

# Noise levels encountered in university dental clinics during different specialty treatments

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## ABSTRACT

**Background:** Noise levels encountered during the dental treatments in different departments have deleterious effects on the ears of dental healthcare providers and there is scarcity of data in the literature in Saudi Arabia. Hence, the aim of the study was to determine the noise levels resulting from the usage of different specialty instruments and equipment. **Material and Methods:** A cross-sectional study was conducted to measure the level of noise produced by different specialty instruments and equipment within the dental clinics of the College of Dentistry, Riyadh Elm University (REU), Riyadh. The noise produced during the restorative treatments, endodontics and prosthodontics was recorded objectively using a decibel (dB) meter placed at a distance of 30 cm from the operator's ear. Mean noise levels were calculated and compared among the various specialty treatments using Analysis of Variance (ANOVA). Furthermore, Tukey's test was applied to perform a pairwise comparison between the groups. **Results:** An overall noise of  $73.83 \pm 4.39$  dB was found to be generated within the dental clinical setting. A highest sound level of  $79.44 \pm 2.10$  dB was observed during restorative treatment followed by  $74.14 \pm 3.08$ ,  $73.22 \pm 1.93$ ,  $71.39 \pm 3.37$  and  $70.97 \pm 4.70$  dB for endodontic, periodontal, and prosthodontic treatments, respectively. A statistically significant difference was observed in the noise levels produced from the different specialty treatments ( $P = 0.000$ ). **Conclusion:** The greatest noise level was recorded with the use of the amalgamator in restorative dental treatment. It was inferred that the noise emanating from all the specialty dental treatments was below the hazardous levels. Long-term exposure may, however, have adverse effects on auditory as well as general health.

**Keywords:** Auditory effect decibel (dB), dental clinics, noise, specialty treatment, University

## Introduction

Occupational noise is described as an unacceptable sound in work settings. Noise in general refers to an intolerable random sound, which is considered as a kind of pollution and is measured in

decibels (dB).<sup>[1]</sup> It can have several auditory and non-auditory effects including increased heart rate, respiratory rate and blood pressure. Besides, excessive noise can lead to psychological effects such as annoyance, stress, and mental fatigue. Prolonged acoustic noise is harmful and may induce hearing loss, sleep problems, tinnitus irritation, and deterioration in the quality of life.<sup>[2-4]</sup>

According to the National Institute for Occupational Safety and Health Administration, the daily allowable noise level is 85 dB for 8 hours. Exposures beyond this level are considered hazardous.<sup>[5]</sup>

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High- and low-speed handpieces, high velocity suction, ultrasonic instruments and cleaners, as well as vibrators and mixing devices, such as amalgamators, are the main sources of noise within the clinical setup.<sup>[6-8]</sup> Several factors like frequency of noise, exposure time, intensity, noise type and individual susceptibility collectively determine the adverse health effects resulting from the high noise level produced within the working environment.<sup>[9]</sup>

In dental school setup, practitioners, students and ancillaries working in different departments are exposed to variable levels of sound emanating from equipment and instruments, which may exert harmful effects. The noise produced by various dental equipment while performing different specialty treatments within the clinical setup must be quantified to take appropriate prevention and control measures. Hence, the purpose of the present study was to determine the noise generated by different specialty instruments and equipment within the university dental clinics in Riyadh city, Saudi Arabia.

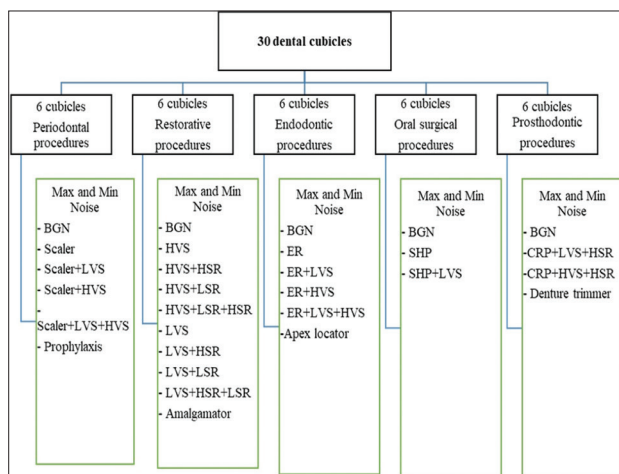
### Material and Methods

The study proposal was registered (FUGRP\2018\225) in the Research Centre of Riyadh Elm University (REU), and the Institutional Review Board formally approved the study (RC/IRB/2018/1387) on 30-01-2019.

