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Gunshot injuries

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Abstract: This clinical study was carried out to evaluate the effect of gunshot injuries in the mandibular-facial region caused by modern weapons that are used in the current Syrian crisis, to evaluate the probability of injuries of specific sections of the Syrian society in these injuries more than any section and the extent of its effect on them. Twenty clinical injuries, related to injured patients aged 10 to 52 years old, were selected. Subgroup analysis according to age and gender was also performed. Subjects were categorized into three categories; Group I: the incident which contain entry – stability of the bullet to be extracted later. 2- Group II: fragment in the mandibular- facial bones 3- Group III entry- exit and stability of the shot in other area. Penetration opening, size of injury, the type of modern weapon in every incident, the severity of injury in soft tissues, or bone tissues or both were documented in every group. The penetration's effect and type of modern weapon in each case on the rate of injury were also reported. Quality of treatment and incorrect management were also recorded.

Keywords: Gunshot Injuries, Mandibular-Facial Area, Modern Weapons, the Syrian Crisis

1. Introduction

The medical sector in Syria is witnessing an increase in the incidence of fire and shrapnel open due to current events in Syria. The injuries of the gunshots in mandibular-facial region is one of the most dangerous and challenging injuries in this region due to the difficulty in treatment to restore the function and aesthetic aspect of soldiers who might have low self –esteem and psychological problems because of the non-cooperation of health professionals and medical errors as a result of health management

Despite the increased reported cases of gunshot injuries in the countries of the world (USA, Iraq, and Afghanistan and currently Syria) scientific studies and existing research are very limited.

Coben and Steiner in 2003 stated that more than 115,000 shooting cases occur annually in the United States in which 58% of these cases are murders, and 57% suicides. About 3000 died by gunshots, but twice of this number included people who survived with sustained injuries and disabilities [1].

Ismach et al (2003) estimated casualties in the Atlanta area from May 1996 to June 2000 to determine the incidence of these injuries which might be prevented by safe storage for weapons and case management or design of arms. They noted that most of the victims were between the ages of 15 and 34 years old, where 25% of injuries involved adults over 18 years and 87% of injuries were related to individual revolvers, and 74% of the cases were caused by misuse of arms, and 32% were due to attempt and figure out the problem in the weapon [2].

The scientists Paris et al (2002) found that children living with only one parent tend to have frequent absence from school with a previous arrest incidents, and this is more common in Afro Caribbeans who are at increased risk of injuries related to gunshots fire [3, 4].

Heninger Hanzlick in 2008 found that 88% of willful injury and 61% of suicides were unfortunately among injured adolescents and teens in Atlanta [5].

Lew et al (2010) investigated the prevalence of gunshots injuries that pierced soft tissue and fractures in the military crew who involved in the war in Afghanistan and Iraq, and found that the prevalence of soft tissue-penetration reached 58% and the rate of fractures was 27% of all injuries. In addition they stated that the largest location was in the mandibular (36%) followed by the maxillary, zygoma (19%), the nose (14%) and Orbit (11%) [6].

The gunshot injuries were classified depending on the distance from the target such as Sherman and Parrish (1963),

and the categories were as follows:

The first model: injuries that has occurred at a distance that is more that than 7 meters.

The second model: injuries that has occurred at distance between 3-7 meters [7].

Glezer et al (2003) classified the injuries depending on the volume of the projectile spread extent of the projectile. The first model refers to injuries occurring with the spread of the projectile in an area about 25 cm^2. The second form is within 10-25 cm^2, and the third model refers to in an area that is less than 10 cm^2 [8].

In this present research, injuries of the gun shooting that affect mandibular -facial region caused by modern weapons used in the Syrian war (Kalashnikov, 7.62 sniper and the American machine gun M16) were investigated, injuries including hunting rifles and pistols, as well as suicides injuries were not included in this study.

2. Mechanical Properties of Modern Weapons

Tissue injuries are determined by 3 factors: location, size of the projectile, and the initial speed. Wounds of gunshots are classified as penetrating or perforating

To make distinction between entry and exit wound:

entry zone is surrounded scraped reddish brown skin with mild bleeding. The exit opening is characterized with pop-up tissues and much bleeding (in other references: it is difficult to distinguish between the two openings, and originally it doesn't matter).

