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Technical Note

Toolmarks made by lathe chuck jaws

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ABSTRACT

This paper presents a forensic method to evidentially tie a workpiece with a specific lathe. Examining using this method can prove or exclude a connection between the two. The importance of this method is mostly due to the growing trend among lawbreakers of manufacturing improvised firearm parts using machining processes. This method is based on comparing jaw impressions made by the chuck on a workpiece.

1. Introduction

Recent years have seen a rapid increase in use of improvised, homemade, re-activated, and converted firearms among criminals and terrorists [1–4]. One may find improvised pen-guns, mole-guns, pistols, revolvers, shot-guns, rifles, and even submachine-guns and machine-guns [5–9]. Most available studies by law-enforcement authorities and forensic laboratories address changing trends, increase in quantity, improvised firearm properties and features, and traditional firearms examination (comparing bullets and cartridge cases to the suspected weapon) [2,4,5,11].

Considering the fact that a small workshop equipped with a lathe and a milling machine is all it takes to set up a production line capable of churning out improvised firearms, law-enforcement authorities are concentrating their efforts on fighting the manufacturers. One criminalistics approach is to try to discover a forensic connection for instance between a suspect workshop and an illegal weapon seized from a criminal or obtained via an arms dealer.

To machine a workpiece in a lathe, the raw material (in this case an improvised barrel) must be inserted into the chuck and then clamped in the chuck jaws [10]. This means that gripping toolmark methods [11,12] can be used to analyze improvised firearms. An opportunity to explore this presented itself when, in a preliminary inspection of a seized lathe and of barrels that were impounded separately, gripping tools impressions were found on the barrels. There was, therefore, reason to suspect a connection between the lathes and barrels, and that the grip marks on the barrels had been made by the jaws of the impounded lathes. In search of a potential forensic connection, manufacturing process toolmarks were compared and the resulting study and its conclusions are presented in this paper.

2. Materials and methods

Forty five metal rods and tubes (two of these are shown in Fig. 1), in various stages of conversion into improvised barrel rifles, were visually inspected for impression marks using unaided observation. This was followed with a microscopic examination using a MZ7.5 Leica stereomicroscope.

Ten impounded chucks that had been taken from several lathes were also examined. All chucks were standard commercially-available three-jaw chucks (Fig. 2 shows one of the impounded chucks).

Using a Leica DMC comparison microscope, impressions found on the impounded barrels were compared to the replicated impressions created for this study on sample metal rods, using the impounded chucks.

To replicate the impressions from a specific jaw, sample rods were wrapped in a 1.5 mm lead[1] sheet, so that the final diameter of the sheet-wrapped rod was similar to that of the barrel to which is was being compared. Next, jaw impressions were created by

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[1] Lead is one of the traditional and commonly used materials for test impression and replication of toolmarks. Lead is a soft, pliable metal that can replicate the microscopic grooves present on a tool's working surface without damaging the tool [13].

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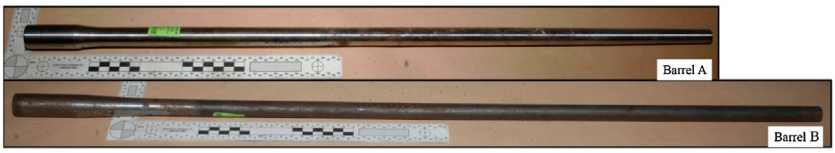

Fig. 1. Two of the 45 improvised rifle barrels in various stages of manufacturing. One measuring 65 and the other 75 cm long.

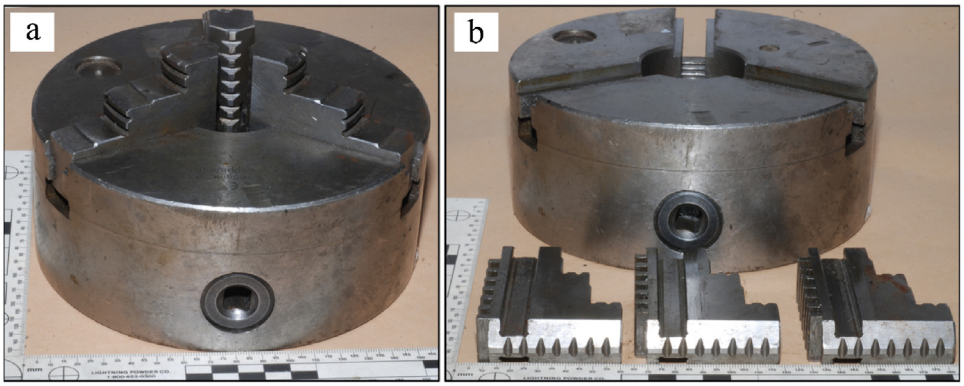

Fig. 2. (a) Three-jaw chuck body (φ160 mm max 250 n/min); (b) three jaws removed from the chuck.

Fig. 3. A lead sheet with impression marks, after being taken off the sample rod.

clamping a lead-wrapped rod in the chuck. After clamping it, the lead-wrapped rod was removed from the jaws and the lead sheet detached from the sample rod. Each lead sheet now carried three sets of jaw impressions (three from each chuck) that could be compared with the impressions on the impounded barrels. Fig. 3 shows an example of a lead sheet carrying replicated impressions.

3. Results and discussion

Unaided and microscopic examination of the forty five barrels revealed nine barrels with impression marks. Each of these nine barrels exhibited three sets of impressions at a distance of 120° from each other, around the barrel circumference. Each set was composed of a row of evenly-spaced longitudinal impressions (Fig. 4 shows examples of the impressions).

Microscopic examination of the impressions on the lead sheets revealed excellent impressions exhibiting class characteristics and multiple individual characteristics (Fig. 5).

By comparing class characteristics of the impressions (size, shape, gaps), it was possible to rule out a connection between a

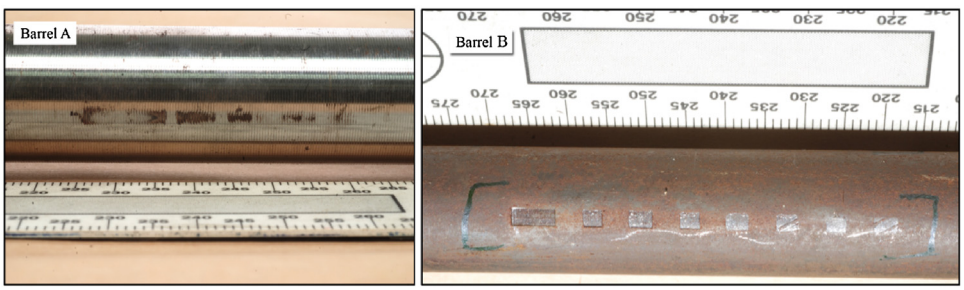

Fig. 4. One set of evenly-spaced longitudinal impression marks found on two of the impounded barrels.