HUMANITARIAN AND HUMAN RIGHTS LAW IN THE CONTEXT OF WOUND BALLISTICS AND SELECTION OF HANDGUN AMMUNITION

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Abstract

This article will present a study of effects on the human body produced by penetrating projectiles, which is called terminal ballistics or wound ballistics. For more than 150 years, scientists have studied the interaction of bullets and fragments from explosive weapons with human tissue. Such studies so far have influenced medicine (how wounded people were treated), the development of international humanitarian law (restriction of specific weapons) and, more recently, crime investigation (crimes committed with firearms have been used). The selection of effective handgun ammunition for law enforcement is a critical and complex issue. It is critical because of that which is at stake when an officer is required to use his handgun to protect his own life or that of another. International humanitarian law, as a set of rules which seek, for humanitarian reasons, to limit the effects of armed conflict, protects persons who are not participating in the hostilities, and prohibits the use of certain weapons. This article brings together what is believed to be the most credible information regarding wound ballistics, and how it can be connected with the human rights and humanitarian law concerning the selection of handgun ammunition. It provides common-sense, scientifically supportable, principles by which the effectiveness of law enforcement ammunition may be measured.

Key words: projectile, weapons, bullet wound, wound ballistics, handgun ammunition, law enforcement, international human rights and humanitarian law

Introduction

As a discipline, ballistics generally deals with projectile flight and other parameters such as air resistance - air density, gravitational pull it all - and a host of others which unfortunately have a bearing on the projectile flight and retard it from its ideal motion in 'vaccuo' (see more in G.M. Moss, D.W. Leeming, C. L. Farrar, 1995). By definition, the study of physics inside the gun barrel is called internal ballistics. The physical study of the

projectile, or the bullet, between the muzzle and the target is called external ballistics. The study of effects on the body produced by penetrating projectiles is called terminal ballistics or wound ballistics (see more in Fackler, M.L., MD, 1987 and DiMaio, V.J.M., 1987).

For more than 150 years, scientists have studied the interaction of bullets and fragments from explosive weapons with human tissue. Such studies have had an effect on how wounded people are treated, the development of international humanitarian law in relation to weapons and, more recently, the investigation of crimes in which firearms have been used. This field of study is known as wound ballistics (Fackler, M.L., MD. 1987).

As a general rule military or police academies, and to a certain extent other scientific institutions that have interest in wound ballistics, have insufficient budgets. Therefore instead of running our own researches and experiments, we have to rely on the literature that is out there. Nevertheless as the old Romans used to say while indicating unexplored territory on their ocean and land maps, hic sunt leones ("here be the lions" or sometimes translate in to: "here be the dragons").

A closer look in to existing literature related to the issue in the modern democratic context raises serious dilemma. Precisely there is a considerable disagreement among surgeons, ballistic experts and the manufacturers of bullets on the finer points. Conclusions particularly differ on the nature of the bullet wound and how best it should be treated. The problem becomes even more complex in the context of evolution and development of human rights law on one hand and economic - a profit driven interest related to specific ammunition manufacturing on the other.

Given the limited space the article will address the issues related to nature of the bullet wounds and efforts to foster life protection through international humanitarian law and human rights law.

Comprehending the Problem

The selection of effective handgun ammunition for law enforcement is a critical and complex issue. It is connected to law and order protection and their comrades' lives protection. At the same time practice has shown that human beings are amazingly endurable and capable of sustaining phenomenal punishment while persisting in a determined course of action (i.e. one could survive even after he or she had been shot). The issue is made even more complex by the dearth of credible research and the wealth of uninformed opinion regarding what is commonly referred to as a "stopping power". Finally part of the complexity comes from modern and universally accepted standards of state organization. Today democratic control over the

armed forces (military and law enforcement) is a vigilant corrector of potential abuse of states' power and protector of the individual citizens.

The concept of immediate incapacitation as the only goal of any law enforcement shooting (once when the decision has been made to pull the weapon and shoot and the legal threshold criteria has also been met) is subject of disagreements. Arguably this latent conflict has been exposed only after 11th of September and after the US led coalition has launched the so called Global War on terror approach to confront threats posed by modern terrorism. The approaching to terrorism as an act of war raises serious questions, among others, in the context of use of deadly force by the soldiers on the ground conducting counter-terrorist operations. Although in coalition US soldiers have quite different approach when it comes to the right to life from their European coalition partners.

