CONSECUTIVELY RIFLED GUN BARRELS PRESENT IN MOST CRIME LABS.

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ABSTRACT

Derringer pistols with two or more barrels were removed from the laboratory firearms collection. The barrels were cast with silicone rubber and test fired bullets were collected from the barrels and examined. The silicone casts indicated that several of the firearms had barrels that could be consecutively rifled. Some of thepistols produced muzzle area casts from the two barrels that were easily "matched" as having had a common rifling tool. The test fired bullets from two different barrels, however bear few common striations, and are easily eliminated as having a common source.

Introduction:

The individuality of rifled firearms barrels is commonly based upon the fact that consecutively rifled barrels do not produce fired bullets that can be mistakenly identified to any barrel other than the one from which they were fired. The 1926 Springfield Arsenal experiment[1] using four consecutively rifled barrels was probably the first test of this theory since it followed very closely the development of the bullet comparison microscope by Gravelle in 1925[2]. These same type of studies have been conducted by several AFTE members beginning shortly after the formation of the association. Lutz reported on the examination of broach rifled barrels in 1970[3] that were provided by Smith and Wesson while he was with the U.S. Army Criminal Investigation Laboratory. The test fired bullets could easily be identified to the barrel of origin since the groove markings on the specimens contained a great number of differences.

A study of consecutively button rifled barrels was first reported by Murdock in 1977[4] using .22 Caliber barrels furnished by Marlin, Mossberg and Remington. This comparison of both land and groove impressions found that there was no carry-over of family-type striations between barrels that would lead to a misidentification. Murdock further points out that "only by making comparisons of known 'mismatches' that the examiner can gain the ability to appreciate the significance of matching striae observed when comparing questioned and test fired bullets."

A hammer forged polygonal rifled barrel furnished to Haag[5] by Heckler and Koch produced fired bullets with few markings. Three of these same consecutively produced H & K barrels were provided to Freeman for study while he was stationed in the U.S. Army Criminal Investigation Laboratory in Frankfort[6]. The testing disclosed "that each barrel has a distinct and separate individuality."

Hall studied consecutively rifled polygonal button-swaged barrels that were furnished by Shilen Rifle Inc. in Ennis, Texas[7]. Again, as was the case with Freeman, an integral part of the study was a visit to the firearms manufacturing plant. The consecutively manufactured rifle barrels did not produce fired bullets that would lead to a false identification.

A recent study conducted by Brundage involved ten Ruger barrels that were monitored on the production line to assure consecutiveness and orientation[8]. The fired 9mm bullets from the barrels were blind tested by thirty different laboratories to assure that identification bias had not been introduced into the study. Again, as in all the previously mentioned studies, the test fired bullets were correctly identified to the barrel of origin.

Each of these studies have contributed greatly to the body of literature that verifies that each and every rifled firearms barrel is unique. There are, however, two major drawbacks to this type of testing. The first problem is that in order for the study to take place a manufacturer must be willing to provide barrels that have been carefully marked and monitored throughout the entire production process. Ideally the person conducting the test will be able to follow the barrels from start to finish.

This forces a great imposition on the manufacturer and can be quite expensive for the firearms examiner conducting the study. The second and truly greatest problem with these studies is identified by Biasotti as to the subjective nature of these examinations[9]. The greatest value of the previously listed studies are to the examiner that performed the work and made the microscopic comparisons. This information is of value to firearms examiners outside of the study for citing in court when testifying to a bullet identification, but are very subject to challenge on the grounds that the testifying expert did not actually conduct the experiment himself. Since the criterion for determining whether a fired bullet could be misidentified to the wrong barrel is strictly subjective, those examiners not involved in the study must rely on photographs or statements of the author of the experiments.

Ideally objective criterion for identification will be developed, and this could be approaching very rapidly with the ever increasing presence of computer programs used for bullet searching. In the meantime, Biasotti's proposal to cast barrels and studying those casts to determine that within the length of each barrel there are so many changes that it is therefore unique in and of itself has great merit.

