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Measuring Noise Levels in Dental Clinics

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Abstract

Compared to other educational environment, the acoustic environment in the dental practical classes has been characterized by high dental noise levels. The presented study aims to quantify noise levels generated by the dental equipment under working settings throughout various dental clinics. A sound level meter with a microphone has been used for measuring the noise levels. The meter was positioned in the clinic at a 15cm distance from operator's ear, at the chair side instrument tray to increase noise levels that would reach a person standing close, and in the middle of the learning area. For stimulating the operator's auditory position in laboratories, a microphone was positioned 15cm from the technician's ear, and a second reading was acquired from a 2 m distance. When trimming acrylic, the acrylic trimmer (85.4 decibel (dB) at a 15cm distance) was the noisiest piece of equipment measured in this investigation. When drilling teeth in dental clinics, the turbine in the middle of the learning area made the most noise (79.1 dB). The dental equipment's noise levels throughout cutting activities have been quite different from those during non-cutting activities. The study's noise levels were deemed to be somewhat close to the 85 dB threshold, which is the limit of hearing loss risk.

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Introduction

Noise is one of the top 10 factors contributing to work-related illnesses or injuries according to National Institute for Occupational Safety and Health (NIOSH) [1]. Occupational Safety and Health Administration (OSHA) states that eight hours of continuous exposure to a noise level of 85dB daily is tolerable. Beyond that level, noise could cause discomfort, temporary and permanent hearing loss, interference with communication and speech [2]. Individuals can lose approximately 28% of their hearing sense before realizing having a problem. Extended exposure to high levels of noise could deteriorate the inner ear hearing mechanism, resulting in noise-induced hearing loss (NIHL) [2,3]. Elevated noise levels could have adverse effect on blood pressure, disturbance of focus and communication, heightened stress reactivity, mental exhaustion, and decreased productivity [4-8].

Dentists and dental assistants are working in an environment with varying levels of noise generated by different dental equipment like the ultrasonic scalers, dental handpieces, amalgamators, quick evacuation…etc [9,10]. Moreover, noise can have a negative impact on patients prompting anxiety and fear, which can make them uncooperative and less likely to accept dental treatment [11,12].

Several operators and students are working simultaneously in the dental clinics of the teaching hospitals where the measured level of noise hit a record compared to other scholastic settings, exposing the working staff to a constant raised level of noise [5,13]. The aim of the present study is to measure the noise-level in different dental teaching clinics as well as in the technical laboratories in the College of Dentistry at the University of Mustansiriyah in Iraq.

Materials and Methods

This cross-sectional study was conducted in the College of Dentistry, Mustansiriyah University. The noise-level has been measured in different dental settings including department of operative, pedodontic, and periodontic in addition to prosthodontics technical laboratory.

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The decibulometer is a sound level meter device with a mounted microphone directed toward the sound source to measure the noise-level. Three points were fixed to measure the noise-level in each dental clinical: at the chair side to detect the noise affecting the person standing there; 15cm away from operator's ear to identify the noise that reaches the ear drum and at the clinic's center.

The minimum and maximum decibel intensities of the noise levels have been measured during a period of approximately 30 seconds and recorded. This has been repeated 3 times in succession on the same day, resulting in six readings for each tool a minimum and maximum for each interval of time — being taken. After calculating data average, the total value was noted. Dental clinical is equipped with various tools such as the amalgamator (capsule), turbine, micro motor handpiece, and ultrasonic scaler. The noise-levels have been tested twice; while these tools were in use and when they were just turned on. Turbine both without and with a low volume suction pump when cutting teeth. Sonic scalers, both pump-equipped and not. A comparable method was used for measuring the noise levels regarding laboratory equipment at dental laboratories. For simulating the operator's auditory position, the technician held the microphone 15 cm from their ear, and a second reading was taken 2 meters distant. This was done to stimulate everyone who was subjected to the identical noise and was within a 2-meter radius of the operator. The dental laboratories used a vibrator, a sandpaper mandrel, an acrylic trimmer, a lathe acrylic trimmer, and a sandblaster to measure the noise levels of their equipment. After being gathered, the data were tallied and statistically examined.

Results

I Regarding dental laboratories and clinical settings, sound levels range from 56.9 dB to 85.4 dB at a 15cm distance from operator's ear. Acrylic trimmers have been the study's loudest piece of equipment (Figure 1).

The findings of equipment noise level measurements made in dental labs at 2 distances of 15cm and 2m in two different scenarios— first, in the case when the equipment is turned on, and second, while it is being used for its intended purpose— are displayed in Figure 2. The findings showed that the vibrator, when just turned on, produced the least noise (49.5dB at 2m), while the acrylic trimmer produced the highest sound levels (85.4dB at 15cm).

