

CASE REPORT

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Development of firing pin and breech face impression on lead and plasticine surfaces- a case report

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Abstract

Background: The microscopic examination of fired cartridge cases and fired bullets helps the expert to determine if a suspect firearm/firearms were, or were not, discharged in a shooting incident. This is achieved by using a combination of class and individual characteristics. But in case of malfunctioning of firearm, experts have to adopt different methods to link fired cartridge cases and fired bullets with the suspected firearm.

Case presentation: In this paper, a new method for the reproduction of the firing pin and breech face impression on two different surfaces are reported. Two chosen surfaces are plasticine and lead metal.

Conclusions: The surface of the lead being soft and brittle reproduced the impression with maximum detail. Five match points were seen on the lead surface with clear demarcation whereas only three points of individual characteristics marks were observed on plasticine surface.

Keywords: Plasticine, Lead, Pistol, Impression, Breech face, Firing pin

Background

Linking of the firearm, fired cartridge case and bullet is a classical example of tool mark identification. It follows the forensic science basic principle of individuality that no two tools marks should produce the same microscopic marks on two separate objects that they would be inaccurately or wrongly identified (Smith et al., 2016). Fired cartridge cases and bullets bear characteristic marks, which enable firearm examiners to identify the firearm that fired them (Kinder et al., 2004). Examination of firing pin and breech face impression on the fired cartridge case is essential link for the linkage of firearm with the fired cartridges (Sharma, 1963). But in few cases it becomes difficult to match the fired cartridge with the alleged firearm due to malfunctioning of firearm or in cases where the firearm misfires live test cartridges. In such cases the firing impressions could be reproduced on various soft surfaces without damaging the firing pin. Firing pin impressions are generated because of striking of firing pin on the percussion cap of the cartridge. Similarly breech face impression are

obtained when a cartridge is fired in the gun the very heavy pressure of the gas generated inside the cartridge force the head of the cartridge back against the head of the breech block which imprints the impression on the breech on the brittle material commonly brass or germanium silver (Harding-Barlow, 1950).

In this paper, the breech and firing impression were reproduced on different surfaces to match the impression with the fired shell. First surface selected is Plasticine. Plasticine is a trademark name for an oil-based modeling material that was developed in England in 1897. Unlike clay and wax, plasticine stays soft and workable: it neither hardens nor dries (<http://www.kirkside.com.au/Uploads/Images/plasticene.pdf>). It has wide range of application in forensic science. It has been used successfully in examination of footwear impression (Morgan et al., 2009), facial reconstruction (Stephan & Henneberg, 2001; Benazzi et al., 2009; Claes et al., 2006; Cesarani et al., 2004; George, 1987), forensic ballistics (Jain et al., 2004; Hejna & Safr, 2009), restoration of obliterated marks (Kuppuswamy, 2011), tool mark impression (Rees, 1969) and Odontology (Gorea et al., 2007).

The second surface selected for the study is lead. It is heavy, soft, bluish metal, and occurs in nature in the

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form of ores. Being soft the marks could be easily reproduced on lead and it could be used as a surface for reproduction of marks. These findings are put into context for the comparison of cartridge cases.

Case presentation

A case for linking of fired cartridge with a country made pistol having a broken barrel was received in Punjab Forensic Science Laboratory, Mohali, Punjab (India). The length of the country made pistol was 15 cm and a weight of 0.670 g (Fig. 1). It had a single column, box-type magazine with a capacity of 12 rounds and was designed to fire 7.65 mm cartridges. No land and groove were present inside the barrel of the firearm. Length of the barrel was 7 cm but the barrel of the firearm was found broken (Fig. 2). Five 7.65 mm test cartridges were fired through the country made pistol, but it misfired all the test cartridges, leaving a minute impression without sufficient detail for comparison with crime cartridge case. So, the firing pin and breech face impressions were successfully reproduced on two surfaces for comparison with fired crime cartridge case.

