



Pathology Biology Section – 2007

G82 Comparison of Wound Severity Between Center-Fire Rifle Projectiles and Shotgun Slugs

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After attending this presentation, attendees will understand how the kinetic energy and fragmentation properties of a missile affect the extent of firearm wounds in a human body.

This presentation will impact the forensic community and/or humanity by contributing to the understanding of the relationship of a missile's kinetic energy and its wounding pattern in actual firearm wounds.

Introduction: Contemporary understanding of wound ballistics relates the severity of wounds to the temporary cavity that a projectile creates as it passes through the body tissues. This cavity is felt to be proportional to the kinetic energy (KE) possessed by the projectile. KE is related to both the mass (m) and the velocity (v) by the well-known formula: $KE = \frac{1}{2} mv^2$. This concept generally fits with ballistic experiments using gelatin, and accords well with general practical experience of forensic pathologists. There is little literature; however, that analyzes this relationship in actual firearm wounds. This study sought to explore this hypothesis using scientific methods on examples from medical examiner cases. A comparison was made of wounds produced by high velocity, center-fire rifles projectiles (CFRP) with those produced by shotgun slugs (SGS). The basis for this comparison is that CFRP have a relatively small mass and extremely high velocity while SGS have a large mass and a relatively low velocity.

Methods: A search was performed of the records at the King County Medical Examiner Office, Washington, for SGS and CFRP wound cases over the last 12 years – from mid-1993 to mid-2005. For these cases, the caliber of the CFRP and gauge of the SGS were obtained from the investigator reports, along with an examination of the weapon, ammunition, and recovered projectile. Only head wounds were used to compare wounds produced by CFRP and SGS. A grading scheme was developed based on head wounds documented in the autopsy reports, radiographs, diagrams and photographs. Grade I was limited to a skin laceration at the entry site, with minimal fractures or avulsion injuries. Grade II included complex skull fractures and limited avulsion of the scalp, skull, or brain. Grade III involved extensive avulsion of the scalp, skull, or brain.

Results: A total of 80 suicide and homicide SGS and CFR cases were evaluated, the majority of which were contact wounds of the head. In all the SGS cases, the slugs exited the body. Forty-two of 61 CFR cases showed fragmentation in the body. Overall, 64 cases were suicides and 16 were homicides. All of the contact head wounds resulted in extensive destruction of bony and soft tissue structures in the path of the wound with complete or near complete avulsion of the brain. For CFR, both high (e.g., .223, 3030, 30-06 caliber) and intermediate velocity (e.g., .45 caliber) ammunition were considered. Using the KE equation, it was calculated that the extent of the wound of a .223 should be approximately 90% that of a SGS wound. In the majority of SGS cases, slugs exit the body; therefore not all of the KE is transferred to the tissues. The majority of CFR projectiles fragment and remain in the body; however, resulting in the maximum transfer of KE to the tissues.

Conclusion: The results support the general observation that the extent of wounds of SGS is similar to that of CFR wounds. The objective of this study was not to compare the gauge and manufacturers of the weapons, but to provide the results of a general observation of wounding characteristics using scientific methods. CFR bullets fragment because of their high velocity and not because of hitting bone. The majority of the time, SGS do not fragment because of their lower velocities. Fragmentation allows for the dispersion of kinetic energy to the tissues. CFR projectiles possess approximately 90% of the energy of that of SGS; however, because most CFR bullets do not exit, there is more transfer of kinetic energy to the tissues than that of SGS bullets, where majority exit the body.

Firearm Wounds, Shotgun Slugs, High Velocity Center-Fire Rifles