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**FORENSIC BALLISTIC  
AND EXPERT  
INTELLIGENCE:  
PRELIMINARY  
CONTRIBUTIONS OF  
THE EVOFINDER®  
SYSTEM**

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**Abstract:** The ballistic confrontation exam is one that, when carried out, establishes correlations between ammunition elements and firearms in order to determine whether the projectiles were expelled by them and/or cases detonated by them. In the course of criminal investigation, the production of expert evidence to identify the use of firearms is a determining condition for establishing the means used and indicating probable authorship. A form of ballistic confrontation is one carried out using a computerized system. This *in silico* ballistic confrontation contributes to the acquisition of optimized results, given the possibility of simultaneously confronting different ammunition elements. The Forensic Ballistics Laboratory of the Criminalistics Institute of the Civil Police of the Federal District uses the EVOFINDER® Computerized Ballistic Indexing System and, in the period from 2020 to 2023, produced 488 hits – exams with positive correlations – of which 273 reports were generated. Expert Intelligence that supported ongoing criminal investigations. Four cases were selected to illustrate the possibilities of the computerized ballistic confrontation tool.

**Keywords:** ballistic confrontation; expert intelligence; EVOFINDER; forensic ballistics.

## INTRODUCTION

In Brazil, the Code of Criminal Procedure [1] determines that whenever the criminal offense leaves traces, it is considered essential that there be an examination of the direct or indirect crime. The Criminal Expertise is responsible for this responsibility. Forensic Ballistics, as a discipline within Criminalistics, studies firearms, their ammunition and the effects of the shots they produce whenever they have a direct or indirect relationship with criminal offenses [2]. Ammunition elements collected at crime scenes and/or extracted from victims are sent for examination at

the Forensic Ballistics Laboratory (LBF) of the PCDF Criminalistics Institute (IC). The seized weapons that were used in crimes have the same destination.

Among the exams carried out at LBF, we highlight those of nature, efficiency and ballistic confrontation, the latter of which may or may not be required [3].

The nature examination aims to identify the material sent to the Laboratory. Ammunition elements can be projectiles expelled from firearm barrels or casings struck by them. If there is a comparable area for future ballistic confrontation examination and acceptable geometry for inclusion in the Computerized Ballistic Indexing System (SIIB), the ammunition elements will then be registered in the ballistic profile database and kept in custody.

The efficiency exam seeks, in addition to identifying the firearm, its brand, model, caliber and particularities, to determine whether the weapon is effective for firing shots. When carrying out this examination, projectiles and standard cases are collected in order to individualize it. Individualization occurs through the identification of the profile of microstriations printed on the inside of the barrel (rifled core) on the projectile and by the percussion and breech marks (obturation plate). When the firearm has an ejector and extractor, this information is also individualized on the case.

The ballistic confrontation examination is carried out when seeking to identify correlations between projectiles and cases. It can be carried out with ammunition elements questioned against each other or compared with patterns extracted from examined firearms. It is said that ballistic confrontation is required when there is a request to carry out this exam. The non-demanded comparison is the one carried out through routine *in silico* examinations carried out using the SIIB.

According to data from the Technical and Statistical Analysis Division (DATE) of the Civil Police of the Federal District (PCDF), 1331 homicides using firearms were recorded in the Federal District between the years 2019 and 2022. Alcântara and Ramos [4] carried out a study aiming to correlate the reduction in the number of homicides with the increase in the seizure of firearms used in crimes in the Federal District. On the other hand, it is necessary to understand the importance of not only removing illegal weapons from the streets, but also determining in which crimes these weapons were used.

In a study to optimize the insertion and routine of *in silico* ballistic confrontations, as well as determining which would be the most appropriate option for the forensic reality, Santos [5] identified parameters that optimize the use of computerized systems. These findings were in line with those reported by Mattijssen and collaborators [6] in a review study carried out by members of the Netherlands Forensic Institute, Netherlands.

With the implementation of the computerized routine, the Forensic Ballistics Laboratory of the Civil Police of the Federal District obtained initial results of relevant importance for criminal investigation and the initial contributions of the routine will be exposed here.

