

CASE REPORT

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Physical Match of Fragmented Bullets

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ABSTRACT: The technique of physical match, which is widely used with materials such as plastic and glass, is applied to fragmented bullets for determination of common origin. The more conventional method, of tool marks comparison, is later used to connect the bullet with a firearm.

KEYWORDS: forensic science, physical match, physical fit, mechanical fit, fracture match, bullet fragments, firearms

The technique of physical match, which is also known as physical or mechanical fit and fracture match, is often used by forensic experts in order to determine a common origin of two, or more, fragments of plastic, glass, metals or other substances. Physical match as defined by the AFTE (1) glossary, “the examination of two or more objects either through physical, optical or photographic means which permits one to conclude whether the objects were either one entity or were held or bonded together in a unique arrangement.”

The biggest advantage of this technique lies in the fact that it is not necessary to be an expert to come to the conclusion that there is a physical match. Walls (2) wrote, “Physical fits and broken edges. If anything gets broken in committing a crime, and if one of these parts is found at the scene and the other can be linked with the suspect, then the fitting together of the broken edges may provide the most incontrovertible evidence possible—evidence which needs no scientific training for its appreciation.” He conveyed the common belief among forensic experts that this is the best kind of evidence.

Kirk (3) used even stronger words when he wrote, “. . . when the fragments show a physical fit of a fractured surface, such evidence being so strong as to constitute almost absolute proof.” These words emphasize the importance of physical match in the world of forensic science. We should also remember the reason

for all this work, meaning our appearance at court in order to convince the judge(s) and/or jury, of the importance and weight of our evidence. Quotations from two transportation trials, held in Israel, will show the effect of physical match on judges when they write their verdicts: “glass break . . . is a random process and can happen in infinite ways, but there is no practical way of creating a similar break line. As we know that there are no where in the world two identical fingerprints, I am convinced that there is a connection between the glass pieces from the scene and the glass pieces from the defendant’s car.” From another trial, “The evidence brought before court, in the testimony of the tool marks expert, who demonstrated the match between the different plastic pieces, prove beyond any doubt the possibility to connect the defendant’s car to the scene of the accident . . .”

Although this technique is widely used when handling fragments of plastic, glass and metal objects, it is rarely used with fragmented bullets.

In this article we will discuss this problem and give two examples of physical matches of fragmented bullets. Being able to find such a match gave us the answer to the question of whether there was only one firearm, or more, in the incident.

Bullet Fragmentation

When a bullet hits its target, it sometimes fragments. The fragmentation depends on the bullet’s caliber, type, impact velocity, and trajectory within the target. Bullets, like the caliber 9 × 19 mm (9 mm Parabellum), with typical velocities of 350 meters per second (1150 ft/sec) can fragment into two or more fragments. Higher velocity bullets, such as the caliber 5.56 × 45 mm (5.56 NATO), fragment into a great number of fragments, starting at velocities of approximately 799 meters per second (2620 ft/sec), creating the “snow storm” effect. See Fig. 1. (Courtesy of M. L. Fackler, M.D., F.A.C.S., Wound Ballistic Consultant, Permission granted via written correspondence dated March 19, 1999.)

On occasion parts of the fragmented bullets go through the body and are left at the crime scene. The examiner who receives this evidence is required to determine, among other things, if the fragments from within and outside of the body originated from a common origin (namely one or more bullets and firearms).

Factors involved in physical matches

Gupta (6) summarizes the factors involved in physical matches:

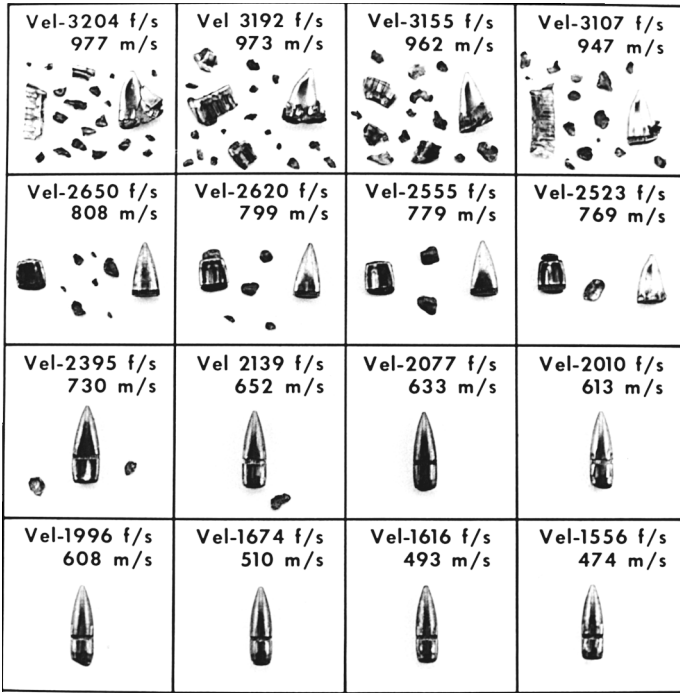
- (a) The average or general thickness of the material.
- (b) The variations and irregularities in this thickness.
- (c) The general color.

