Noise-induced hearing loss in the military dental setting: a UK legislative perspective

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ABSTRACT

Introduction Health professionals working in the dental environment are potentially at risk of noise-induced hearing loss (NIHL) due to the use of clinical and laboratory equipment. Workplaces engaging in the practice of dentistry within the UK are subject to legislation from the Control of Noise at Work (CNW) regulations 2005. Clinicians working in the military are at further increased risk of NIHL due to exposure from additional risk factors such as rifles or aircraft engines. To our knowledge, no authors have previously studied the noise levels experienced in a military dental setting or compared noise levels in a typical dental practice with current UK legislation.

Method Measurements of noise levels experienced by a dentist, dental nurse and dental hygienist during a standard conservation procedure were assessed using wearable noise dose-badges. Furthermore, noise levels within a dental technician's work space were also assessed. Noise levels produced by representative clinical and laboratory equipment were assessed and compared with CNW legislation.

Results The highest level for clinical equipment was produced by the suction apparatus while aspirating up a cup of water at 76 dB. For laboratory equipment, the lower exposure action value (LEAV) of 80 dB would be exceeded in 2.1 hours' use of the trimmer, 3.6 hours' use of the vibrating table and 9 min use of the airline.

Conclusions Noise levels experienced by clinicians within the dental surgery were well below the legislative LEAV thresholds for both peak and continuous noise. However, noise levels produced by laboratory equipment were far higher and there is clearly the potential for excessive noise exposure for dental professional in the everyday setting. Dental professionals responsible for dental laboratory settings must be familiar with the CNW regulations and measures put in place that control the inadvertent breach of legislation. Hearing protection must be mandated when using equipment that exceeds the LEAV and an educational programme is required to explain both their correct use and the rationale behind it. Methods of mitigating that risk further require exploration such as alternative methods of completing the tasks performed by the airline or reducing the noise generated by it, such as by reducing the supply pressure or using an alternative nozzle design.

Key messages

- The majority of dental professionals are not at risk of exceeding the Control of Noise at Work (CNW) threshold levels in their daily business.
- However, dental laboratory settings were found to be at risk of exceeding the CNW threshold levels in certain aspects of their daily business.
- The majority of dental professionals are not at risk of exceeding the CNW threshold levels in their daily business.

INTRODUCTION

Noise-induced hearing loss (NIHL) is a permanent reduction in sensorineural hearing caused by occupational activity.[1] This type of hearing loss is attributed to prolonged exposure to high-intensity noise.[2] This loss begins when high frequencies of about 4000 Hz are reached. Long-term exposure to noise levels beyond 80 dB(A) carries an increased risk of hearing loss, which increases with the noise level and can ultimately lead to hearing impairment.[3] The most commonly used definition for hearing impairment is a weighted average hearing loss at differing frequencies (1 kHz, 2 kHz, 3 kHz and 4 kHz greater than 25 dB).[4] Such a hearing loss decreases the capacity to engage in conversation in meetings or social activities thus creating a significant barrier in establishing or maintaining emotional relationships.[3] Health professionals working in the dental environment are known to be at risk of NIHL due to the use of clinical equipment such as ultrasonic scalers and laboratory equipment (table 1).[2 5–9] The effects on dental health professionals have been studied in dental schools in Hong Kong and has been shown to result in sleep disorders, persistent fatigue, headaches, irritation, hypertensive heart diseases and tinnitus.[10–12]

Workplaces engaging in the practice of dentistry within the UK are subject to the Control of Noise at Work (CNW) regulations 2005, which were introduced on 6 April 2006 by the Health and Safety Executive (HSE).[13] The aim of these regulations is to ensure that the hearing of workers is protected from excessive noise at their place of work. This legislation is applicable to dental staff both under employment and those self-employed. CNW regulations require an employer who carries out work, which is liable to expose any employees to noise at or above a lower exposure action value, to make an assessment of the risk from that noise to the health and safety of their employees. Furthermore, the risk assessment shall identify measures that need to be taken to meet the requirements of these regulations. The guidelines provide lower and upper exposure action values (LEAV and UEAV) thresholds for both continuous and peak sound pressure levels. These are currently 80 dB and 85 dB for LEAV and UEAV, respectively.[13] The peak sound pressure level (Lpk) is a measure of the maximum instantaneous sound

Table 1 Dental equipment at risk of producing harmful noise levels as described in previous papers in the literature

