Occupational Hazard Study: Measurement of Noise Levels of Dental Equipment used in dental clinic and dental laboratory

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ABSTRACT

Objective: To measure noise levels at a dental clinic and a dental lab and compare it with NIOSH recommended exposure level.

Methods: Noise level measurements were taken at Prince Rashid Hospital (Royal Medical Services), in both dental clinics and lab. The measurements were done using equipment within these settings with the microphone (amprobe SM-10 sound meter, IEC 651 type 2) (Figure 1) located 30cm away from the equipment. Cumulative noise in the clinic and lab was measured by locating the microphone in the centre of the room. All measurements were made through the use of a decibulometer. The average noise level was alculated for each item of equipment and compared with the National Institute for Occupational Safety and Health recommended exposure level (REL) .

Results: Values higher than the National Institute for Occupational Safety and Health limit were detected in both the clinics and the lab, with values as high as 98 dB, 93 dB and 85 dB. The highest detected values were for the vacuum, sandblaster, and high-speed handpiece.

Conclusion: This study shows that there are high noise levels in both dental clinics and lab. the dental lab has higher noise levels compared with the clinics in terms of the equipment used, as well as cumulative noise level when measured in the center of the lab.

Keywords: Noise, Dental equipment, Hearing problems, Dental staff, The Royal Medical Services of Jordan.

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Introduction

High noise levels have negative effects on human health, such as increased heart rate, high blood pressure, nervousness and emotional exacerbation (1,2). noise produced in dental clinics results in negative psychological outcomes like anxiety in dental patients and irritation in dentists (2,4). In general, dental clinics use equipment that generate loud noises and sounds.

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Many researchers have studied these levels of noise to understand its effects on patients and dentists (3–5). The extend of damage caused by equipment noise depends mainly on the intensity and frequency of the sounds and the duration of exposure to the noise (6–8).

According to the American National Institute for Occupational Safety and Health (NIOSH) and the World Health Organisation, an eight-hour daily occupational exposure to noise is limited to 85 dB(A) as a weighted equivalent sound level (LAeq) for a five-day workweek in any working environment (https://www.cdc.gov/niosh/topics/noise/default.html). NIOSH listed noise-induced hearing loss is the most common occupational injury (10). Many studies have measured noise with the intention of understanding its effects on hearing (6,9,11) or focused on measuring and evaluating the levels of noise as a source of anxiety in children(12).

The current study focused on the noise in dental clinics and labs. It measured the noise level in dental clinics and at the dental lab of the Royal Medical Service in Jordan (Prince Rashid Hospital).

The aim of this study was to measure noise levels produced by equipment inside dental clinic and dental lab and compare it with the recommended exposure level of NIOSH. The results will be used to understand this problem in this setting, and help with reducing the noise levels if it exceeds the allowed limits.

METHODS

This study was approved by the Research Ethics Committee of the Royal Medical Services of Jordan. It was conducted in the dental clinics and dental lab of Prince Rashid Hospital, which is part of the Royal Medical Services in Jordan. The researcher used a microphone (amprobe SM-10 sound meter, IEC 651 type 2) (Figure 1) to measure the noise level in decibels (dB), which is the unit of
Measuring noise in any given setting. The noise of eights items of dental equipment inside the dental clinic and four items of dental equipment in the dental lab was measured, plus the noise of the clinic (cumulative noise level) on a regular working day. (Table I and II)

The microphone used for each measurement was located at a distance of approximately 30 cm away from the equipment, in an attempt to mimic the possible position of the operator (the position of the microphone-holding researcher was maintained for repeated recordings). The measurement was repeated five times for each suggested item of equipment (Table I and II) to calculate maximum noise, minimum noise and average noise produced by each item of equipment in different scenarios. All measurements were recorded with only the required persons inside the clinic or lab, with the doors and windows closed to exclude outside noise and sounds other than the tested equipment.

The measurement also was done inside the clinic by putting the microphone in the centre of the clinic to measure the cumulative noise of the clinic on a regular working day with all daily activities kept as usual; this measurement was repeated five times on different working days to calculate the maximum cumulative noise, minimum cumulative noise and average cumulative noise of the dental clinic. The location of the microphone was the same for all measurements. All measurements were performed with the use of a decibulometer, also known as a sound level meter.

Figure 1 Amprobe SM-10 sound meter, IEC 651 type 2.

RESULTS

The measurements of noises in the clinics are shown in Table I. The highest level of noise was recorded for the low speed hand piece during tooth cutting with high volume suction (89.4 dB). The second highest recorded noise level was for the high speed hand piece (89.2 dB).The highest average noise level was also recorded for the high-speed hand piece during tooth cutting with high volume suction (85.5 dB). The second highest average noise level was for the low speed hand piece during tooth cutting with high volume suction (83.8 dB). On the other hand, the lowest recorded nose level was for the micro motor hand piece, and only when it was turned on (62.6 dB).

