



## NOISE EXPOSURE DURING ORTHOPAEDICS SURGERY

Ailin Razali\*, HENDY Putra Herman, Ahmad Hafiz Zulkifly,

Department of Otorhinolaryngology-Head and Neck Surgery (ORL-HNS) Kulliyah of Medicine International Islamic University Malaysia 25200 Kuantan Pahang Malaysia.

\*Corresponding author email: [ailin@iium.edu.my](mailto:ailin@iium.edu.my)

This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

### ARTICLE DETAILS

### ABSTRACT

#### Article History:

Received 3 July 2017

Accepted 3 October 2017

Available online 3 December 2017

#### Keywords:

orthopaedics, noise exposure, noise-induced hearing loss, dosimeter.

There is serious concern on noise hazard in operating theatre especially in the orthopaedics field that requires usage of many instruments. However, data on this noise exposure particularly in Malaysia is rather limited. This study was conducted as a pilot study to investigate the noise exposure in orthopaedics theatre in a hospital in Kuantan, Pahang in June 2011. Several different orthopaedics theatres involving procedures that use powered instruments were investigated. Time recorded noise exposures were taken using personal noise dosimeters throughout the surgeries worn by the surgeons. The peak noise level and the average noise exposure within 8 hours were determined, and compared with the available Factory and Machinery Act (Noise) standards. Six out of seven surgeries exceeded 140 dBA for peak sound levels. The average noise exposure within 8 hours was below 85 dBA in all cases. Although the average noise level did not surpass the stipulated guidelines, the peak level exceeding 140 dBA still carries risk for hearing loss. In conclusion, healthcare personnel in operating theatre were exposed to noise hazard for certain medical procedures. Hence, proper noise management should be implemented to protect them from noise-induced hearing loss while maintaining the success and efficiency of the surgeries.

### 1. INTRODUCTION

Noise is unwanted sound that can adversely affect human's hearing. Prolonged, high intensity sound may cause damage to the inner ear's structure leading to noise-induced hearing loss (NIHL) that is common in workplace [1]. NIHL occurs due to prolonged noise exposure at 85-120 dBA while greater than 130 dBA, whole body effects could be observed. This may be presented by a whole spectrum of symptoms from mild to severe hearing loss. NIHL is caused by cumulative effect of noise exposure; hence the intensity and duration of the noise exposure would determine the severity of the disease [2].

Globally, the main cause of NIHL in adults is from occupational source [1]. In Malaysia, there was a rising number of NIHL annually from 2008 to 2012 [3]. Many occupations are at risk of NIHL such as mine and factory workers, military personnel, traffic policemen, as well as dentists and orthopaedics staff from health service. Surgeons and scrub nurses are at high risk due to the use of powered instruments that could exceed the safety regulation by Factories and Machinery (Noise Exposure) Regulations 1989. Therefore, the main objectives of this study were to measure the noise exposure in orthopaedics theatre, determine the peak level of noise produced in orthopaedics surgery, and to determine Time Weighted Average of noise exposure for 8 hours in orthopaedics surgery.

### 2. SUBJECTS AND METHODS

Convenient sampling was used in this study involving 7 cases of orthopaedics surgery that had taken place in a hospital in Kuantan from 8<sup>th</sup> June until 23<sup>rd</sup> June 2011. All orthopaedics surgery using powered instruments was the target population. The ethics committee of the Kulliyah of Medicine, International Islamic University Malaysia (IIUM) has approved this study. The study instrument was a noise dosimeter, used to measure noise exposure in the theatre.

The noise dosimeter model DL of Quest Technologies, was worn by an orthopaedics surgeon under sterile gown with the microphone attached to the collar approximately 10 cm from the ear throughout the operation. The results yielded duration of study, peak noise level, slow maximum level, slow minimum level, Equivalent Levels (Leq), Time Weighted Average (TWA), Time Weighted Average 8-hours (TWA<sub>8h</sub>), dose, dose 8-

hours and Sound Exposure Level (SEL).