This was a cross-sectional study conducted in the dental cubicles located in the first floor of the *Namudhajiya* campus of REU. The noise produced by the instruments and equipment before and during the common dental procedures was recorded.

A convenient sampling methodology was employed to select 30 cubicles where specialty dental treatments in periodontics, restorative dentistry, endodontics, oral surgery and prosthodontics were performed. The minimum and maximum levels of noise produced were measured [Figure 1].

However, the noise produced during the pedodontic and orthodontic clinical procedures was excluded from the study.



**Figure 1:** Dental cubicles and clinical specialty treatments considered in the study

### Measurement of the noise level

A sound level meter (93411 Beha GmbH, Germany) was utilized to measure the noise generated during various clinical procedures [Figure 2]. This device responds to noise in a manner similar to that of the human ear and facilitates an objective and reliable measurement.<sup>[10]</sup>

A sound level meter comes with settings of “A”, “C” or “Flat”, “Slow”/“Fast” response times, and maximum\minimum options. When “A” is selected, the frequency response of the device is like that of the human ear. “A” weighting is commonly used for environmental or hearing conversation programs such as Occupational Safety and Health Administration Agency (OSHA) Regulatory Testing and Noise Ordinance Law. “C” weighting is a much flatter response and is suitable for the sound level analysis of machines and engines. “Fast” must be selected to capture noises and peaks that occur very quickly. “Slow” response should be chosen to monitor a sound source that has a consistent noise level or to average quickly changing levels. The latter response is selected for most applications. To standardize the instrument, an external calibrator (ASU-01) of 94 dB is required in addition to a small screwdriver. The following steps should be followed:

- The device must be turned on.
- It must be preset in the “A” weighting mode.
- It should also be preset to the “Slow” response mode.
- Then, the microphone should be placed in the calibrator, and it must be switched on.
- The CAL potentiometer of the device must be adjusted in such a way that the display matches the output of the calibrator.

During the measurement of noise in the dental cubicle, the sound level meter was placed at a distance of 30 cm from the operator’s ear to gauge the intensity that can affect the ear.

At this point, the sound level is similar to that received by the dental assistant during the clinical procedure. The noise produced by scalar, high-vacuum suction (HVS), low-vacuum suction (LVS), high-speed rotary (HSR), low-speed rotary (LSR), amalgamator, apex locator, endodontic rotary (ER), surgical straight handpiece (SHP), crown preparation (CRP), denture trimmer and background sound were recorded both individually and in combination during the various procedures.



**Figure 2:** Sound level meter

The noise or sound intensity measured in decibels is a logarithmic unit, and hence, simple addition is not achievable. As a standard, it should be noted that a 3-dB noise increase is equivalent to a doubling of sound intensity (100 dB + 100 dB = 103 dB).<sup>[11]</sup> The level of sound was measured at different times when the instrument and equipment were producing maximum sound before and during the specialty treatments. The sound level was measured at the intervals of 30 seconds, and the maximum intensity was noted in decibels. The mean was calculated to obtain the highest maximum value of sound produced during the various clinical procedures. This protocol was repeated at least thrice.<sup>[10]</sup>

Descriptive statistics of mean and standard deviations as well as maximum and minimum values of noise were recorded in decibels. Noise produced by different dental equipment during periodontal, restorative, endodontic, oral and prosthodontic procedures were recorded objectively. Maximum noise levels generated by the departments were compared using Analysis of Variance (ANOVA). Tukey's test was applied for performing a pairwise comparison between the various groups. All the statistical studies were conducted with SPSS version 25. A *P* value of < 0.05 was considered significant for all analyses.

### Results

Periodontal procedures involving scaler and high-vacuum saliva suction produced more noise (71.39 dB) than the scaler alone (68.53 dB), scaler and low-volume aspirator (69.92 dB), scaler low-vacuum and high-volume suction (70.31 dB), and prophylaxis by low-speed handpiece (70.36 dB), as shown in Figure 3. Similarly, the sound level meter recorded a minimum background noise of 53.69 dB, while that produced together by the scaler and HVS was 71.25 dB [Figure 3].

Maximum noise level was observed with the use of the amalgamator (79.44 dB) during the restorative procedures. The minimum noise level measured by the sound meter ranged between 51.22 and 78.28 dB [Figure 4].

The maximum noise ranged from 56.78 dB (background) to 71.67 dB (straight handpiece with high-volume suction), while the minimum noise ranged from 54.75 dB (background) to 73.22 dB (straight handpiece with high-volume suction), as shown in Figure 5.