Equipment	Goswami *et al*[5]	Bahannan *et al*[8]	Singh *et al*[9]
High-speed handpiece	79.3	78.98	73.9
Low-speed handpiece	65.4	71.89	72.6
Suction—dry			
Suction—wet	73.9		
Ultrasonic bath			
Ultrasonic scaler	59.9		76.8
Steriliser			
Trimmer	95.5	77.51	
Airline			
Vibrating table	73.7		

pressure at a specified location. This value is taken into context by different types of weighting, but this is rarely described in papers based in dental settings.[2 5] C-Weighting, which follows the frequency sensitivity of the human ear at very high noise levels, produces a LCpk value. The C-weighted scale best characterises low-frequency sounds capable of inducing vibrations in buildings or other structures and are expressed as dBC.[6] The international standard of the 8-hour daily occupational exposure to noise is no more than 85 dB(A) A-weighted equivalent sound level (LAeq) for a 5-day workweek in any working environment.[6]

Clinicians working in the military are at further increased risk of NIHL due to a number of higher risk occupational exposures.[14 15] These include aviation personnel, engineers and those using machinery including tanks.[14] Like their civilian counterparts, those military personnel working in a dental centre have increased NIHL risk factors. This is further compounded by the use of automatic weapons both in training, but particularly in those required to have used them in combat. It is therefore possible for military personnel working in a dental environment to have at least three separate and cumulative occupational risk factors for NIHL. Defence Primary Healthcare (DPHC) has 120 Dental Surgeries worldwide employing approximately 700 staff. This makes it one of the largest dental employers in the UK. Although the effect of noise in the dental surgery and dental laboratory is well studied, to our knowledge there is no work published in relation to noise levels set against CNW regulations. In addition, no previous study has been undertaken into hearing loss specifically in the military dental setting. The aim of this paper was therefore to ascertain the doses of noise that military clinicians are exposed to in a typical dental centre and relate that to current maximum thresholds as described in CNW legislative regulations for the UK.

METHOD

The assessment was undertaken at Dental Centre at Aldershot, Hampshire, UK within clinical treatment rooms representative of the DPHC organisation in general. This particular dental centre was selected due to the co-location of a dental laboratory with multiple dental surgeries. Measurements of noise levels experienced by a dentist, dental nurse and dental hygienist during a standard conservation procedure were assessed using wearable noise dose-badges (figure 1). In addition, noise levels produced by a variety of dental and dental laboratory equipment were assessed during normal use (table 1). Equipment used comprised three wearable logging noise dose-badges, a single logging handheld sound level meter and two calibrators

Figure 1 Dental officer wearing a noise dose-badge.

(table 2). The meters used were all less than 12 months old and had been both calibrated and validated by the manufacturers. Calibration was repeated immediately prior to each recording. Both high-speed and low-speed hand-pieces as well as suction was assessed. The duration of the procedure undertaken by the dentist and dental nurse was 18 min, representative of the mean time taken to perform a standard conservative dental treatment. No radio music or other extraneous sound sources were in operation during the assessment. The dental hygienist wore a dose-badge for the duration of a single treatment session using ultrasonic scaling and suction which lasted 30 min. Dose-badge measurements were logged at intervals of 1 s. Noise levels produced by individual items of dental equipment were determined using a hand-held sound level meter at 45 to 60 cm away from the item. This distance was chosen to approximate the distance from surgical instrument to the ear in normal use. The cumulative use of each type of dental laboratory equipment over a single clinical day was ascertained.

RESULTS

Dentists and dental nurses were both assessed for similar amounts of time, but the nurses experienced a higher total noise dose (table 3). The hygienist had a greater exposure time (approximately 35 min), but this only resulted in a slightly greater noise dose. The highest noise level in the dental surgery was produced by the suction apparatus while aspirating a cup of water at 92.3 dB based on the LCpk scale (table 4). The use of laboratory equipment resulted in consistently higher values of noise exposure compared with that used in the surgery alone, with the authors producing the highest overall dose

Table 2 Noise measurement equipment used in this study

Item	Serial number	Calibration date
CEL dBadge 2-1	1758541	14 Apr 2015
CEL dBadge 2-2	1758631	14 Apr 2015
CEL dBadge 2-3	1758665	14 Apr 2015
CEL 120/2 calibrator	0255000	14 Apr 2015
Svantek SV977 SLM	36807	26 Mar 2015
Aco 7052E ½″ mic	59384	26 Mar 2015
Svantek SV12L pre-amp	42560	26 Mar 2015
Svantek SV33 calibrator	39679	26 Mar 2015