Noise measurements in the dental laboratory are shown in Table II. The highest recorded level of noise was for the vacuum while it was turned on (100 dB), followed by the sandblaster during sand blasting (97.0 dB). Similarly, the highest average noise was for the vacuum while it was turned on (98.8 dB), followed by the sandblaster (93.5 dB). The highest average recorded noise was 99 dB (Figur 2).

Table I Noise levels of equipment measured in dental clinics

Equipment	Studied process	Min dB level	Max dB level	Average dB
High speed hand piece	turned on only	60.3	66.4	63.35
	Tooth-cutting without suction	71.6	79.4	75.5
	Tooth-cutting with low volume suction	75.5	78.8	77.15
	Tooth-cutting with high volume suction	81.8	89.2	85.5
Low speed handpiece	turned on only	64.6	73.8	69.2
	Tooth-cutting without suction	69.1	76.0	72.55

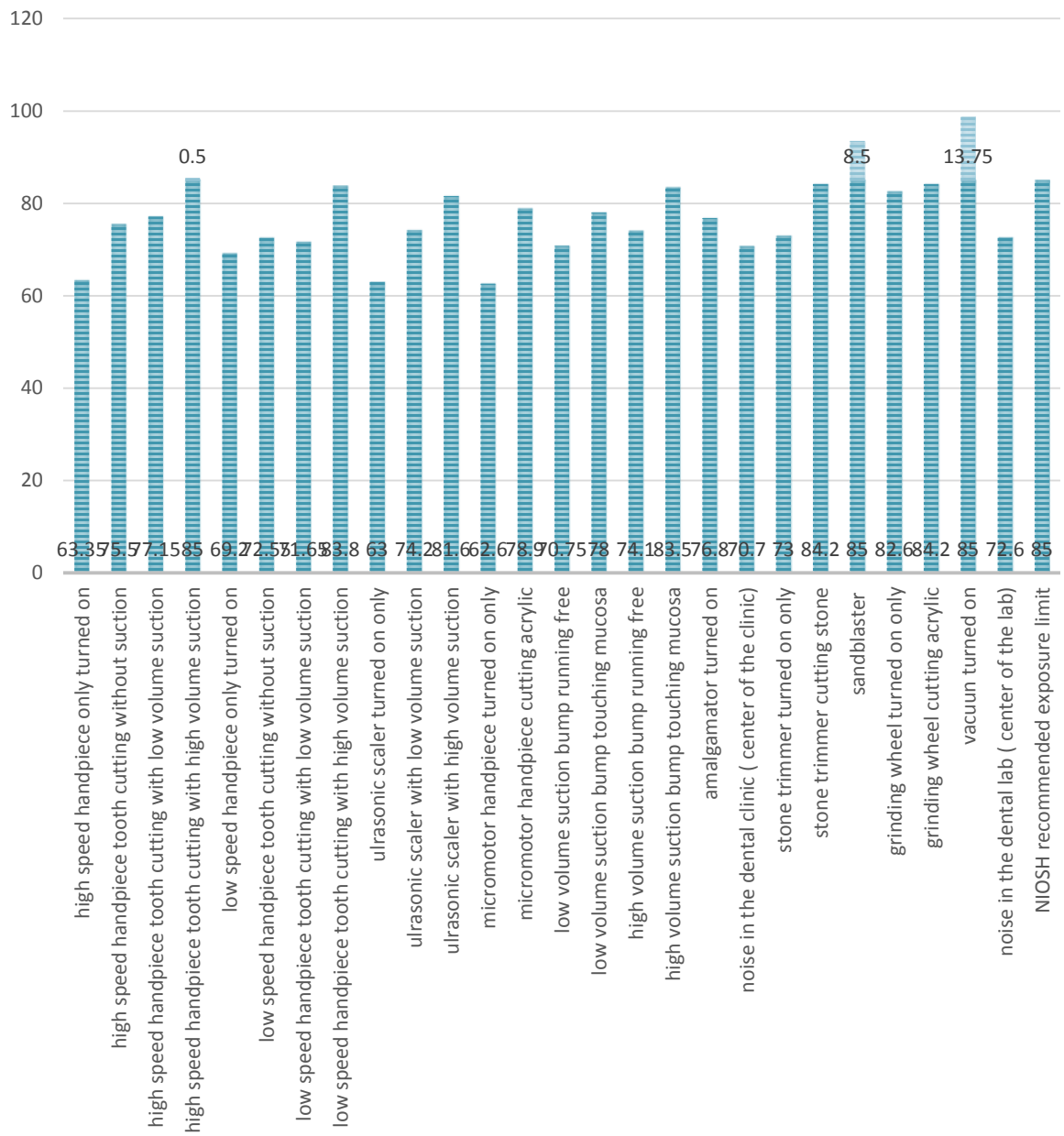
	Tooth-cutting with low volume suction	70.0	73.3	71.65
	Tooth-cutting with high volume suction	78.2	89.4	83.8
Ultrasonic scaler	turned on only	58.0	68.0	63
	Without suction			
	with low volume suction	72.9	75.5	74.2
	with high volume suction	79.6	83.6	81.6
Micro motor handpiece	turned on only	60.1	65.1	62.6
	Cutting acrylic	73.3	84.5	78.9
Low volume Suction bump	Running free	69.8	71.7	70.75
	Touching mucosa	71.4	84.6	78
High volume Suction bump	Running free	71.1	77.1	74.1
	Touching mucosa	80.5	86.5	83.5
Amalgamator	Turned on	72.9	80.7	76.8
Noise in dental clinic*		63.8	77.6	70.7