Namely while US soldiers use "shoot to kill" approach, most of the European coalition partners (including Macedonian soldiers) use "shoot to wound" approach. The root causes of these discrepancies (that have also affected rules of engagement and urged many European countries to put national caveats) come from different legal tradition in the context of human rights protection. Common wisdom today is that human rights are universal (Sepúlveda et al. 2004), egalitarian, inalienable and natural (Nickel, Fall 2010), at the same time they are limited in two directions (Council of Europe, 1950). The first limitation comes from egalitarian other individuals' right. The second limitation comes from the need for public safety or common good as the duty of the state. In this specific context when it comes to the right to life (in the light of protection of security and safety), the US in most cases has so far taken approach that public safety is more valuable than individual freedom (Willson, 2005: 209-234). Quite opposite, most of the European coalition partners give more value to protection of individual freedoms (Londras, 2011: 3-5). Nevertheless, although legal in its essence, this debate has additional background and explanation related to the wound ballistic researches and effects.

According to Jeff Chudwin a shoot-to-wound mandate would "not be valid legally" because it sets a standard far beyond that established by "Graham vs. Connor", the benchmark US Supreme Court decision on police use of force (Force Science News, March 20th 2006). In addition, after the so called Miami shootout incident, the FBI has changed its course. Although both Matix and Platt (two suspected robbers) were hit multiple times during the firefight, Platt fought on and continued to injure and kill agents. This incident led to the introduction of more powerful handguns in the FBI and many police departments around the United States (Federal Bureau of Investigation, 1986). Thus, as Fackler argues while this concept is subject to conflicting theories, widely held misconceptions, and varied opinions

generally distorted by personal experiences, it is critical to the analysis and selection of weapons, ammunition and calibers for use by law enforcement officers (Fackler, M.L., MD. 1987). However, the complexity does not end here.

Parallel to the above debate there is a considerable debate and difference of opinions about the terminal ballistics of an ordinary bullet. The surgeons, the ballisticians and the manufacturers have argued about this effect (i.e. the terminal effect) which has been inaccurately thought to be a function of the muzzle velocity. This unfortunately is not quite true, and this short article should provide useful information for the surgeons, the ballisticians and the layers to understand basics of wound ballistics. These findings and debates have serious influence over the lawmakers opinion and thus consequently over the human rights and humanitarian law norms' development.

Hence despite all of the complexity and overlapping it is clear that to understand complexity created by the quest for democratic control and human rights protection on one hand and appropriate practice of public safety and justice on the other, one needs to consider comprehensive approach connecting social and technical science achievements. Thus, it is clear that wound ballistics as a science connects ballisticians (mechanical aspects of projectiles flights), medical science (nature of the wounds) and legal scholars (international humanitarian and human rights law), shown on Figure 1.

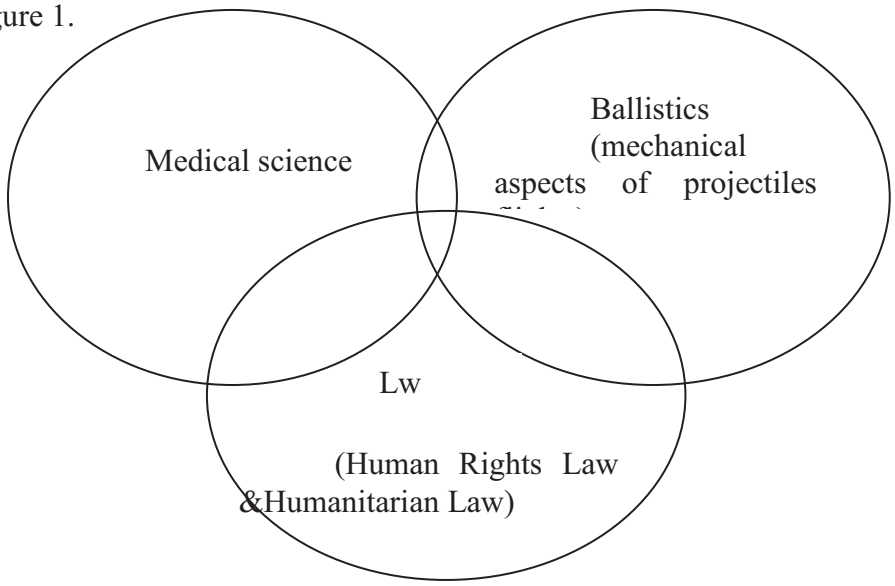

Figure 1 – Elements of wound ballistics and other sciences

Wound Ballistics Issues

Types of ammunition

In order to understand wound ballistics, we must understand the differences between different types of ammunition - bullets. If the bullet is fully covered by the metal, it is called a full metal jacket (FMJ) or full metal cased (FMC) bullet (shown in Figure 2) (see more in Sykes LN Jr, Champion HR, Fouty WJ., 1988). They are also referred to as "military bullets".