**Table 1:** Time recorded noise exposure in orthopaedics theatre in a hospital at Kuantan, Pahang.

Procedure	Time	Peak Level (dB)	Slow Max (dB)	Slow Min (dB)	Leq (dB)	TWA (dB)	TWA (8h) (dB)	Dose (%)	Dose (8h) (%)	SEL (dB)
ILN	3:04:19	146.4	108.4	65.0	62.7	56.9	62.7	1.0	2.3	113.0
Ilizarov	3:28:28	142.0	117.8	65.0	76.0	72.4	76.0	5.4	12.5	116.9
DHS	3:11:17	143.6	114.4	65.0	79.0	75.0	79.0	10.0	25.1	119.6
Plating Femur-1	2:02:09	140.4	112.4	65.0	75.5	69.6	75.5	2.9	11.2	114.2
TKR	4:04:24	143.3	112.4	65.0	75.8	72.8	75.8	6.1	11.9	117.4
Plating Femur-2	2:10:40	135.2	112.6	65.0	75.0	69.4	75.0	2.7	10.0	113.9
Removal of ILN	3:40:06	146.4	106.3	65.0	54.6	49.0	54.6	0.3	0.7	123.1

### 3. RESULTS AND DISCUSSION

From the results (Table 1), peak sound levels were measured in excess of 140 dB on six out of seven occasions. The highest peak level was recorded during interlocking nail of femur, which was 146.4 dB while the lowest peak was recorded during plating of femur, which was 135.2 dBA. This excess over 140 dBA peak levels exceeded the Factories and Machinery (Noise Exposure) Regulations 1989 [4]. Instruments used in most orthopaedics procedures takes up less than 5 % of the procedure [5]. Therefore, even though the time of usage is limited, the long operating lists with multiple procedures might present significant cumulative effects on the hearing of orthopaedics staff involved in surgery. As the use of ear protector might not be suitable as it could hinder communication and is generally regarded as cumbersome; minimizing the noise levels might be the best option. This can be achieved by applying a noise barrier around or near the operating table, isolating the source of noise, increasing the absorption of walls and ceilings, and decreasing the time exposure of health professionals in operating theatre [6]. After all, the most preventive measures to prevent NIHL are the use of hearing protective devices, if it is

not possible; some engineering intervention should be implemented [7].

For maximum sound level, there was only one surgery involving Ilizarov apparatus with pin insertion, which produced maximum sound level more than 115 dB which was 117.8 dBA. For the rest of the cases, the value lies within the range from 54.6 dB to 79.0 dBA. According to Factories and Machinery (Noise Exposure) Regulations 1989, maximum sound level in working place must not exceed 115 dB (A) at any time [4]. The exceeding case of Ilizarov insertion was due to the usage of saw to cut the bone compared to other operations in which the instrument was used intermittently in a brief period of time. For a comparison, like their orthopaedics counterpart, dentists are also exposed to many sources of hazardous noise from their dental procedures; for example, using suction, hand piece, and ultrasonic scaler [8]. After a certain period of exposure to noise, the threshold shift of hearing will increase of 10 dB or more at 2000, 3000, and 4000 Hz in either ear [9]. However, this is unnoticeable until a large threshold shift occurs due to its gradual progress of hearing impairment [10]. At 4000 Hz, the region is most affected by broad-band noise, due to several factors such as the amplification of noise in 2000 to 4000 Hz region when it reaches inner ear and the vulnerability of the cochlea region [11].

Next, the Time Weighed Average (TWA) in 8 hours showed that it lies within the range of 54.6 dB to 79.0 dBA. Based on Factories and Machinery (Noise Exposure) Regulations 1989, the maximal exposure time allowed for noise exposure at 90 dB (A) is 8 hours per day and with 5 dB increments, the exposure times are halved<sup>4</sup>. This study has shown that in all orthopaedics surgeries (7 cases), the noise level was considered safe for all staff involved. This is important because continuous noise exposure would exhaust the stapedius muscle, which protects the inner ear structure from excessive noise and vibration especially the impulsive noise [12]. Apart from that, a study showed that there was dramatic increase of hairy cells damage of guinea pigs that have been exposed to noise between 115 and 120 dBA. The observation of the nuclei showed there were nuclear swelling and condensation that lead to apoptosis [13].