* From the center of the clinic

Table II Noise levels of equipment measured in dental labs
* From the center of the lab.

Equipment	**Studied process**	**Min dB level**	**Max dB level**	**Average dB**
Stone trimmer	Only turned on	72.1	74.0	73
	Cutting stone	82.0	86.5	84.2
Sandblaster	Sand blasting	90.0	97.0	93.5
Grinding wheel	Only turned on	68.1	79.1	82.6
	Cutting acrylic	88.4	80.0	84.2
Vacuum	Turned on	97.5	100.0	98.75
Noise in dental lab*		67.4	77.8	72.6

FIGURE (2): DB MEASURES FOR BOTH DENTAL CLINIC AND LAB COMPARED TO NIOSH RECOMMENDED EXPOSURE



Discussion

According to NIOSH standards, the average noise level should not exceed 85 dB at any working place for five days working week.(1,13) Constant exposure to noise levels exceeding this limit exposes the workers to an increased risk of hearing loss and tinnitus. This limit is based on the limitations of the human ear and human hearing senses (9). According to the results of this research, the noise averages of dental clinic and lab were high ranging from (62-98 dB).

Some of these noise levels are higher than NIOSH noise limit (figure 2).

shows a comparison between the recorded average noise levels and the NIOSH limit. The first and second recorded high average noise levels were higher than the NIOSH limit; as the first was 98.8 dB for the vacuum while it was turned on, and the second was 93.5 dB for the sandblaster while it was sand blasting,
respectively.

It was observed that the highest noise levels were both recorded in the dental laboratory, which had a higher noise levels than the clinics. Both measures were higher than the NIOSH limit, which could indicate a potentially harmful occupational environment for workers inside the lab.
The third highest average measurement was recorded in the clinic, with a value of 85.5 dB. This is also higher than the NIOSH limit, which could lead to negative health consequences for workers at these clinics.

These negative consequences of noise on patient wellbeing are more prevalent in female patients, in the paediatric age group, and in patients living in rural areas (2,4,5,12).

The tools that had the highest noise levels were the vacuum (98.8 dB), sandblaster (93.5 dB), high speed handpiece (85.5 dB), grinding wheel (84.2 dB), low speed handpiece (83.8 dB) and ultrasonic scaler (81.6 dB). Only three of these noise values exceeded the NIOSH limits (over 85 dB). These reported noise levels for dental equipment were similar to levels reported in previous studies (14–17). Qsaibati and Ibrahim reported a noise level for the sandblaster of 96 dB and 92 dB for the handpiece from a 15 cm distance (10), while Al-Omoush et al. reported in a recently published Jordanian study an amalgamator noise level of 55 dB (3).

The difference in the recorded amalgamator noise levels between this study and the Al-Omoush et al. study could be explained by possible differences in equipment type, age and maintenance level.

For the cumulative noise levels in the clinic and the laboratory recorded by positioning the microphone in the centre of the clinic and the laboratory, measures were 70.7 dB in the clinic and 72.6 dB in the dental lab. The reported clinic noise in this study was slightly higher than those previously reported at the Damascus dental collage and lower than those reported at a Brazilian university dental clinic (8,10). Differences in dental

clinics may be due to differences in room size, furniture distribution, equipment, and other factors that could affect noise levels in clinics (8,18).

In the current study, the reported general noise levels in the dental clinic and lab were under the NIOSH limits; however, these levels could change with the use of equipment (aging and maintenance) and with the number and type of patients in the clinic. It has been reported that paediatric dental clinics have higher noise levels due to children crying and screaming (1,19,20).

Conclusion

The noise levels of dental clinics and labs are high, some of them higher than the NIOSH limit of 85 dB which could have harmful consequences on dental care workers in this assessed Jordanian hospital. The dental lab has higher noise levels compared with the clinics in terms of the equipment used, as well as regarding the cumulative noise level when measured in the centre of the lab.

Further longitudinal research is needed to assess the health effects of these detected high noise levels. It is recommended for dental workers to use hearing protection devices to avoid any possible negative effects of high noise levels, this also valid for dental patients despite short periods of exposure to dental environment.

Raising awareness about hearing precautionary measures, regular maintainers of dental equipment, and regular check-ups at specialised clinics for dental health care providers could be the first step toward a healthy dental occupational environment.

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