Glock Experiments with New Prototype Rifling Method Barrel

By: Gabriel A. Hernandez M.S., Thomas G. Fadul Jr. Ph.D., John M. Mancini M.S.

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ABSTRACT

The Miami-Dade Police Department Crime Laboratory obtained two sets of ten 9mm caliber consecutively manufactured Glock prototype barrels in order to explore the repeatability and uniqueness of striations/impressions, as well as the capability of examiners to identify bullets fired through consecutively manufactured Glock barrels. There were two sets of ten barrels. The general rifling characteristics for the first group was 12 right. The second group was 18 right. On a voluntary basis, five test sets were created and distributed to ten examiners in the Miami-Dade Police Department Crime Laboratory. The test set was designed to evaluate the identifiability of the two sets of consecutively manufactured Glock Prototype barrels (two sets of ten).

Introduction

The Miami-Dade Police Department (MDPD) Crime Laboratory received a National Institute of Justice research grant to study the manufacturing of the Glock EBIS barrel (Fadul, Hernandez, Wilson, Stoiloff, & Gulati, 2013)[1]. In discussion with representatives from Glock, Inc., it was revealed that Glock had a desire to revamp the way it currently manufactures the Enhanced Bullet Identification System (EBIS) barrels in order to save costs. Their engineers had some prototype rifling designs in mind and wanted to have them evaluated by the Miami-Dade Crime Laboratory Firearm and Toolmark Unit. Glock sent two sets of ten consecutively manufactured Glock prototype barrels to the MDPD.

One set of prototype barrels had rifling characteristics that were 12 right in appearance. There were six rounded (rounded in cross-sectional appearance) lands within this barrel design that had the same appearance as the rounded lands that are typically seen in 9mm Glock polygonal barrels. However, in between the rounded lands, in the center of what would be the groove portion in a typical 9mm Glock polygonal barrel, there were six rectangular (rectangular in cross-sectional appearance) lands that that were smaller in width than their rounded counterparts (**Figure 1**).

The second set of prototype barrels had rifling characteristics that were 18 right in appearance. Again, there were six rounded lands within this barrel design that had the same appearance as the rounded lands that are typically seen in 9mm Glock polygonal barrels. However, each rounded land had one micro land on either side of it. In this design, there were six sets of lands, with three lands in each set (one rounded surrounded by two micro), within this 18 right barrel. The micro-lands were significantly smaller in cross-sectional width than their rounded counterparts (**Figure 2**).

