CASE REPORT

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Human Osteology: Key to the Sequence of Events in a Postmortem Shooting

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ABSTRACT: Forensic anthropologic examination of human skeletal remains found when a field was plowed provides evidence of both perimortem trauma, suggesting cause of death, and of subsequent shooting of the disarticulated skeleton. The case exemplifies the application of the specialized skills and knowledge of the physical anthropologist to determination of the postmortem sequence of events.

KEYWORDS: physical anthropology, osteological evidence, premortem/postmortem trauma, postmortem interval, gunshot

On September 9, 1991, the Division of Physical Anthropology, National Museum of Natural History, Smithsonian Institution, received the skeletal remains of a 37-year-old white male who was last seen alive on January 27, 1987. The human remains and winter clothing had recently been found by a farmer plowing his field. Near the skeleton was a 12-gauge shotgun with a spent rifled slug casing in the breach. The unusual circumstances surrounding the individual's death prompted the medical examiner of the local jurisdiction to seek the assistance of Smithsonian anthropologists. The scientists were requested to conduct a forensic anthropologic examination of the remains and to provide an opinion on the manner (for example, homicide, suicide) and method (for example, shooting, stabbing) of death.

Examination of the skeletonized remains and clothing revealed that the decedent sustained perimortem gunshot injuries to the head and postmortem gunshot injuries to the pelvic region. Although it is not uncommon for a human skeleton to be altered postmortem (for example, carnivore chewing and breakage [*1–5*]), it *is* uncommon to encounter one that has been shot. The pattern and location of penetrating and perforating injuries to the pelvic region provided evidence that the skeleton was disarticulated when the second shot was sustained.

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Perimortem Trauma

The skull and mandible are broken and exhibit a mosaic (that is, "checkerboard") pattern of sun bleaching, ranging from brownish to whitish (Fig. 1.). The skull is broken into many pieces, some of which (that is, facial bones) were not recovered. These bones show no evidence of crushing or of sharp or blunt force injuries. The separated bones of the skull are not deformed (suggesting rapid loading forces) and exhibit separation and displacement of the bones along the sagittal and lambdoidal sutures, as well as fractures of all the major bones. The mandible is broken in two and has a single vertical fracture through the socket of the right canine tooth. Bone on the buccal surface to the right of the fracture is darkly stained; the bone to the left is sun bleached. The pattern and degree of discoloration of the skull and mandible indicate that breakage occurred early in the process of decomposition, possibly at the time of death. Radiographs revealed no bullet particles or wipe.

For postmortem events to result in such extensive breakage of the skull and mandible without concomitant damage to other bones, especially those of the neck (that is, cervical vertebrae), would be unusual. The pattern of bone breakage and absence of warping are consistent with a perforating injury such as a gunshot that entered under the chin, traveled from below to above and from back to front, and exited through the facial region. Such an injury might result in extensive fracturing of the skull and mandible without leaving bullet wipe on the bones of the head. In this case it is possible that the gunshot exited through the vertex of the right parietal where a small triangular section of bone is missing.

Microscopic examination of the fracture margins of the frontal bone revealed numerous particles embedded in the spongiosa above the eye orbits. Analysis using infrared spectrometry identified the particles as plastics containing cellulose nitrate (that is, gunpowder residue), a substance commonly found as part of an explosive mixture used in firearms [6]. This discovery supported the hypothesis that the person sustained a perimortem close-range gunshot to the face or throat.

