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Otoscopic Changes Before and After Shooting Amongst Military Army Personnel

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ABSTRACT

The effect of loud noise to the army personnel is often identified when hearing loss had already developed. Acoustic trauma during shooting training can also lead to acute changes in the ear which is shown on otoscopic examination. This study was undertaken to determine the effectiveness of hearing protective device (earplug) on the prevalence of external ear changes amongst military personnel during shooting. This is a prospective cross sectional study that was conducted among 76 military personnel, who were divided into two groups: those with and without earplugs during shooting. Each participant underwent 3 otoscopic examinations: (a) pre-shooting, (b) immediate post-shooting (within 48 hours) and (c) 2 weeks after shooting. A total of 78 army personnel who were scheduled to undergo shooting training were otoscopically examined. Eighty three percent of them did not wear earplugs before. The percentage of inflammation of external auditory canal and tympanic membrane dullness increased tremendously among subjects from non–earplug group less than 48 hours post-shooting. Assessment after 2 weeks showed improvement in around 30% of the subjects. Loud noise has become an occupational hazard not only to the inner ear but it also predisposes the external and middle ear structures to some form of injury. Although improvement is seen after some period, a protective device such as an earplug should be recommended and the usage should be reinforced among the army personnel involved in shooting.

Keywords: Noise, shooting, otoscopy, external ear, middle ear

INTRODUCTION

Acoustic trauma can occur following exposure to very intense noise, typically blasts more than 150 dBA. Humans experiencing blasts at very high sound levels (~180 dB SPL) may suffer damage to the middle ear, including haemorrhage or perforation of the eardrum and fracture of the malleus.[1,2] It is a part of important physiological protection of the ear to protect the inner ear components, which is more sensitive to irreversible sensorineural damages. If the eardrum does not rupture during such an intense exposure, the organ of Corti is likely to rupture off the basilar membrane.[1-3] Once this occurs, it does not re-attach to the basilar membrane. The organ of Corti will eventually degenerate, leading to the permanent noise-induced hearing loss (NIHL).

Several ear protective devices such as earmuffs and earplugs have been introduced to reduce the incidence of noise-induced occupational hazard. This is to protect the sensorineural integrity especially of those predisposed to loud noise; for example, during shooting training among army personnel. However, their effects on physical appearance of external and middle ears are rarely evaluated. This study was conducted to evaluate the otoscopic changes on the army personnel involved in shooting and the effect of using earplugs in reducing the incidence of acoustic trauma.

METHODOLOGY

This was a prospective cross sectional study to evaluate the external and middle ear changes following loud intense noise which resulted from shooting. Theparticipants were given questionnaires about the knowledge of noise-induced hearing loss in a military setting, whether they had used earplugs before and the reasons of not wearing any. Then, they were randomly divided (not age-matched) into 2 groups, those using earplugs and a non-earplug using group. Those in the earplug group were given earplugs (Surefire EP3 Sonic Defender ™ earplug from Surefire Company, USA), and needed to wear them during shooting training. Otoscopic examination was performed for both before

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and after shooting (within 48 hours) in both groups. A repeat otoscopic examination was again performed 2 weeks after shooting to evaluate the recovery of the condition.

RESULTS

A total of 78 army personnel who were scheduled to undergo shooting training were included in the study. The age ranged from 18 years to 49 years old. A majority of the subjects (47.2%) fell in the age group of 31 to 40 years old with the mean age of 33 years old. Sixty seven subjects (88.2%) were males. A total of 66 subjects (84.2%) were the right-handed shooters. Among all the subjects, only 17.1% (13 subjects) wore earplugs during shooting although the majority (95 %) of them knew that loud noise could affect their hearing.

Fisher's exact test was done to see the correlation between knowledge about loud noise (which can cause noise-induced hearing loss) with the use of earplug during shooting. It was not statistically significant (p value > 0.05).

