The Importance of Careful Interpretation of Shell Casing Ejection Patterns

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Abstract: An experiment was conducted to gain information about shell casing ejection patterns. The research project showed that shell casing ejection patterns are dependent on a number of variables: type of firearm, stance, hand and weapon position (grip), and movement.

Background

A review of the literature indicated some disparity in the opinions of crime scene investigators concerning the position of casings related to shooting incidents.

Ogle notes that the "location of fired cartridge cases may be valuable in a reconstruction attempt of the shooting incident. The location(s) of the shooter(s) may be determined by the analysis of the locations of the fired cases" [1]. Gardner writes that firearms examiners conduct, on occasion, ejection studies with the purpose of determining the distance and direction that a casing will eject when the weapon is held in any given orientation. He continues by noting that ejection studies have limited value, because casings will roll when they hit the ground or ricochet from walls or objects [2].

Garrison conducted a study on the position of casings dropped from a moving vehicle. He posited that some of the variables that can affect the final location of ejected casings are speed, road surfaces, vehicular traffic, crowds that might move the casings, and cartridge types [3]. One of his observations was that, under similar circumstances, rimmed casings tend to travel less distance [3]. Other research suggests that depending on many variables, extracted casings can end up virtually anywhere [4-6].

Case History

A patrol officer observed a black Cadillac with expired license plates driving on the city streets. The officer attempted to initiate a traffic stop. The vehicle fled, the officer began to pursue the vehicle and, within a few seconds, the suspect lost control of the Cadillac, which jumped a curb and came to rest in the yard of a residential neighborhood. The officer stopped behind the vehicle and exited his cruiser to make contact with the driver. The suspect exited his vehicle and fired two shots from a handgun. The officer took cover between the two vehicles and returned fire. (The officer later said that he thought he had fired his weapon four times.) The suspect then ran from the scene, entered a trailer park, turned, and fired three more shots in the direction of the officer. The officer radioed for assistance. A second officer observed a person matching the suspect's physical description running through the trailer park. The second officer identified himself, ordered the suspect to stop, and gave foot chase. The suspect was subsequently taken into custody, and was later identified by the initial officer. Neither the suspect nor the officer was injured during the shooting. The suspect was intoxicated, had narcotics on his person, and had six live .357 caliber rounds in his pocket. During a search of the area, a .357 caliber Ruger 6-shot revolver was located on the ground between the initiating officer's cruiser and the location of arrest. One live round and five spent shell casings were located inside this handgun.

During the investigation of the crime scene, two bullet strikes were located on the police cruiser, one in the hood and one in the windshield. Two bullet holes were also located in the siding of a nearby trailer. The officer's weapon, a department-issued Smith & Wesson, model 5906, 9 mm semi-automatic pistol, with two additional magazines, was secured at the scene. Fully loaded, his weapon and magazines would contain forty-six rounds. Thirty-nine rounds were recovered from the officer's weapon and magazines. Seven shell casings were located on the ground west of the suspect's vehicle. The shell casings were located between five feet and thirty feet from the suspect's driver's door, in grass and on an asphalt roadway (Figure 1).

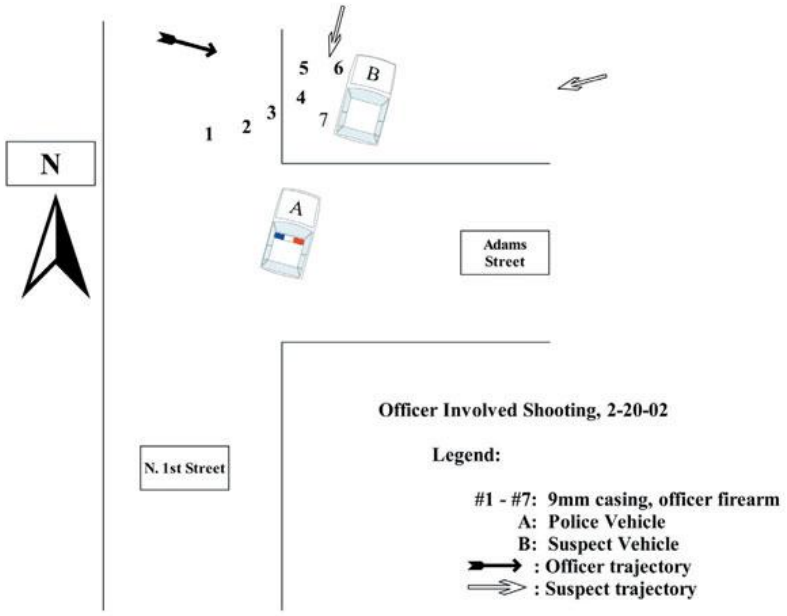

Figure 1 (Diagram of scene)

