A STUDY ON THE EFFECT OF FIREARMS ON THE HEARING OF MILITARY PERSONNEL

by

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Dissertation Submitted In

Partial Fulfillment Of The

Requirements For The Degree Of

Master Of Medicine

(Otorhinolaryngology – Head And Neck Surgery)



UNIVERSITI SAINS MALAYSIA

In The Name Of ALLAH The Most Beneficient The Most Merciful

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ACKNOWLEDMENTS

I would like to address my sincere thanks and deepest gratitude to my supervisor, Professor Dr. Din Suhaimi Sidek, a lecturer in Department of Otorhinolaryngology – Head and Neck Surgery, School of Medical Science, Universiti Sains Malaysia, for his assistance and consultation during the period of preparing this precious dissertation. I would like also like to forward my deepest gratitude to my co-supervisor, Professor Madya Dr. Shahid Hassan, a lecturer in Department of Otorhinolaryngology – Head and Neck Surgery, School of Medical Science, Universiti Sains Malaysia, Dr Siti Sabzah Mohd Hashim, the Head of the Department of Otorhinolaryngology , Hospital Sultanah Bahiyah, Alor Star and Kapten Khalid Yaacob, a Deputy Commanding Officer of 12 Medical Company, Territorial Army, HUSM for their guidance and support during the period of research preparation. Without their expert advice and gracious comments, this research could not have been possible.

I would also forever grateful to Dr. Haji Rosdan bin Salim, the Head of the Department of Otorhinolaryngology – Head and Neck Surgery for his scholarly guidance and faith during the period of research preparation.

My special thanks to Lt Col. Amiruddin Dato' Sulaiman, the Commanding Officer of 301 Infantry Camp, Tanah Merah, Kelantan and Lt Col. Ismail Abd Rahman for their help and permission for this study. Without their contribution, this research would have not become a reality.

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I would also like to address my thanks to the statisticians and my brother Dr Mohd Zukri Ibrahim for helping me in statistical analysis.

My appreciation to all lecturers, audiologist, fellow colleagues, clinic nursing staff of ORL – HNS and soldier medical department staff for their cooperation and friendly support.

Finally, to my beloved wife Puan Nazmin Yusoff, my charming child Muhammad Safwan and both my parent and parent in law to whom I dedicate this research: Everything I have ever accomplished and ever will accomplish goes to their credits. Without their love and support, none if this would have been worthwhile.

November 2007

TABLE OF CONTENTS

CONTENTS

Page			
LIST OF TABL	ES	ix	
LIST OF FIGU	RES	xi	
LIST OF ABBR	REVIATIONS	xiii	
LIST OF DEFINITION OF TERMS			
ABSTRACT IN BAHASA MELAYU			
ABSTRACT IN ENGLISH			
CHAPTER 1:	INTRODUCTION		
	1.1 DEFINITION OF HEARING LOSS	2	
	1.2 ANATOMY AND PHYSIOLOGY OF INNER EAR	3	

1.2.1 ANATOMY	3
1.2.2 BLOOD SUPPLY OF LABYRINTH	6
1.2.3 AUDITORY PATHWAY	8
1.2.4 PHYSIOLOGY OF HEARING	10
1.3 PATHOPHYSIOLOGY	12
1.4 IMPORTANCE OF HEARING FOR SOLDIERS	14
1.4.1 IN OFFENSIVE OPERATIONS	14

1.4.2 IN DEFENSIVE OPERATIONS 14

1.4.3 OFFENSIVE AND DEFENSIVE MISSIONS 15

CHAPTER 2:	OBJECTIVES OF THE STUDY			
	2.1 GENE	RAL OBJECTIVES	17	
	2.2 SPECIFIC OBJECTIVES			
	2.3 RESE	ARCH HYPOTHESIS	17	
	2.4 SIGN	IFICANCE	18	
CHAPTER 3:	METHOD	DLOGY	19	
	3.1 STUD	DY DESIGN	19	
	3.2 SAMP	PLING FRAME	19	
	3.3 SAMP	PLE SIZE	19	
	3.4 RESE	ARCH TOOLS	20	
	3.4.1	OTOSCOPE	20	
	3.4.2	TYMPANOMETRY	20	
	3.4.3	OTOACOUSTIC EMISSION	21	
	3.4.4	PURE TONE AUDIOMETRY	22	
	3.4.5	SOUND LEVEL METER	22	
	3.4.6	PORTABLE TREATED SOUND PROOF		
		BOOTH	23	
	3.5 DATA	COLLECTION METHOD	24	
	3.5.1	QUESTIONNAIRE AND CONSENT	24	
	3.5.2	PRE SHOOTING EXAMINATION	25	
	3.5.3	SHOOTING	27	
	3.5.4	POST SHOOTING LESS THAN 48 HOURS	28	
	3.5.5	POST SHOOTING MORE THAN 2 WEEKS	28	
	3.6 ETHIC	AL CONSIDERATION	28	

.