Figure 2 - Full metal jacket (FMJ)

Figure 3 - The mushroom deformation of a bullet tip

It was agreed in the Hague Convention of 1899 that all military-grade bullets must be of FMJ type (see more in Sykes LN Jr, Champion HR, Fouty WJ., 1988,). This resolution was intended to minimize the damage caused by bullets during wartime. However, the main purpose of using bullets in a civilian situation, especially in law enforcement, has been different. That aim has been to maximize the ability of the bullet to injure, so that the adversary would be incapacitated almost instantly. This goal led to the design of a bullet whose lead core is exposed at the tip - Semi-jacketed bullet (SJB) (see

more in Sykes LN Jr, Champion HR, Fouty WJ., 1988). A number of other names are used, such as “dum-dum bullet”, “soft-point bullet”, “soft-nose bullet”, or “hollow-point bullet” (shown in Figure 3), of which there are various kinds of designs. Basically, the tip of the bullet has a hollow in the middle and the soft lead is usually exposed, features that facilitate the deformation of the bullet on impact. The metal used for bullet casings is usually brass, an alloy made of copper and zinc.

A bullet does not fly in a straight line; it is affected by gravity and air friction. As do all other projectiles, a bullet flies in a nearly parabolic line. Most weapons have rifling inside their barrels, which spins the bullet on its axis of travel. This spinning helps to stabilize the bullet (see more in Sebourn CL, Peters CE, 1966). During its flight through the air, there is also yawing, precession, and nutation motion (shown in Figure 4). This peculiar external ballistics imposes uncertainties on the exact orientation of the bullet on impact with its target, which in turn affects the wound ballistics.

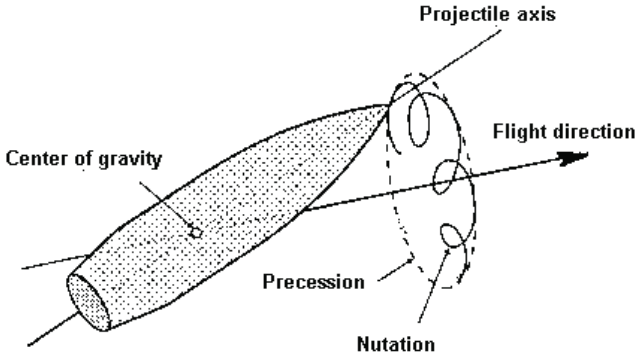

Figure 4 - Motions of a bullet during its flight

(Source: G.M. Moss, D.W. Leeming, C. L. Farrar (1995): Military Ballistics, Brassey’s (UK) Ltd, London)

On impaction with a human target, the bullet tears through clothing or body amour, if there were any. Then it penetrates the body by crushing skin and subcutaneous tissue. The energy possessed by the bullet dissipates to the surroundings, which causes cavitations and a transient vacuum. The vacuum may suck fragments of skin, pieces of cloth, or dirt from outside into the wound, and thus contaminate it. The bullet may also fragment, deform, or tumble and slow down and transfer more energy to the surroundings. Hard tissues like bone may be shattered, and the bone and bullet fragments often form secondary projectiles that cause further damage. If the bullet still possesses sufficient energy, it may exit the body and leave a hole. The exact

path of a bullet inside the human body is difficult, if not impossible, to predict. Even under a laboratory-controlled environment, the path of a bullet inside a gelatin block is not always consistent.

Mechanics of handgun wounding

The wounding mechanisms of projectiles are usually discussed in the literature under various categories, namely, permanent cavity, temporary cavity, sonic waves, and secondary projectiles (fragmentation). In order to predict the likelihood of incapacitation with any handgun round, an understanding of the mechanics of wounding is necessary. There are four components of projectile wounding (see more in Josselson, A., MD, 1982 - 1983). Not all of these components relate to incapacitation, but each of them must be considered. They are:

Penetration. The tissue through which the projectile passes, and which it disrupts or destroys.

