EXPERIMENTAL STUDY OF BULLET HOLES ON ALUMINIUM TARGETS FIRED WITH 9 MM PISTOL AND 9 MM SUBMACHINE GUN (SMG) AT VARYING DISTANCES

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ABSTRACT

All the guns have their own unique identifying features and even if the gun has not been left at the crime scene many degrees of information can be determined from the bullet, bullet holes on the targets, the nature of the wound and any residue that is left around it. Researchers have conducted studies about the evaluation and reconstruction of fired bullet paths delivered in indoor scenes and their performance in a unique environment. Bullet performance is typically a function of the matrix in which the bullet interacts. The identification of bullet holes is based, besides the morphology of the hole in question, on the presence of gunshot residue and of blackening in the vicinity of the hole. It is shown that field tests were conducted by police agencies and researchers to discover the relationship between bullet holes on different types of targets and firearms. The present study was aimed to conduct an experimental study of bullet holes on aluminium targets fired with 9 mm pistol and 9 mm submachine gun with varying distances which formed a database for forensic application. The shooting exercise was conducted at Sungai Buloh shooting range by trained firearm experts, Polis Di Raja Malaysia, Bukit Aman, Kuala Lumpur.

Key words: Forensic science, 9 mm pistol, 9 mm SMG, aluminium targets, bullet holes

INTRODUCTION

During investigative proceedings of incidents involving the use of firearms, forensic expertise can provide key elements for the court to reach an opinion. In such context, particular attention is usually drawn to evaluative issues associated with firearms and related evidence such as gunshot residues (Laurent, 2007; Druid, 1997). In many firearm crime scenes the investigators cannot find out any bullets or their castings but the available firearm evidence is the presence of bullet holes on various objects including human dead bodies (Katerina et al., 2009; David & Carin, 2008). When there are bullet holes in the victim or in other objects at the scene, specialists can determine where and from what height the bullet was fired from, as well as the position of the victim when it was fired. Researchers have conducted studies about the evaluation and reconstruction of fired bullet paths delivered in indoor scenes (Gardner et al., 2009; Haag & Lucien, 2006; Trahin, 1987; Bunch & Stephen, 1998) and their performance in a unique environment (Noedel, 2010). Many firearm experimental studies were conducted relating different types of firearms with variety of targets material with varying objectives and the result of the investigation can be used to utilize in real crime scenarios. Several investigations were conducted on effect of projectile nose shape, impact velocity and target thickness on deformation behaviour of various target materials (Borvik et al., 2002; Camacho & Ortiz, 1997; Chocron et al., 2001; Corran et al., 1983; Damoder et al., 2001; Gupta et al., 2006). The characterisation of bullets holes on targets like glass (Stahl et al., 1979; Albanese et al.,...
1984; Thornton & Cashman, 1986), paper board (Mulani et al., 2016), plywood (Nattaponangtawe & Weerachaiphutdhawong, 2015), metal sheets (Jeremy et al., 2013) multi-layered metal sheets (Flores-Johnson et al., 2011), helmet (Naday & Baruch, 2001) and concrete walls (Scott et al., 2002) were studied in different countries and manufacturers. Literature review shows that no study was conducted to investigate bullet holes on aluminium targets fired with 9 mm pistol and 9 mm submachine gun at varying distances. Hence the present experimental study was aimed to investigate the bullets holes fired on aluminium targets fired with 9 mm pistol 9 mm submachine gun at varying distances.

MATERIALS AND METHODS

As suggested by Polis Di Raja Malaysia, Bukit Aman, Kuala Lumpur, the experimental shooting exercise was conducted at Sungai Buloh shooting range, Selangor state by trained police firearms experts. The target used was six numbers of 4 mm thickness aluminium plates with size of 210 mm x 148 mm available in Malaysia. Following PDRM protocol, each metal target was fired with 9 mm pistol and 9 mm submachine gun (SMG) at a distances of 15m, 20m, 30m and 35 m respectively. The shape of the bullet holes are mostly irregular and is cumbersome to measure the accurate diameter. Hence the circumference of the bullets holes were measured using string technique. Stringing has been used at crime scenes of firearms and blood spatter. (Gregory, 2003; DeFrance et al., 2009). All the bullet holes were photographed and recorded the measurements.

RESULTS & DISCUSSION

Fig. 1 depicts the appearance of bullet holes on front and rear side of the 4 mm aluminium sheets (entry and exit holes) fired at a distance of 15m, 20m, 30m and 35m by using 9 mm pistol. All aluminium sheets are of same size (210 mm x 148 mm) with 4mm thickness and separate target sheet was used for each firing and thus 12 aluminium sheets were used for this experimental firing exercise. Each resulting bullet hole was examined and measured by “stringing” technique and recorded the measurements.