CHAPTER 4:	RESULTS				29
	4.1	GENERAL			29
	4.2	RACIAL DISTRIBUTION			
	4.3	HANDEDNESS DURING SHOOTING			
	4.4	AGE DIS	STRIBU	TION	32
	4.5	DURATION OF WORKING			
	4.6	FREQUENCY OF FIREARM TRAINING			
	4.7	OTOSCO	OPIC E	XAMINATION	35
	4.8	HEARIN	G LEV	EL FOR PRE SHOOTING , POST	
		SHOOTI	NG LE	SS THAN 48 HOURS AND POST	
		SHOOTI	NG 2 V	VEEKS.	
		4.8.1	RIGH	IT EAR	37
		4.8.2	LEFT	EAR	40
	4.9	PREVAL	.ENCE	OF SENSORINEURAL	
		HEARIN	IG LOS	S AT (4KHZ)	43
	4.10	DIFFERE	ENCE E	BETWEEN SNHL WITH	
		HANDE	DNESS	DURING SHOOTING.	43
	4.11	DPOAE	RESUL	TS	
		4.12.1	RIGH	T EAR	44
		4.12.2	LEFT	EAR	
	4.12	COMPAR	rison	BETWEEN DPOAE WITH	
		HEARIN	G LEV	EL OF PTA	
	4.	12.1 POS ⁻	T SHO	OTING LESS THAN 48 HOURS	46
		4.12.	1.1	DPOAE AND PTA AT	
				FREQUENCY OF 6 KHZ	46

4	.12.1.2	DPOAE AND PTA AT	
		FREQUENCY OF 8 KHZ	48
4.12	.2 POST	SHOOTING MORE THAN 2	
	WEEK	S	50
4	1.12.2.1	DPOAE AND PTA AT	
		FREQUENCY OF 6 KHZ	50
	4.12.2.2	DPOAE AND PTA AT	
		FREQUENCY OF 8 KHZ	52
4.13 TYMPANOM	ETRY		54
4.14 DIFFERENC	E BETWEEN	N NORMAL HEARING	
WITH AGE ,	DURATION	OF WORK AND FREQUENCY O	F
FIREARM T	RAINING AT	4KHZ AND 6KHZ.	55
4.15 DIFFERENC	E BETWEE	N SNHL WITH POST SHOOTING	1
48 HOURS A	ND POST S	HOOTING 2 WEEKS AT PTA OF	
(4KHZ , 6KH	IZ AND 8KH	Z)	57

.

CHAPTER 5:	DISCUSSION	58
CHAPTER 6:	CONCLUSION AND SUGGESTION	66
CHAPTER 7:	LIMITATIONS AND RECOMMENDATIONS	68
REFERENCES		69
APPENDICES		73

TABLE OF CONTENT

Table 1.1	A WHO classification system for degree of hearing loss 3			
Table 4.1	Ambient sound at different stage of evaluation			
	using SLM prior to hearing assessment	29		
Table 4.2	Distribution of age, duration of working and			
	frequency of training	34		
Table 4.3	Comparison of right otoscopic examination			
	findings for pre shooting, post shooting 2 days			
	and post shooting 2 weeks	35		
Table 4.4	Frequency of hearing involved in SNHL	42		
Table 4.5	SNHL for Left ear post shooting less than			
	48 hours compare with right and left handedness			
	shooter.	43		
Table 4.6	DPOAE – Different between preshooting and			
	post shooting less than 48 hours	44		
Table 4.7	DPOAE – Different between post shooting less			
	than 48 hours and post shooting more than 2 weeks	45		
Table 4.8	Chi square test right DPOAE with Hearing			
	level pta at 6 kHz	46		
Table 4.9	Chi square test left DPOAE with hearing			
	level of pta at 6 kHz	47		
Table 4.10	Chi square test right DPOAE with Hearing			
	level pta at 8 kHz	48		
Table 4.11	Chi square test left DPOAE with hearing			
	level of pta at 8 kHz	59		

iv

Table 4.12 Chi square test right DPOAE with Hearing		
	level pta at 6 kHz Post shooting 2 weeks	50
Table 4.13	Chi square test left DPOAE with hearing	
	level of pta at 6 kHz Post shooting 2 weeks	51
Table 4.14	Chi square test right DPOAE with Hearing	
	level pta at 8 kHz Post shooting 2 weeks	52
Table 4.15	Chi square test left DPOAE with hearing	
	level of pta at 8 kHz Post shooting 2 weeks	53
Table 4.16	Chi squaretest age, duration of work, frequency of	
	firearm training with normal hearing	55