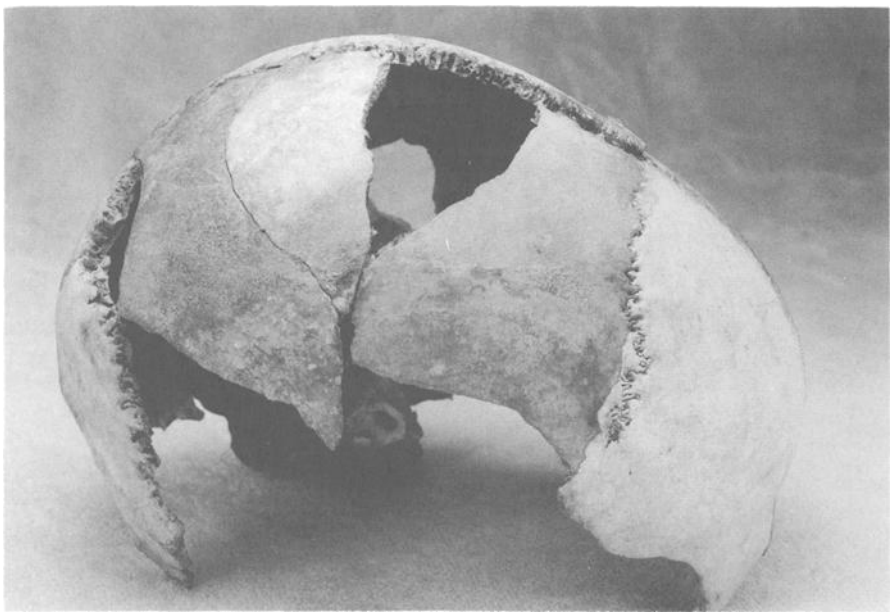

FIG. 1—*Reconstructed skull showing the "checkerboard" pattern of discoloration (light areas were exposed to the sun for a period of years).*

Postmortem Alteration of the Skeleton

The skeleton exhibits a number of unusual features that occurred postmortem, including:

(a) numerous penetrating and perforating wounds in the os coxae, right femoral head, greater trochanter of the proximal left femur, and spinous process of the third lumbar vertebra (71 pellet holes were identified in the skeleton and clothing);

(b) a broken right tibia, left scapula, and fifth lumbar vertebra;

(c) cuts from a chisel plow on some arm bones and os coxae; and

(d) blue-green algae stains on the mandible and on the medullary cavity of the broken right tibia.

The skeleton shows varying discoloration, ranging from dark brownish to whitish, depending on whether the bones were exposed to the sun because sun bleaching turns bones white, or were either in contact with the ground or covered with clothing (that is, brownish). The pattern of weathering indicates that the bones of the upper body and bones of the thorax are darkly discolored as a result of being covered with clothing during most or all of the process of decomposition [*7*]. Bones of the lower body, other than the feet, which were sheltered inside athletic shoes and socks, show sun bleaching and surface cracks resembling spiderwebs. The fibulae and fragmentary right tibia are evenly bleached, indicating exposure to the sun for a period of at least a few months. The broken right tibia displayed blue-green algae on the surface of the medullary cavity. (Under favorable environmental conditions blue-green algae can colonize on a substrate such as bone and become visible to the naked eye in 2 to 3 weeks.[3]) The inner surface of the right os coxae exhibits the most severe surface cracking as a result of fluctuations in moisture and increased daytime temperatures. This cracking is consistent with a period of about two years or somewhat more [*9*]. It is apparent that after death the upper body remained inside the clothing, as did the lower body until the jeans became severely decayed and exposed the bones to the sun.

Several bones show postmortem breakage and loss. Shallow cuts made long after the skeleton had become disarticulated appear on the os coxae, the right humerus, radius, and ulna, the left scapula, the tenth thoracic vertebra, and the right femur, fibula, and calcaneus. The cuts resulted in breakage of the right tibia, left scapula, and right os coxae. The anterior surface of the left femur has two parallel cuts separated by a distance of 191 mm, the distance between the plow tines. Disturbance by a plow or tractor would account for the cuts and breaks of the bones of the torso and lower body but not for those found on the skull and mandible.

Postmortem Shooting

The os coxae, femora, and third lumbar vertebra show penetrating and perforating wounds, or both, resulting from a shotgun sustained long after the individual was dead. The pellets (that is, birdshot) entered the inner surfaces of the os coxae, the lateral portion of the greater trochanter of the left femur, and the right arch of the third lumbar vertebra.

The orientation and direction of the pellets were determined by placing wood probes in the entry holes (Fig. 2). The direction of the shotgun blast (with the decedent lying face up on the ground) was from his right side. The pellets traveled from behind to front, above to below, and right to left. The pellets are restricted to the pelvic region (Fig. 3), striking only the os coxae, proximal femora, and one lumbar vertebra. Based on the

[3]Norris, J., Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, DC, personal communication, 1992.