## **OBJECTIVES**

Demonstrate the contribution of the routine treatment and insertion of material into the Computerized Ballistic Indexing System – EVOFINDER® – and the results obtained that supported several criminal investigations.

## **MATERIALS AND METHODS**

### **BALLISTIC PROFILE DATABASE**

The SIIB database used in the LBF of the PCDF IC has, as of 9/25/2023, 38,130 inserted

ammunition elements, including questioned (incriminated) material and patterns collected from firearms examined in this Laboratory.

This Laboratory uses ScannBI Technology's EVOFINDER® Automated Ballistic Identification acquisition stations and software. Each station is equipped with cassettes and accessories that allow the insertion, into the database, of cases and projectiles of different calibers of short and long weapons.

## **INSERTION OF MATERIAL INTO THE DATABASE**

The material is entered into the database according to its caliber. Projectile parameters involve number and direction of streaks. The marking of rebounds and digs follows a defined methodology with the aim of optimizing the confrontation routine. Likewise, the cases are inserted following a specific methodology that involves identifying and correctly positioning ejection marks, percussion marks, striker drag marks, as well as breech marks.

## **BALLISTIC CONFRONTATION**

As the material is inserted into the database, the software is required to compare the inserted elements. After the software indicates similarities between the elements, the Criminal Experts manually perform the comparison in an attempt to determine possible correlations. If there is a positive correlation, the material is then physically compared in a ballistic microcomparator.

The Laboratory has two Leica comparators, one model FSM DFC 450 and one model FSC DFC 280.

## **CASE SELECTION**

Among the 273 Expert Intelligence Reports (LIP) produced in this LBF, four cases were selected to illustrate the use of the *in silico* confrontation tool and how its results could

assist the criminal investigation.

In order to preserve the sensitivity of occurrence data, information regarding protocols, occurrence numbers, police investigations and names or qualifications of those involved will not be exposed. The dates, the Police Stations that worked on the investigation and the locations will be provided only to illustrate how occurrences in different Administrative Regions of the Federal District and at different times can be correlated based on information obtained through the actions of this LBF.

## **RESULTS AND DISCUSSION**

Since the confrontation routine through the SIIB was definitively implemented at the LBF until September 25, 2023, 488 *in silico* confrontation exams were carried out, resulting in 273 Expert Intelligence Reports (LIP) and 215 Criminal Expertise Reports (LPC). Of these 273 LIPS, four were separated for case studies.

### **CASE 1**

A homicide incident was registered in April 2014 at the Twenty-Seventh Police Station, Administrative Region of ``Recanto das Emas``. The projectiles collected at the scene of the crime, as well as those removed from the corpse, were sent to the LBF to be examined and stored.

For years, the investigation requested ballistic comparison tests between the questioned projectiles and firearms of the same caliber that were seized over time. The examinations were exhaustive, but they were unable to identify the firearm that had actually been used in the crime.

With the implementation of the *in silico* ballistic confrontation examination routine at the Laboratory, the Criminal Experts identified previous requests for confrontation examination for the material previously

forwarded and inserted, into the ballistic profiles database, firearm patterns that had the same characteristics of caliber, number and width of streaks. The effort resulted in a positive confrontation with a Rossi brand .38 SPECIAL caliber revolver. This weapon had been seized, in ``Recanto das Emas``, in June 2014, just two months after the murder.

The positive ballistic confrontation exam was carried out in November 2021, seven years after the events. This case illustrates a mutual and cooperative effort between the investigation and Criminal Forensics.

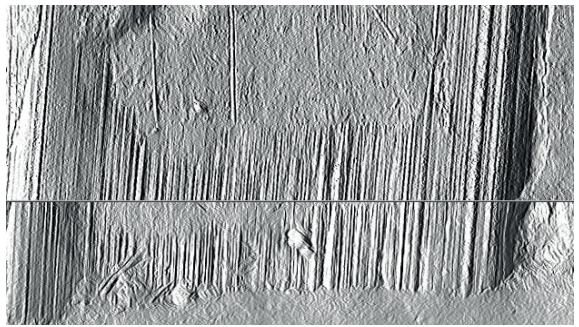


Figure 2 – Image of *in silico* ballistic confrontation between the projectile removed from the victim and the projectile collected at the crime scene.