Table 4.17	Difference between SNHL with post shooting less		
	than 48 hours and post shooting 2 weeks	57	

LIST OF FIGURE:

Figure 1.1	Crossectional view of cochlea	4		
Figure 1.2	Organ of corti			
Figure 1.3	Outer and inner hair cell			
Figure 1.4	Arterial supply of the cochlea	7		
Figure 1.5	Pathway of the cochlea nerve	9		
Figure 1.6	Movement of cochlea hair cells	11		
Figure 1.7	Electron microscope showing cochlea hair cell	11		
Figure 1.8	Pathophysiology of TTS andPTS	12		
Figure 1.9	Pathway of TTS and PTS	13		
Figure 3.1	Otoscopic examination	25		
Figure 3.2	Head phone using during pure tone audiometry	26		
Figure 3.3	Army holding the pure tone response	26		
Figure 3.4	Otoacoustic emission in progress	27		
Figure 3.5	Army during firearm training at "Kem Desa Pahlawan"	27		
Figure 4.1	Race Distribution	30		
Figure 4.2	Handedness during shooting.	31		
Figure 4.3	Distribution of age	32		
Figure 4.4	Duration of working	33		
Figure 4.5	Frequency of shooting	34		
Figure 4.6	Hearing level for right ear preshooting	37		
Figure 4.7	Hearing level for right ear post shooting less			
	than 48 hours	37		
Figure 4.8	Hearing level for right ear post shooting more			
	than 2 weeks	38		

Figure 4.9	Hearing level for left ear preshooting	40
Figure 4.10	Hearing level for left ear post shooting less	
	than 48 hours	40
Figure 4.11	Hearing level for left ear post shooting more	
	than 2 weeks	41
Figure 4.12	Percentage of fail right ear DPOAE	44
Figure 4.13	Percentage of fail left ear DPOAE	45
Figure 4.14	Results of right tympanometry	54
Figure 4.15	Results of left tympanometry	54

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ABBREVIATIONS

dB	=	decibel
DPOAE	=	distortion product otoacoustic emission
Hz	=	hertz
kHz	=	kilohertz
NIHL	=	noise induced hearing loss
OAE	=	otoacoustic emission
OHC	=	outer hair cells
ΡΤΑ	=	pure tone audiometry
PTS	=	permanent threshold shift
RMAF	=	Royal Malaysian Arm Forces
SLM	=	Sound Level Meter
SNHL	=	sensorineural hearing loss
SPL	=	sound pressure level
TTS	=	temporary threshold shift

DEFINITION OF TERMS

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Audiogram	-	Graph of hearing threshold level as a function	
		of frequency (ANSI, 1995)	
Audiometry	-	Measurement of the hearing threshold for the	
		various frequencies of sound waves	
Audiometer	-	The equipment used to perform audiometry	
Decibel (dB)	-	The unit used to express the level of sound.	
		The decibel is a logarithm of a ratio of two	
		quantities, the denominator of which has been	
		specified such that 0 dB approximates the	
		threshold of hearing in the middle frequencies	
		for young adults. The reference quantity in the	
		denominator of the ratio is either a sound	
		pressure of 20 micropascals (μ Pa) or a sound	
		intensity of 10 ⁻¹² watts/m ² .	

Frequency - The number of times that a periodic process, such as a sound wave, repeats each second.

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 Hertz (Hz):
 A unit of frequency equal to one cycle per seconds.

Noise - Undesired sound. By extension, noise is any unwarranted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device (ANSI, 1994)

Permanent threshold shift - Permanent increase, measured in decibels, in the threshold of audibility for an ear (ANSI, 1995).

Prevalence - The number of events (e.g., instances of a given disease or other condition) in a given population at a designated time (Last, 1995).

Sound - Auditory sensation evoked by an oscillation in pressure, stress, particle displacement, particle velocity, and so on, in a medium with internal forces (e.g., elastic or viscous) (after ANSI, 1999).

