixty-one (93.8%) were Malay while 4 (6.2 per cent) were Chinese. This probably reflects the actual racial composition of the local population. Participants worked 5 days per week and were exposed to dental instruments 6.6 hours (SD 1.16) per day. All used hand piece and saliva suction. Only 6 (6.2 per cent) did not use an ultrasonic scaler. Most (67.7%) worked as a dental staff nurse for more than ten years.

Table 1 shows the mean intensity and frequency component of hand pieces, scalers, and saliva suction. The mean intensity level for hand pieces and scalers were above 85 dBA; saliva suction was less. The frequency components for the instruments were between 3,000 Hz and 8,000 Hz.

Table 2 shows the threshold at 4 kHz and the duration of work of the subjects with hearing loss. Three subjects have a notch of more than 20 dB at 4 kHz on audiogram. Each of these participants was affected in one ear only. All three had worked as a dental staff nurse for at least 11 years. Two of the ears were on the left side. Therefore, the prevalence of noise induced hearing loss was 5.0% (95% CI: -1.0%, 10.0%). However, no participant was categorized as having hearing impairment.

Discussion

There is no doubt that sound intensity plays a major role in the development of noise induced hearing loss. Dental equipment that can be considered harmful to hearing includes the hand piece, saliva suction, and scaler. In this study, we measured intensity level

Table 1

Mean intensity and frequency component of hand pieces, scalers, and saliva suction

Instrument	Mean intensity dB(sd)	Frequency component Hz
Hand pieces	88.7(2.2)	3,880
Scalers	87.1(2.6)	7,997
Saliva suction	77.4(6.3)	3,513

Table 2
Threshold at 4 kHz and side of the ear affected of participants with a notch at 4 kHz

Subject	Threshold at 4 kHz (dB)	Side of the ear	Duration of working (years)
A	30	Left	11
B	30	Right	21
C	35	Left	13

and frequency output of the instruments in the clinical setting.

The mean intensity levels of hand pieces and scalers exceeded the level recommended by NIOSH; levels for hand pieces and scalers were 88.8 dBA (SD 2.2) and 87.1 dBA (SD 2.6), respectively. The mean intensity level for saliva suctions was below the hazardous level. According to OSHA regulations, the mean intensity of all instruments measured is below the hazardous level.

The findings of noise level in this study are comparable to previous reports. Sorainen and Rytkonen[13] reported that during normal work at the dental clinic, the A-weighted sound pressure level was occasionally over 85 dBA and the equivalent continuous A-weighted sound pressure level was 76 dBA. In a laboratory, they found that the average A-weighted sound pressure level of the new and old hand pieces was 76-82 dBA, the power suction tube 77 dBA, the saliva suction tube 75 dBA, and the ultrasonic scaler 83 dBA.[5] Setcos and Mahyuddin[14] found that the noise levels at the dental clinic were below 85 dBA but reached 96 dBA in the dental laboratories. The noise levels in the dental schools were similar. Sampaio Fernandes *et al*.[15] reported levels between 60 and 99 dBA during learning-teaching activities. In general, the noise levels from the dental instruments do not seem to be excessively high, but can be considered at least close to the limit of safety.

Any noise with a frequency greater than 1,000 Hz is considered dangerous to hearing.[10] We found the most prominent frequencies to be 3,880 Hz for hand piece, 3,513 Hz for saliva suction, and 7,997 Hz for scaler. These frequency measurements could be used to determine the hearing threshold frequency shift due to noise exposure. Barek *et al*.[16] found that in term of frequencies generated by high-speed air turbines, there were four main peaks and the one in the audible range was 5.6 kHz.

A dip or a notch in the audiogram at 4 kHz has long been recognized as a clinical sign of continuous exposure to noise. Together with an accurate history of exposure to noise, the audiogram pattern may be valuable in confirming the diagnosis of noise induced hearing loss.[17] In this study, the prevalence of subjects with hearing threshold greater than 20 dB at 4 kHz was 5% (95% CI: -1.0%, 10.0%). However, no participant met the criteria for hearing impairment. Even though their hearing was not considered to be impaired, the audiogram notch at 4 kHz may become deeper and wider over time if preventive measures are not implemented.

The prevalence of hearing loss in this study was low in comparison to other studies involving occupational noise. More than 60 percent of operating engineers who operate heavy construction machinery showed hearing loss at frequencies of 4 and 6 kHz.[1] Willett[3] reported that half of the senior orthopedic staff had evidence of noise-induced hearing loss. Bray *et al*.[2] reported 3 out of 23 disc jockeys had hearing impairment. As regard to the frequencies involved, Korres *et al*.[18] have found that even frequencies higher than 9 kHz might be affected.

Whether the dental working environment can be hazardous to the hearing of dental personnel or not has been a topic of discussion for quite sometime. Zubick *et al*.[6] showed that physicians have better hearing threshold levels, notably in the 4000 Hz center frequency range, than dentists. Wilson *et al*.[19] compared the hearing of dental hygienists with a high ultrasonic usage rate with a matched group of dental hygienists who had a low ultrasonic usage rate. They found a significant difference in both groups at 3000 Hz. Bali *et al*.[20] reported statistically significant changes in distortion product amplitude in the 6 kHz and 4 kHz ranges in a group of dentists in a dental school. A pilot follow-up data on auditory performance of dentists in Flanders, Belgium over a 10 year period indicate pronounced hearing loss at 4 kHz for the left ear.[21] However, several other studies showed that dental instrumentation has never been a risk to dentists' hearing.[22-25]

The exact duration of exposure is difficult to estimate or measure as it varies between days depending on the content of the work tasks and rest time. The mean hours of exposure to noise per day of the dental staff nurses in this study was 6.6 (SD 1.16). This

does not exceed the allowable hours at the lowest permissible noise level as indicated by both OSHA and NIOSH. The duration of exposure was self-reported and might not be accurate. Akesson *et al*.[26] found that the average total daily measured time of vibration exposure at ultrasonic scaling in dental hygienist was only 12 minutes and was overestimated in self-reports. However, we believed that the total exposure is not similar between different centers or nations due to differences in workload. The dental personnel in developing country might have more patients to be served since the ratio between providers and patients is generally lower.

A number of previous studies shown that the left ear of dentists is affected more than the right.[6,20,21] The reason was thought to be due to the left ear being closer to the drill during the clinical procedure. In contrast, Wilson *et al*.[19] did not find any significant difference between the two ears in their study on dental hygienists. In this study, the dip at 4 kHz was on the left in two out of three subjects. Even though it appears that the left ear is affected more frequently, no firm conclusion can be drawn because of the small number of subjects with hearing loss. Apart from that, our study showed that there might not be any correlation between the duration in years of working and the notch on audiogram. In other words, certain people might be more susceptible to noise induced hearing loss regardless of the duration of exposure.

In the present study, diagnosis was made based on history and the presence of the classic and most common frequency notch at 4 kHz. Including notches at 3 and 6 kHz, which are also important in the case of noise induced hearing loss, might increase the number of subjects affected. For future studies, comparison to an age matched control group would be useful to determine the significance of noise induced hearing loss among dental staff.

Conclusion

In general, the intensity level of dental instruments can be considered to be near the hazardous noise level. Depending on susceptibility of an individual to noise induced hearing loss and duration of exposure, dental staff nurses might have an increased risk. At least periodic hearing evaluation should be done to monitor for hearing loss in this occupation.

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