Purpose of the Study:

This study was initiated to determine if derringer pistols in the laboratory firearms collection could be used as a source of consecutively rifled barrels. If silicone casting of these barrels disclose a large number of matching striation patterns, sometimes referred to as family resemblances, the assumption could be made that they were manufactured consecutively or at least in close enough sequence that the rifling tool had not changed significantly.

If the mated barrel casts do bear significant family resemblances the next procedure would be to determine if fired bullets could be identified back to the correct barrel.

Testing Procedure:

Twenty-nine multiple barrel derringers were removed from the laboratory firearms collection. Two of the pistols were Sharps four barrel reproductions[10], and all of the rest were super imposed tip-up double barrels. Fourteen of the pistols had sleeved barrels as described by Hawkins and Dragan[11,12].

The barrels were thoroughly cleaned to remove fouling and lead deposits. The barrels were then cast using Mikrosil brand silicone rubber compound[13,14,15,16]. A plastic 12cc hypodermic syringe was filled with the two part premixed casting material and injected into the barrels. The use of a syringe as suggested by Komar and Garrison[17,18] reduced the incidences of trapped air bubbles in the barrel and permitted rapid casting of several barrels with one blending of the base silicone compound and hardener.

The mated casts from each pistol were mounted on the comparison microscope using plastic headed map pins. Plastic map pins that have "dumb bell" shaped heads fit perfectly into a Leitz bullet stage mount if the end ridge is shaved off. The end of the rubber cast can be impaled upon the pin and viewed as if it were a bullet.

All pistols that had barrels producing casts that exhibited matching striation patterns were then test-fired in a water tank. Each test fired bullet was marked with an index mark that corresponded to the position of the front sight. Multiple test shots from the same barrel were sequentially numbered and all top and bottom barrel test shots were marked with a 'T' or 'B'.

Initial test firings were attempted with jacketed ammunition, however it was soon discovered that most of the bullets were failing to expand sufficiently to provide definitive markings on the bearing surfaces. Lead wadcutter, caliber .38 bullets with deep concave bases provided the best obturation and thus the least gas cutting in the base area. Lead bullets were also used for the caliber .22 pistols.

Several of the pistols were in fairly poor condition with loose fitting barrel locks and in some instances with internal parts missing or broken. To avoid the possibility of doubling as related by Celovsky and Fournier[19,20] all test firings were performed with only one barrel loaded.

Discussion:

The original hypothesis for this study was that derringer pistols are relatively inexpensive guns, and therefore little expense or effort would go into the production of the barrel bores. If this were the case we would expect to find very rough barrel surfaces that have been produced by poorly maintained and worn tools. These barrels would therefore produce test fired bullets with very heavy, easily identified striation patterns, especially on the groove impressions.

This proved to be the case with only one pistol. Even though many of the pistols were very poorly made, the barrels generally were finely machined. This original hypothesis was initiated by the research of Lomoro performed on several F.I.E. Titanic revolvers that had matching striae on the groove impressions(labeled bullet lands by the author)[21,22,23]. These matching striae photographed very readily because they were very coarse, indicating that they should probably be treated as class characteristics rather than individual characteristics. The one derringer pistol in this study had very heavy matching striation patterns on the bullet groove impressions from both barrels that could easily be matched, and no matching striation patterns on the bullet land impressions(photos #1 & #2). This research further reinforces the importance of not relying upon groove striae for an identification, when matching striae are not found on the land impressions.

The microscopic comparisons of the casts from two additional solid barrel derringer pistols in this project had matching striation patterns near the muzzle on both the lands and the grooves. The test fired bullets from one of these pistols did have some major striations present on the land and groove impressions. These striations were directly associated with major striations present on the casts that ran the entire length of the barrels and should therefore, also be treated as class characteristics rather than identification characteristics. These heavy marks would be useful for orientation purposes on an unknown or evidence bullet, but are not present in nearly sufficient numbers to be mistakenly used for an identification.

