



Pathology Biology Section – 2007

G83 A Comparison of Penetration Distances for Five Ballistic Gelatins to a BB Gunshot Wound to a Live Human Forearm

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After attending this presentation, attendees will see the accidental result of a BB gunshot and learn how ballistic gelatin preparation methodology can affect penetration results.

This presentation will impact the forensic community and/or humanity by demonstrating the only documented case where precise BB gun firing distance is known for a wound to a live human forearm. The penetration distance was determined using X-Rays. This data was then compared with recreated BB gun firings into five (5) different ballistic gelatins to determine which average penetration distance is the closest to this single human case.

Misuse of BB guns causes a significant number of injuries each year. One of the authors was subjected to such misuse and the result was a penetrating wound to the proximal anteromedial aspect of the right forearm. The subject was a healthy, 37-year-old male with fairly well muscled forearms due to years of baseball playing. Fortunately, this accident occurred in a laboratory setting and all parameters were recorded. The gun was a Daisy-brand Powerline Model 1200. This carbon dioxide powered pistol can fire a standard steel BB at up to 420 feet/second. In this case, the muzzle was located precisely 126 cm from the subject's bare forearm and the gun was equipped with a fresh CO₂ cartridge. Radiographs were made and the BB was noted to have penetrated just over 63 mm into the flesh (after magnification was taken into account). The BB was surgically removed under fluoroscopy. The surgeon noted no involvement of the radius, ulna or major neurovasculature. However, the BB did pierce the interosseous membrane. The wound was irrigated and sutured closed with no significant complications.

It is an extremely rare case when such precise data is known about an actual gunshot wound to a live human being. It afforded the authors an interesting opportunity to compare the BB penetration in this person to a laboratory-based series of experiments utilizing ballistic gelatins.

In order to perform better controlled studies on the damaging effects of various bullets passing through soft tissues, ballistic gelatin was created many years ago. The gelatin is said to simulate the density and viscosity of human and animal muscle tissues. A standard gelatin powder (250 Bloom Type A Ordinance Gelatin) was purchased from Kind & Knox Gelatine, Inc. (Sioux City, Iowa). There are a variety of methods published for the preparation of 10% gelatin blocks. Five were chosen for this study:

1) The manufacturer's directions; 2) The Vyse gelatin utilized by the FBI; 3) A technique in which the maximum temperature never exceeds 104 degrees F; 4) A technique in which the starting water is at 129 degrees F; and 5) A recipe published by Lewis et al. 1982. They appear to have relatively minor differences (mostly related to various temperatures and standing times).

Gels were poured into transparent hard plastic cups. Each cup was placed in a protective firing range and subjected to five BB shots from 126 cm away- using the same Daisy gun. A total of 25 shots were recorded for each of the five gelatin recipes and all penetration distances were measured with digital calipers. The data were stored in Microsoft Excel, then imported to Stata 8.0 (College Station, Texas) for analysis. The mean penetration distance for each recipe was: 1) 62.24 mm; 2) 43.25 mm; 3) 56.13 mm; 4) 64.22 mm, and 5) 40.98 mm. ANOVA testing was significant between all groups but the chi-squared analysis results were <0.05; therefore, variances were not equal and parametric testing was dropped. Kruskal-Wallis tests indicated statistically significant differences between the mean penetration distances for all the recipes. The Mann-Whitney test indicated significant differences between each recipe except when comparing one and four. Interestingly, the mean penetration distances for those recipes were the closest to the actual penetration depth in the live human subject (63 mm).

In summary, a live human subject was accidentally shot in a muscular area of his forearm with a BB gun. The penetration distance compared favorably with two of five ballistic gelatin preparations. Although the live human data consists of a population (n) of one, it appears to be the only such data in the medical literature. Based on this, it seems the preparation method for ballistic gelatin has significant effects on the penetration distance for BB gunshots.

BB Gunshot, Ballistic Gelatin, Live Human Forearm