Figure 3 displays the findings of the sound level meter measurements made in clinical settings at three separate locations for the equipment's noise levels. In the case when 12 devices were turned on simultaneously at a dental clinic, the turbine in the middle of the learning area produced the most noise (79.1 dB), while the handpiece at the chairside produced the least noise (56 dB). The noise levels of turbine during work have been measured in clinical areas at a 15cm distance from the operator's ear. The difference in noise-level recorded while the turbine was running compared to that when it was just switched on was statistically significant ($p < 0.001$), there have been also highly significant differences in noise levels when turbine was cutting teeth and using a low volume suction pump ($p < 0.001$). The noise levels of scalers that used a sucker in comparison with those that did not ($p < 0.001$) showed a highly significant difference, and the noise levels of the micromotor hand piece during cutting activities differed significantly from those during non-cutting activities ($p < 0.001$).

In the case when multiple turbines (12 in number), micro-motor handpieces (12 in number), and scalers (12 in number) have been utilized in a simultaneous manner in their respective work areas, in addition to the first location (15 cm from the operator's ear), noise levels have been measured as well from a central location of clinic area. The results shown in Figure 2 demonstrate that, while several turbines were operating, the noise level at a central location was significantly greater than the site at 15 cm from the operator's ear ($p = 0.001$). There has been a highly significant difference in noise levels between the two locations when numerous scalers were operating, with a p-value of less than 0.0001. Additionally, the micro motor handpiece noise levels in the two sites differed significantly (p value less than 0.0001). When two Amalgamators were operating simultaneously, there was a very noticeable variation in the noise levels between the two locations for Amalgamator (p-value is smaller than 0.0001).

In the case when 12 devices were turned on simultaneously at a dental clinic, the turbine in the middle of the learning area produced the most noise (79.1 dB), while the handpiece at the chairside produced the least noise (56 dB).

Discussion

Various occupational health issue as noise, still exist in modern dentistry despite major technological advancements recently. Noise from dental equipment is widely acknowledged as one of the main sources of noise in a dental setting. During their daily work, dentists are inevitably subjected to noise from various equipment and from other sources [15]. Our study has examined the noise-level generated by numerous gears in several dental clinics and labs of the teaching hospital.

Technical dental labs are shown to experience higher noise levels than other dental settings. The recorded noise levels range from 49.5 to 85.4 dB and are consistent with findings from other international investigations [4,5,8,16,17]. The findings showed that there were variations in the levels of sound while the machinery has just been powered on and when cutting has been taking place. The reported noise-levels are thought to be near the threshold where hearing loss risk is greatest (85 dB is the limit of hearing loss) such sandpaper, sandblasters, and acrylic trimmers (at 15cm and 2m distance). Our findings showed that the turbine produce the higher noise-level in the dental clinic when it was running which could be due to the friction between the dental bur and tooth surface. These results are agreeing with the outcomes of other studies conducted by Fernandes et al., Bahannan et al., and Altin┼z et al. [8,18,19]. Saliva suction and dental equipment are typically utilized in tandem. Therefore, it was not possible to measure analyze noise frequency of each equipment separately [20]. Thus, there were very noticeable changes in noise levels between the low volume suction pump and the turbine cutting teeth. As a result, saliva suction and the ultrasonic scaler have been utilized concurrently, and all noise spectrums of these two dental tools showed highly significant reading disparities. The outcomes concur with earlier research [21]. The dental clinic's micro motor handpiece had a lower noise level than a turbine, which might be because students are rarely use the micro motor handpiece at its maximum speed during practice. The obtained results are coincident with those reported in previous studies [17,22]. The highest noise levels recorded in this investigation were 84.2 dB, 77.3 dB, and 72.9 dB, respectively, when various dental units (turbines, handpieces, and ultrasonic scalers) were employed. Even though these numbers are lower than the maximum allowable value stated by OSHA, care must be taken when drawing conclusions because extended exposure to such noise levels could result in damage of hearing sense. Fernandes et al. recommended Cavanaugh's classification employment to establish a lower bound for learning environments in dental education establishments. Therefore, an upper limit of 56 dB at a typical tone and relaxed communication at 3 m may be sufficient [8]. Every assessed area had a value that was greater than this maximum. The long-term noise exposure that dental professionals face at work will have an impact on both their productivity and job satisfaction. It was discovered that dental professionals' exposure

to sharp occupational noise was linked to short-term physiological signs of headache, nausea, weariness, hypertension, irritability, and tinnitus [24]. The dentists' and dental assistants' impaired hearing and general health deterioration would eventually be the result of such symptoms. It was inferred that continuous monitoring of noise-level to ensure environment serenity and well-being of dental staff is necessary for the environmental management planning to improve working conditions and lower risks of health hazards to dental operators. Programs that prevent hearing loss are vital for maintaining the mental and physical well-being of professionals.