Figure 1 – Image of *in silico* ballistic confrontation between a standard projectile collected from the forwarded firearm and one of the projectiles in custody.

## CASE 2

On March 30, 2023, the LBF received two 9 mm caliber projectiles, one taken from the victim and the other collected at the scene. Due to the geographic proximity of the two locations, this Laboratory was asked to perform a ballistic confrontation examination to determine whether both had been expelled through the same pipe.

When carrying out the ballistic confrontation examination, it was found that the projectiles had, in fact, been expelled through the same firearm barrel.

The characteristics of width, projections and grooves observed in the examined projectiles, as well as their microstriations combined with the expertise of the Experts of this LBF, allowed the exclusion of several brands and models of firearms. Furthermore, it was possible to indicate a specific brand of firearm as the main candidate for having been used in firing the questioned projectiles, given the pattern of production of microstriations in the projections and hollows in the projectiles.

Carrying out investigations in the area where the incident occurred, the Police Authority in charge of the case managed to determine the seizure of a firearm whose characteristics were in line with those indicated by the Criminal Experts of this LBF, and together with the request for an examination of the firearm's efficiency, a ballistic comparison examination of the patterns of the aforementioned weapon with the previously examined projectiles was requested.

When carrying out the ballistic confrontation examination, the Criminal Experts concluded that that weapon had, in fact, been used to carry out the shots that resulted, in sequence, in a homicide and damage to property.



Figure 3 – Image of *in silico* ballistic confrontation between a standard projectile collected from the forwarded firearm and the projectile removed from the victim.



Figure 4 – Image of *in silico* ballistic confrontation between a standard projectile collected from the forwarded firearm and the projectile collected at the crime scene.

Although this case was a ballistic confrontation demanded, there was a particularity that brought to light a new way of using the EVOFINDER® tool: the recognition of marking patterns, on projectiles, from barrels of different firearms, which makes it possible to exclude marks and restrict the list of possibilities for investigation.

### CASE 3

On May 19, 2023, this Forensic Ballistics Laboratory carried out an examination of the nature of three ammunition elements extracted from the corpse of a victim of femicide committed in the circumscription area of the Twenty-First Police Station. This homicide had occurred around nine o'clock on May 13th. Simultaneously, a .38 SPECIAL caliber revolver was examined.

This revolver had been seized around twenty-three hours on May 13, 2023 at a bus terminal in the Administrative Region of Planaltina, Federal District. The nature of the incident, registered at the Sixteenth Police Station, was possession of a narcotic substance for consumption and illegal possession of

a firearm for permitted use. In addition to the narcotic substances and the firearm, five cartridges of 38 SPL caliber ammunition and five cartridge cases of 38 SPL caliber ammunition were seized.

The Laboratory proceeded with its routine of inserting elements into the Computerized System and, subsequently, the *in silico* comparison routine. Two months later, an Expert Intelligence Report would bring important information to the two Police Stations: the weapon seized in the 16th DP area had been used in the completed femicide in the 21st DP area. The ballistic confrontation carried out by the Criminal Experts made it possible not only to indicate which weapon was used, but to make the material sent (five cartridge cases struck) compatible with the facts narrated in the incident record, which described five firearm shots.

To give you an idea, the distance between the two crime scenes (femicide and seizure of the firearm) is fifty-five kilometers. The time lag between occurrences was four hours. The person carrying the weapon was fleeing to the State of Bahia.

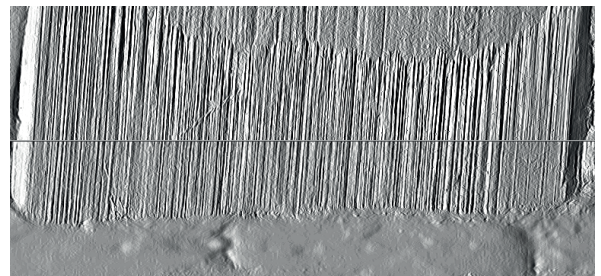


Figure 5 – Image of *in silico* ballistic confrontation between a standard projectile collected from the forwarded firearm and one of the projectiles extracted from the victim.