Among recommended hazard communication to be installed in operating theatres is installing warning signs on hearing hazard in Malay (Malaysian national language) and English and it should be clearly visible for all staff using the operating theatre. Additionally, all workers should be well informed on the noise exposure and prevention of NIHL. Lastly, training program including physical and psychological effect of hearing loss, hearing protector selection, audiometric testing and roles and responsibilities of both employers and workers should be done annually [9].

#### 4. CONCLUSION

In conclusion, the average noise exposure in 8 hours time was within the legislation by Ministry of Human Resources Malaysia but the peak sound level recorded were exceeded 140 dB (six out of seven cases) and the maximum noise level (slow max) was more than 115 dB in Ilizarov application. Therefore, it was advised that noise level in Orthopaedics theatre be monitored regularly and some precautionary measures should be done to reduce the risk to all staff involved.

#### ACKNOWLEDGEMENT

The study was conducted by Aisyah Bt. Badhrulhisham as her elective posting in Audiology Unit, Department of Otorhinolaryngology-Head and Neck Surgery (ORL-HNS), Kulliyah of Medicine.

#### REFERENCES

- [1] John, A.G.B., Graville, A., Rosser, J., Black, D. 1994. Noise induced hearing loss of occupational origin. Wellington: Department of Labour.
- [2] Rampal, K.G., Ailin, R., Noor, H.I. 2011. Auditory disorders. In: Koh D, Takahashi K, editor. Textbook of Occupational Medical Practices, 3<sup>rd</sup> ed. Singapore: World Scientific Publication, 295-29.
- [3] Norazimah, C.A., Badrul, B. 2014. Noise-induced hearing loss (NIHL): An ignorant workplace hazard. 5th International Conference on Business and Economic Research (5th ICBER) Proceeding, 635-51.
- [4] Ministry of Human Resources. 2007. Factories and Machinery (Noise Exposure) Regulations 1989. In: Laws of Malaysia Factories and Machinery Act with Regulations, 18<sup>th</sup> ed. Kuala Lumpur: MDC Publishers Sdn Bhd, 411-25.
- [5] Willet, K.M. 1991. Noise induced hearing loss in Orthopaedics staff. The Bone and Joint Journal, 73 (1),113-115.
- [6] Oliveira, C.R.D., Arenas, G.W.N. 2012. Occupational exposure to noise pollution in Anesthesiology. Revista Brasileira de Anestesiologia, 62 (2), 253-261.
- [7] Chen, W.L., Chen, C.J., Yeh, C.Y., Lin, C.T., Chen, H.C., Chen, R.Y. 2013. Workplace noise exposure and its consequent annoyance to dentists. Journal of Experimental and Clinical Medicine, 5 (5), 177-180.
- [8] National Institute for Occupational Health and Safety (NIOSH). 1998. Occupational Noise Exposure Revised Criteria 1998. Cincinnati: National Institute for Occupational Safety and Health, 1-105.
- [9] Concha-Barrientos, M., Campbell-Lendrum, D., Steenland, K. 2004. Occupational noise: assessing the burden of disease from work-related hearing impairment at national and local levels. Geneva: World Health Organization, 1-33.
- [10] Bess, F.H., Humes, L.E. 2006. Audiology the Fundamentals, 3<sup>rd</sup> ed. Baltimore: Lippincott Williams and Wilkins, 145-84.
- [11] Nott, M.R. 2003. Orthopaedics theatre noise: a potential hazard to patients. Anaesthesia, 58, 775-03.
- [12] Hu, B.H., Guo, W., Wang, P.Y., Henderson, D., Jiang, S.C. 2000. Intense noise-induced apoptosis in hair cells of guinea pig cochleae. Acta Otolaryngol, 120, 19-24.
- [13] Siverdeen, Z., Ali, A., Lakdawala, A.S., Mckay, C. 2008. Exposure to noise in orthopaedics theatres – do we need protection? International Journal of Clinical Practice, 62 (11), 1720-22.