At trial, the defense argued that the officer was lying about the incident because he had stated that he had fired only four times. The defense theorized that because of the location of the shell casings near the suspect's car, the officer had fired the first shots and had done so as he contacted the driver. A defense witness with 25 years of police experience was asked whether he could determine the exact location of the parties at the time of the shooting, given the location from which the shell casings were recovered. The witness answered, "Yes, within a few feet of their location." He was also asked whether he knew the reason the numbers did not add up on the bullet count. To this he simply answered, "No." The defense attorney alluded to a "police cover-up" of the shooting events "because things just didn't add up".

In rebuttal, the supervising crime scene investigator (S.C.S.I.) took the stand and testified that the location of shell casings could give only a suggestion as to the general area of the shooter and that there are many variables that could account for the movement of the shell casings. The S.C.S.I. listed variables such as surface type; weather conditions; pedestrian and vehicular traffic in the area, including the arrival of additional officers and medical personnel prior to securing the scene; the condition of the weapons; types of firearms ammunition; differences in shooting experience and training; the movement of the shooter at the time that the shots were fired; and other alterations (intentional or unintentional) concerning the crime scene. The S.C.S.I. also testified that, because of the high level of stress that the officer was most likely experiencing during this shooting confrontation, he may simply have not counted his shots correctly while trying to simultaneously take cover and return fire.

The defendant was found guilty on all charges. This trial experience gave the S.C.S.I. the idea for this research project, as well as an opportunity to give newer C.S.I.s some hands-on training in the interpretation of shell casing evidence at shooting scenes.

Experiment

The experiment took place at the Lincoln Police Department's firing range. The range is constructed with a series of concrete walkways at various shooting distances. The majority of the range surface consists of regularly mowed blue-grass between the walkways. The shooters were commissioned law enforcement officers with training and experience in firing the selected weapons. The officers were all right-handed and stood behind the 4-foot-wide walkways while firing at targets 25 yards down range. The shell casings were flagged by members of the crime scene investigations unit and were measured to determine distance, direction, and angle from the shooter's firing position. The experiment occurred during daylight hours, on a windless, cloudy day, with temperatures of approximately 60 degrees F.

Ten firearms were used in this experiment, two each of five different models. The firearms had no known modifications. New factory (Remington) loads, specifically manufactured for each weapon, were used. The firearms consisted of:

1. Smith & Wesson, model 5906, 9 mm semi-auto handgun (police issue), casings eject top, right
2. Browning, Hi-Power, 9 mm semi-auto handgun, casings eject top, right
3. Norinco SKS, 7.62 x 39 mm caliber rifle, casings eject top, right, and angled forward at 45 degrees
4. Smith & Wesson, .22 caliber semi-auto handgun, casings eject top, right
5. Heckler & Koch USP, .45 caliber handgun, casings eject top, right

The officers fired the weapons from two stances: the "Weaver" stance and the "Isosceles" stance. In the Weaver stance, the shooter stands with his or her strong side at a 45-degree angle away from the target. The gun hand pushes out toward the target, and the supporting arm is bent sharply with the elbow pointing toward the ground. In the Isosceles stance, the shooter stands facing the target. The feet are approximately shoulders' width apart, and the gun hand and the support hand are pointed straight ahead at the target. Both stances are traditionally taught to law enforcement officers during firearms training (Figure 2).

Figure 2

The Weaver stance. *The Isosceles stance.*

The officers also fired the weapons from the two stances with a modified grip (Figure 3). The shooters positioned their bodies in both the Weaver and Isosceles stances, with the weapons rotated 90 degrees counter-clockwise, shooting the weapons using a "gangster" grip (a style of grip made popular by movie and TV gangsters).

Following range safety rules, the crime scene unit stood approximately 15 feet behind the shooters and attempted to watch where the shell casings landed. After each five shots, the investigators would search for the shell casings, flag the locations, and ultimately measure them. Of the 100 rounds fired, three of the .22 caliber casings could not be located. (Investigators spent some time looking for the shells and decided it was possible that, given the size of the casings, they had fallen into the cracks of the dirt. The use of a metal detector to assist in locating the missing shells was not thought to be practical, given the range history.)