Experimental

Equipment

Leica FSC comparison microscope with Leica DFC320 camera (Switzerland) was used for the comparison of marks. Leica application suite software version 3.7.0 was used for the processing of the processing of the data. Afco-set electronic balance (ER-18 2A, Bombay Burmah trading Corp, Ltd., India) was used for weighing of the materials.

Materials

Experimental firings were conducted through a country made pistol (Fig. 1), K.F. S&WL, Indian Ordnance Factory, Kirkee (Pune, India) manufactured cartridges. Plasticine was purchased from local shop. Lead metal was obtained from the lead bullet by removing it using a bullet puller.



Fig. 2 Showing broken barrel of country made pistol (India)

Impression surfaces

The surfaces chosen for the reproduction of the firing pin and breech face impression were lead and plasticine. These surfaces were chosen due to tendency of being softer than firing pin and breech face and the marks could be easily reproduced without destroying the original surface. The surface of firing pin and breechface were cleaned with acetone to remove dust material adhered to it and then plasticine/lead were pressed against firing pin and breechface surfaces the surface impression.

Preparation of cast

For the preparation of the impression of the firing pin and breech face two surfaces were selected. First surface was plasticine. Plasticine was pressed against the hard surface of the firing pin and breech face to reproduce the surface impression.



Fig. 1 Showing dimension of country made pistol (India)

The second surface selected was lead metal. It was obtained from lead bullet of 0.32 in. by removing it using bullet puller and then hammered and flattened. Lead/plasticine were pressed on breech face to collect the firing pin

and breechface impressions. Being a soft material the impression of the firing pin and breech were reproduced on the lead/plasticine material. A flow chart showing methodology of case study is shown in Fig. 3.