Table 1 presents the descriptive statistics of firing range, entry and exit bullet hole circumferences, weight of the metal before and after firing. The investigation reveals that the size of entry hole (front side) is comparatively larger than the exit hole (real side). It is interested to note that at a firing distance of 20 m, no hole was formed but showing deep dent mark of 6 m depth with a diameter of 57 mm. External or exterior ballistics is concerned with the flight of the projectile from the muzzle to the target. This is involving parameters such as bullet shape, sectional density, atmospheric pressure and other environmental factors. These factors can affect the penetration power (Brian, 2008). The major forces which exert their inference upon the bullet include gravitational force and the resistance of the
Table 1. Descriptive statistics of bullet holes circumference (in mm) on aluminium targets fired with 9 mm pistol at varying distances and changes in weight

<table>
<thead>
<tr>
<th>Trial No.</th>
<th>Firing range (meter)</th>
<th>Size of entry hole</th>
<th>Size of exit hole</th>
<th>Weight of metal before firing (g)</th>
<th>Weight of metal after firing (g)</th>
<th>Weight loss (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate 1</td>
<td>15</td>
<td>38</td>
<td>46</td>
<td>355</td>
<td>349</td>
<td>6</td>
</tr>
<tr>
<td>Plate 2</td>
<td>20</td>
<td>41 (inward dent)</td>
<td>Outward dent (6mm depth, 57 mm dia)</td>
<td>355</td>
<td>351</td>
<td>4</td>
</tr>
<tr>
<td>Plate 3</td>
<td>30</td>
<td>42</td>
<td>47</td>
<td>355</td>
<td>348</td>
<td>7</td>
</tr>
<tr>
<td>Plate 4</td>
<td>35</td>
<td>55</td>
<td>57</td>
<td>355</td>
<td>344</td>
<td>11</td>
</tr>
</tbody>
</table>

opposing wind forces which slow the velocity of bullet (Tom Warlow, 1996). When the firing exercise was conducted at a distance of 20 m on plate 2, the climate was cloudy and drizzling and the effect was indicated by the formation of dent mark rather than penetration since the velocity of the bullet was retarded by the environmental factor. The target did not show any hole but showing inward dent of 41mm and outward dent of 57 mm (Fig. 1). The investigation shows that there is an increase trend in weight loss except metal 2 showing tent mark only. The size of the entry hole is smaller than exit hole. The study on bullet holes fired by different types of bullet on sheet metal and wooden board have shown significant difference that can be used to identify the type of bullet (Nattapontangtawee & Weerachaiphutdhawong, 2015). A study of characterisation of bullet holes in helmet made of composite materials indicated whether the hole is from bullet entrance or exit (Nadav & Baruch, 2001). Fig. 2 depicts the appearance of bullet holes on front and rear side of the 4 mm aluminium sheets (entry and exit holes) fired at a distance of 15 m, 20 m, 30 m and 35 m by using 9 mm SMG. The entry hole (front side) is smaller than the exit hole (rear side) as observed in the previous firing exercise by 9 mm pistol.

Table 2 presents the descriptive statistics of firing range, entry and exit bullet hole circumferences, weight of the metal before and after firing. The investigation reveals that irrespective of distance, the size of entry hole (front side) is comparatively larger than the exit hole (real side). The size of entry and exit hole did not show variation (40 mm) in the plate when fired at a distance of 15 m and the variation is very less (40 and 41 mm) when fired at a distance of 20 m. Appreciable variation in size were observed between entry and exit holes when the range of fire is 30 m (41 and 47 mm) and 35 m (50 and 57 mm). As the range of firing increases, the size of the hole showed upward trend. The researchers have been measuring the bullet holes through diameter. But size of the bullets holes are not uniform in size, in the present study to measure the size of bullet holes, circumference measurement was used by stringing...
method so that accurate measurements were achieved (Gregory, 2003; DeFrance et al., 2009). The entry holes are comparatively smaller than exit holes. The penetration effect on aluminum targets were influenced by the shape, impact velocity of the projectile and thickness of the targets (Gupta et al., 2006).

CONCLUSION

The legislation of firearms control is extremely strict almost in all countries including Malaysia. The terminal ballistic effects on the aluminium plate provide valuable information to the investigators in the form of bullet holes. The entry holes are comparatively smaller than the exit holes when fired with 9 mm pistol and 9 mm submachine gun in various range of fire. But the size of entry holes and exit holes produced by 9 mm SMG are found to be smaller than the entry and exit holes produced by 9 mm pistol. The size of bullet holes provided valuable information to recognize the range of firing and type of weapon used in real crime scenarios. Once the suspected weapon is seized, it is advisable to conduct test firing with the suspected firearm and then to compare the crime scene bullet holes and test bullet holes so as to arrive a definite conclusion and further to prove this fact in the court of law.

ACKNOWLEDGEMENTS

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REFERENCES


Table 2. Descriptive statistics of bullet holes circumference (in mm) on aluminium targets fired with 9 mm SMG at varying distances and changes in weight

<table>
<thead>
<tr>
<th>Trial No.</th>
<th>Range of fire (meter)</th>
<th>Size of entry hole</th>
<th>Size of exit hole</th>
<th>Size of bullet before firing (g)</th>
<th>Size of bullet after firing (g)</th>
<th>Weight loss (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate 1</td>
<td>15</td>
<td>40</td>
<td>40</td>
<td>355</td>
<td>342</td>
<td>13</td>
</tr>
<tr>
<td>Plate 2</td>
<td>20</td>
<td>40</td>
<td>41</td>
<td>355</td>
<td>347</td>
<td>8</td>
</tr>
<tr>
<td>Plate 3</td>
<td>30</td>
<td>41</td>
<td>47</td>
<td>355</td>
<td>341</td>
<td>14</td>
</tr>
<tr>
<td>Plate 4</td>
<td>35</td>
<td>50</td>
<td>57</td>
<td>355</td>
<td>346</td>
<td>9</td>
</tr>
</tbody>
</table>