Conclusion

The findings presented here show how much the dentist is exposed to high intensity of noise since the begging of dental school. The noise peaks become closer to the limit of 85dB, which can determine reduction of hearing to the dental operators with daily work time and longer time. Therefore, each dental operator should follow aperiodic audiometric evaluation to assess their hearing level, and as a rule, hearing protection devices, including ear plugs and muffs, should be used.

Furthermore, constructing sound-proof barriers and walls between dental clinics is needed to reduce and control the environmental noise.

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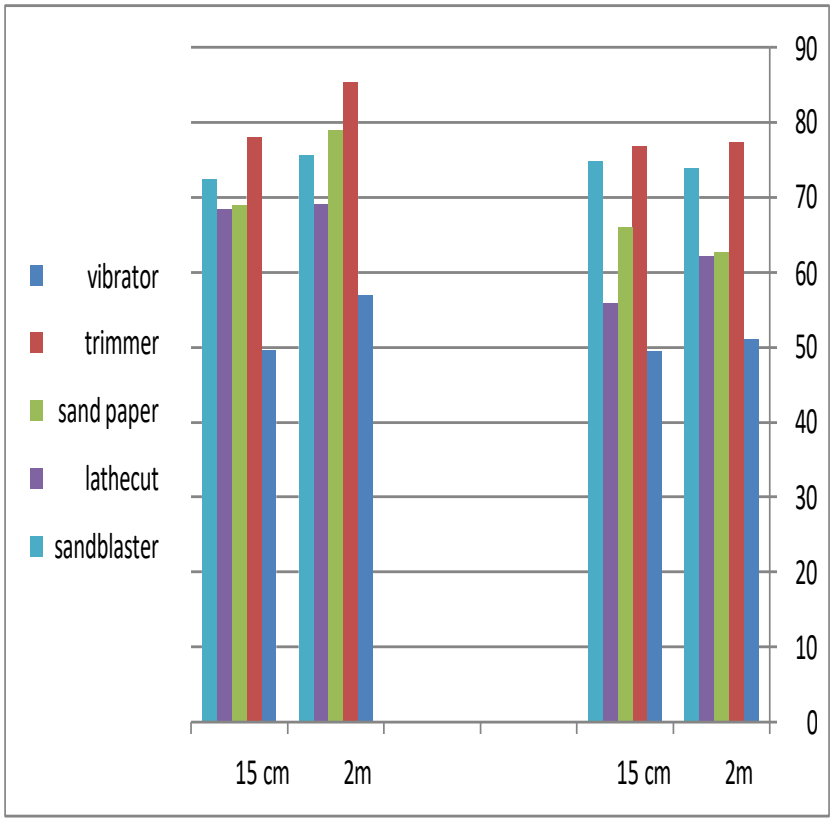

Figure 1. The sound level meter measurements made in clinical settings at three separate locations.