A large number of the pistols with cut rifling had large matching ridge striation patterns running parallel to the bore, the entire length of both barrels in the land areas. These marks indicate that a bore button with large defects was forced the length of the barrels to supplant the reaming process[4]. Bore button reaming was further supported by the fact that no reamer marks were present running at a right angle to the bore length. Even though these ridge defects were large and easily matched on the silicone casts, they did not produce matching striae on the fired bullets from mated barrels. This was expected since the defects ran parallel to the bore and not parallel to the rifling.

Initially most of the bullet microscopic comparison work had encompassed the solid barrel derringers. When, however, only three pistols produced silicone casts with matching striation patterns, the sleeve barreled pistols were cast and test fired. The sleeve barreled pistols had been ignored earlier since it was assumed that it was highly unlikely that two consecutive barrel sleeves would be installed in proper orientation in the same pistol. Five of the pistols, however with sleeved barrels had button rifling that produced casts with matching striation patterns near the muzzles. Five of the solid barrel pistols had button rifling and all but one had some matching striation patterns.

Even though these nine pistols with button rifled barrels produced very extensive matching striation patterns on the silicone casts near the muzzles, none produced fired bullets that were identifiable to the opposing barrel.

The original assumption was that striations in matching patterns near the muzzle would be the last bearing surface to make contact with the bullet and therefore would produce interchangeable identifiable bullets between mated barrels. This soon proved not to be the case, thus showing that striations on a bullet are an accumulation of data derived from various locations along the length of the barrel. A major contributor to the individual bullet striae from the button rifled barrels is certainly the partially compressed reamer marks that appear very prominently in the casts of the lands and grooves. These marks are very random in size and position across the face of the rifling. This randomness reveals that they definitely are not a result of a planned design in the manufacturing process and therefore would not be expected to produce class type striations.

The ability to observe the interrelationship of the matching striae on the lands and grooves and the random marks from the reamer further verifies the importance of barrel casting to the total understanding of forensic bullet identification. After observing the surface features along the entire length of the barrel it becomes obvious to the examiner that marks viewed near the muzzle play only a partial role in bullet bearing surface profiles.

Conclusion:

The examination of barrel casts is one of the simplest and most important procedures for determining if prominent striation patterns on the bullet are class markings or identification characteristics. The use of derringer barrel castings and test fired bullets is a readily available training aid for the new examiner. Even the veteran examiner should be impressed by the number of matching striae that are present in consecutively or near consecutively rifled barrel casts. The experienced examiner that has never compared these casts to the test fired bullets from the same barrels will be even more impressed that there is so little carry over to the projectiles.

After a study of tooling marks in consecutively rifled barrels the examiner should be able to testify with greater

confidence that no two barrels mark a bullet the same. The convenience of performing the study with derringer barrels means that the tools for the experiments are available to every laboratory with out imposing upon gun manufacturers.