Permanent Cavity. The volume of space once occupied by tissue that has been destroyed by the passage of the projectile. This is a function of penetration and the frontal area of the projectile. Quite simply, it is the hole left by the passage of the bullet.

Temporary Cavity. The expansion of the permanent cavity by stretching due to the transfer of kinetic energy during the projectile's passage.

Fragmentation. Projectile pieces or secondary fragments of bone which are impelled outward from the permanent cavity and may sever muscle tissues, blood vessels, etc., apart from the permanent cavity (according to DiMaio, V.J.M, 1987). Fragmentation is not necessarily present in every projectile wound. It may, or may not, occur and can be considered a secondary effect (see more in Fackler, M.L., Malinowski, J.A., 1985).

The physical characteristics of projectiles also contribute important effects to the extent of tissue damage that is produced. The tendency of a projectile to deform, fragment, or change its orientation inside the human body (stability of the projectile during its flight and motion in the human body – Figure 4) can help to transfer energy and thus cause more damage. Most bullets used in the civilian or law enforcement agencies nowadays have hollow-point designs, and they tend to deform or mushroom on impact (shown in Figure 3). This mushroom effect slows the bullet down and allows energy transfer into the surrounding tissues, but the slowing-down effect hampers the penetration power of the bullet.

Projectiles incapacitate by damaging or destroying the central nervous system, or by causing lethal blood loss. To the extent the wound

components cause or increase the effects of these two mechanisms, the likelihood of incapacitation increases. Because of the impracticality of training for head shots, this examination of handgun wounding relative to law enforcement use is focused upon torso wounds and the probable results.

All handgun wounds will combine the components of penetration, permanent cavity, and temporary cavity to a greater or lesser degree (as it is shown in Figure 5). Fragmentation, on the other hand, does not reliably occur in handgun wounds due to the relatively low velocities of handgun bullets. Fragmentation occurs reliable in high velocity projectile wounds (impact velocity in excess of 600 meters per second) inflicted by soft or hollow point bullets (according to Josselson, A., MD, 1982-1983). In such a case, the permanent cavity is stretched so far, and so fast, that tearing and rupturing can occur in tissues surrounding the wound channel which were weakened by fragmentation damage (see more in Fackler, M.L., MD, 1986). It can significantly increase damage (according to Fackler, M.L., Surinchak, J.S., Malinowski, J.A., 1984) in rifle bullet wounds.

In cases where some fragmentation has occurred in handgun wounds, the bullet fragments are generally found within one centimeter of the permanent cavity. DiMaio, V.J.M. (1987), stated that "the velocity of pistol bullets, even of the new high-velocity loadings, is insufficient to cause the shedding of lead fragments seen with rifle bullets". It is obvious that any additional wounding effect caused by such fragmentation in a handgun wound is inconsequential.

Of the remaining factors, temporary cavity is frequently and grossly overrated as a wounding factor when analyzing wounds (according to Lindsay, Douglas, MD, 1980). Nevertheless, historically it has been used in some cases as the primary means of assessing the wounding effectiveness of bullets.

Further, the temporary cavity is caused by the tissue being stretched away from the permanent cavity, not being destroyed. By definition, a cavity is a space (according to Webster's Ninth New Collegiate Dictionary, Merriam-Webster Inc., Springfield MA, 1986) in which nothing exists. A temporary cavity is only a temporary space caused by tissue being pushed aside. That same space then disappears when the tissue returns to its original configuration.