Casts were made of one barrel from each set. Potential for

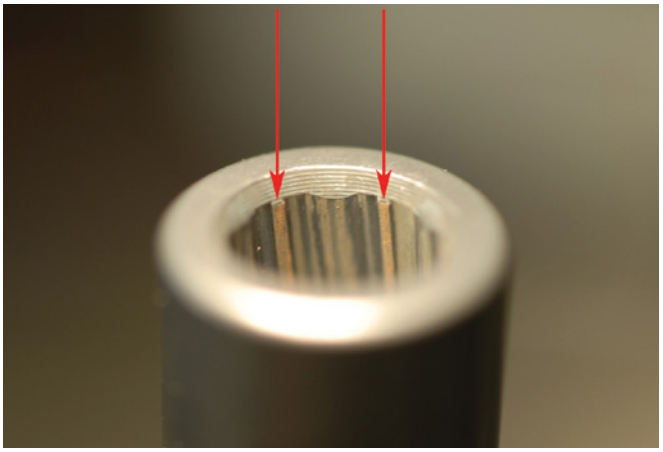

Figure 1: Micro lands in first set of prototype barrels

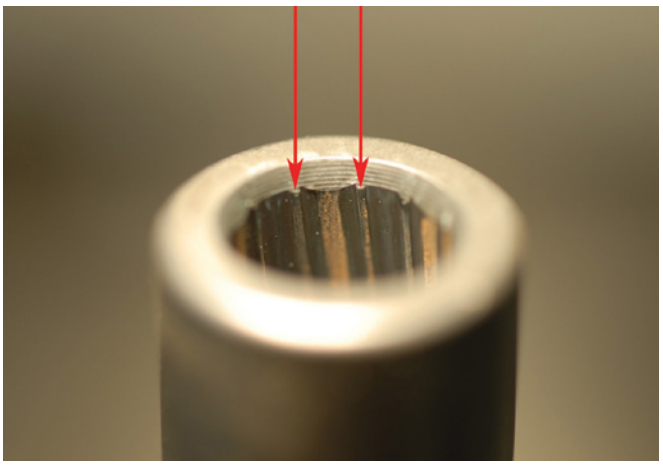

Figure 2: Micro lands in second set of prototype barrels

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subclass carryover was seen on the surface of the non-rounded lands in each set with striations traveling the length of the barrel from muzzle to chamber. These striations traveled parallel to the direction of travel of the bullet. Furthermore, it was noted that a second set of striations that ran at an approximately 45 degree angle to the direction of travel of the bullet occupied the same space as the striations that ran the length of the barrel from muzzle to chamber.

The rifling profiles of the prototype sets were made through a cold hammer forging process using a mandrel. Each prototype set had a mandrel associated with it so that the negative of the profile was apparent on the mandrel surface. The mandrels responsible for each set of ten consecutively manufactured barrels were inspected by one of the researchers during a tour of the Glock Manufacturing facility in Ferlach, Austria.

The low areas on the mandrel (what would become the lands in the barrel) had parallel striations running the length of, and parallel to, the long axis of the mandrel. These particular striations have a high degree for carryover due to the fact that many barrels will be made with the one mandrel. No approximately 45 degree striations were seen in the low portions.

The cold hammer forging operation takes place after the barrels are drilled, reamed and honed. The approximately 45 degree striations are manufacturing marks from these operations (particularly the honing and reaming operations) that existed in the barrel prior to contact with the mandrel. The approximately 45 degree striations, therefore have a low potential for sub-class carryover. The marks made from these honing and reaming marks on the bearing surface of a bullet could be used for identification purposes.

Materials & Methods

This study utilized an experimental research design (Christensen, 2004; Creswell, 2005), and was conducted in a crime laboratory setting [2, 3]. Participants examined and compared questioned bullets to the known standards, which were fired through two sets of ten consecutively manufactured Glock prototype barrels in order to determine whether or not consecutively manufactured Glock prototype barrels differ from each other, producing different signatures. Quantitative data (Creswell, 2005) was analyzed to determine if the examiners could correctly distinguish questioned bullets from multiple consecutively manufactured Glock prototype barrels. Survey/answer sheets were utilized to collect the quantitative data.

Research Question

Will firearm and tool mark examiners be able to identify the barrels that fired the questioned bullets when examining bullets fired through consecutively manufactured Glock prototype barrels?

Research Hypothesis

Firearm and tool mark examiners will not be able to correctly identify the Glock prototype barrels that fired the questioned bullets.

There is one dependent variable that was examined in this study. The dependent variable was accuracy, which measured whether or not the questioned bullets could be distinguished between the consecutively manufactured Glock prototype barrels. There is one independent variable in this study, which is assessment. Assessment is defined as the examination and comparison of the questioned bullets to the known standards, which were fired in ten consecutively manufactured Glock prototype barrels. The intervening variable is the amount of training, and experience of the examiners (participants). Extraneous variables were controlled by utilizing a laboratory setting, and through sampling.

Data Collection Methods

- The researchers performed the following steps:
- Obtained twenty Glock prototype barrels and labeled them 1 through 20.
- Obtained Federal 9mm cartridges (ammunition/ bullets).
- Obtained a 9mm Glock pistol for the test firing.
- Utilized an indoor range for test firing. The break in period for each barrel was 25 rounds.
- Utilized a horizontal water tank for the test firing and retrieval of the bullets.
- Placed each barrel one at a time in the Glock pistol.
- Loaded Glock pistol with five cartridges.
- Fired the weapon into the horizontal water tank.
- Fired five bullets through each barrel to create one test

set. This process was repeated five times to create five test sets.