The use of endodontic rotary system with high-volume suction produced more sound (4.14 dB) when compared with the other endodontic practices. The use of the apex locator generated a minimum sound level of 55.28 dB [Figure 6].

Similarly, prosthodontic treatment procedure of crown preparation using high-speed handpiece and high-volume suction during denture trimming produced a maximum noise of 70.97 dB [Figure 7].

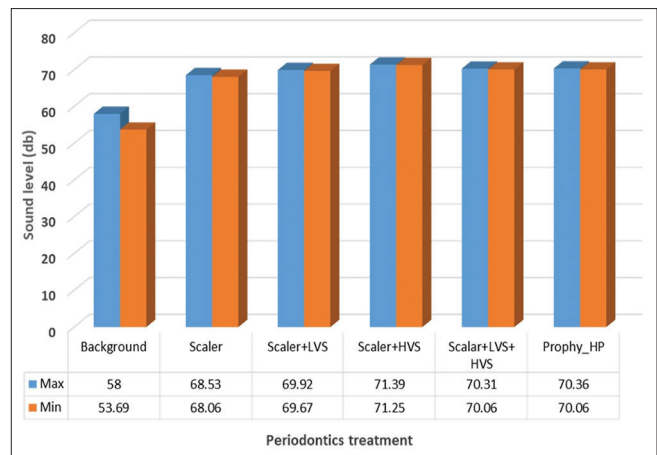


Figure 3: Noise level recorded in periodontics specialty treatment

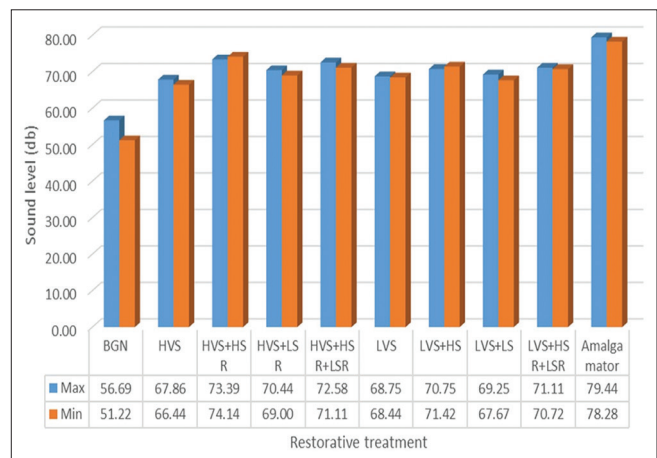


Figure 4: Sound level recorded in restorative dentistry specialty treatment

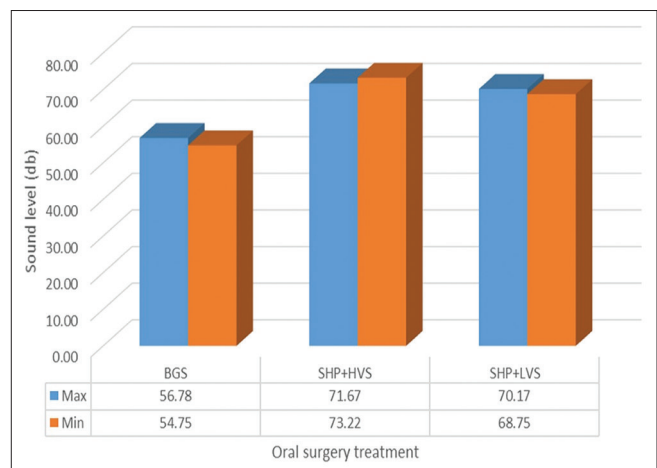


Figure 5: Sound level recorded in oral surgery specialty treatment

A comparison of the maximum noise levels in various departments exhibited a statistically significant difference, with the amalgamator used in the restorative department producing the highest level of sound ( $F = 40.598, P = 0.001$  by ANOVA test) [Table 1].

