Bullet Deflection off Tissue and Small Bones

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Introduction

When investigating a scene and trying to determine trajectory, it is important to remember the possibility of bullet deflection. This study shows the probability of bullet deflection through small bones, such as ribs, and soft tissue in the human body. While an inconsistency occurred in degree of deflection, one thing always occurred, deflection. In addition, fragmentation occurred in some instances. In this study pork ribs and pork flank were used to simulate small bones and tissue.

Literature Review

The Measurement of Bullet Deflection by Intervening Objects and the Study of Bullet Behavior after Impact

Written by Lucien C. Haag (1), this article discusses the importance of knowing if deflection occurred in incidences where bullets have passed through more than one target before coming to rest. This is important in reconstruction as well as knowing the degree of deflection that ensued. Haag tests deflection using two situations: short and long range.

Short range situations are used to answer questions about bullet termination measured in inches to a few feet. Short range was set up using pre-impact and post-impact (witness panels) targets on either side of the rotatable plate in the center (test material holder). The rotatable plate was made so one could adjust the angles of the test materials. An initial shot would be fired before test material was put into place, then shots with the test material in place. Determination of deflection was done by the displaced second shot from the initial test fire.

Long range situations involve deflection over distances of hundreds of feet or yards. Multiple witness panels should be used in these tests placed 10 to 20 yards apart along with a sturdy firing platform. This set up uses the same center rotating plate to hold the test materials. Multiple shots were fired without the test material in place to make sure the weapon returned to its original position and fired in the same spot every time.

The purpose of this paper was to demonstrate two ways of measuring bullet deflection at different distances. This paper also assesses the behavior of bullets after impacting an intervening object.

Bullet Deflection Due to Angled Intervening Materials

Dale Theiling (2) completed a study on bullet deflection using just about the same method as Haag (1). He used drywall, plywood, and sheet metal as his test materials and tested them at

angles of 15°, 30°, 45°, 60°, 75°, and 90°. Theiling (2) used a ransom rest to system to hold the 9mm Sig Sauer P226 pistol and the .40 S&W caliber Glock that he used in these tests.

The long range set up from Haag's (1) initial study was used with only a few differences. The results yielded what was expected: deflection. While the different materials varied, like in any situation, the result was almost always deflection. While some deflection was very minimal it was still almost always present in all of the materials.

This paper explains the need to understand deflection being present but very difficult to pinpoint because of its inconsistency.

The Need for Bullet Deflection Training for Field Investigators

Edward Hueske (3) conducted a study in order to demonstrate the presence of bullet deflection and exhibit the need for understanding in the Criminal Justice community. Test fires were shot into eight substrates as well as a vehicle by three different weapons. The weapons used were a 40 caliber Glock model 22 pistol, a Rock River AR-15 style 223 caliber rifle and a Norinco AKS 7.62X39 mm rifle.

A sturdy, shooting table was constructed by Hueske (3) standing 33 inches tall. A further explanation of the construction can be found in his paper. A Ransom Rest and Shooter's Ridge long gun rest were purchased to steady the weapons used.

The target materials consisted of; cardboard, 'thin' aluminum sheet, 'thick' aluminum sheet, 18 gauge sheet metal, plywood, hollow door, dry wall, corrugated iron and a 1980's era Suzuki pickup (used, not only for the metal frame, but the glass as well). The primary target (consisting of target material) was set up 6 feet from the bore of the weapon at a 45 degree angle. The secondary target was an additional 6 feet behind the first target. This was done for the eight target materials (not including vehicle). The weapon used for these test fires was the 40 caliber Glock. The vehicle test fires were done by the two long guns and at varying orientations.

Three shots were fired into each of the eight target materials in the same situation was used to determine if any consistency occurred. For the vehicle test fires, witness panels were placed inside the cab to determine points of deflection.

The results demonstrated deflection in almost every situation but with no consistency. The conclusion of this article discusses the fact that after a bullet passes through a primary target the succeeding impact to a secondary target is not predictable.