- Utilized a test assembler.
- Used properly labeled containers that were pre-labeled by the test assembler to keep each group of five bullets separated.
- Labeled two of the five bullets from each set with the number of the barrel in which they were fired in (1 through 20) to create the test fired bullets (known standards). These known standards were placed in a coin envelope that was pre-labeled by the test assembler.
- Labeled remaining three bullets with an alpha character designated by the test assembler to represent the questioned bullets. Note: different alpha characters were assigned to each barrel.
- Randomly selected one questioned bullet from each barrel (1 through 20) from each container and placed it in a white pill box that was pre-labeled by the test assembler.
- Selected an additional five questioned bullets to complete the test set of 25 questioned bullets. The additional five bullets were each placed in a white pill box that was pre-labeled by the test assembler.
- The 25 questioned fired bullets were labeled with the following alpha characters: A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y and Z.
- Created five test sets of 25 bullets and placed each test set in a medium manila envelope.

Each participant received one test packet which included the following:

- One questionnaire/answer sheet
- 25 questioned bullets
- 20 sets of test fired bullets (known standards) that were fired through two sets of ten consecutively manufactured Glock prototype barrels.
- Instructed the participants via the questionnaire/answer sheet to compare the questioned bullets to the known standards, and to place their answers on the questionnaire/answer sheet.
- The participants were instructed to return the answer sheet to the test assembler.
- Conducted the data collection.
- Coded and entered data into Excel.
- Performed data analyses.

Results

For this research study a total of ten examiners from the Miami-Dade Police Department participated. The instrument utilized for this study allowed the participants to record their answer by circling the appropriate alpha designator of the unknown bullets on the same line as the known test fired bullet sets designated by a numerical character 1 – 20. This experimental exercise of the instrument was designed to measure accuracy. The alpha characters were coded as 1 = correct, 2 = incorrect. A total score of 10 for each of the alpha characters used was possible. Participants received one point for each correct answer. A total assessment score of 25 indicated a score of 100% correct.

Each participant received a total of twenty pairs of known test fired bullets labeled Barrel 1 through Barrel 20, and 25 questioned fired bullets labeled with an alpha character. The participants examined and compared the 25 questioned fired bullets to the twenty pairs of known test fired bullets, which were labeled Barrel 1 through Barrel 20, and determined which barrels fired the 25 questioned fired bullets. **Table 1** depicts the results of the examination and comparison of each questioned fired bullet. There were a total of 250 questioned fired bullets examined, which resulted in 250 correct answers and no incorrect answers. There were a total of 8 inconclusive answers; however, all of the correct answers were circled and it was noted that the inconclusive bullets exhibited class and some individual matching characteristics.

Seven participants scored 25 points (100% correct). Three participants made a determination of inconclusive. Table 2 illustrates the total number of inconclusive answers based on a scale of 1 – 25, with one point for every correct answer. The eight inconclusive answers were not considered incorrect by the researchers since the participant(s) properly selected the correct barrel and eliminated the other 19 barrels. The inconclusive rate was determined to be 3.2%.

Research Question

The research question asked if firearm and tool mark examiners would be able to identify the barrels that fired the questioned bullets when examining bullets fired through consecutively manufactured Glock prototype barrels. The dependent variable (accuracy) was compared against the independent variable (assessment – experimental exercise). The data collection revealed that 100% of the participants did not make an error. Seven out of ten participants were able to correctly identify the Glock prototype barrels that fired the questioned bullets.

Three participants reported inconclusive answers. Where an inconclusive conclusion was rendered, the three participants correctly selected the actual barrel (or barrels depending if more than one inconclusive result was reported) that fired each of these particular bullets; however, sufficient agreement was not seen in these examples in order to make a conclusion of identification and only an inconclusive result was rendered.

The hypothesis stated: "firearm and tool mark examiners will not be able to correctly identify the Glock prototype barrels that fired the questioned bullets." The findings of this research study do not support this hypothesis. Based on this study, the analysis of the data revealed that none of the participants made an error in identifying the Glock prototype barrels that fired the questioned bullets. The data revealed that the participants were able to identify 96.8% of the questioned bullets to the Glock prototype barrels that fired them. The data also revealed that that the participants were able to eliminate the barrels 100% of the time. Additionally, the data collected demonstrates that consecutively manufactured gun barrels differ from each other, producing different signatures.

