



## Case Report

# Bone-patch type secondary projectiles: A report on two shots fired at point-blank range using hollow point bullets



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## ABSTRACT

The number of head wounds due to firearms remains low in France because these cases are primarily linked to suicide (or attempted suicide) and, to a lesser extent, to attacks or hunting accidents [1]. Characterized by the impact of a projectile, which in most cases is made of metal, at high levels of kinetic energy, such acts generally result in severe trans-cerebral lesions with significant levels of morbidity/mortality [2].

Seldom are cases reported in the literature that give a detailed study of intracranial foreign bodies made of bone in such situations [3].

Here we report on the case of two suicides resulting from a transcranial gunshot wounds caused by weapons and ammunition issued by the French police force. Each case helped distinguish a characteristic bone fragment, in the form of a “patch”, equivalent in size to the caliber of the bullet.

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## 1. Introduction

An expanding bullet is one characterized by its potential to open and possibly fragment upon impact, resulting in major tissue damage [4]. Such bullets, made of bare lead or coated with an alloy, are constructed with a hollow tip, which directs the pressure outwards upon impact, causing them to open from the front and increasing their diameter.

As such, an expanding bullet is better at transferring its energy to the soft body it penetrates, and therein lies its advantage, characterized by (a) stopping power [the usual definition of which is the ability of a bullet to put an opponent out of action on first impact], (b) delivery of its energy to the target and, (c) absence of “over-penetration”, or the risk of ending its path in a third-party body located near the shot’s trajectory.

All this implies a substantial lesional potential, most likely to stop an aggressor in their tracks; combined with a successful target hit that is very likely to produce major associated lesions.

Conversely, these same effects reduce the efficiency of such a projectile against ballistic protection, since the increased diameter

of the bullet increases its contact surface, against which energy is dissipated.

As regards hollow point bullets, it is also frequently observed that because of their hollow tip, the mere fact of penetrating an obstacle, such as thick clothing, will result in the hollow being filled, thus reducing their expanding effect. Indeed, when such bullets penetrate a flexible covering, the tip becomes weighed down and then behaves like a “standard” bullet.

The SIG Pro semi-automatic pistol, made by Swiss and German manufacturers Swiss Arms AG and Sauer & Sohn is used by the U.S. Drug Enforcement Administration (DEA), as well as by other law enforcement agencies around the world. In 2003, French police and customs adopted a version of this weapon known as the SP 2022. Weighing in at just under 1 kg, it was the first gun to use polymer materials for its frame. It has a so-called double-trigger system, which means that its security is equivalent to that of the revolver. Its feeder can hold up to 15 cartridges of 9 mm Parabellum (.40 S&W).

The Gold Dot regulation issue cartridge made by U.S. manufacturer SPEER (Table 1) consists of a brass case, a Boxer-type primer, double base propellant powder and a lead-core bullet with a copper jacket and a hollow or recessed tip. Its most striking characteristic is that the compression of material in its central channel initially causes a deformation of the front portion (“mushrooming”) which increases its nominal diameter, then,

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**Table 1**  
Speer 9 mm 124 grain Gold Dot JHP.

Test gun	Barrel length	Velocity	Bare gelatin		Denim covered gelatin	
			Penetration	Expansion	Penetration	Expansion
Star M43 Firestar	3.4"	1068 fps	12.6"	0.59"	17.5"	0.51"

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due to the effect of tissue resistance, causes its structure to separate, in the form of a "petalization". The thickness of the jacket gradually increases to ensure better expansion control, ending with a warhead diameter that is generally double the size of the original [5–8].

From an epidemiological perspective, suicidal behavior using firearms in France accounts for a large proportion of suicides and attempted suicides. In fact, in 1999 this type of mortality stood at the rate of 3.4 per 100,000 residents. Firearms thus rank second in terms of suicide methods used by men, after hanging [9].