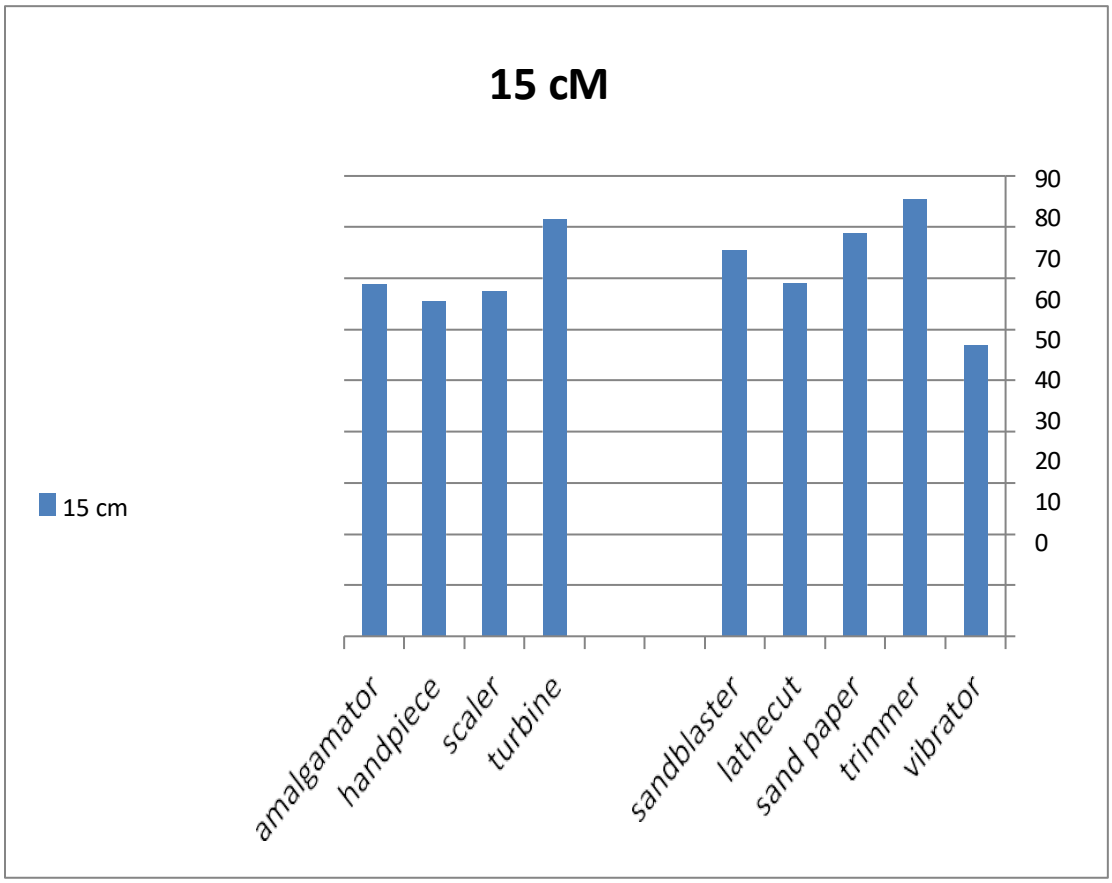

Figure 2. Equipment noise level measurements made in dental labs at three separate locations.

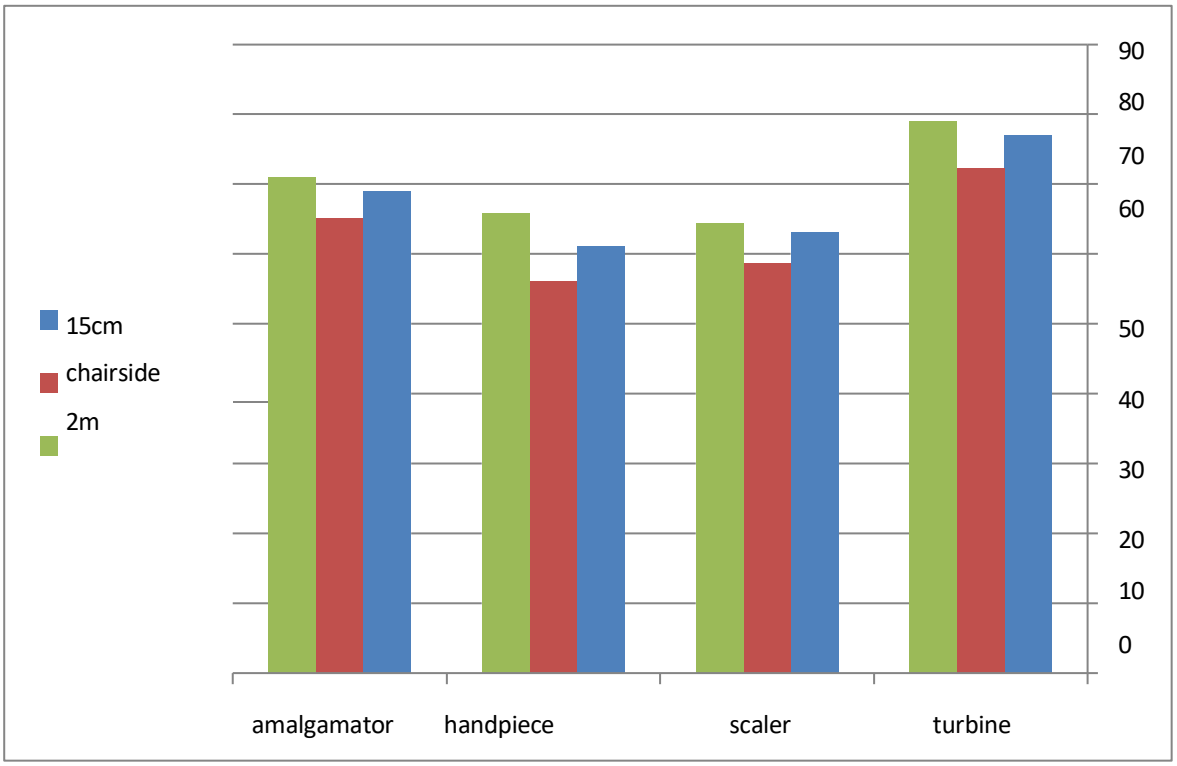

Figure 3. Average noise levels of clinical and laboratory equipment.