Figure 3
The Weaver stance with modified "gangster grip".

Results

Shell casing ejection patterns (Table 1 and Appendix) were similar when comparing firearms of the same make, model, caliber, and similar ammunition. There were also observable differences in the shell casing ejection patterns among the five different types of weapons fired in this experiment. These results could be considered important if the type of weapon and ammunition used is known, but the original weapon is often not available for test firing or reconstruction research. Investigators could use the same type of firearm and ammunition used in an offense (when all other variables are constant or known) and expect to get similar results. However, the use of the original firearm and ammunition, when possible, is always the best choice when conducting research for a specific case investigation.

Varying the shooting stances between the Weaver stance and the Isosceles stance did not appear to have much impact on the overall appearance of the ejection patterns. This is likely because both stances give similar support to the shooter, and the firearms themselves are in the same position when fired. It should be noted that these two firing stances are not the only firing stances. Additional variables, such as shooter movement while firing (running, taking cover, etc.), will also likely affect shell casing patterns.

Weapon	Weaver Stance Gangster Grip	Weaver Stance Police Grip	Isosceles Stance Gangster Grip	Isosceles Stance Police Grip
Smith & Wesson model 5906 9 mm	10'6" W / 3'6" S	4'6" E / 2' S	6'6" W / 2'6" S	4' E / 6" S
	8' W / 1'6" S	5'9" E / 1'6" S	5'9" W / 1'6" S	6' E / 1' S
	8' W / 2'6" S	6'6" E / 1' S	5' W / 2'9" S	7' E / 9" S
	5'6" W / 1' S	5'6" E / 3' S	6' W / 3'6" S	8' E / 1'3" S
	4'6" W / 2' S	6' E / 2'6" S	5' W / 4' S	6'6" E / 3' S
Browning semi-auto 9 mm	5'6" W / 6' S	4'6" E / 4'9" S	4' W / 6' S	3' E / 6" S
	4' W / 3' S	5'6" E / 5'3" S	3'9" W / 5' S	4'6" E / 2'6" S
	3'6" W / 4' S	6'3" E / 5'9" S	3'6" W / 8' S	6'6" E / 6' S
	3'3" W / 5' S	7'6" E / 5'6" S	2' W / 4'6" S	7'6" E / 5'9" S
	2'3" W / 3'9" S	8' E / 5' S	2' W / 5'3" S	8'3" E / 7' S
Norinco SKS rifle 7.62 x 39 mm	19'6" W / 6" N	7' W / 5'6" N	11' W / 1' N	4' W / 6' N
	18' W / 10' N	4'9" W / 2'9" N	10' W / 2' N	4' W / 5' N
	17' W / 8' N	3' W / 3' N	9'6" W / 1' N	3'3" W / 5' N
	12' W / 1' S	4' E / 8' N	9' W / 1'9" N	3' W / 2' N
	10' W / 1' N	8'6" E / 3' N	8'6" W / 1'6" N	5' W / 4' S
Smith & Wesson semi-auto .22 caliber	17'3" W / 6'6" S	18'6" E / 1'3" S	21' W / 10'3" S	17'6" E / 3' S
	14' W / 3' S	17'9" E / 3' S	18'6" W / 8'3" S	17'9" E / 1' S
	13' W / 4'3" S	18'6" E / 4' S	18'9" W / 7'6" S	17'9" E / 4' S
	12' W / 3'9" S	21'3" E / 5' S	17' W / 6'6" S	19' E / 2' S
	Could not locate	Could not locate	Could not locate	19'6" E / 5'6" S
Heckler & Koch .45 caliber	11' W / 1' S	1'6" E / 9" S	8'6" W / 4'6" S	4' E / 3' S
	10' W / 3'9" S	3'9" E / 3' S	5'9" W / 4' S	5'6" E / 1' S
	9'9" W / 2'3" S	6' E / 2'6" S	5'3" W / 2' S	6'6" E / 9" S
	8' W / 6' S	7'6" E / 4' S	4' W / 1' S	7'9" E / 1'6" S
	6' W / 3'6" S	10' E / 6' S	4'3" W / 6' S	9' E / 4' S

Table 1

Shell casing ejection pattern measurements. Shell casing measurements were taken from the location of the shooter. Five shots, from the four shooting stances, were fired from each weapon.