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FIG. 1—Impact velocity effect on bullet’s fragmentation. Courtesy of Dr. M. L. Fackler. Reprinted with permission.

- (d) The general shape of the line of the tear or break i.e., zigzag, curved, straight, etc.
- (e) The irregularities from point to point along the line of the break.
- (f) The striations, rib-marks or imperfections along the cross-sectional surfaces of the broken edge.

When examining bullet fragments, we observed three basic manners of breakage (separation):

1. Along the longitudinal axis of the bullet. Usually along the driving or trailing edge of the land impressions, however it can occur in between the land impressions. See Fig. 2.

2. Along the horizontal axis forward of the land impression. See Fig. 5.

3. Along the horizontal axis-inside the land marks impressions section or along a cannellure. Also, bullet breakup can occur with different combinations of the above manners.

When encountering options 1 & 3 the examiner can use traditional comparison methods to try to connect two or more fragments. Such a comparison needs the “help” of a complete bullet, for example another evidence bullet or a test bullet (if the examiner has the firearm in his possession). On both cases, he can conduct a comparison between each fragment to the test bullet’s land and groove impressions. The outcome of the comparison might conclude that both fragments were fired from the same barrel. However, this does not necessarily mean the fragments came from the same bullet.

In option number 2, a comparison will be even more difficult since the upper part of the bullet (where the cannellures are located) generally contain a lower quantity and quality of bullet striae (individual marks from the firearm’s barrel).

In all these cases a physical match can prove, beyond any doubt, that two fragments come from a common origin, one bullet. The following examples will show that even if one of the fragments is severely damaged, it is still possible to get a physical match.

Case Studies

Case 1

In the course of a dispute between two gangs, several shots were fired by a member of one gang at members of the other gang. One man was injured in his leg.

Recovered at the crime scene were four 9 mm Short (9 × 17 mm) cartridge cases and a fragment of a bullet which was determined at the firearms laboratory, as a part of 9 Short mm bullet, FMJ type.

Later, another fragment of a bullet, surgically removed from the victim’s leg, was sent to the firearms laboratory. This piece was also identified as part of a 9 mm Short FMJ bullet. Figure 2 show a base view of the two fragments, positioned side by side.

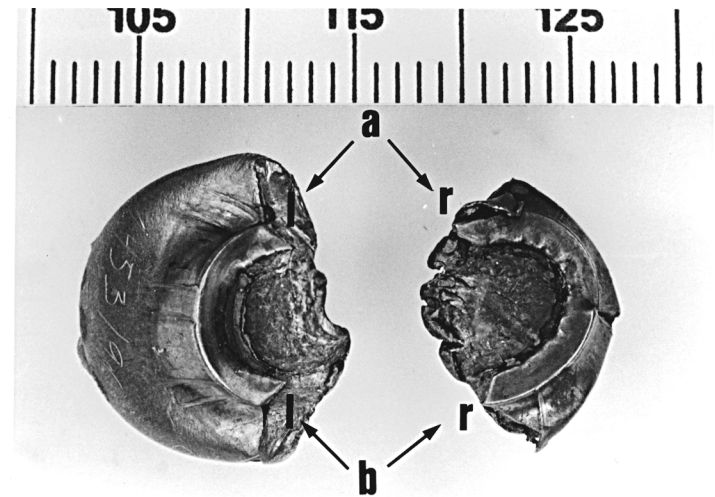


FIG. 2—A base view of the two fragments, positioned side by side. FMJ bullet caliber 9 × 17 mm. a = area a; b = area b; l = left; r = right.