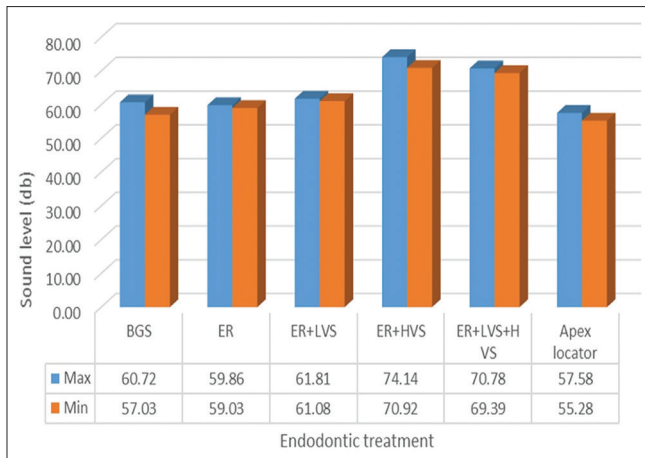


Figure 6: Sound level recorded in endodontic specialty treatment

Furthermore, the analysis revealed that restorative dental specialty produced a significantly higher sound level than all the other dental specialty treatments ( $P = 0.001$ ). The mean difference in the noise level varied significantly between oral surgery and prosthodontic specialties ( $P = 0.026$ ). Similarly, the sound levels differed significantly between endodontic and prosthodontic specialty treatments ( $P = 0.001$ ), as shown in Table 2.

### Discussion

Occupational noise can, over the years, lead to bilateral sensori-neural hearing loss because of prolonged exposure within the workplace.<sup>[12-14]</sup> Excessive noise can harm the auditory apparatus and cause physical and psychological nervousness. Hence, sensori-neural prevention is the key to avoid excessive noise and preventing associated harms.<sup>[15-17]</sup> This study assessed the noise levels of the different handpieces and equipment used in the dental clinics of the teaching hospital for providing specialty care.

Sounds originating from high-speed turbine, high-volume aspirator and ultrasonic scaler as well as the mixing devices for stone, amalgam and other materials could be considered hazardous to the dental professionals.<sup>[8]</sup> In this study, the maximum sound level was recorded to be the highest for the amalgamator (79.44 dB) and lowest for the ER (59.03 dB). Mojarad *et al.*<sup>[9]</sup> reported the highest noise level for the ultrasonic scaler (85.8 dB) and the lowest for the amalgamator (75.50 dB). Another study indicated that the highest noise level was produced by the denture trimmer (92.2 dB) and the lowest by the ultrasonic scaler (51.7 dB).<sup>[18]</sup> A research from the United Kingdom suggested that ultrasonic scalers (88 dB) and amalgamators (65.8 dB) produced the highest and the lowest levels of sound, respectively, within the clinical setup.<sup>[10]</sup> On the contrary, Bahannan *et al.*<sup>[19]</sup> documented that more noise resulted from the use of the handpiece than the scaler. Background noise originating from the building facilities, human voices and dental equipment affect the health adversely.<sup>[20]</sup>

In periodontics, the use of scaler and high-vacuum saliva ejector created maximum noise (71.39 dB), while the scaler alone

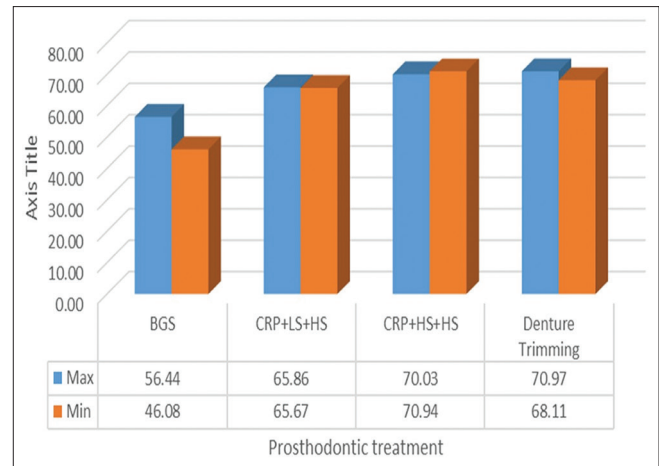


Figure 7: Sound level recorded in prosthodontic specialty treatment

Table 1: Comparison of the maximum noise levels produced in different departments

Specialty	n	Mean	SD	Std. error	95% CI for mean		F	P
					LB	UB		
Periodontics	36	71.39	3.37	0.56	70.25	72.53	40.598	0.001
Restorative	36	79.44	2.10	0.35	78.73	80.16		
Oral surgery	36	73.22	1.93	0.32	72.57	73.87		
Endodontics	36	74.14	3.08	0.51	73.10	75.18		
Prosthodontics	36	70.97	4.70	0.78	69.38	72.56		
Total	180	73.83	4.39	0.33	73.19	74.48		

Table 2: Tukey's post-hoc test of multiple comparisons for the different noise levels