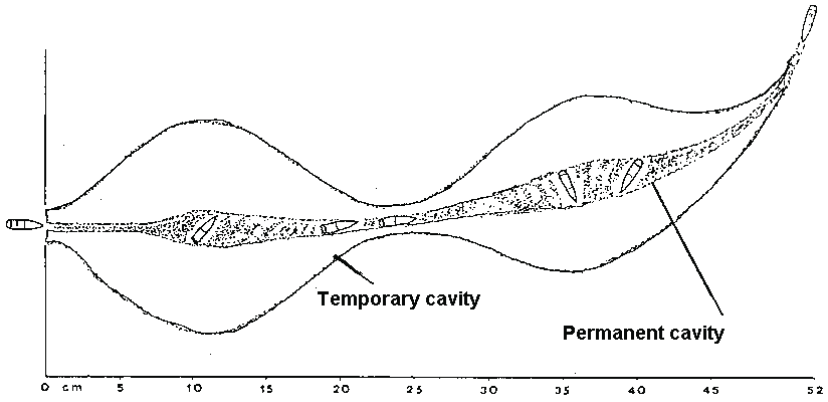

Figure 5 – Wound profile caused by the 5,45 mm bullet fired from AK 47 rifle
(Source: B.P. Kneubehl: Measuring the Wounding Potential of Rifle and Handgun Bullets, International Workshop on Wound Ballistics, Thun, 1999.)

Frequently, forensic pathologists cannot distinguish the wound track caused by a hollow point bullet (large temporary cavity) from that caused by a solid bullet (very small temporary cavity). There may be no physical difference in the wounds. If there is no fragmentation, remote damage due to temporary cavitation may be minor even with high velocity rifle projectiles (see more in Fackler, M.L., Surinchak, J.S., Malinowski, J.A., 1984). Even those who have espoused the significance of temporary cavity agree that it is not a factor in handgun wounds.

In the case of low-velocity missiles, e.g., pistol bullets, the bullet produces a direct path of destruction with very little lateral extension within the surrounding tissues. Only a small temporary cavity is produced. To cause significant injuries to a structure, a pistol bullet must strike that structure directly. The amount of kinetic energy lost in tissue by a pistol bullet is insufficient to cause remote injuries produced by a high velocity rifle bullet (according to DiMaio, V.J.M., 1987, page 42).

The tissue disruption caused by a handgun bullet is limited to two mechanisms. The first, or crush mechanism is the hole which the bullet makes passing through the tissue. The second, or stretch mechanism is the temporary cavity formed by the tissues being driven outward in a radial direction away from the path of the bullet. Of the two, the crush mechanism, the result of penetration and permanent cavity, is the only handgun wounding mechanism which damages tissue (see more in Wound Ballistic Workshop: "9mm vs. .45 Auto", FBI Academy, Quantico, VA, September, 1987, Conclusion of the Workshop). To cause significant injuries to a structure

within the body using a handgun, the bullet must penetrate the structure. Temporary cavity has no reliable wounding effect in elastic body tissues. Temporary cavitation is nothing more than a stretch of the tissues, generally no larger than 10 times the bullet diameter (in handgun calibers), and elastic tissues sustain little, if any, residual damage (see more in Fackler, M.L., MD, 1986).

International human rights and humanitarian law norms in the context of wound ballistics

International humanitarian law is a set of rules which seek, for humanitarian reasons, to limit the effects of armed conflict. The law protects persons who are not, or are no longer, participating in the hostilities. It places restrictions or prohibitions on the use of certain weapons and methods of warfare. But also, (according to the "UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials"), governments and law enforcement agencies should develop a range of means as broad as possible and equip law enforcement officials with various types of weapons and ammunition that would allow for a differentiated use of force and firearms. These should include the development of non-lethal incapacitating weapons for use in appropriate situations, with a view to increasingly restraining the application of means capable of causing death or injury to persons. For the same purpose, it should also be possible for law enforcement officials to be equipped with self-defensive equipment such as shields, helmets, bullet-proof vests and bullet-proof means of transportation, in order to decrease the need to use weapons of any kind.

The right to use force is a right of an individual or authority to settle conflicts or prevent certain actions by using force to either: a) dissuade another party from a particular course of action, or b) physically intervene to stop them. In nations of the developed world and the developing world, governments allow police, citizen, corrections, or other security personnel to employ force to actively prevent imminent commission of crime, or even for deterrence. It may also be exercised by the executive branch (i.e., through the president, prime minister, premier, governor, or mayor) of a political jurisdiction, deploying the police or military to maintain public order. The use of force is governed by statute and is usually authorized in a progressive series of actions, referred to as a "use of force continuum" (O'Connell, Mary Ellen, 2007).

International humanitarian law also prohibits the use of certain weapons. These are weapons that, by virtue of their design, cause particularly severe injuries against combatants. Such weapons are prohibited

on the basis of the general prohibition to use weapons and methods of warfare which cause "superfluous injury or unnecessary suffering".

