G44 An Experimental Comparison of Bone Wound Ballistics of Non-Lead and Lead Bullets

Bryce O. Anderson, PhD, and Tyler A. Kress, PhD, BEST Engineering, 2312 Craig Cove, Knoxville, TN 37919; Anne M. Kroman, MA, University of Tennessee, Department of Anthropology, Knoxville, TN 37996; David J. Porta, PhD, Bellarmine University, Department of Biology, 2001 Newburg Road, Louisville, KY 40205; and John C. Hungerford, PhD, University of Tennessee, 208 ESH, Knoxville, TN 37996*

After attending this presentation, attendees will gain an understanding of how the increasingly prevalent use of non-lead bullets affects forensic examination and investigation.

This presentation will impact the forensic community and/or humanity by increasing knowledge of wound ballistics extended to the non-lead bullet trajectory through results from experimental impact biomechanics testing.

In this work a new type of small arms ammunition is evaluated to determine its capability of producing wound trauma. This new ammunition dispenses the toxic lead core of conventional bullets in favor of a non-toxic pressed tungsten and tin powder core. The testing involved firing rifle and pistol caliber tungsten tin and lead core bullets against real porcine femurs encased in ballistic gelatin. The lead bullets were used to establish a benchmark of performance for the tungsten tin bullets to be measured against. Various metrics such as penetration depth and bone fragment weight were recorded.

The specific cartridge calibers used in the testing were the 9mm x 19mm (Luger) and the 5.56mm x 45mm (5.56 NATO). The specific bullet types evaluated were the semi-jacketed soft point with a brass enclosed base. The bullet weight of the 9mm projectile was 124 grains and the bullet weight of the 5.56mm projectile was 60 grains. The ratio of tungsten powder to tin powder was set by weight at 68% W and 32% Sn for a net density nearly identical to lead. This resulted in the tungsten tin bullets being the same shape, size, and density as the lead bullets.

Ordnance gelatin powder was mixed 10% by weight according to accepted standards to replicate within 3% the penetration depth measured in living swine leg muscle as established by Fackler (1985). The gelatin was molded into a rectangular block with a rounded front face. The overall dimensions of the block were 24” long, 8” wide, and 16” high and required 36 liters of water and 4 kilograms of gelatin powder to manufacture. The bones were mounted upright approximately 4” behind the front face. The blocks were maintained at 39º F for at least eight hours prior to and during the shot. The ballistic gelatin block was mounted on a table 10’ away from the muzzle of the firearm in accordance with FBI ballistic testing protocol. Three separate 0.177” BB’s were fired into each ballistic gelatin block to verify acceptable block density.

Four combinations of bullet type were evaluated and three shots of each combination were made. The tungsten tin pistol bullets had a mean velocity of 1035 ft/s and a total mean penetration depth of about 14.5” with a mean distance of 9.12” beyond the bone. There were approximately 180 grains of bone fragments generated by the W-Sn bullet impact. The lead pistol bullets had a mean velocity of 1048 ft/s and a total mean penetration depth of about 13” with a mean distance of 6.78” beyond the bone. There were approximately 73 grains of bone fragments generated by the Pb pistol bullet impact. The lead rifle bullets had a mean velocity of 2792 ft/s and a total mean penetration depth of about 6” and went a mean distance of 1.08” beyond the bone. There were approximately 287 grains of bone fragments generated by the Pb rifle bullet impact. The tungsten tin rifle bullets had a mean velocity of 2843 ft/s and a total mean penetration depth of about 16” with a mean distance of 10.33” beyond the bone. There were approximately 266 grains of bone fragments created by the W-Sn rifle bullet impact.

It was found that the performance of the W-Sn pistol bullets was closely similar to that of the Pb pistol bullets, but the W-Sn bullets created a higher mean collective weight of bone fragments than the Pb pistol bullets did. The W-Sn rifle bullets exhibited much deeper post-bone penetration depth than the Pb rifle bullets, although the mean collective bone fragment weight was approximately the same. It was concluded that there was essentially no difference between the W-Sn and Pb pistol bullets but that the W-Sn rifle bullets would create a much deeper permanent cavity than Pb rifle bullets. The mechanism of this deeper penetration depth was attributed to the resistance to fragmentation of the W-Sn bullet in hard and soft tissue.

Reference:

1 Fackler, M.L., Malinowski, J.A.: The Wound Profile: A Visual Method for Quantifying Gunshot Wound Components. J. Trauma, 25 (6) : 522- 529, 1985.

Bone Wound Ballistics, Non-Lead Bullet, Ballistic Gelatin

 ** Presenting Author*