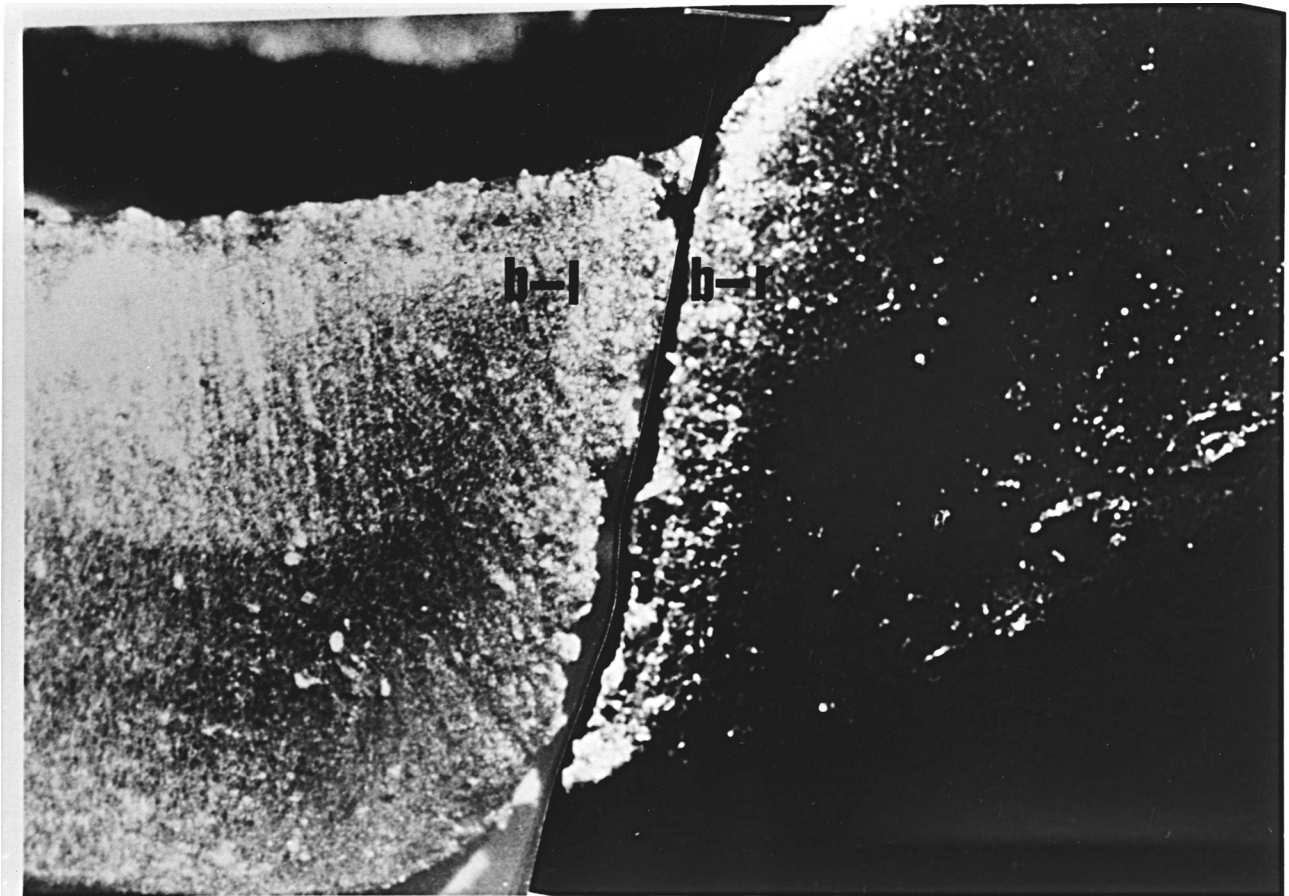


FIG. 3—Physical match along the tear line, area b.

