Effect of Different Bullet Calibers and Target Distances on Blood Spatter

Victoria Erb and Cassandra Sheffield

Edited by Heidi Rockwell

Texas A&M University – College Station, TX

Abstract: This study was carried out in order to determine how different bullet calibers shot from different distances would affect blood spatter. Using two distinct firearms and varying distances, bullets were shot at a target in order to make blood spatter from different angles onto a tri-fold project board. The results illustrated that as the caliber of a bullet and the distance away from a target increase the area of blood spatter will increase and higher caliber bullets create more spatter because of their increased force.

***Keywords*:** blood spatter, firearm, caliber, forensic science

Blood spatter analysis is arguably one of the most important components of forensic science, as it can help authorities reconstruct crimes, corroborate witness testimonies, and apprehend suspects (James et al. 2014). It also can be used to determine the position of a person when they were shot, the direction the shot came from, and the minimum number of times a victim was shot (Hakim and Liscio 2006). At the same time, the topic of firearms is at the forefront of everyone's mind with the increasing number of police brutality cases and violent hate crimes. This experiment is meant to demonstrate the differences of spatter patterns depending on the type of firearm used.

There have been several experiments in the past that covered the same topic, one of which was conducted in 2013 by William Ristenpart et al. The purpose of the study was "to establish statistically significant classifications of blood spatter patterns resulting from the interactions between a weapon, suspect and victim" (Ristenpart et al. 2013). In order to do this, Ristenpart et al. impacted blood-soaked sponges with different caliber bullets (Ristenpart et al. 2013). They found that it is difficult to determine with certainty the impact velocity of an unknown spatter pattern, and bloodstain interpretation is incredibly subjective (Ristenpart et al. 2013).

The purpose of this study was to analyze the differences in blood spatter patterns

depending on the caliber of bullet used and the distance away from the target. It is likely that the closer the firearm is to a target, the larger the area of blood spatter will be. Blood spatter will likely increase as the caliber of the firearm increases.

Methods and Materials

Firearms and Ammunition

This experiment was conducted using two personally owned firearms: (1) a Smith and Wesson Model 19, and (2) an M1 Carbine. The Smith and Wesson revolver is a 0.357 magnum, and the M1 is a 0.30 semiautomatic rifle. The two types of ammunition used were (1) Hornady 125 grain, hollow point bullets with a speed of 1,500 feet per second for the Smith and Wesson, and (2) Monarch brass, 110 grain, soft point bullets for the M1, all purchased from Academy (Hornady Manufacturing Company, Grand Island, NE). A 0.357 magnum is simply longer and holds a significantly higher amount of power than a 0.38 special (Amselle 2011). These firearms were chosen because they have different uses: the 0.357 magnum is more of a self-defense weapon, while the 0.30 rifle is more appropriate for deer hunting.

Blood Source

Four gallon-sized water jugs dyed different colors with food coloring were used to act as the blood source for this experiment (Target Brands, Inc., Minneapolis, MN). Pink, purple, blue, and orange colored food dyes were used to differentiate the firearm used and the distance away from the target in four different rounds: the pink dye represented the 0.357 magnum shot from 20 feet, the purple dye represented the 0.357 magnum shot from 40 feet, the blue dye represented the 0.30 rifle shot from 20 feet, and the orange dye represented the 0.30 rifle shot from 40 feet.

Collection Technique

Three tri-fold project boards purchased from Target were used to catch the blood spatter from all angles. For each round of the experiment, one of the jugs was placed on a small stool approximately six inches in front of the project board and shot at from a distance of either 20 or 40 feet, as previously stated. One poster board was used for each round done at 20 feet, while both rounds done at 40 feet spattered onto the third board. The majority of the data from this experiment are qualitative in nature. The amount of observable blood spatter indicates what area on the project board had visible droplets instead of being fully covered by the blood.

Results

Quantitative Data

Because of the nature of this experiment, it is very difficult to obtain much quantitative data. The data that were obtained can be found in Table 1. The largest blood drop was 1.5 inches in length and came from the round when the 0.30 rifle was fired from 20 feet. The area of project board that contained observable blood spatter was also calculated for each round; 378.0625 in^2 of project board was visible for the round

where the 0.357 magnum was shot from 40 feet, compared to a mere 106.875 in^2 visible when the 0.30 rifle was shot from 20 feet.

TABLE 1: Quantitative Data of Blood Spatter			
	Distance from Target	Area of Observable Blood Spatter	Largest Blood Drop
.30 rifle	20 ft	106.875 in^2	1.5 in with a tail of 6.75 in
	40 ft	No observable drops	
.357 magnum	20 ft	300 in^2	1.25 in
	40 ft	378.0625 in^2	0.875 in

Qualitative Data

The majority of the data are qualitative in nature. The droplets that spattered after the 0.30 rifle was shot from 20 feet tended to be much bigger than those that spattered after the 0.357 magnum was shot at the same distance. Some spikes/satellites were observable, but they are not nearly as long those present on the blood spattered with the other firearm at the same distance. The droplets that spattered after the 0.30 rifle was shot from 40 feet were not easily observable.

The blood droplets that spattered after the 0.357 magnum was shot from 20 feet are generally very small, though there are several larger drops. These droplets are grouped closely together, and there is ample evidence of passive fall. Some of these droplets also have spikes/satellites present. When the same firearm was shot from 40 feet, the droplets appeared much bigger and further away from each other. There were also several instances of passive fall. Both rounds involving the 0.357 magnum have a mist pattern with hundreds of miniscule droplets.

We know that the spatter is high velocity because of "fine spray" that is present. Many of the drops are less than one millimeter in diameter and come from weapons that discharge at greater than 100 feet per second, which would indicate a high velocity spatter (Akin 2005 and Oller 2006).

Discussion

The results illustrate that the area of observable blood spatter will increase with the caliber of the firearm and the distance away from the target. This makes ample sense because the further a bullet must travel to strike its target, the smaller force it will have. This finding proves the initial half original hypothesis wrong because, in this case, with water as the material used for blood, the water will explode out of the container upon the bullet's impact and create a large mass of spatter that blends together. With a smaller impact, the water does not have as much force behind it, causing it to create that blended mass.

The findings prove the latter half of the hypothesis correct because the stronger firearm, the 0.357 magnum, created many more droplets with the impact of the bullet.

This experiment could have been improved in several ways. First of all, if more firearms had been used, there would have been a broader range of data and more data to compare. Having different firearms would also increase the variation in the calibers that were tested. Another improvement would be using a thicker liquid whose consistency is more like blood. One of the unique properties of blood is its ability to coagulate upon leaving the body. Coagulation causes the blood to thicken, which causes its viscosity to be much higher than water, which would in turn cause the spatter to be different to some degree.

In conclusion, a higher caliber bullet will produce more blood spatter because it has a larger impact. At the same time, there would be a larger area of observable blood spatter the further away a firearm is shot from a target because the bullet has time to slow down and lose some of its initial impact. The next step in this study would be to carry it out on a larger scale with better-suited materials and more firearms of different calibers so as to test the continuity of the results.

Acknowledgements

We would like to thank Neva Lund and the Family of Bryan, TX, for generously offering their personal land as a means to carry out the experiment. We also thank Baylee Adams of Amarillo, TX, for proofreading the paper before submission.

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