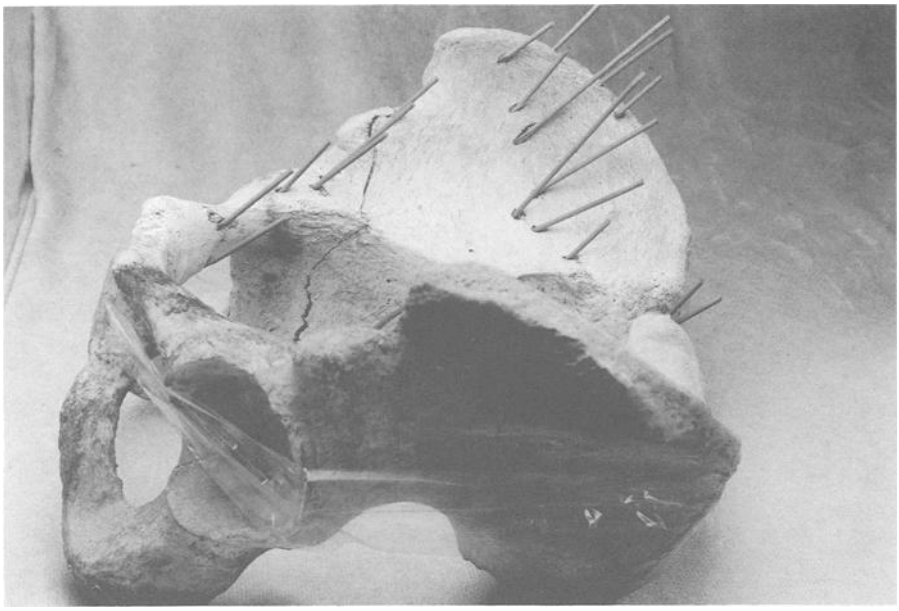

FIG. 2—*Left lateral view of the pelvis showing the orientation of the pellets (probes inserted in the holes) that traveled from behind to front and from above to below.*

following observations, it was concluded that the pellets had entered the bones long after the disarticulated skeleton of the decedent had been lying on the ground:

(a) The outer, superior surface of the right acetabulum (that is, hip socket) contains pellets that penetrated but did not perforate the bone (Fig. 4). The corresponding femoral

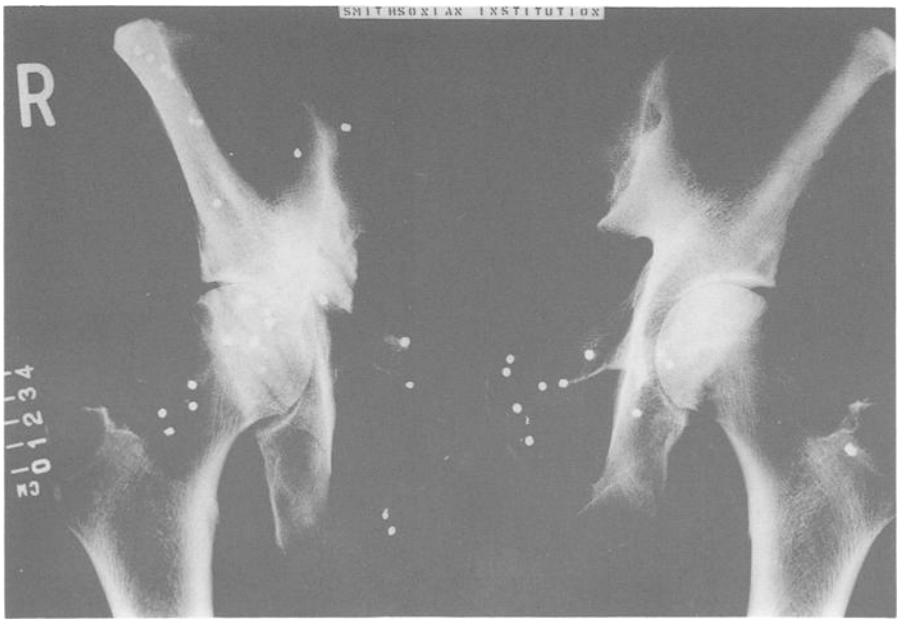

FIG. 3—*Postmortem radiograph showing shotgun pellets embedded in the pelvic region.*

FIG. 4—*Superior surfaces of the right os coxae and femur showing entry holes and direction (that is, probes) of the pellets (note the upper group of probes does not pass through the "hip socket").*

head also has penetrating wounds situated such that, if the femoral head was in the hip socket, they would have had to pass through the socket to penetrate the femoral head (this finding indicates that the right pelvic girdle was disarticulated when shot).

(b) Pellets are embedded in the left symphysis pubis. Their position indicates that the right symphysis pubis was not in the path of the pellets and, therefore, that the pubic bones must have been disarticulated.

(c) Two pellets penetrated the lateral surface of the left greater trochanter of the femur. Probes placed into the wound tracks in the left femur reveal that the pellets entered from the decedent's left side. Such an entry could only be accomplished if the left femur was disarticulated from the pelvis and rotated or abducted outward, thereby allowing the lateral surface of the femur to be in line with the shotgun blast from the decedent's right side.