Sound Level Meter - The equipment to measure the environment sound

Steady-state noise - Ongoing noise, the intensity of which remains at a measurable level without interruptions

xv

over an indefinite or specified period of time

Sensorineural -	Pertaining to a sensory nerve of mechanism
Temporary threshold shift -	Temporary increase, measured in decibels, in
	the threshold of audibility for an ear
	(ANSI, 1995).

ABSTRAK

Tujuan utama kajian ini adalah untuk mempastikan jumlah peratus telinga kurang pendengaran dan penyakit telinga sementara ke atas anggota tentera yang menjalani latihan menembak.

Kajian ini adalah kajian hirisan lintang yang telah di jalankan di Kem16 Melayu, Rejimen Askar Melayu Diraja, Kem Desa Pahlawan , Air Lanas, Kelantan dan Kem 301, Tanah Merah, Kelantan , dari Julai 2007 sehingga Oktober 2007. Populasi kajian di ambil dari anggota tentera yang terlibat dalam latihan membak. Sejarah dan maklumat anggota tentera yang terlibat di rekod dan di simpan. Pemeriksaan telinga, "tympanometry", audiometri dan "otoacoustic emission (DPOAE)" di lakukan kepada semua yang terlibat, keputusan kajian akan di rekod. Kajian dan pemeriksaan di jalankan sebanyak tiga peringkat, iaitu sebelum latihan menembak , kurang 48 jam selepas latihan menembak dan dua minggu selepas latihan menembak. Subjek di anggap mempunyai kekurangan pendengaran jika paras pendengaran melebihi 30 db pada mana-mana frekuensi.

Sejumlah 210 orang anggota tentera terlibat di dalam kajian ini. Kesemuanya adalah lelaki. Taburan umur mereka adalah di antara 21 tahun sehingga 47 tahun. Peratus mereka yang mengalami telinga tengah berair adalah sebanyak 21.1% untuk telinga sebelah kanan, manakala untuk telinga kiri adalah 20%. Kebanyakkan masalah kurang pendengaran bagi kedua-dua belah telinga berlaku pada frekuensi 6 kHz, 50.5% adalah pada telinga kanan dan 67% pada telinga kiri. Peratusan mereka yang mengalami kekurangan pendengaran sementara selepas menembak untuk telinga kanan adalah 26%, sementara sebalah kiri 21.4%. Bagi kekurangan pendengaran kekal selepas menembak, untuk telinga kanan dan kiri , masing–masing adalah 11% dan 8%. Mereka yang menembak dengan menggunakan tangan kanan ,memberi nilai kemaknaan pada "p value<0.05" yang menyebabkan kekurangan tahap pendengaran pada telinga sebelah kiri. Terdapat hubungan yang kuat di antara umur, bilangan

xvii

bekerja dalam tahun dan frekuensi latihan menembak yang menyebabkan kekurangan tahap pendengaran dengan nilai "p value < 0.005".

Kesimpulan daripada kajian ini, Kementerian Pertahanan perlu melaksanakan "Program Pemeliharaan Pendengaran", bagi mencegah kejadian keterukkan pendengaran di sebab kan bunyi bising.

ABSTRACT

The aim of this study was to establish the prevalence of hearing impairment and transient effect of ear pathology among the army personnel who underwent firearm training without wearing hearing protection.

A prospective cross-sectional study was carried out in RMAF 16 Melayu Infantry unit of Desa Pahlawan camp, Kelantan and from infantry unit of 301 camp, Tanah Merah , Kelantan, from July 2007 till October 2007. The population was taken from an army personnel who involved in firearm training. The subject's particulars and history takings were recorded and compiled. The subject's were examined by using otoscope, tymponometry, portable audiometry and otoacoustic emission (DPOAE) and findings were recorded. Evaluation and examination was performed in three stage , pre shooting , post shooting less than 48 hours and post shooting more than 2 weeks. Hearing threshold above 30 db at any frequencies was considered hearing impairment.

A total number of 210 army personnel were involved in this study. All were males. The age range was from 21 years to 47 years old. The prevalence for post shooting of the right middle ear effusion was 21.1% and for left 20%. Majority of the hearing impairment occured at frequency of 6 kHz for both ears, 50.5% for right ear and 67% at left ear. The prevalence of temporary threshold shift was 26% for right ear and 21.4% for left ear. For permanent threshold shift, the prevalence for right and left ear was 11% and 8.1%. Those who were right handed shooter gave a significant p value < 0.05, caused hearing impairment to the left ear. There was strong relation between age, duration of work and frequency of firearm training causing hearing impairment, with p value < 0.05.