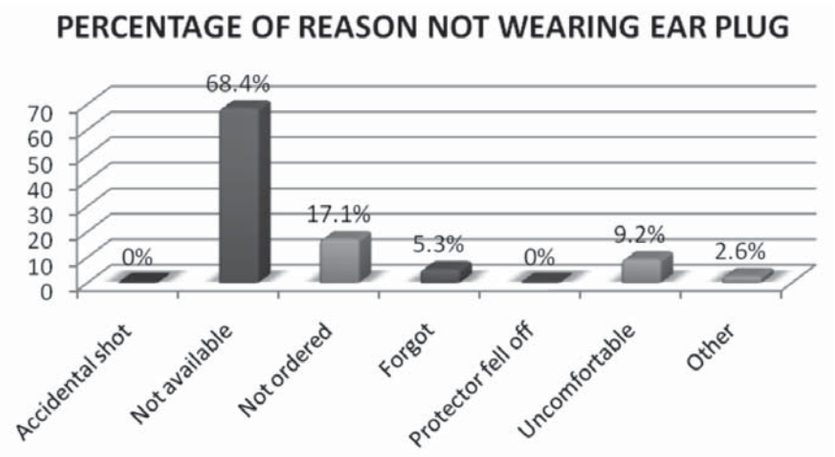

Figure 1. Reasons for not wearing earplugs during shooting.

As for the reasons for not wearing earplugs, 68.4% citedearplugs were not available as the main reason for not wearing it, followed by other reasons: not ordered to do so (17.1%), uncomfortable (9.2%) and 2.6% not familiar with the earplug usage and could not focus during shooting.

Otoscopic examination of the ear was performed prior toshooting. On the right ear, we found that there were a few subjects who had ear pathologies. A majority of the ear pathology was retracted tympanic membrane 3.9% (3 subjects) and 2.6% (2 subjects) had discharge at the external ear canal.

Examinations of the left ear showed the presence of tympanic membrane dullness in 10.5% (8 subjects)while 3.9% (3 subjects) had impacted wax and followed by 1.3% (1 subject each pathology) who had an inflammation

Table 1. Otoscopic findings for of both ears pre-shooting.

		Pre Shooting			
		Earplug Group		Non-Earplug Group	
		Right Ear	Left Ear	Right Ear	Left Ear
External Auditory Canal	Inflammation	-	-	1 (1.3%)	1 (1.3%)
	Impacted Wax	-	-	1 (1.3%)	3 (3.9%)
	Foreign Body	-	-	-	-
	Discharge	-	-	2 (2.6%)	-
Tympanic Membrane	Inflammation	-	1 (1.3%)	-	-
	Perforation	-	-	-	-
	Dull	1 (1.3%)	1 (1.3%)	1 (1.3%)	7 (9.2%)
	Retracted	-	-	3 (3.9%)	-
	Plastered	-	-	-	1 (1.3%)

of the external auditory canal, inflammation of tympanic membrane, plastered tympanic membrane and retracted tympanic membrane respectively. A majority of subjects with the pathologies were from the non-earplug wearing group during shooting.

Table 2. Otoscopic findings for post-shooting (less than 48 hours).

		Post Shooting 2 Days			
		Earplug Group		Non-Earplug Group	
		Right Ear	Left Ear	Right Ear	Left Ear
External Auditory Canal	Inflammation	4 (5.3%)	4 (5.3%)	27 (35.5%)	28 (36.8%)
	Impacted Wax	-	-	-	-
	Foreign Body	-	-	-	-
	Discharge	-	-	1 (1.3%)	-
Tympanic Membrane	Inflammation	1 (1.3%)	3 (3.9%)	16 (21.1%)	29 (38.2%)
	Perforation	-	-	-	-
	Dull	1 (1.3%)	1 (1.3%)	7 (9.2%)	7 (9.2%)
	Retracted	-	1 (1.3%)	1 (1.3%)	1 (1.3%)
	Plastered	-	-	-	1 (1.3%)

The percentage of inflammation of the external auditory canal increased tremendously among subjects from non–earplug wearing group less than 48 hours post-shooting (35.5.% for right ear and 36.8% for left ear) compared to 5.3% in both ears among subjects in the earplug wearing group. There was also an increase in the percentage of tympanic membrane dullness in both ears (9.2% for right ear and 7.9% for left ear) in the non-earplug wearing group compared to 1.3% in the earplug wearing group. Generally, most of the changes occurred among subjects from the non-earplug wearing group compared to the earplug wearing group.

Table 3. Otoscopic findings for post-shooting (after 2 weeks).

