Examination of Striations on Bullets Discharged from 3D Printed Metallic Gun Barrels

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INTRODUCTION

3D printing is becoming an affordable and a popular manufacturing process that is cable of transforming a virtual digital model into a real-world three-dimensional solid object. Because it might be a choice to manufacture functional products, including firearms.[1,2] There is need to add a new chapter for forensic examination of 3D printed materials in both pattern examination and material analysis. 3D-printed firearms are manufactured without the need of physical contacts between any tools and the inner surface of the barrels to create rifling. It is uncertain whether distinguishable striations can be produced from 3D-printed barrels manufactured from the same printer using the same blueprint.

In this preliminary study, bullets discharged by using two 3D-printed 1911 barrels were examined.

MATERIALS AND METHODS

The 3D model of a 1911 gun barrel was created through a computer software based on the original M1911 blueprint.

The digital model was first tested by 3D-printing with plastic to observe any fallible design errors. Then, two gun barrels (Barrel A and B) were 3D-printed using the metal alloy form a local 3D printing service provider.

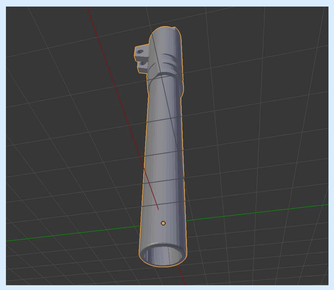

Figure 1: Digital model of a 1911 gun barrel

Figure 2: Two identical 3D printed gun barrel

No post-printing surface treatment was performed on both of the barrels. The barrels were assembled to a reference pistol and test-fired by the firearm examiners at Harris County Institute of Forensic Sciences (HCIFS) in Houston, TX.

For safety reasons, the firearm was mounted on a ransom rest set-up to secure the pistol during test-firing (Figure 2a). A piece of tape was used to disengage the grip safety of the firearm for successful firing (Figure 2b). A total of 100 cartridges were test-fired from each barrel and the striations on the fired bullets were examined by the firearm examiners at HCIFS.

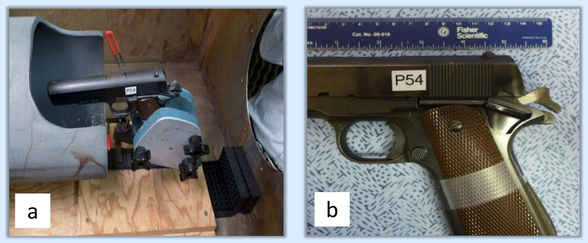

Figure 3: (a)The assembled pistol was secured in the ransom rest for test-firing; (b) The grip safety on the reference pistol was disengaged using a piece of tape before test-firing.

RESULTS & DISCUSSION

Functionality of 3D printed gun barrel:

- Because no post-treatment was rendered to the 3D printed gun barrel, hand-fitting was required to fit the barrels to the reference pistol and to ensure proper cycling and locking.
- The chambers of the 3D-printed barrels were dremeled, smoothed, and oiled to properly seat the cartridges.
- The first 50 test-fires from both barrels were discharged without incident.
- Starting from around the 65th round to the end of the test-firing for both barrels, the slide was locked up and was unable to cycle back for extraction.

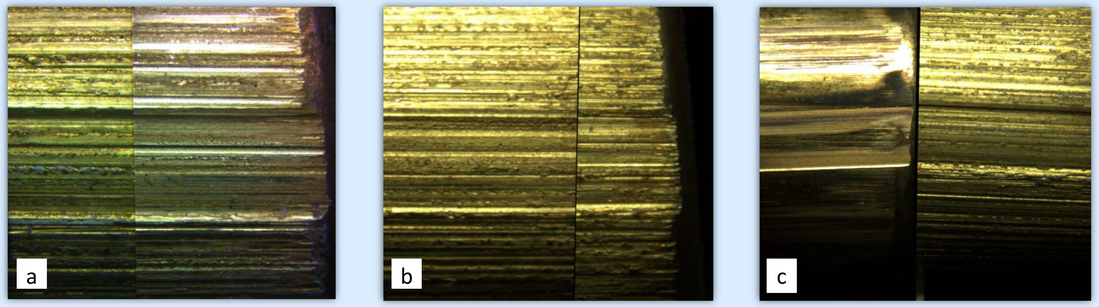

Figure 4: (a) Identifiable striations were observed from bullets fired from barrel A between 1st and 100th bullets; (b) Striations comparison between bullet fired from barrel A (left) and that from barrel B (Right) resulted in an elimination of firing from the same barrel; (c) Obvious differences between the striations obtained from bullets fired from the conventional reference barrel (left) and that from the 3D-printed barrel A (right).

CONCLUSIONS

- 3D-printed gun barrels manufactured from 3D modeling are functional at a certain extent.
- Bullets discharged from 3D-printed barrels manufactured from the same printer were differentiable from each other and from conventional model under the microscope.
- Designers of 3D-printed firearm require extensive knowledge and experience in the design and structure of the firearms. This might provide investigative leads if such firearms were involved in casework.
- Post-printing treatment for the outer surface of 3D printed barrels might be necessary to eliminate mechanical malfunction. The process of the treatment might result in characteristic toolmarks that would assist in examination.
- Although there are not too many crime cases involve 3D printed materials, there is a need to develop a database of 3D printed materials to enhance our research and understanding of these types of next generation of crime tools.

ACKNOWLEDGEMENTS

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