With 40–55 suicides per year among police officers, a figure that is ten times the national average, France is ranked third in terms of OECD police forces who fall victim to such acts. Generally speaking, several risk factors are identified, including divorce, alcohol addiction and occupational instability [10]. Although we did not identify any studies highlighting a link between the profession of police officer and suicide rates, several studies have shown the existence of a positive correlation between the availability of firearms and the rate of suicide via this method (around 50% in the case in point) [11].

Numerous studies on gunshot wounds show that regarding suicide, the head is the main point of entry, and that in terms of handguns, the ipsilateral temple on the dominant side is the preferred target area [12,13].

Reviewing 65 intracranial shots, M. Faller-Marquardt [3] noted that in five cases, along with entry-level lesions, there were noticeable elements ("small bone plates") located near the entry wound, though no information was provided as to their size, shape or the nature of the projectile responsible for death.

Due to its ability to perforate, in other words to go through barriers and penetrate deep into the target, and its ability to expand within tissues, can the Speer Gold Dot® bullet generate a specific bone fragment in the form of a patch as described above, in the event of a transcranial shot at point-blank range?

We will study the case of two police officers who fell victim to this type of behavior, in an attempt to find an answer.

## 2. Report on two cases

The two men in question were 43 and 46 years of age, one a policeman and the other an officer; who committed suicide just a few weeks apart using their regulation firearms and ammunition as described above. Both shots were fired at point-blank range in the temporal region, and were transfixial. At the request of the public prosecutor, examinations at the scene and autopsies were performed, preceded by a full body CT scan. After our examinations, and at the magistrate's discretion, only the suicide committed on the service premises (as opposed to the one committed at home) was subject to an additional histopathological study of the brain.

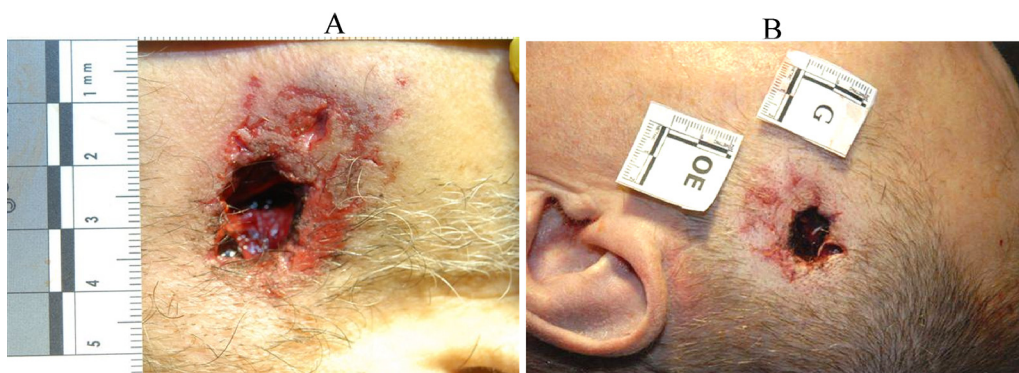
## 3. Autopsies

The entry skin lesions are characterized by circular, "cookie cutter"-shaped wounds of 17 and 15 mm in diameter, with an abrasive collar and soot deposits on their inner edges (Fig. 1A and B).

Dissection revealed an underlying bony opening of diameter 9 mm that was perfectly circular, moving a splayed cone shape toward the endocranial aspect, also showing blackish deposits on its inner edges.

Two other parietal wounds on the opposite laterality were noted, with irregular linear edges, one of which was 3 cm long, the other being in the form of three branches, measuring 15 mm long × 10 mm high. We observed the absence of any abrasive collar or soot-type deposits around the edges, giving them the characteristics of shot exit wounds (Fig. 2A and B).

As regards lesions, there were stigma relating to ballistic cranial trauma, including hemorrhagic infiltrations to the internal side of the scalp and opposite the temporal muscles, bone shattering along the entire skull vault, and diffuse subarachnoid bleeding. Similarly, there was widespread destruction of the cerebral parenchyma affecting the frontal, parietal and temporal lobes, with damage to both brain stems.



**Fig. 1.** (A) Entry wound, case 1. (B) Entry wound, case 2.

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