E64 Detection of Residual Metal on Bone From Bullet Hole Periphery Using Digital Radiography

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After attending this presentation, attendees will be familiar with: (1) examining bullet holes in sections of bone using a NOMAD™ X-ray device; (2) reviewing radiographs for the presence of residual metal on bone; and, (3) some of the factors that affect the transfer of metal from the bullet to the periphery of the bullet hole.

This presentation will impact the forensic science community by describing a non-destructive method for identifying possible bullet holes in bone by detecting residual metal around the bullet hole periphery.

Portable X-ray equipment may be used at the scene to examine suspected bullet holes on skeletal remains or fragmented skeletal elements for the presence of residual metal. The examination is not destructive and may provide investigators with preliminary information while the skeletal remains are more thoroughly examined.[1]

In this study, sections of bovine bone were cut to 10cm to 18cm in length, then cut longitudinally and used as a substrate for producing bullet holes. The sections of bone were taken to the firing range and shot at a muzzle-to-target distance of approximately one meter with a variety of firearms and ammunition. Four types of firearms were used to produce the bullet holes including: a Smith & Wesson® model 686, a Smith & Wesson® model 5906, a Smith & Wesson® model 617, and a Beretta® model 950. Fifteen brands of ammunition were used which consisted of: eight .22 caliber brands, one .25 caliber brand, three .38 caliber brands, and three 9mm brands. The bullet styles from these brands included: Lead Round Nose (LRN), Hollow Point (HP), Full Metal Jacket (FMJ), and Semi-Jacketed Hollow Point (SJHP).

Eighteen gunshots produced bullet holes. One .22 caliber bullet grazed the bone without producing a bullet hole and the round lead shot from a .38 caliber shot shell produced indentions in the bone without producing a bullet hole. The grazed bullet and the shot from the shot shell both left contact marks on the bone that were gray in color. Some bone samples shattered into multiple pieces and were assembled with the use of shipping tape before making radiographs.

After assembling the bone fragments, radiographs of the bone sections were obtained with the use of a NOMAD™ X-ray device and digital sensor. The NOMAD™ is a hand-held X-ray device powered by a 14.4-volt battery. It has been tested for safety and is approved for use in North Carolina.[2,3] When the device is energized, the output power for generating X-rays is constant at 2.3mA at 60kVp±10%. The exposure is controlled by adjusting the time on the device. The NOMAD™ has an exposure range of 0.01–0.99sec.[4] Average exposure time used to obtain radiographs of the bone with bullet holes was 100 milliseconds.

In conclusion, 18 of the 20 bone samples had bullet holes. One bone sample had shot impressions .140 inches in diameter from the .38 caliber shot shell and one sample was grazed with a .22 caliber bullet, both leaving gray marks on the bone. From the 20 bone radiographs examined, 16 (80%) had residual metal on the bone. Of the 18 bullet holes, 15 had metal in the bullet hole periphery. Metal was detected in only one out of five bullet holes when full metal jacketed bullets were fired. Not all bullets transfer metal to bone; however, when metal is transferred, digital radiography is useful in detecting the transfer.

References:

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2. Herschaft, E.H. Current radiation safety regulatory policies and the utilization status in the United States of the Nomad™ portable hand-held dental radiation emitting device. Proceedings of the American Academy of Forensic Sciences, 62nd Annual Scientific Meeting, Seattle, WA. 2010. p. 265.
3. Kenneth P. Hermsen, K.P. A review of the literature concerning radiation safety features of the Nomad™ portable hand-held dental radiation emitting device. Proceedings of the American Academy of Forensic Sciences, 62nd Annual Scientific Meeting, Seattle, WA. 2010. p. 265.
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