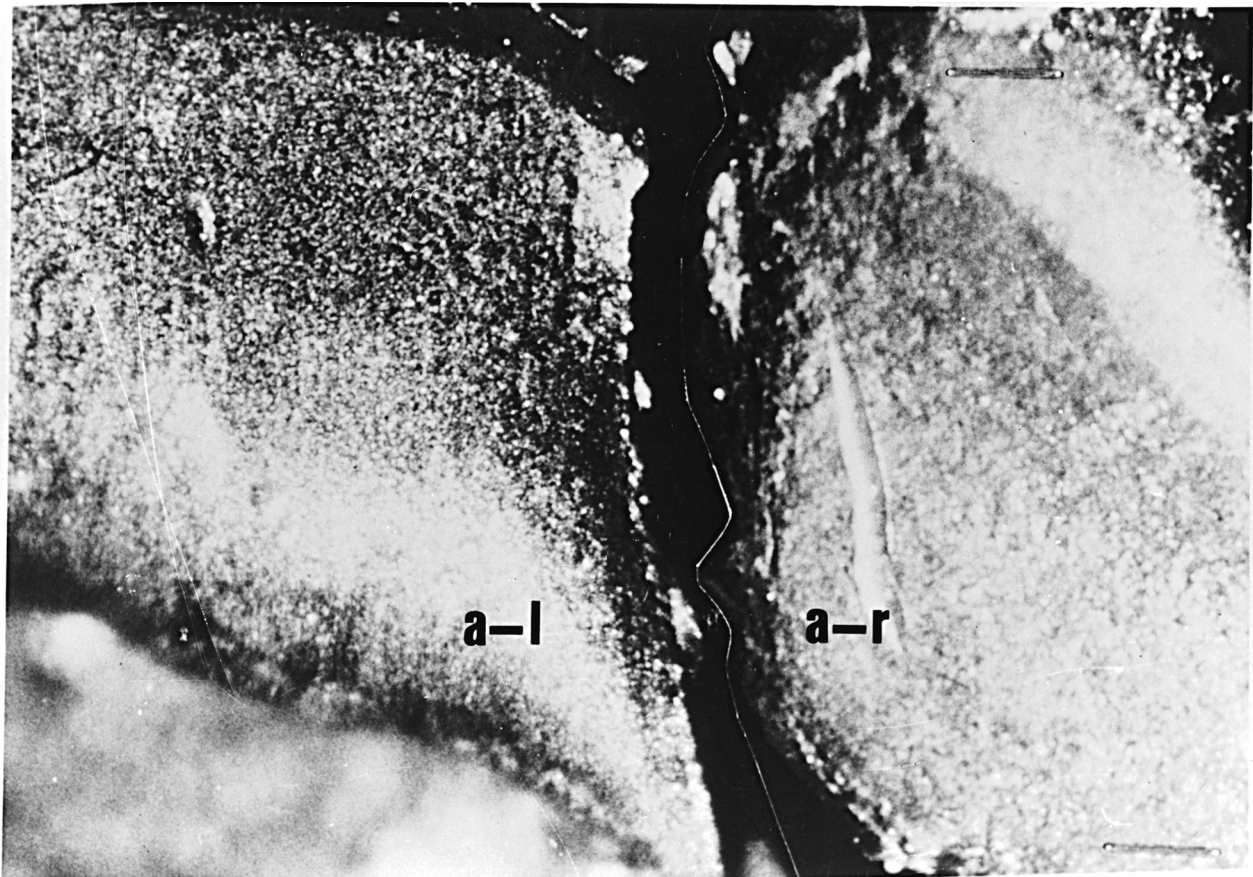


FIG. 4—Physical match along the tear line, area a.

Examination of the evidence revealed the following facts:

1. The cartridge cases were fired from one semi-automatic pistol, most probably a Czechoslovakian CZ model 83, caliber 9 mm Short.
2. Class characteristics on both fragments also agree with those of the CZ 83 barrel.

The chief investigator of this case asked, if the two bullet fragments are a part of one bullet or originate from two different bullets. The answer to this question was important in order to remove any doubt about the fact that there was only one shooter at the crime scene which was information vital to advancement of the investigation.

The tear line on the bullet's envelope, on both fragments, was located between land impressions. Therefore, there was no way of connecting them by means of comparison of land impression striations.

Since there was no other bullet recovered and the pistol was not recovered, the way to tie the two fragments together is by means of physical match. Note: Elemental metal analysis can be performed in conjunction with physical matches, however, elemental metal analysis only provides a family characteristic, while a physical match provides an unique match (based on individual characteristics).

The edges of the bullet envelope's base were examined, using the comparison microscope under high power magnification. By bring-

ing them together, one edge next to its counterpart, it was possible to see the physical match along the tear line. See Figs. 3 and 4. The final expert report stated that the two fragments were of one bullet.

In this case, a certain amount of "acrobatic" dexterity in handling the two pieces on the comparison microscope, was necessary in order to position them in a way which would emphasize the match. It required manipulation of the objects on the microscope's stubs, the light's position and the light's angle before the match became apparent. A table top Lietz comparison microscope was used.

Case 2

A criminal was slain in broad day light. The murderer shot him five times with a Colt Cobra 38 Special revolver, the sixth bullet was a misfire. The victim got up, ran from his attacker but dropped in the middle of the street. At this point the murderer came closer, pulled out a semi-automatic Smith & Wesson model 39-2 caliber 9 mm Parabellum (9 × 19 mm) pistol and shot him once in the head.