Materials

The materials and procedure of this project is based on a previous study done by Edward E. Hueske (3) in which he discussed the need for bullet deflection training among criminal justice

professionals. The materials, such as the table, Ransom Rest, Shooter's Ridge, and target frames, were all borrowed from Hueskes' initial study.

Weapons and Ammo

40 caliber Glock model 22 pistol
Bushmaster AR-15 223 Rifle

.40 flat nose Remington umc 180 grain
.40 jacketed hollow point Federal 155 grain
223 full metal jacket Independence 55 grain
223 pointed soft point Remington 55 grain
223 jacketed hollow point Remington umc 45 grain

Primary Target Materials

Pork Ribs were used to simulate the shooting of small bones.
Pork Flank was used to simulate shooting through soft tissue.

Mounting of test materials was done by setting up two ladders and running a shower rod between the two, then putting a hanger through the meat and allowing it to hang from the rod. The Ransom Rest (with Glock) was clamped to the shooting table and 12ft from the Glocks bore was the primary target at 90° to the weapon. Approximately 12ft behind the primary target was the secondary target. The same set up was used when using the 223 except it was placed on a shooter's Ridge rest and the clamped Ransom Rest was removed.

Secondary target was a poster board mounted on a wooden frame.

Methodology

The primary muzzle-to-target distance was, as mentioned earlier, approximately 12ft from the bore of each weapon with a secondary target 12ft behind that. Primary targets were set up at a 90° angle from the bore of the weapons. Figure 1 demonstrates the set up.

Three rounds were fired for each circumstance set up (different ammo, weapon, and target). A bore laser was inserted into the weapons after each round and the primary target moved out of the way to determine the expected trajectory. This was indicated by the center of a small colored circle dot attached to the poster as well as with a picture of the laser at the center of the colored dots. Each color dot represented a different round (Fig. 2). Deflection was determined based on measurement from the center of the colored dot to the center of the actual perforation point on the secondary target.

Each shot with the pork ribs were pre-determined with the bore laser to make sure the shot went through an actual bone.

Figure 1.