There did appear to be quite a difference between firearm types with regard to the distance away from the shooter that the shell casings landed. This is important to keep in mind when searching a crime scene for shell casing evidence. In this experiment, the Smith & Wesson 9 mm, the Browning 9 mm, and the Heckler & Koch .45 caliber shell casings all landed slightly behind and within approximately 10 feet of the shooter. The shell casings from the Smith & Wesson .22 caliber firearm were more difficult to locate because of their size and the distance they flew. When the .22 caliber casings were located, they were found slightly behind the shooter but as far out as 21' 3". The Norinco SKS rifle's shell casings were found approximately 20 feet from the shooter, but were mainly located in front of the shooter. These results suggest that it is a good idea to expand the area of a crime scene search when looking for shell casings.

The variable that made the most difference in the shell casing ejection patterns was the grip selected to fire each weapon. With the exception of the Norinco SKS rifle, shell casings were located to the right and slightly behind the shooter when firing a weapon using the standard "police" grip. When firing a weapon using the "gangster" grip, the shell casings were located to the left and slightly behind the shooter. The shell casing ejection patterns made by the Norinco SKS rifle showed the casings landing to the far left when using the "gangster" grip, and landing in front of the shooter when using the "police" grip. It was determined that varying the grip changes the ejection port position, thus affecting the final resting position of the shell casings.

One should also be cognizant of the type of surface the casings impact. In the aforementioned shooting case and the range research project, the surfaces included both hard (concrete and asphalt) and grassy areas. During the project, investigators observed shell casings to bounce and roll further upon impacting the concrete surface. Clearly, many variables affect the final position of the shell casing ejection patterns.

Conclusions

The investigators from the crime scene unit learned several valuable lessons from this experiment. They learned that there are many variables that will affect shell casing ejection patterns; therefore, care should be taken when searching a scene to recover all evidence possible. This experiment considered the variables of stance, grip, and weapon type; however, investigators realized that there are a myriad of possible variables that could affect shell casing evidence. The investigators learned the value of research when faced with the challenge of reconstructing the events of a crime scene and that care should be taken when asked to testify or give opinions about circumstances that have not been fully researched.

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References

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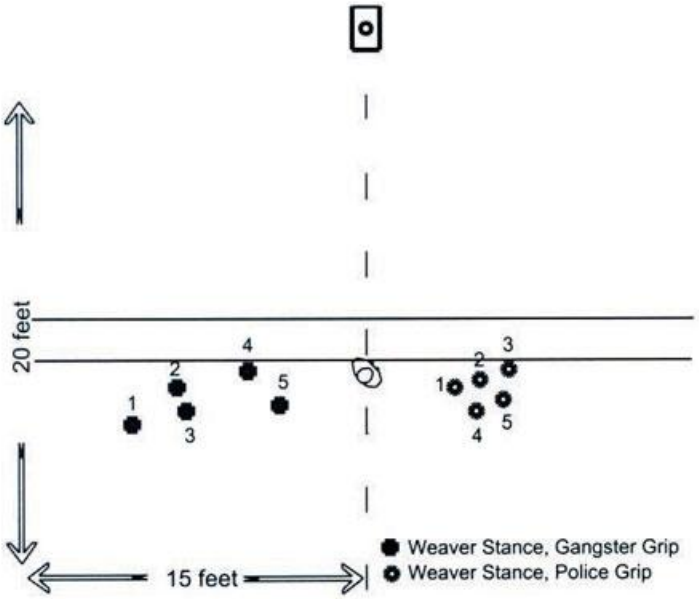
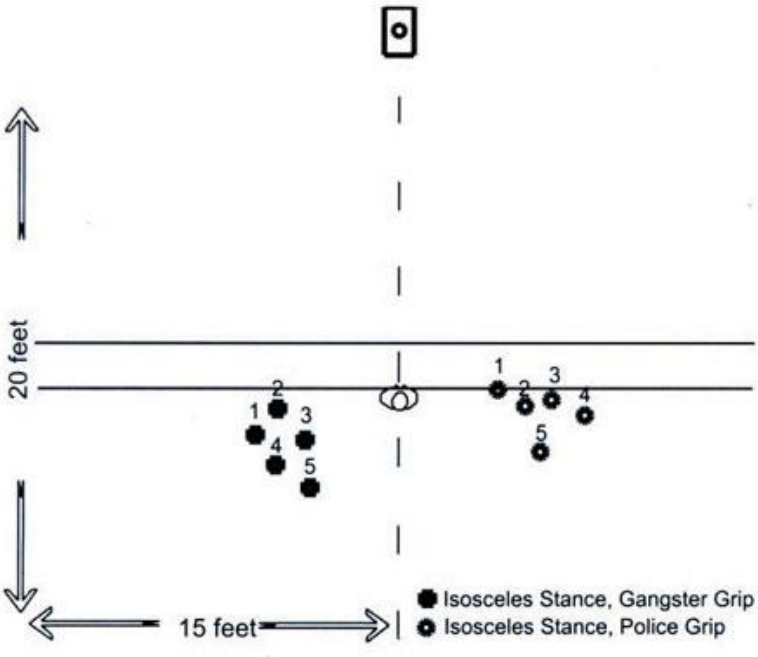
Appendix

