The Effects of Powder, Barrel Length, and Velocity on Distance Determination

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Abstract
Distance determination can be used to show familiarity between shooter and victim, or it could confirm or disprove a suspect’s story. This study aims to question whether access to the firearm and ammunition used is really necessary in distance determination. Different barrel lengths, reloading powder type and loads were used to observe differences that may be expected from firearms and ammunition used to fire a bullet of a .357” diameter. Patterns illustrate a wide range of characteristics with a level of inconsistency. There are a number of factors that could play a role in distance determination, but this study showed a good correlation between powder burn rate and maximum distance of GSR pattern persistence.

Introduction
Frequently, a firearm or the ammunition used in a shooting incident is not present or acquired at the time of the incident, but a bullet may be recovered from the victim. Regardless, investigators are generally interested in the distance of the shooter. Typically, Gun shot residue (GSR) patterns produced using the firearm and ammunition from an incident can be used to determine distance of the muzzle of a firearm to an object through comparative analysis. Patterns typically consist of a mixture of vaporous lead, nitrates, varying degrees of burned gunpowder and other foulings produced by firing a cartridge. According to the guidelines set forth by Scientific Working Group for Firearms and Toolmarks (SWGFGUN), it is recommended that the actual firearm and similar ammunition be used. [1] But is this really necessary?

Materials and Methods

Firearms
• Smith & Wesson® .357 Magnum Revolver model 686 8 3/8” Barrel
• Smith & Wesson® .357 Magnum Revolver model 66-1 4” Barrel
• Smith & Wesson® .357 Magnum Revolver model 19-4 2.5” Barrel
• Smith & Wesson® .38 Special Revolver model 10-5 2” Barrel
• Rossi® .357 Lever Action Rifle Model 92 SRC 20” Barrel

Factory Cartridges
• Remington® .357 Magnum 110 Gr. JHP – Lot # J30UB117
• Winchester® .357 Magnum 110 Gr. JHP – Lot # L117PD2185
• Federal® .357 Magnum 110 Gr. JHP – Lot # 17A-0225
• Remington® UMC .357 Magnum 125 Gr. JSP – Lot # L357M12
• Remington® UMC .38 Special 130 Gr. FMJ – Lot # L38311
• Winchester® 38 Special 148 Gr. LWC – Lot # 27UF50

Reloading Powders and Charge Loads [2-6]
• Hercules Blue Dot®:
  .38 Special Load @ 7.5 Gr.
  .357 Magnum Load @ 12.0 Gr.
• Accurate No. 5®:
  .38 Special Load @ 6.1 Gr.
  .357 Magnum Load @ 11.0 Gr.
• Hercules UNIQUE®:
  .38 Special Load @ 5.0 Gr.
  .357 Magnum Load @ 9.6 Gr.
• Hercules Bullseye®:
  .38 Special Load @ 4.0 Gr.
  .357 Magnum Load @ 8.0 Gr.
• Hodgdon Clays®:
  .38 Special Load @ 3.5 Gr.

Methods

All firearms were fired remotely using a Ransom Rest. All firearms were fired remotely using a Ransom Rest. After photo documentation of all targets was completed, the firearm readied and fired remotely. The target was then affixed to a standard cardboard box acting as a backboard. The author thanks Dwight Deskins, Jessica Copeland and the rest of the KSP-Eastern Laboratory, Mrs. Catherine Rabbitt, Dr. Stasia, Jessica Ybarra, and Alison Quereau for their support, facilities, and knowledge.

Discussion

• Velocity showed only a very weak association and when observing faster loads within a given powder, there is no evident increase in distance (Chart 1).
• Powder burn rate shows the highest and most consistent relationship to maximum pattern distance (Chart 2).
• Barre length shows a slight link in .38 Spl loads, but that association breaks down in .357 Mag loads (Table 1).

Conclusions

Many trends that are readily visible can be fairly accurate. A contact shot will produce physical tearing and ripping, a gunshot at close range will produce a smoke pattern up to 12” even with the cleanest burning powder, and as a shooter’s distance increases, the pattern will typically become wider and less dense. But maximum pattern distance has been shown to range anywhere from 12” up to 48” with an average of about 30”. The strongest association shown was with relative powder burn rate and the faster the relative burning rate of the powder, the lower the maximum distance of a GSR pattern is. Ultimately, these results support the use of specific ammunition, as similar ammunition may produce a different pattern series and maximum distance.

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