Human rights law stipulates that the use of force by law-enforcement officials must be legitimate and proportionate. These rules derive in particular from the right to life and the obligations to respect human dignity and the physical and mental integrity of the individual. Guidance on how the use of firearms can comply with legitimate and proportionate use of force can be found in the general and specific provisions of the United Nations' Basic Principles on the Use of Force and Firearms by Law Enforcement Officials.

One of the earliest international humanitarian law treaties dealt with the design-dependent effects of bullets: in the St Petersburg Declaration of 1868, States responded to the development of bullets designed to explode within the human body by renouncing "the use, in time of war, of explosive projectiles under 400 grams weight." The preamble to this Declaration affirms that the only legitimate objective of war is to weaken the military forces of the enemy. It therefore stated that in war it is "sufficient to disable the greatest possible number of men". This objective would be exceeded by the use of weapons which "uselessly aggravate the sufferings of disabled men, or render their death inevitable" (See more in Customary International Humanitarian Law, Volume I: Rules, Jean-Marie Henckaerts and Louise Doswald-Beck, 2005).

Even though bullet technology and military practice have evolved, making some aspects of this prohibition (e.g. the anti-material use of exploding projectiles under 400 grams) obsolete, the preamble of this instrument is of lasting value and is the basis of the prohibition on weapons which cause "superfluous injury or unnecessary suffering". Furthermore, States still generally refrain from the anti-personnel use of bullets which explode within the human body.

In 1899, the States adopted the Hague Declaration Concerning Expanding Bullets. This was "inspired by the sentiments which found expression" in the St Petersburg Declaration. The Declaration prohibited "the use of bullets which expand or flatten easily in the human body, such as bullets with a hard envelope which does not entirely cover the core or is pierced with incisions". The severe wounds are caused by such bullets, also called semi-jacketed bullets. The prohibition on the use of such bullets is widely respected in armed conflicts and virtually all State armed forces equip their soldiers only with full metal jacket bullets.

In 1977, the principle originally contained in the St Petersburg Declaration of 1868 was confirmed with the adoption of Article 35 (2) of Protocol I additional to the 1949 Geneva Conventions. This provision prohibits the use in international armed conflict of "weapons, projectiles and

material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering". The subsequent prohibitions of the use of anti-personnel landmines, blinding laser weapons and weapons the primary effect of which is to injure by fragments which in the human body escape detection by X-rays have been inspired entirely or in part by this rule (See the 1997 Convention on the Prohibition of Anti-personnel Mines; See the 1980 Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to Have Indiscriminate Effects, and that instrument's Protocol I on non-detectable fragments, as well as its Protocol IV on blinding laser weapons).

The 2005 ICRC study on customary international humanitarian law (see more in Customary International Humanitarian Law, Volume I: Rules, Jean-Marie Henckaerts and Louise Doswald-Beck, Cambridge University Press, 2005, pp. 237 - 244, 268 - 274) concluded that the prohibition on the use of means and methods of warfare of a nature to cause superfluous injury or unnecessary suffering has become a rule of customary international law binding on all parties to both international and non-international armed conflicts, whether or not they are parties to the specific treaties containing this prohibition. This study also stated that the prohibition on the use of bullets which expand or flatten easily in the human body and the prohibition on the anti-personnel use of bullets which explode within the human body have achieved the status of customary international humanitarian law and are applicable both in international and non-international armed conflicts.

Conclusion

Wound ballistics is a science that is partly physical and partly biomedical. Gunshot wounding mechanisms should be looked at as interactions between the penetrating projectile and the body. In fact, the resultant damage depends on many factors, which include the anatomy of the wounded subject, the bullet and firearm designs, and the specific organ being injured. Chance occurrence also takes an important role in determining the exact missile path inside the body.

It has been frequently said that "no two shootings in real life would be the same". On the whole, the mass and velocity of the projectile establish the upper limits of possible tissue damage, whereas which tissue the missile encounters and where, whether the missile fragments or expands, and at what point the missile yaws or tumbles all have important roles in the ultimate damage.

International humanitarian law is a set of rules to place restrictions or prohibitions on the use of certain weapons and methods of warfare. The selection of effective handgun ammunition for law enforcement is a critical

and complex issue. Human rights law stipulates that the use of force by law-enforcement officials must be legitimate and proportionate. These rules derive in particular from the right to life and the obligations to respect human dignity and the physical and mental integrity of the individual.

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