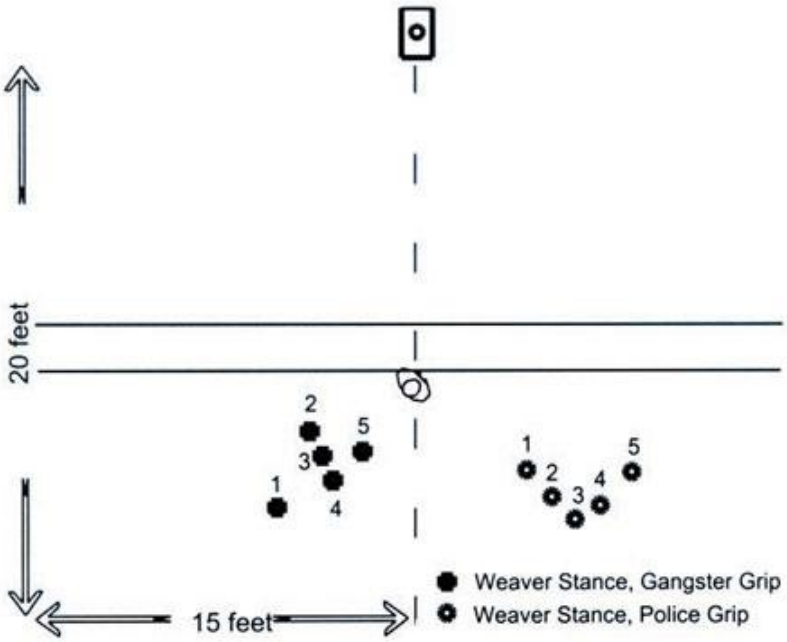
The following diagrams depict each of 10 weapons fired and show the stance and grip used in relation to where the shell casings were located.