(d) The pellets interrupt weathering cracks (Fig. 5) located on the surface of the right os coxae. Weathering cracks typically take two or three years to become visible, and they do so only after skeletonization and prolonged exposure to the elements [*9*,*10*].

Two additional observations suggest that the weathering cracks were present at the time that the pellets penetrated the bone. First, the entire surface of the right ilium has cracks of varying lengths and widths oriented along the "grain" of the bone (contrasting with traumatic fractures), most of which are not associated with pellet wounds. Second, pellet wounds along the iliac crest, an area of thick, spongy bone, also interrupt faintly visible cracks in the cortex. The cracks are extremely shallow, are parallel to one another, and appear to have been there prior to being struck by pellets.

Two perforations of the left acetabulum and left femoral head indicate that these bones were still articulated when shot and that the body was not standing at the time. The perforations, which are one centimetre apart, traveled completely through the acetabulum and barely mark the femoral head. When these perforations of the acetabulum and femoral head are aligned so that they match, the resulting position of the leg shows that the skeleton had to be supine.

Shotgun pellets are also present in the waistband of the underwear and in the victim's leather belt. Radiographs of the hooded sweatshirt revealed two pellets in each sleeve and seven in the midsection.

The evidence suggests that the individual was dead for a minimum of 2 to 3 years (that is, skeletonized and weathered) when shot. The narrow, approximately 1 square foot,

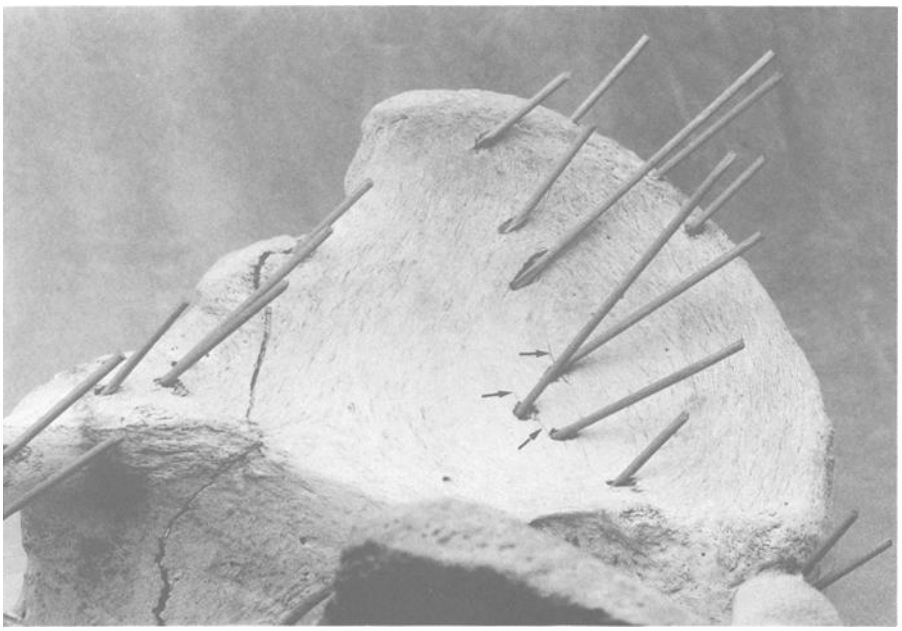

FIG. 5—*Pellet holes that interrupt weathering cracks (arrows) in the inner surface of the right ilium.*

dispersion of the pellets restricted to the pelvic and lower back region suggests that the skeleton was shot at a distance greater than 30 feet, depending on the amount of choke used.

Summary

Examination of the human skeleton and clothing yielded information consistent with a single gunshot wound that entered under the chin and exited the facial region or upper vault, causing massive fracturing and displacement of the bones of the head and mandible, and death. The pattern and location of penetrating and perforating lead shot in the os coxae, right femoral head, greater trochanter of the proximal left femur, and spinous process of the third lumbar vertebra are consistent with a second shooting some two to three years after death. By articulating the skeleton and tracking pellet entries and directionality, the authors were able to determine that the individual was skeletonized and disarticulated at the time of the second shooting. This case exemplifies the information that can be obtained through careful examination of the human skeleton and associated material evidence and the specialized skills and knowledge of the forensic anthropologist.

Acknowledgments

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