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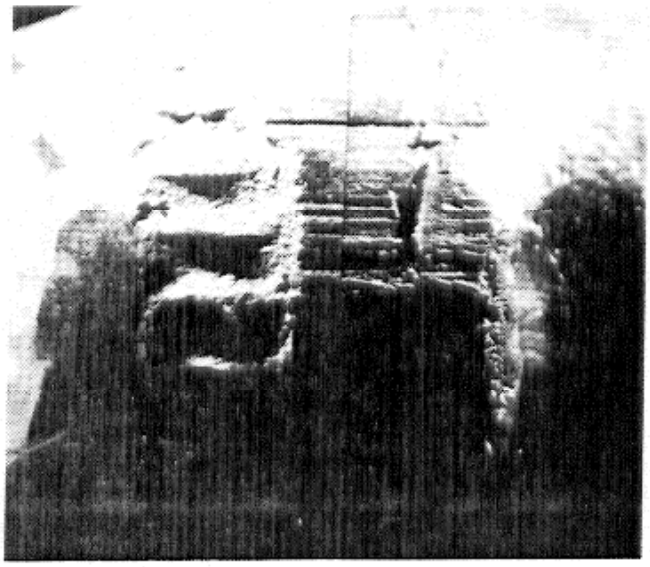
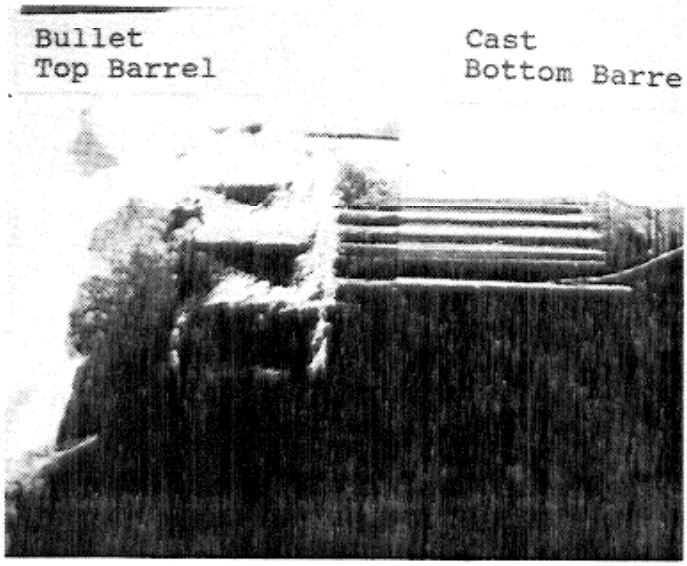
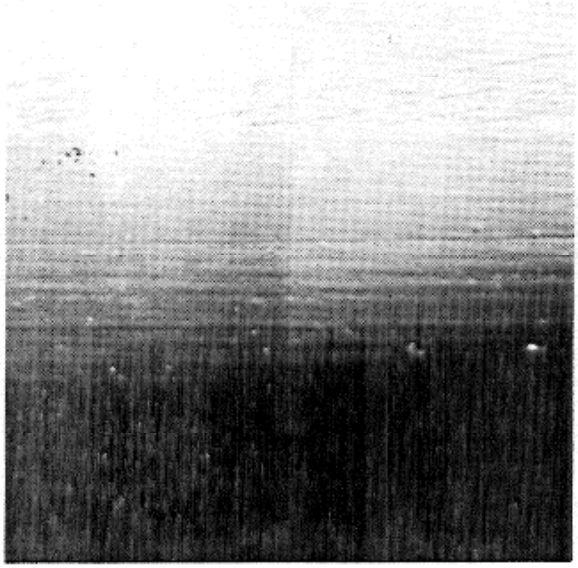


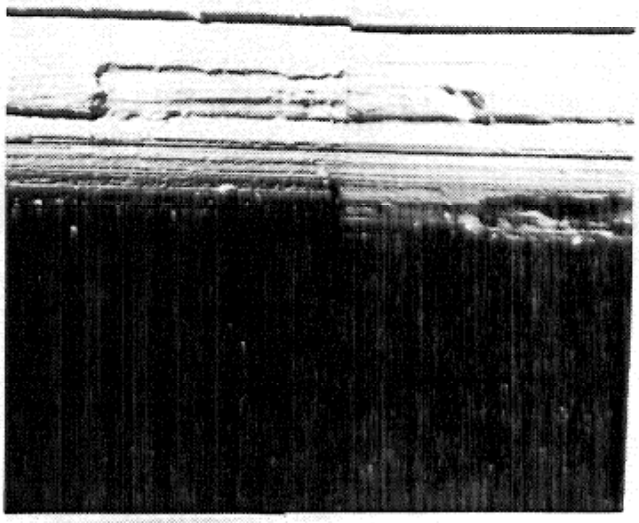
#1. Matching stria on groove impressions of bullets from pistol with cut rifling, Left-bottom barrel, Right-top barrel.



#2. Left-Bullet from top barrel, Right-Cast from bottom barrel. Same pistol as #1.



#3. Cast showing matching striae near muzzle of two button rifled barrels-same pistol.



#4. Cast of changing striae in cut rifled barrel.