C34 Experimental Model for the Determination of Coefficients Penetrating through the Skin of Bullets from Different Gauges of Short Weapons: A Preliminary Study Partially

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After attending this presentation, attendees will: (1) understand some principles of forensic ballistics; (2) the necessary elements for the application on treminal ballistics; and, (3) its experimental paths.

This presentation will impact the forensic science community by describing the key aspect of scientific research in terminal ballistics on a biological target. These experimental applications will be useful for a better and more reliable reconstruction of violent crimes made with firearms in the future.

Before a bullet can cause significant injury, it must be able to pierce the skin. The penetration of a projectile into the skin is different from other tissues because the drilling process requires a relatively high impact velocity. The knowledge of the minimum speed of penetration of the skin is important data for forensic medicine and forensic ballistics to evaluate the penetration ability of offensive missiles or to determine the operating range of the use of a firearm.

It is important to consider that the diversity of materials and the different behavior of individual bullets, depending on their structure and the speed at impact, do not allow the use of a mathematical model generally, but only empirical formulas. On the one hand, some high-speed projectiles deform easily on impact and, on the other hand, some bullets do not rapidly transfer their energy to the target. The starting point for calculating the penetration of the projectile in most materials is its kinetic energy. The penetration of bullets into iron (armor, etc.) has been the subject of extensive studies in the military. From this research, a formula has been developed by Krupp. The penetration of spruce wood is commonly taken as an indicator of the penetration effectiveness of a bullet. It can be calculated with the formula Weigel.

For the study of bone penetration, the formula used is:

$$P = 0.44 \frac{G}{C} \frac{(V-60)^2}{100}$$

V = Velocity at impact
G = weight in grams of the projectile
C = mm caliber bullet

The speed limit at which a projectile is able to pierce human skin has been studied for pistol bullets or spherical balls, using the formula of Sellier:

$$V\ lim = 125 \frac{1}{Ds} + 22$$

DS: sectional density of the projectile (G / S)
G: the bullet weight in grams
S: section of the projectile sq. cm

EXPERIMENTAL STUDY: A study was performed to check the validity of the Sellier formula and search for a coefficient of penetration for projectiles involving "no Round Nose". The usefulness of the formula Sellier in terminal ballistics, is its ability to determine - with a close approximation - the speed that a bullet loses in crossing a biological target/human. The study was performed to determine exactly how fast a bullet lost speed as it passed through a biological target, to define the effects of terminal ballistics on the target material (interior ballistics), and clarify many aspects of exterior ballistics of the bullet that caused the gunshot wound (distance firing, identification of such ...). The purpose of the study was to identify a factor of one or two pure numbers which, when inserted in the formula of Sellier, which respectively include a factor (125) or addendum (22), may be representative of the particular morphology of the projectile. In fact, the Sellier is only applicable for round nose bullets, ie round toe, and many times there is a case study on the use of bullets of different morphology [Hollow Point (hollow point), wad cutters (flat tip) truncated cone (conical), metal piercings]. This change, which will be performed on that of the two pure numbers that experimentally vary more depending on the specific type used, would be the attempted penetration coefficient, which in fact is closely connected to the shape of the bullet.

With the testing done, the equation can be rewritten in the form of Sellier and solve the two equations X verifying which of the two numbers that we have replaced the X with several more. The number varies more to become the "C pen"

$$\text{Experimental limit } V = x \frac{1}{Ds} + 22$$

or

 ** Presenting Author*

Experimental Limit = 125 V 1 + x
Ds

Verification of the Applicability of the Theoretical Sellier Formula

MATERIALS AND METHODS: To make the velocity measurements two ballistic CED M2 chronographs were used which were managed by a microprocessor at 48 MHz with a measuring range from 50 fps to 7000 fps, which can store over 1000 speed measurements.

The two chronographs were placed in tandem with each other by interposing the target on first obtaining the impact speed of the projectile and the second speed output from the target.

The target was made on a young pig slaughtered the same morning of the tests with a skin thickness of 0.2 cm, comparable to the human model.

CONCLUSIONS: Although it is believed that the measurements taken in this first trial are not yet sufficient for the determination of the requested drag coefficient, the trend appears to confirm the validity of the results of the first scenario. The balls from the .32 caliber S & W and the .38 caliber Special lost speed in crossing the simulator at much higher levels than theoretical prediction, and that seems congruent with the obvious lower penetration of these projectiles by the morphology of flat and cylindrical tip section similar to the gauge.

However, there were some inconsistencies in the data, especially in the results obtained for the two series of shots in caliber Br 7.65 mm, which could indicate excessive accuracy of this first experimental model used.

The weapons used in this study were from TSN training center of Messina. These weapons had been fired several thousand times and consequently had very worn barrels. Some variability in speeds measured at the mouth of the weapons appear to contradict the noted condition. Hollow point bullets were not tested using the skin simulant.

To continue this work, which looks promising, it will be necessary to refine the experimental model especially in relation to the medium simulating the biological target. Future experiments should include a tissue of known thickness, which is able to simulate the response of human muscle to a ballistic penetration agent.

Terminal Ballistics, Biologic Paths, Forensic Pathology