Conclusions

This research study showed that it is possible for qualified examiners to make correct identifications with bullets fired through both types of consecutively manufactured Glock prototype barrels. This research study also demonstrated that the potential for subclass carryover with these barrels is of no consequence to the ability to make correct identifications. There were no incorrect identifications reported. There were three participants who reported inconclusive answers; however, for each inconclusive selection, the correct barrel was identified noting that there were insufficient markings to make a more conclusive identification.

The findings of this research study also supports the theory in firearm and tool mark identification that each firearm/tool produces a signature of identification (striation/impression) that is unique to that firearm/tool, and through examining the individual striations/impressions, the signature can be positively identified to the firearm/tool that produced it by a qualified examiner.

Limitations

There were a few limitations to this study. First of all, the researchers did not witness the production of the barrels. The researchers had to rely on Glock for the authenticity of the consecutiveness of the barrels. However, during a tour of the Glock manufacturing facility in Ferlach, Austria, one of the researchers had the opportunity to observe the manufacturing process firsthand. In addition, the researcher was shown the mandrels that were used to produce each set of prototype Glock barrels.

Another limitation was the assembly of the test sets. The work of the assembler was not verified.

Also, the skill level of each person could vary depending upon the training and amount of examinations performed on a routine basis. For example, six of the eight reported inconclusives were reported by a newly trained examiner.

Recommendations for Future Research

The researchers recommend further exploration into Glock's next barrel design.

Further research will continually improve the scientific foundation of forensic firearm and tool mark identification through evaluation, testing and study to determine the uniqueness of striations/impressions. Furthermore, it will allow the error rates for identifications of same gun evidence to be calculated from the additional data. This empirical data will continue to strengthen the foundation of firearms identification.

Acknowledgements

Miami-Dade Police Department Crime Laboratory Firearm and Tool Mark Examiners.

References

[1] Fadul, T., Hernandez, G., Wilson, E., Stoiloff, S., & Gulati, S. An Empirical Study to Improve the Scientific Foundation of Forensic Firearm and Tool Mark Identification Utilizing Consecutively Manufactured Glock EBIS Barrels with the Same EBIS Pattern, (2013). National Institute of Justice. http://www.ncjrs.gov/pdffiles1/nij/grants/244232.pdf

Questioned Fired Bullets n=10		**Frequency**	**Percent**
A	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
B	Correct	9	90%
	Incorrect	0	0%
	Inconclusive	1	10%
C	Correct	9	90%
	Incorrect	0	0%
	Inconclusive	1	10%
D	Correct	9	90%
	Incorrect	0	0%
	Inconclusive	1	10%
E	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
F	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
G	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
H	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
J	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
K	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
L	Correct	9	90%
	Incorrect	0	0%
	Inconclusive	1	10%
M	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
N	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
O	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
P	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
Q	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
R	Correct	9	90%
	Incorrect	0	0%
	Inconclusive	1	10%
S	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
T	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
U	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
V	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
W	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
X	Correct	9	90%
	Incorrect	0	0%
	Inconclusive	1	10%
Y	Correct	10	100%
	Incorrect	0	0%
	Inconclusive	0	0%
Z	Correct	8	80%
	Incorrect	0	0%
	Inconclusive	2	10%

Table 1: Results of examination/comparison of questioned fired bullets

Total Score	**Frequency**	**Percent**
n=10		
19	1	10%
24	2	20%
25	7	70%
Total	10	100%
8/ 250 (10 participants x 25 bullets)	x 100 =	0.032

Table 2: Glock prototype barrel inconclusive rate

[2] Christensen, L., Experimental Methodology, (9th ed.). Boston, MA: Pearson, 2004.
[3] Creswell, J., Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research (2nd ed.) Upper Saddle River, NL: Pearson, 2005.