The path of the projectile in the body is unexpected but it is not necessarily straight.

It is difficult to determine the number of shots in the body by number of wounds, because the bullet bounces in the body.

The Injury amount = weight of the projectile x square of velocity [9].

The pistol is slower than the gun so it is much less serious.

Notable modern weapons causing gunshot injuries:

1. The American M16 machine gun: the projectiles of famous American gun M 16 (used previously in the war on Iraq) behave in a unique way. When a bullet enters the head and gets out of the knee devastating all the organs in its course leading to this strange path of the projectile inside the body.
2. The thermal snipers: the thermal sniper's casualties are considered of the most serious injuries due to accuracy in determining the target and the projectile spreads a big quantity of heat that lead to tissues devastation.
3. Kalashnikov 7.62 (the famous Russian weapon): It is an offensive weapon designed by Mikhail Kalashnikov during the second world war in 1941. The killing Range killer is between 350-400 meters, the effective range is between 700-800 metres, the either maximum range is 1000 meters. Bullet caliber is 7.62 mm. the initial speed is 710 meters per second. There are several models of this gun with various sizes and calibers, but they have the same mechanism, such as: AK-47, AKMS AKM, 6P1, AK-101.
4. There is a kind of modern weapons whose bullets crush (explode) when hitting an area causing extensive wide and scattered injuries in the affected tissue [9].

2.1. The Research Importance and Objectives

1. It investigates gunshots injuries in the mandibular-facial region caused by modern weapons in the war on Syria (the thermal sniper, Kalashnikov 7.62, American gun M16).
2. It addresses the impact of these injuries on the bony and soft tissue and size of the caused injury.
3. It assesses the quality of the surgical treatment provided to patients and evaluates their effectiveness and success clinically.
4. It determines the psychological impact of these injuries, on soldiers in the light of need for later cosmetic treatments.
5. It analyzes and appraises the treatment provided and define a rational for optimal health care to those affected children

2.2. Materials and Methods

Patients, and outpatient who attended the Assad University Hospital and other hospitals in Lattakia, to perform required treatments, between 2011 and 2014, were invited to participate in this study. The sample included 20 cases of gunfire shots. About 8 cases included the perforating, survival and extraction or fiery projectile shot later 5 cases of penetrating projectile. The rest is fragmentation to cheekbone jaw.

We adopted the following classification according to the cases that we have seen:

1. The incident which contain bullet entry– stability to be extracted later.
2. Fragment in the mandibular- facial bones
3. Entry-exit and stability of the shot in other area.

3. Inclusion Criteria

Patients aged between 10 to 25 years who had gunshot wound caused by modern machinegun during the Syrian crisis.

4. Exclusion Criteria

Injuries included suicide or cases caused by misuse accidents during cleaning the weapon or similar incidents.

Exclusion criteria: topical suicides or cases resulting from accidents at bug when cleaning or similar institutions.

Classification of devastation ratios that have been adopted in the statistical study are:

(0+): Classified tissues devastation that involve the entire mandibular or maxilla, with tissue- bony deformation.

(+ 3): devastation that includes a certain area of the mandibular or maxillary, with average tissue- bony deformation.

(+ 5) devastation that includes a certain area of the mandibular or maxillary with simple tissue-bony deformation (can be improved).

5. Results and Discussion

1. Group I: the incident which contains entry – stability of the bullet to be extracted later.
2. Group II: fragment in the mandibular- facial bones
3. Group III entry- exit and stability of the shot in other area.

Table 1 shows distribution of groups according to gender. Males are more prone to injuries of gunshots than females.

The age group [18-35] was the most affected by gunshot injuries, gunshots remaining in their places, and exit to another place. It also shows that the patients aged more than 18 had the same level of devastation injuries. Table 2 shows the distribution of groups I, II and III according to age.

Table 3 shows that the highest destruction was in the second group (57.1%). The destruction in the third group was 40% and about 37.5% in the first group.