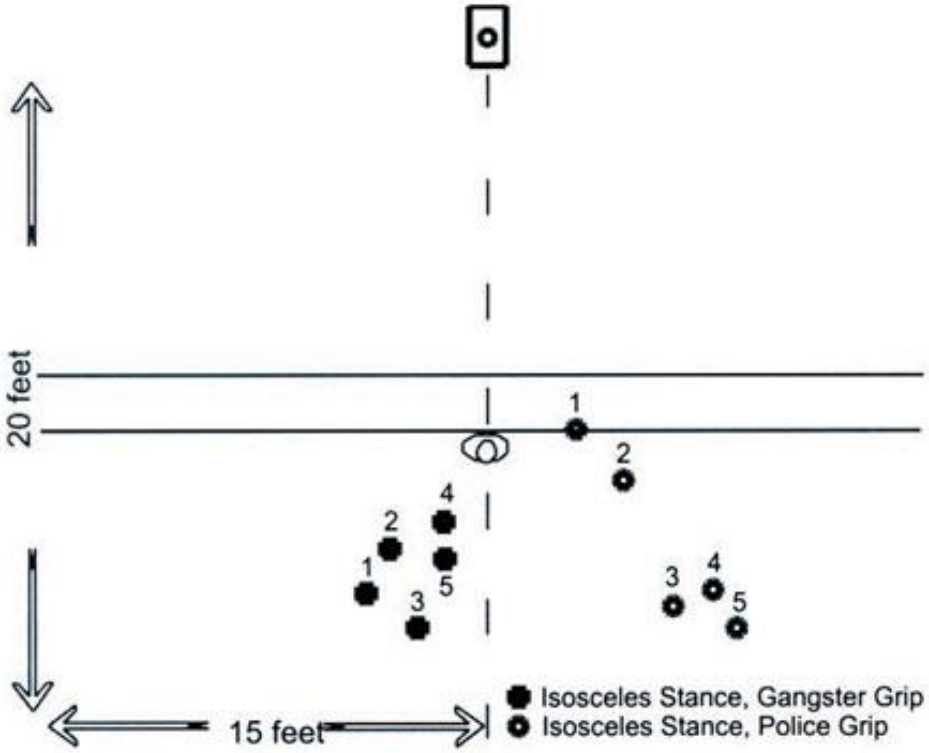
Smith & Wesson 9 mm, Model 5906



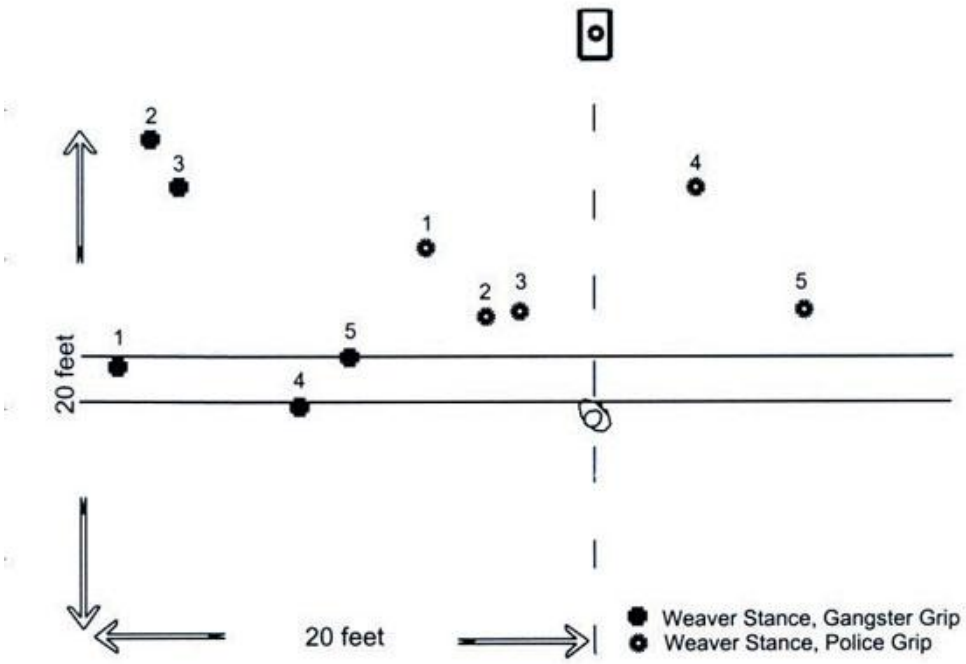
Smith & Wesson 9 mm, Model 5906



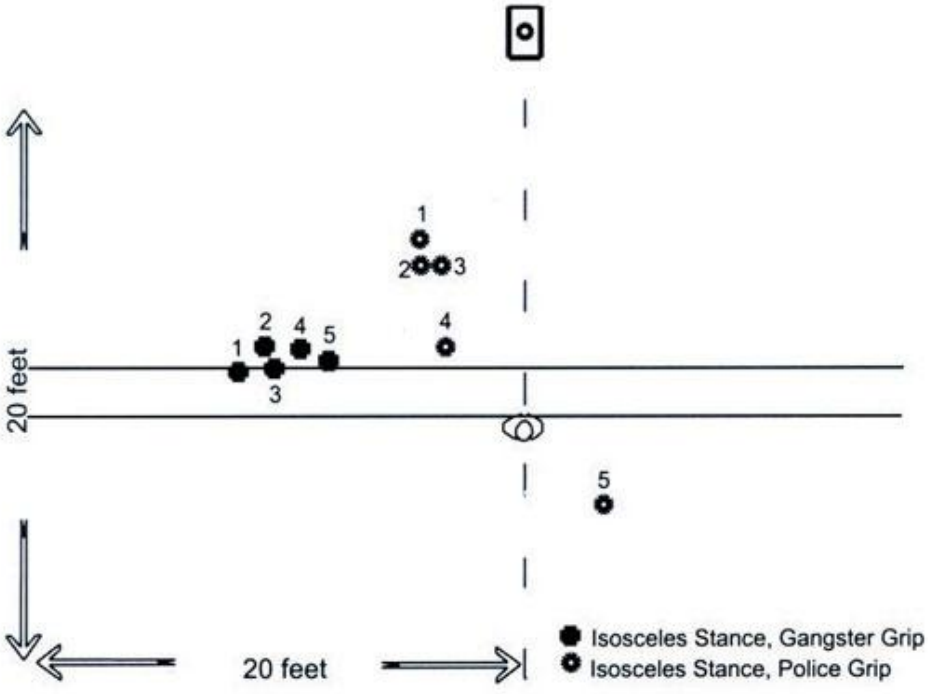
Browning 9 mm