		Post Shooting 2 Weeks			
		Earplug Group		Non-Earplug Group	
		Right Ear	Left Ear	Right Ear	Left Ear
External Auditory Canal	Inflammation	-	-	2 (2.6%)	4 (5.3%)
	Impacted Wax	-	-	-	-
	Foreign Body	-	-	-	-
	Discharge	-	-	1 (1.3%)	1 (1.3%)
Tympanic Membrane	Inflammation	-	1 (1.3%)	4 (5.3%)	7 (9.2%)
	Perforation	-	-	1 (1.3%)	-
	Dull	-	-	10 (13.2%)	8 (10.5%)
	Retracted	-	-	-	-
	Plastered	-	-	-	1 (1.3%)

The inflammation of the external auditory canal reduced markedly to around 32.9% in the right ear and 31.5% in the left ear among non–earplug wearing group at 2 weeks post-shooting as compared to at 2 days post-shooting. The inflammation of the tympanic membrane was also reduced to around 29% in the left ear and 15.8% in the right ear. A majority of the external ear pathology occurred among subjects from the non–earplug wearing group. Meanwhile, only a small number of subjects among the earplug wearing group (one to four subjects) had changes in the external ear in all three occasions of otoscopic examination. However, there was increased tympanic membrane dullness 2 weeks post-shooting as shown in Table 3. At two weeks, the changes in the external ear were more prominent and persistent in subjects from the non-earplug wearing group compared to subjects from the earplug wearing group.

DISCUSSION

A few subjects (10.5%) in this study had dullness of the tympanic membrane even before they underwent firearm training. There were also the presence of retracted tympanic membrane and plastered tympanic membrane. This may indicate they already had the middle ear effusion. Retraction or dullness of the tympanic membrane usually indicates negative middle ear pressure, effusion or both in which the lateral process of malleus and posterior malleolar fold are prominent and the handle of malleus appears shortened.[4]

At 2 days post-shooting, the majority of the changes occurred in the non-earplug wearing group. Inflammation of the external auditory canal in the group not wearing earplugs was very prominent (35.5 % for right ear and 36.8 % for left ear) compared to 5.3 % in both ears among subjects who wore earplugs during shooting. Inflammation of the external ear could be due to direct trauma of the rifles. The most common types of trauma to the tympanic membrane or middle ear usually results from thermal, blunt or penetrating trauma.[5]

We also noted that there was an increased number of subjects with middle ear effusion at 2 days post-shooting. Otoscopic examination done within 48 hours post-shooting showed an increase in the percentage of tympanic membrane dullness in right ears (9.2%) but there were no changes in the left ear in non-earplug wearing group compared to 1.3% in earplug wearing group for both ears. This percentage is low compared to a study by Zambri in 2007 which was 21.1 % on clinical examination and 22.9% with flat tympanometry. Tympanometry was not done in this study and this objective test will help to confirm the presence of middle ear effusion.[6] DPOAE is also a good objective test to detect the presence of middle ear effusion. DPOAEs input–output (I-O) function curve, elicited by two primary tones f1 and f2 will diminish at 3 kHz and 4 kHz under conditions of middle ear effusion.[7] However, DPOAEs at low frequency was not tested in this present study.

Besides tympanic membrane dullness, the frequency of tympanic membrane inflammation at 2 days post-shooting was also noted to be higher in the left ears among the shooters in both groups (2.6% higher in the earplug group and 17.1% in non-earplug group). These figures correlate well with the number of right-handed shooters which account for more than 60%. In the right-handed shooters, the ipsilateral ear is somewhat protected by the angle of the head when shooting. Thus, the contralateral ear will be exposed to a greater degree of acoustic trauma.[8]

None of the subjects had any tympanic membrane perforation at 2 days post-firearm training. This was comparable with another previous study whereby none of the subjects had tympanic membrane perforation.[6]

There was strong evidence in this study the ear had undergone a recovery phase after nearly 2 weeks post-firearm training. Otoscopic examination showed the inflammation of external auditory canal reduced markedly, around 32.9% in the right ear and 31.5% in the left ear. The tympanic membrane inflammation also reduced to around 29% in the left ear and 15.8% in the right ear. A majority of the external ear changes post-firearm training occurred among subjects in the group which did not wearing earplugs during shooting. Meanwhile only a small number of subjects among the earplug wearing group (one to four subjects) had changes in the external ear on all three occasions of otoscopic examination. However, clinical improvement of pain associated with the ear pathology, if there was any, was not assessed in this study.

CONCLUSION

Exposure to loud noise does not only cause sensorineural effect of permanent noise-induced hearing loss but also leads to other ear pathology such as external ear canal inflammation and tympanic membrane changes. The use of ear protective devices such as earplugs is helpful to reduce the prevalence. Although the lesion is temporary and might show improvement after 2 weeks, repetitive damage to the external and middle ear structures should be avoided as far as long-term complication is concerned.

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