Table 1. *Distribution of groups in males and females.*

	Group I		Group II		Group III	
	frequencies	%	frequencies	%	frequencies	%
Male	7	87.5	5	71.4	5	100.0
Female	1	12.5	2	28.6		

Table 2. *Distribution of groups I, II and III according to age.*

	Group I		Group II		Group III	
	Frequencies	%	Frequencies	%	Frequencies	%
<18yr	1	12.5	1	14.3		
18-35yr	6	75.0	3	42.9	4	80.0
>36yr	1	12.5	3	42.9	1	20.0

Table 3. *Devastation in group I,II and III.*

	Group I		Group II		Group III	
	frequencies	%	frequencies	%	frequencies	%
0	3	37.5	4	57.1	2	40.0
3	2	25.0	2	28.6	3	60.0
5	3	37.5	1	14.3		

I. Effect of entry orifice on the ratio of devastation

Table 4 shows the distribution of injuries according to the entry zone. The highest destruction was in group III in entry zones (right & left cheeks, the lower rim of the zygomatic bone, maxilla(anterior teeth), and the angle of the left mandibular).

Table 4. *The entry orifice in groups.*

	Group I		Group II		Group III	
	frequencies	%	frequencies	%	frequencies	%
The upper lateral rim of the eye ball	1	12.5				
The lateral rim of the left orbit	1	12.5				
Right cheek	1	12.5	1	14.3	1	20.0
Left cheek	1	12.5			1	20.0
Left symphysis mentalis	1	12.5	1	14.3		
Right symphysis mentalis	1	12.5	1	14.3		
The upper rim of the zygomatic bone	1	12.5				
The lower rim of the zygomatic bone	1	12.5			1	20.0
The angle of the right mandibular			1	14.3		
The nose			1	14.3		
The left zygomatic bone			1	14.3		
Maxilla (anterior teeth)			1	14.3		
The angle of the left mandibular					1	20.0
Maxilla (anterior teeth)					1	20.0
Total	8	100	7	100	5	100

I. the effect size of damage on the devastation rate:

Table 6 shows that the highest proportion in the Group I was in soft tissue and both injuries, and in the Group II was in bony tissue damage, while Group III was both injuries.

Table 6. *The injury in groups I,II and III.*

Injury	Group I		Group II		Group III	
	n	%	n	%	n	%
Soft tissue injuries only	3	37.5	1	14.3		
Bony tissue injuries only	2	25.0	6	85.7		
Both injuries together	3	37.5			5	100.0
Total	8	100.0	7	100.0	5	100.0

II. the effect of exit orifice on the rate of devastation

Table 7. *The influence of the exit orifice on the rate of devastation.*

Exit orifice	0		3				
	n	%	n	%	Total	χ^2	*P* value
The angle of the left mandibular	1	100.0%	0	.0%	1	5.000a	.28
Right cheek	0	.0%	1	100.0%	1		
The right side	1	100.0%	0	.0%	1		
Left symphysis mentalis	0	.0%	1	100.0%	1		
The body of the right mandibular	0	.0%	1	100.0%	1		
Total	2	40.0%	3	60.0%	5		

Table 7 shows that the *P* value of 0.28 is greater than 0.05 in which there is no effect of exit orifice on the rate of destruction.

With regard to the distribution ratio of devastation by exit orifice, the highest rate of devastation was the angel of the left mandible, and the right side of the mandible

III. the effect of bullet's stabilizing side on the ratio of devastation

Table 8 shows that the significance level of 0.32 is greater than 0.05 in which there is no effect of bullet's stabilizing side on the devastation ratio.

Table 8. *The influence of bullet's stabilizing side on the ratio of devastation.*

	0		3		5		Total	χ^2	*P* value
The upper lateral rim of the eye ball	1	100%	0	.0%	0	.0%	1	16.000a	.32
The lateral lateral rim of the left orbit	1	100%	0	.0%	0	.0%	1		
Right check	1	100%	0	.0%	0	.0%	1		
Left cheek	0	.0%	0	.0%	1	100%	1		
Left symphysis mentalis	0	.0%	1	100%	0	.0%	1		
Right symphysis mentalis	0	.0%	1	100%	0	.0%	1		
The upper rim of the buccal bone	0	.0%	0	.0%	1	100%	1		
The lower rim of the buccal bone	0	.0%	0	.0%	1	100%	1		
Total	3	37.5%	2	25.0%	3	37.5%	8		

IV. Devastation ratio and the size of damage

Table 9 shows that there was no effect of the type of weapon on the devastation ratio in which the level of significance (0.27) was greater than 0.05.