(I) Departments	J Departments	Mean difference (I-J)	P	95% CI	
				LB	UB
Periodontics	Restorative	-8.05*	0.001	-10.13	-5.98
	Oral surgery	-1.83	0.112	-3.91	0.24
	Endodontics	-2.75*	0.003	-4.83	-0.67
	Prosthodontics	0.41	0.981	-1.66	2.49
Restorative	Periodontics	8.05*	0.001	5.98	10.13
	Oral surgery	6.22*	0.001	4.14	8.30
	Endodontics	5.30*	0.001	3.23	7.38
	Prosthodontics	8.47*	0.001	6.39	10.55
Oral surgery	Periodontics	1.83	0.112	-0.24	3.91
	Restorative	-6.22*	0.001	-8.30	-4.14
	Endodontics	-0.91	0.742	-2.99	1.16
	Prosthodontics	2.25*	0.026	0.17	4.33
Endodontics	Periodontics	2.75*	0.003	0.67	4.83
	Restorative	-5.30*	0.001	-7.38	-3.23
	Oral surgery	0.91	0.742	-1.16	2.99
	Prosthodontics	3.16*	0.001	1.09	5.24
Prosthodontics	Periodontics	-0.41	0.981	-2.49	1.66
	Restorative	-8.47*	0.001	-10.55	-6.39
	Oral surgery	-2.25*	0.026	-4.33	-0.17
	Endodontics	-3.16*	0.001	-5.24	-1.09

\* $P \leq 0.05$

produced minimum noise (68.53 dB). Qsaibati and Ibrahim<sup>[18]</sup> also found that the lowest noise (51.7 dB) was created by the ultrasonic scaler without suction pump. In the restorative

department, the highest noise was recorded with the use of the amalgamator (79.44 dB), which is greater than that reported by Mojarad *et al.* (75.50 dB). Ever since the introduction of the high-speed turbine handpiece in 1957, the release of harmful sound from the device has been a concern.<sup>[21]</sup> However, with the advent of air bearings in the handpieces, the noise level has been reduced considerably. Currently, a majority of the handpieces emit sound of less than 75 dB. Improved design and air exhaustion have resulted in quieter instruments than the ones previously used.<sup>[21]</sup> In this study, high-speed handpiece produced a low noise level of 67.89 dB, which is within the acceptable range.

Past studies have reported variations in the noise frequencies generated from different types of handpieces. Sound frequencies of 76.8, 79.6 and 82.6 dB have been reported for the low-speed straight handpiece, low-speed angle handpiece and high-speed turbine-angle handpiece, respectively.<sup>[8,12,19]</sup> In oral surgical practice, a maximum noise level of 71.67 dB was observed with the use of straight handpiece and HVS. The maximum sound levels produced by dental drills ranged from 61.0 to 82.0 dB, which lies within the safe limits.<sup>[22]</sup> Hence, the effect of noise emanating from the dental turbine is insignificant.<sup>[9]</sup> Similarly, the ER equipment with high-vacuum saliva ejector produced maximum noise (74.14 dB), while the apex locator created the minimum (57.58 dB) sound.

In prosthodontics, chairside denture trimming with the use of acrylic burs produced the maximum noise levels (70.97 dB), while minimum noise was witnessed during crown preparation with high-speed and low-vacuum saliva suction (65.86 dB). However, previous studies reported the highest noise from the engines during grinding by the stonecutter (92.0 dB) and the lowest noise by the denture polishing unit (41.0 dB).<sup>[9]</sup> In this study, the sound produced within the clinical situation was recorded without making any effort to measure the one coming from the dental laboratory as it was in a different floor of the building.

Literature is fraught with contradicting views on the effects of dental drill and other noises on the hearing ability of the practitioner. Some authors have reported substantial hearing loss owing to the noise pollution associated with dental practice,<sup>[10,23]</sup> while others have found no significant change in the auditory threshold.<sup>[10,24]</sup> Occupational Safety and Health Administration permits 8 hours of continuous exposure to a sound level of 90 dB per day.<sup>[25,26]</sup>

On the contrary, hearing loss was more among dental professionals as compared to dental assistants and technicians.<sup>[27]</sup>

Based on the overall measurements of noise in this study, maximum noise level (79.44 dB) was recorded for the amalgamator. However, this level is also below the risk of hearing loss (85 dB). Moreover, none of the dental staff used any type of ear protection as it can cause discomfort, communication problems and disturbances.<sup>[14]</sup>

## Conclusion

The noise recorded for amalgamator use is below the level that causes harmful auditory effects (85 dB). However, long-term exposure can have adverse impacts on hearing and general health. Hence, the students and staff should be educated about taking precautions such as wearing earplugs and earmuffs for their safety. Besides, the noise emission levels should be considered when purchasing new equipment.

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## Conflicts of interest

There are no conflicts of interest.

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