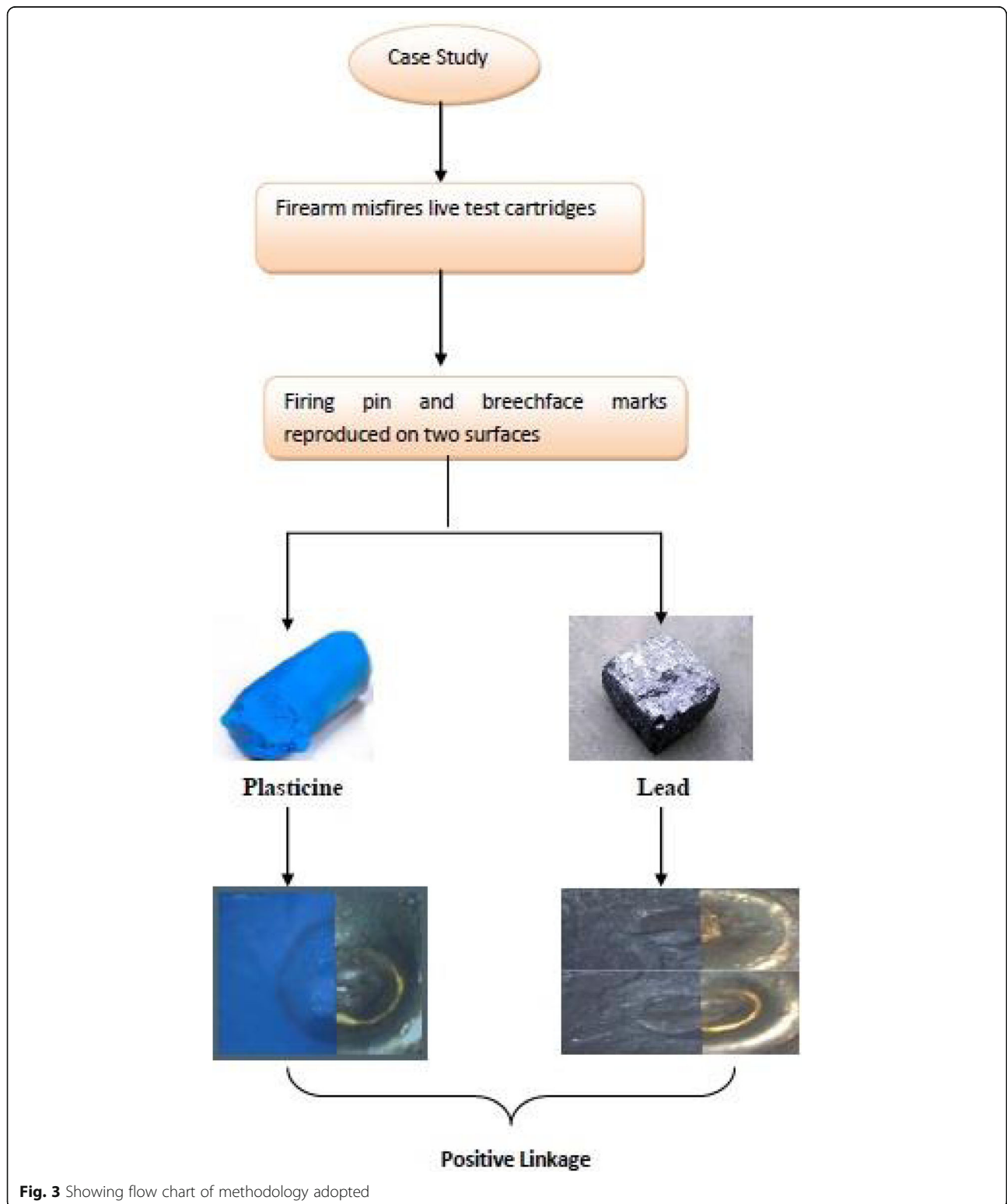


Fig. 3 Showing flow chart of methodology adopted

Results and discussion

Various casting methods (Plaster, Moulage, Faxfilm (Cowres, Davm L, Dodge, James K. A Method for Comparison of Tool Marks, 1948; Science and Practice Committee Report, 1949), plasticine (Kirk, 1953; O'hara & Osterbtrn, 1949), thermoplastics (Kirk, 1953), wax and electroplating (Tarko, 1948)) have been proposed for reproduction and comparison of individual characteristics marks on fired cartridge cases as an aid to firearms and tool mark identification. Most of the proposed methods had little or limited success due to time-consuming techniques and unsatisfactory results. In 1938, Moritz proposed a technique utilizing cellulose acetate with an acetone or amyl-acetate vehicle for the reproduction and comparison of the individual characteristics on cartridge cases, bullets and breech faces (Morrrz, 1938; Biasotti, 1956). The only advantage of the technique was preparation of flexible, translucent cast that could be flattened and viewed by transillumination thus reducing or obviating the difficulties inherent in the direct observation of curved or inaccessible surfaces by reflected illumination. Later, Faxfilm (trade name) became a commercial adaptation of the technique proposed by Moritz. It had larger application in studying the quality of finish on machined metal parts. The use of Faxfilm in law enforcement work has been reported, but literature on its practical application is meager (Science and Practice Committee Report, 1949; Biasotti, 1956). Cowles and Dodge have reported the successful application of Faxfilm to tool mark recovery and comparison and have pointed out its limitations when applied to deep impressions or to painted surfaces (Cowres, Davm L, Dodge, James K. A Method for Comparison of Tool Marks, 1948). Later another method for to form replicas of the fired bullets were proposed using sheets of vinyl thermoplastic varying in thickness from 0.030 to 0.125" (depending on the depth of the mark). The disadvantage of the method was the application of heat (100 to 125 °C.) and pressure (Kirk, 1953). An infrared lamp or electric hot plates were used for heating. These replicas were flattened and viewed by transillumination as either a positive or negative image. Accurate, reproducible replicas, free from air bubbles, shrinkage, and warping were obtained. However, the necessity of applying heat and pressure simultaneously, which may not be a serious disadvantage in the laboratory, makes this method rather impractical to use at the crime scene in the recovery of tool marks. Another material commonly used for lifting firing pin impression is plasticine, it is also used for replication of rifling marks of fired bullet (Jain et al., 2004).