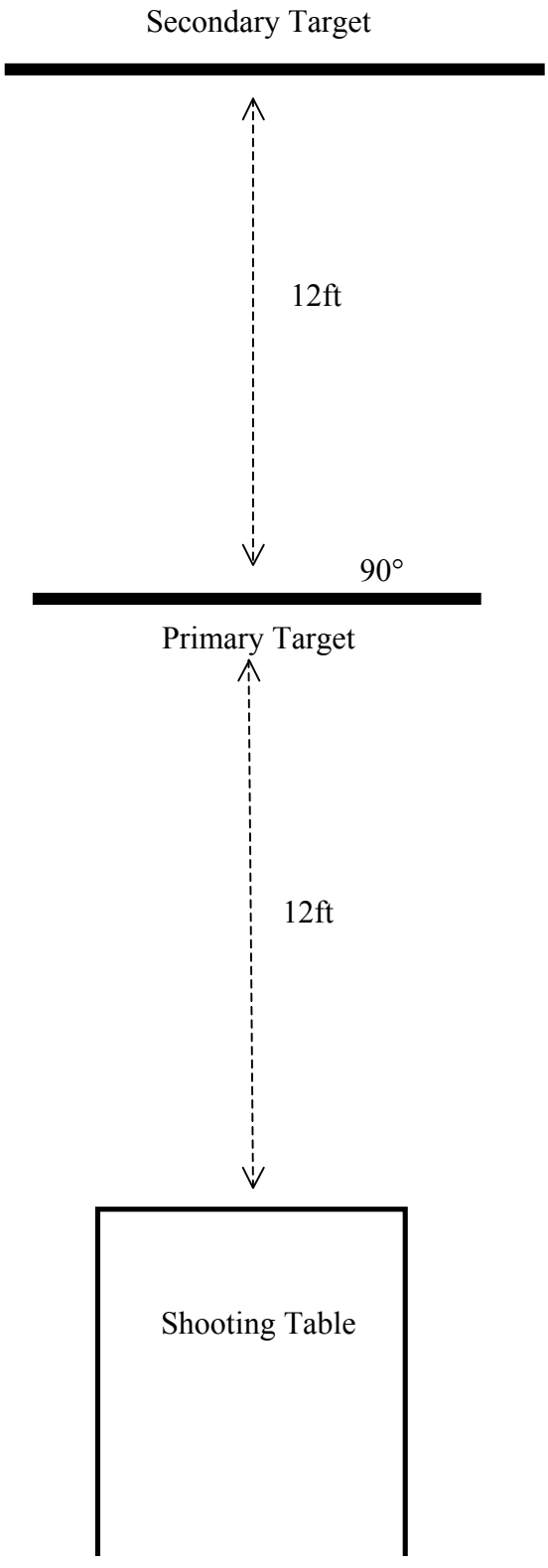

Figure 2. Dot Color Key

Color	Round
Green	Flat Nose FMJ 40
Red	JHP 40
Yellow	PSP 223
Blue	FMJ 223
Black	JHP 223

Results

The results are demonstrated in the chart in figure 3. As expected, deflection occurred in every condition. No consistency was determined and in three situations the deflection was so great that the bullet did not come in contact with the secondary target therefore making measurement difficult. In some cases, fragmentation occurred and determining entry to measure was problematic and is listed as undetermined. The picture below demonstrates this phenomenon.

Variation in the results with the ribs can be partially explained by the shots going through different curvatures of the ribs and the varying rib formations. The same can be said for the pork flank, different thicknesses and consistency in certain areas are hard to control for therefore resulting in inconsistency. This is more like a real life situation when considering the human body and differences in mass in different people and different parts of the body.

Figure 3.

Target	Round	Shot 1	Shot 2	Shot 3
ork Ribs	.40 Flat Nose	18.12mm S 50° W	14.38mm S	16.67mm N
ork Ribs	.40 JHP	64.93mm S 70° W	47.16mm S 80° W	Fragmentation/ Undetermined
ork Ribs	223 PSP	12.56mm S 85° E	?	12.64mm N 30° E
ork Ribs	223 FMJ	29.4mm S 20° E	56.49mm S 70° E	23.47mm S
ork Ribs	223 JHP	?	?	33.72mm S 60° E
ork Flank	.40 Flat Nose	9.15mm E	24.97mm S 25° E	17.79mm S
ork Flank	.40 JHP	78.5mm S 60° W	286.71mm N 45° W	231.26mm S 80° E
ork Flank	223 PSP	112.45mm N 55° E	Fragmentation/Undetermined	354.85mm S 70° W
ork Flank	223 FMJ	428.39mm N	271.57mm S 50° E	154.31mm N 85° E
ork Flank	223 JHP	Deflection/Undetermined	Deflection/Undetermined	324.82mm S 30° E

Conclusion

When investigating a shooting scene with a body, the trajectory will often be in question. Destabilization of bullets can, and often will, occur with the slightest disturbance. The importance of this study was to show the likelihood of deflection occurring and the fact that one cannot assume straight trajectories when passing through human tissue and small bones. While a very limited study the result suggests the need for deflection consideration in all cases.

References

(1)Haag, Lucien C., “The Measurement of Bullet Deflection by Intervening Objects and the Study of Bullet Behavior After Impact,” AFTE Journal, Vol. 19, No. 4, Oct. 1987, pp.382-87.

(2)Theiling, Dale., “Bullet Deflection Due to Angled Intervening Materials,” AFTE Journal, Vol. 33 No. 4, Fall 2001, pp. 304-309.

(3)Hueske, Edward E., “The Need for Bullet Deflection Training for Field Investigators”