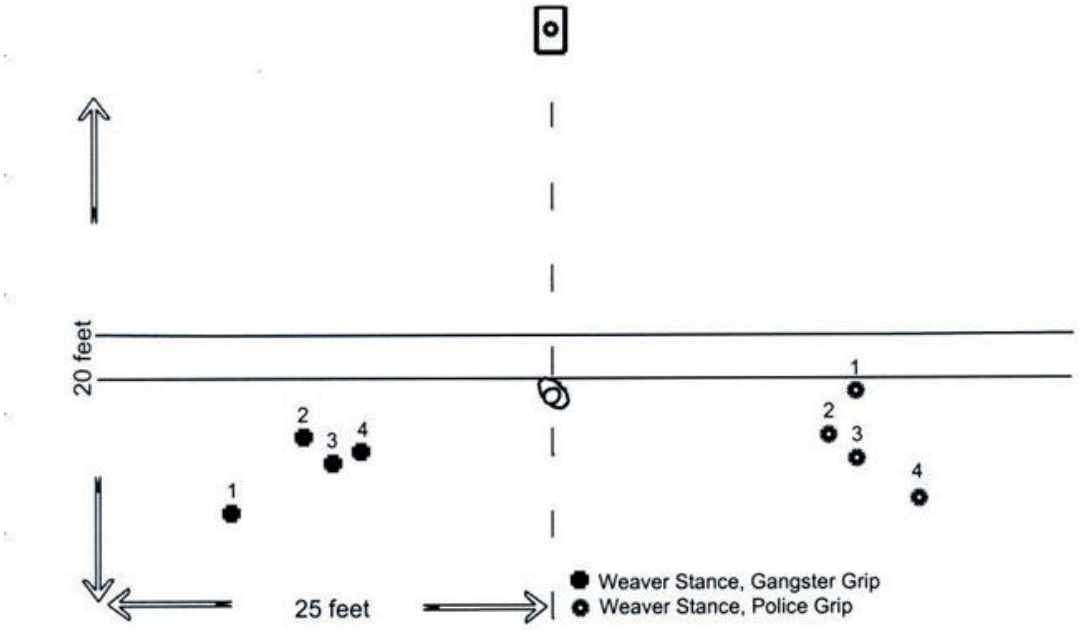
Browning 9 mm



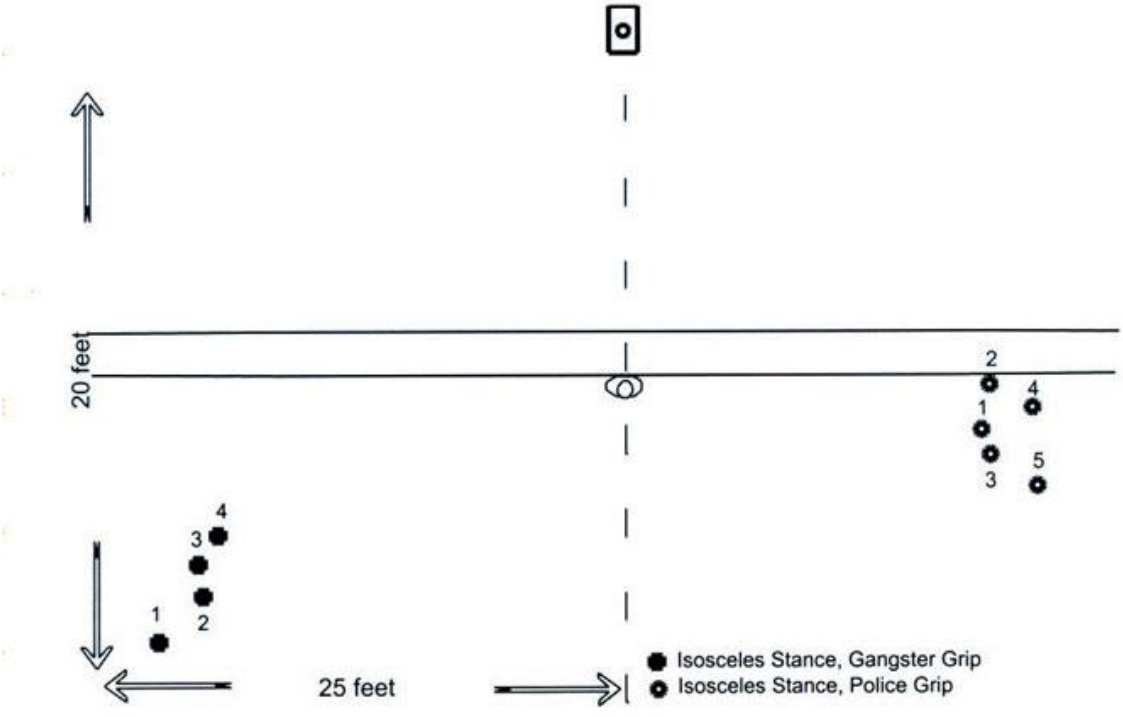
Norinco SKS Rifle 7.62 mm 9 mm



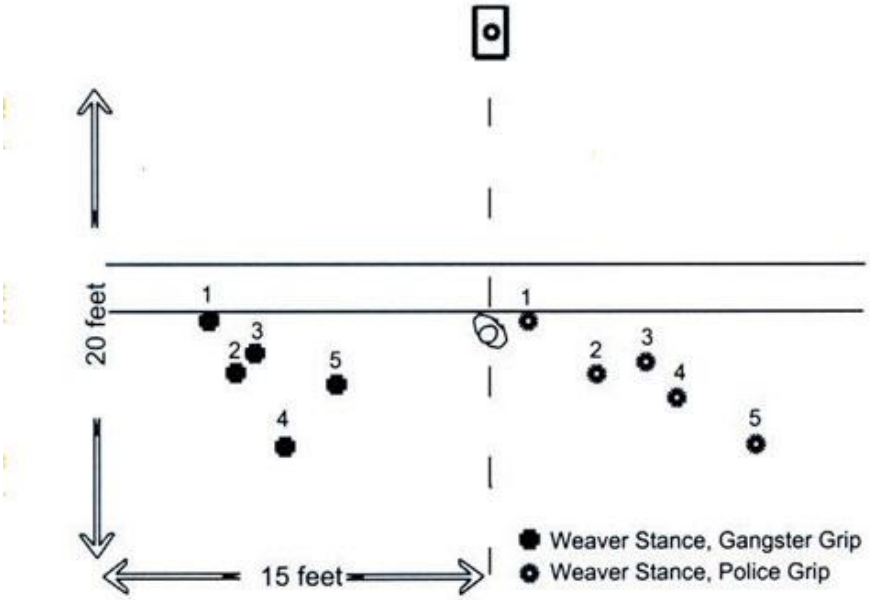
Norinco SKS Rifle 7.62 mm 9 mm