Table 9. *Type of weapon* devastation Crosstabulation.*

		0	3	5	Total	χ^2	*P* value
The thermal sniper	N.	3	3	0	6		
	%	50.0%	50.0%	.0%	100.0%		
M16	N.	0	2	1	3		
	%	.0%	66.7%	33.3%	100.0%		
Kalashnikov	N.	1	0	2	3		
	%	33.3%	.0%	66.7%	100.0%	12.233	.270
Explosive shells	N.	2	0	0	2		
	%	100.0%	.0%	.0%	100.0%		
Grenades' shells	N.	2	2	1	5		
	%	40.0%	40.0%	20.0%	100.0%		
Total	N.	9	7	4	20		
	%	45.0%	35.0%	20.0%	100.0%		

The bombs' shells and explosive shots caused most of the devastation cases and fragmentation of maxillary-facial bones while heat snipers' shots caused the most of entry and remaining of gunshots in their place.

Table 10 shows that the type of weapon has significant influence on the injury site (entry and exit, stability, fragmentation), where the level of significance of 0.012 and is smaller than 0.05.

Table 10. *Types of weapons in group I,II and III*

		Group I	Group II	Group III	Total	χ^2	*P* value
The thermal sniper	N.	4	0	2	6		
	%	66.7%	.0%	33.3%	100.0%		
M16	N.	1	0	2	3		
	%	33.3%	.0%	66.7%	100.0%		
Kalashnikov	N.	3	0	1	3		
	%	66.7%	.0%	33.3%	100.0%	22.667	.012
Explosive shells	N.	0	2	0	2		
	%	.0%	100.0%	.0%	100.0%		
Grenades' scheels	N.	0	5	0	5		
	%	.0%	100.0%	.0%	100.0%		
Total	N.	8	7	5	20		
	%	40.0%	35.0%	25.0%	100.0%		

6. Discussion

This clinical study was carried out to evaluate the effect of gunshot injuries in the mandibluar-facial region caused by modern weapon that are used in current Syrian crisis. We investigated the region's fiery injuries related to modern weapons used in Syrian war. To our knowledge, there is no similar study in the literature to allow for comparison. By analyzing the results obtained we noticed that ages groups between 18-35 years were more vulnerable to fragmentation injuries, while the percentage in entry-stabilization of gunshot were ≥75% of the cases of entry and exit of gunshot 42.9% We have noticed that the entry-exit cases didn't record any improvement. The highest devastation rate was in fragmentation injuries. With regard to entry orifices, right

cheek, left symphysis mental, the maxilla (the anterior teeth region) had the highest rate of devastation.

With regard to entry orifice, the devastation rate was maximum in Group III.

We noticed from the study that the highest damage in Group I was in the soft tissues and both injuries, and the highest damage in Group II was for the bony tissues, but Group III the highest injury was for both injuries (soft and bony tissues).

There is no effect of the weapon type on the devastation rate, while there was an effect of the weapon type on the injury site (entry and stabilization, entry and exit, fragmentation). The total ratio of the explosive bullets and greandes' schells that cause fragmentation.

7. Conclusions and Recommendations

From the present study, we concluded that there is no effect of exit orifice of the shot and also that the site of bullet stability has no effect on the rate of devastation.

There is no influence of the size of the damage on the rate of devastation but the type of Group had influenced (entry and exit, entry and settlement, fragmentation) in devastation.

The use of modern and sophisticated weapons has an influence on the seriousness of their injuries, and the size of the devastation and the injury they cause (not clear…… explain).

The ages between 18 and 35 years (mostly military soldiers) were more vulnerable than other age groups and this supports the idea that military troops are more likely to have injuries related to gunshots.

The fragmentation cases need urgent and optimal care including plastic surgery.

Negative psychological impact of the injuries that were observed with soldiers were the main obstacle that delay healing and improvement, so it is important to pay attention to psychological and moral side and it is important to train health professionals to deal with such cases in this critical stage.

Medical errors during surgical operations should be avoided in order to prevent complications and consequences that will affect mental and physical health of injured patients during Syrian crisis.

A specialized sophisticated educational training program should be organized in order to prepare health professionals to deal properly with this type of injured patients who are psychologically and physically affected.

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