The *in silico* ballistic insertion and confrontation routine was decisive for, in a short space of time, providing the investigation of the intentional violent crime against life with a main suspect, for bringing with him the firearm used in the described femicide, as

well as assuming his property.

#### CASE 4

In 2020, on the twenty-eighth day of October, there was a homicide in a cafeteria in the Administrative Region of Ceilândia, an incident investigated by the Nineteenth Police Station. From the facts narrated in this Police Station, one of the victim's relatives recognized the person identified as the main suspect of the crime. A 7.65 mm caliber projectile, with five right-handed rays, was sent to the Forensic Ballistics Laboratory by the Legal Medical Institute. This ammunition element was duly treated and entered into the computerized ballistic database.

Three months later, in January 2021, this Laboratory would receive a short firearm, revolver type, INA bran.32 caliber. After carrying out the efficiency tests, the patterns of the firearm examined were entered into the computerized ballistics database.

Proceeding with the routine *in silico* confrontation, on March 9, 2021, this Laboratory issued an Expert Intelligence Report indicating that the weapon that had been sent in January had been used in the homicide in October of the previous year.

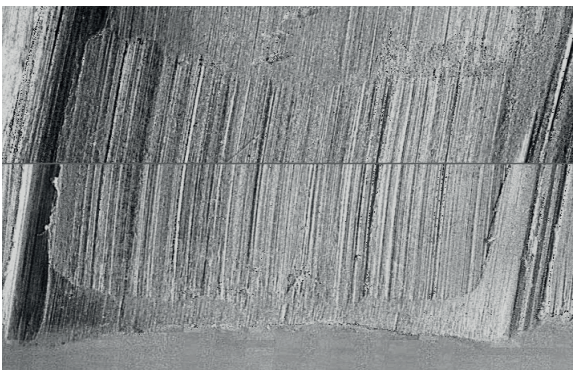


Figure 6 – Image of *in silico* ballistic confrontation between a standard projectile collected from the forwarded firearm and one of the projectiles extracted from the victim.

The first particularity of this case lies in

the fact that the projectile removed from the corpse was of 7.65 mm caliber and the weapon was of 32 caliber, which demonstrates that although of different nominal calibers (.32 AUTO – or 7.65 mm – and .32 S&WL), the cartridge developed for use in pistols with a nominal caliber of 7.65 mm can also be used in revolvers with caliber .32 S&WL, given that it is a cartridge with a semi-rimmed base.

The second particularity is that the perpetrator of the crime of illegal possession of a permitted firearm is the same person identified as the main suspect of having committed the homicide reported here. The crime of illegal possession of a firearm for permitted use occurred in the Asa Sul neighborhood, an area within the jurisdiction of the First Police Station, during a pursuit undertaken by the Military Police of the Federal District of a vehicle resulting from a robbery, driven by the perpetrator.

Finally, it is worth noting that the author would be arrested for the theft of the vehicle and the illegal possession of the permitted firearm, but it was the *in silico* ballistic confrontation examination that made it possible to definitively link the same author to the two incidents (homicide and illegal possession).

#### CONCLUSION

Solving crimes involves the coordinated action of several actors. Among these actors, we highlight the Criminal Experts who examine the crime scene, carefully collect the traces and send them for complementary exams. Likewise, the Criminal Experts of the Forensic Ballistics Laboratory carry out the necessary treatment and examination of the remains, as well as performing the ballistic confrontation examination routine in the computerized system. This routine has greatly contributed to the correlation between seized firearms and incriminated material, which was either

extracted from victims or collected at crime scenes. Considering the moment in which the routine was definitively implemented – 2020 – and the results obtained so far (488 hits, 273 of which were expert intelligence), the tool that allows increased productivity and reduced response time for the desired result deserves to be highlighted. For the investigation, placing Criminal Forensics in a proactive position that supports the investigation with expert evidence that indicates important correlations

between occurrences in the same Police Station, or even in different Police Stations, in different Administrative Regions and with significant time lapses.

This expert evidence allows the investigation to identify which crimes were committed with which weapons, as well as to map areas of action of criminal organizations, identify their members and act preventively, preventing new crimes from being committed.

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