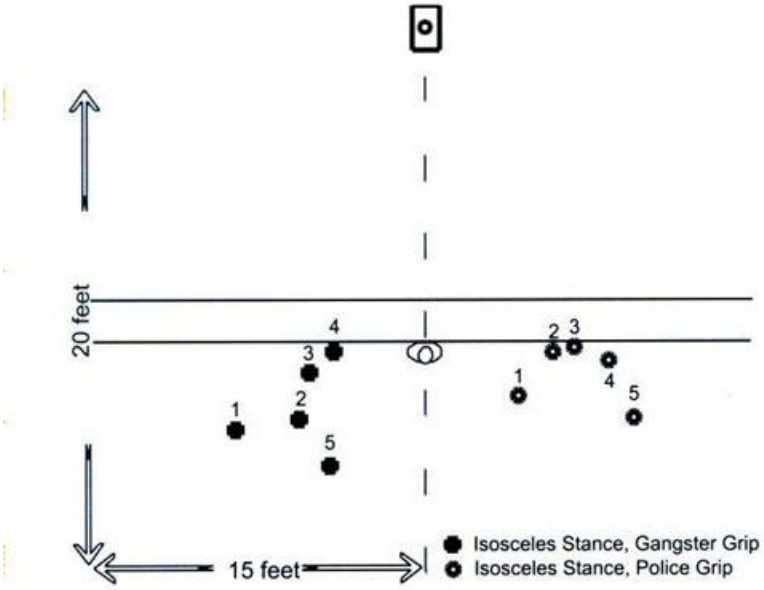
Smith & Wesson .22 caliber



Smith & Wesson .22 caliber



Heckler & Koch .45 caliber



Heckler & Koch .45 caliber

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