The crime scene unit arrived at the scene and collected one 9 × 19 mm cartridge case, one 38 Special lead bullet and a fragment of a 9 × 19 mm FMJ bullet. Later, two more 38 Special lead bullets and another fragment of a 9 × 19 mm FMJ bullet were recovered by the coroner during the autopsy of the victim. Figures 5 and 6 show the two 9 × 19 mm bullet fragments.



FIG. 5—Physical match of the two 9 × 19 mm FMJ bullet fragments.



FIG. 6—Physical match of the two 9 × 19 mm FMJ bullet fragments.

It was obvious that at least two firearms were involved, but the investigating team needed to know if a third firearm was involved. It was necessary to determine if the two 9 × 19 mm fragments came out of the same barrel. It could not be done by means of land and groove impression comparisons since the first fragment, found at the scene, was the forward section of the bullet and there were no land impression marks on it. The only way to connect this fragment to a specific firearm was by finding some connection to the fragment recovered from the body. Amazingly enough, though the two fragments were deformed, a physical match was possible. See Figs. 5–7.

Later in the investigation, the semi-automatic S&W 39-2 was recovered and a comparison was made between the “rebuilt” bullet and test bullets fired from the pistol.

When the case was presented at court, the defense counsel objected to the process of physical match of the bullet fragments and requested that the fragments be examined by his own expert. The trial ended with a plea bargain and this evidence was never challenged.

Summary

Physical matches between bullet fragments can be a very powerful tool to the firearms examiner, investigators, lawyers and the courts. Sometimes it is the only way to establish a connection be-

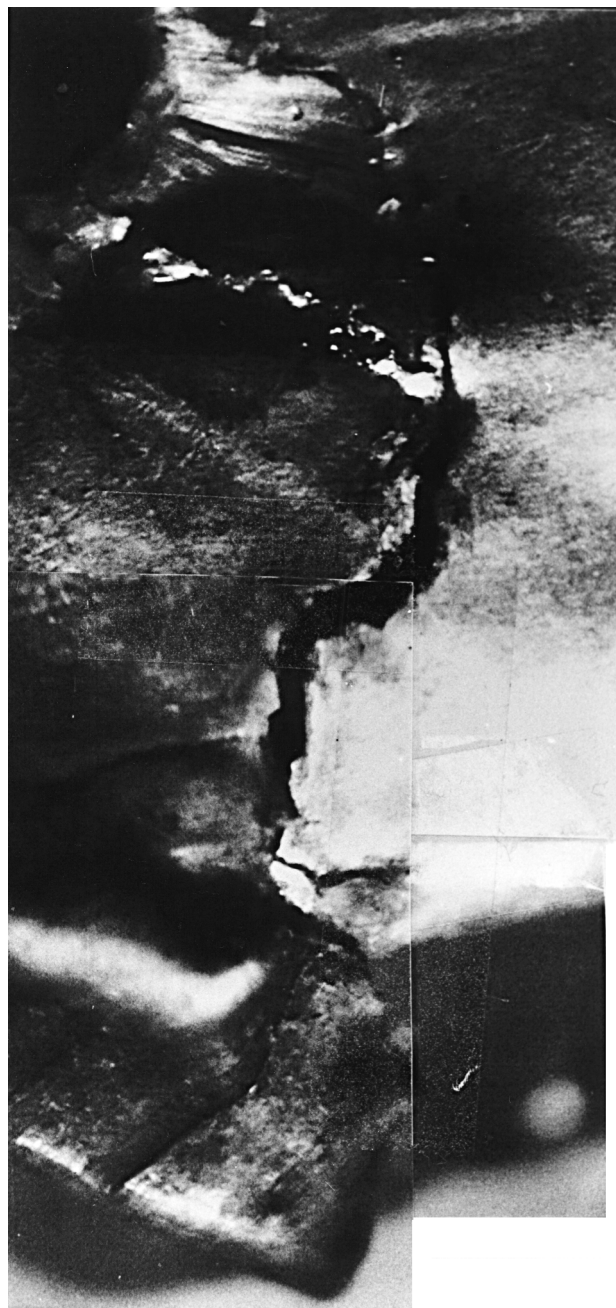


FIG. 7—Close view of the tear line.

tween a bullet fragment and the firearm from which it was fired. As mentioned, elemental metal analysis can be performed in conjunction with physical matches. However, in physical matches there is an infinite number of matches all along the fracture (break), and this reduces the importance of this elemental metal analysis of the jacket and core (providing family characteristics). Physical matches “(2) . . . may provide the most incontrovertible evidence possible,” and it provides evidence “(3) . . . so strong as to constitute almost absolute proof.”

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