In the present study, plasticine and lead surfaces were used. The advantage of current method with previous methods reported is accurate, reproducible replicas, free

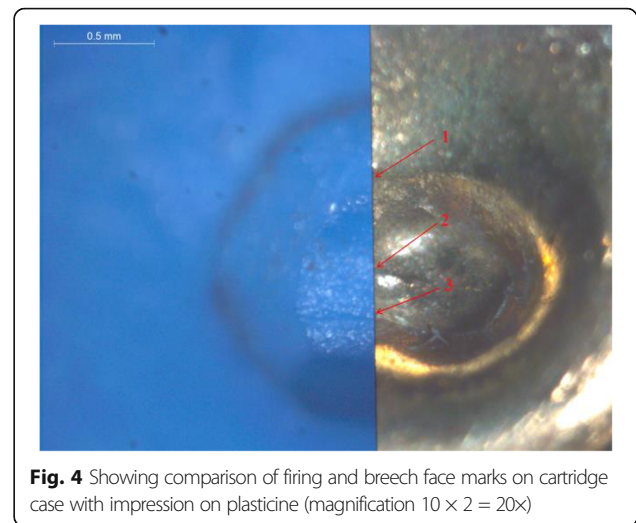


Fig. 4 Showing comparison of firing and breech face marks on cartridge case with impression on plasticine (magnification $10 \times 2 = 20\times$)

from air bubbles and non application of heat and pressure for reproduction of marks. On comparison of firing pin and breech face impression of crime cartridge case with the impression of firing pin and breech face taken on plasticine. Three points in a match were found to be reproduced on the plasticine impression. Point-1 shows the periphery of the firing pin. Point-2 shows a horizontal line passing through the middle of firing pin impression. Point-3 shows a line at 7 O'Clock position (Fig. 4). However, the same impression was reproduced on lead surface was much pronounced than plasticine surface. Five match points were seen on the lead surface with clear demarcation (Fig. 5). Point-1 shows firing pin impression at 12 O'Clock position. Then moving down point-2 is a line at 2 O'Clock position. Point-3 shows an arc at 3 O'Clock position. In the middle a line crossing

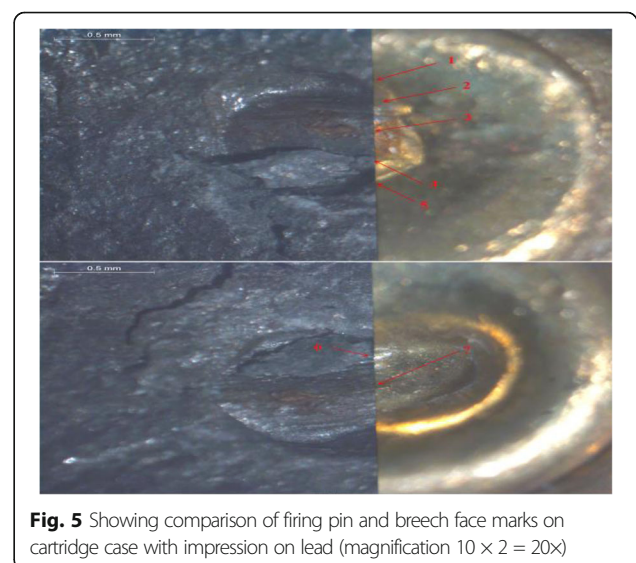


Fig. 5 Showing comparison of firing pin and breech face marks on cartridge case with impression on lead (magnification $10 \times 2 = 20\times$)

shows point-4. Point-5 is again a clear demarcation of firing pin impression at 6 O'Clock position.

Conclusion

On the comparison of marks on two substrates, lead was found most suitable surface for the reproduction of marks as lead surface gave more detail as compared to the plasticine. Further research could be carried out exploring different surface for the successive reproduction of the marks of firing pin and breech face in case of malfunctioning of firearm.

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