Results from this study indicate that there is an urgent need from the Ministry of Defense to develop appropriate intervention or hearing conservation program in order to prevent army personnel from developing the noise induced hearing loss.

xix

CHAPTER ONE:

INTRODUCTION AND LITERATURE REVIEW

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CHAPTER 1

INTRODUCTION

Noise-induced hearing loss is the number one occupational disability. It is generally painless, progressive over time and permanent, however it is preventable. Noise is define as unwanted sound , which is characterize by frequency(pitch), intensity(loudness), nature(steady-state vs. impulse/impact) and duration.(Clark. W. W. 1991).

Initially, exposure to noise causes a loss of sensitivity to high frequency (high pitch) sound, continued exposure results in damage to mid frequency region as well. (Henderson et al 1993). One can experience progressive high frequency hearing loss and not be aware of it until it becomes severe (doesn't affect loudness perception). (Mcfadden. D, 1986)

Noise scientifically defined to be a hazard depending on duration of exposure, intensity (volume) of sound, repeated exposure, individual susceptibility ,Berger EH (2000), for example exposure to >85dBA for steady-state noise sources and >140dBP for impulse/impact noise sources. Examples for steady-state noise are Rustling Leave(20dB), Conversation(60dB), Automobile(70dB), Alarm Clock(80dB), Screaming Child (90dB), Helicopter(110dB) and Live Concert(130dB). Examples for impulse noise are M16, blanks w/suppressor (147dB), Vulcan XM197 20mm

(159dB), Shotgun 12 gauge(160dB), Machine Gun 60 cal(165dB), Launcher, M20-A 35" Rocket(171dB), TOW Missile(180dB). Loss of hearing sensitivity due to hazardous noise exposures from either steady state noise or impulse noise does occur even before we can measure the change and it does carry negative consequences. (Alberti. P. w. 1990)

1

Temporary Threshold Shift (TTS): During short exposure to noise, most people experience a rise in the auditory threshold which normally disappears in 24 hours, but may last as long as a week.(Bohne D.A 1982). Recovery is slow and related to the degree of temporary threshold shift. If the stimulus is strong enough, irreversible changes may occur, although it was originally stated that the maximum temporary threshold shift occurs half an octave above the centre frequency of .the stimulating sound (McFadden, 1986). Most recovery occurs in the first 2 days. (Henderson *et al.* (1992).

Permanent Threshold Shift (PTS) or Noise Induced Permanent Threshold Shift

(*NIPTS*): After prolonged exposure to noise, permanent hearing damage may result in the inner ear. This is an irreversible elevation of the auditory threshold produced by noise exposure, associated with permanent pathological changes in the cochlea. noise damage the sterocilia, hair cells body suffer from metabolic exhaustion, swell up and finally lead to death of the cell, may damage the microvascular system, reduced nutrients supply to organ of corti.(Boettcher 1989)

Noise is one of the most common health hazards soldiers and civilians face in the workplace and during training. (Berger et al, 2000). The most dangerous occupational and recreational noise is from firing weapons. Exposure to high-intensity noise may cause hearing loss that can adversely affect combat effectiveness and soldier readiness

1.1 DEFINITION OF HEARING LOSS

The degree of hearing loss is described in decibels (dB), a unit of intensity or loudness. Levels of hearing handicaps are usually described as the degree of hearing loss in decibels.

2

According to WHO classification, the degree of hearing impairment has been classified accordingly.

Degree of Hearing Loss	Decibels (dB)	
Normal	< 25	
Mild	26-40	
Moderate	41-60	
Severe	61-80	
Profound	>81	

Table 1. WHO classification system for degree of hearing loss (Andrew.S, 1999)

1.2 ANATOMY AND PHYSIOLOGYOF THE INNER EAR

1.2.1 ANATOMY

The inner ear consists of the auditory and vestibular labyrinths. The term labyrinth is used to denote an elaborate and careful of connecting pathways in the petrous portion of each temporal bone. The osseous labyrinth is the channel in the bone; the membranous labyrinth is composed of soft tissues fluid filled channels within the osseous labyrinth that contain the end- organ structures of hearing and vestibular systems.

The auditory labyrinth is called the cochlea and is the sensory end organ of hearing. It consists of fluid filled membranous channels within a spiral canal that encircles a bony central core. Here the sound waves, transformed into mechanical energy by

3