Table 3 Summary of dose-badge measurements produces in this study

	Start	End	Duration (h:min:s)	LCpk (dB)	LCpk time	LAeq (dB)	LCeq (dB)	LAE (dB)	NEP	Number to LEAV
Dentist	10:25:00	10:43:55	00:18:59	108.7	10:35:09	72.7	74.7	103.0	0.2	146
Dental nurse	10:25:00	10:45:46	00:19:51	110.5	10:39:14	70.1	72.2	100.8	0.1	243
Hygienist	12:00:00	12:35:00	00:35:00	113.9	10:59:00	81.4	83.9	114.6	3.2	10

LAE, Sound exposure level; LAeq, A-weighted equivalent continuous level; LCeq, C-weighted equivalent continuous level; LCpk, Peak noise level - C weighting; LEAV, lower exposure action value; NEP, Noise-equivalent power.

(113.2 dB). The LEAV of LEP,d 80 dB would be exceeded in approximately 2.1 hours' use of the trimmer, 3.6 hours' use of the vibrating table and 9 min use of the airline. For the HSE UEAV of LEP,d 85 dB, these times become approximately 6.7 hours for trimmer, 11.3 hours for vibrating table and 28 min for the airline. Assessment of use of laboratory equipment over a single 24-hour period demonstrated that the vibrating table was the most commonly used, with a cumulative use of 0.12 hours per day (table 5).

DISCUSSION

The aim of this paper was therefore to ascertain the doses of noise that military clinicians are exposed to in a typical dental centre and relate that to current maximum thresholds as described in CNW legislation. Noise levels experienced by the dentist, nurse and hygienist during a normal conservative procedure were well below the legislative LEAV thresholds or both peak and continuous noise of 80 dB. The highest level was produced by the suction while sucking up a cup of water at 76 dB, consistent with previous research.[5] However, noise levels measured from using dental laboratory equipment were far higher and there is clearly the potential for excessive noise exposure for dental professionals in the everyday setting. In particular, the use of the airline (used to produce a jet of air to disperse particulates) poses a risk of exceeding the daily exposure levels within 9 min. It is also possible that the trimmer could exceed the exposure levels if used for over 2 hours and dental centres in which this may be of increased risk (such as those producing large quantities of models) should have time restrictions instigated. Methods of mitigating that risk require exploration. An audit of the time spent by three dental technicians within the Aldershot Dental laboratory using the trimmer, vibrating table and airline demonstrated that they did not exceed the time levels required to breach the regulations. However, a programme for continuous audit needs to be put in place especially if working patterns alter the time spent on each high risk laboratory item. While this paper was conducted with the military setting, the messages also translate to the non-military setting. Dental professionals responsible for dental laboratory settings must be familiar with the CNW regulations and measures put in place that control the inadvertent breach of legislation.

Hearing protection in terms of earmuffs and earplugs can reduce noise exposure to safe levels,[3] but their use must be both enforced and checked. In addition, an educational programme is required to explain both their correct use and the rationale behind it or compliance is unlikely. Alternative methods of completing the tasks performed by the airline could be explored such as by washing or vacuuming. In addition, it is recommended that ways of reducing the noise generated by the airline be explored, such as by reducing the supply pressure or using an alternative nozzle design.

Table 4 Summary of dental equipment noise measurements compared with Control of Noise at Work regulations

Process	LCpk (dB)	LAeq (dB)	LCeq (dB)	Time to LEAV (h)	Time to UEAV (h)
High speed	79.3	67.4	66.7	>24	>24
Low speed	81.5	64.8	64.2	>24	>24
Dry suction	84.6	71.1	72.0	>24	>24
Wet suction	92.3	75.9	75.9	20.6	>24
Ultrasonic bath	90.3	69.6	69.2	>24	>24
Ultrasonic scaler	93.1	75.3	74.0	23.6	>24
Steriliser	102.2	51.2	59.0	>24	>24
Trimmer	101.3	85.8	90.0	2.1	6.7
Airline	113.2	97.3	95.4	0.15	0.47
Vibrating table	101.5	83.5	86.9	3.6	11.3

LAeq, A-weighted equivalent continuous level; LCeq, C-weighted equivalent continuous level; LCpk, Peak noise level - C weighting; LEAV, lower exposure action value; UEAV, upper exposure action value.

Table 5 Mean use of dental laboratory equipment per hour based on a standard 8-hour clinical day

Process	Mean usage per hour (min)
Trimmer	1.7
Airline	0.8
Vibrating Table	7.2

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