CASE REPORT

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Multiple Gunshot Wounds of the Head: An Anthropological View

REFERENCE: Rhine, J. S. and Curran, B. K., "**Multiple Gunshot Wounds of the Head: An Anthropological View,**" *Journal of Forensic Sciences,* JFSCA, Vol. 35, No. 5, Sept. 1990, pp. 1236–1245.

ABSTRACT: A decomposed body was judged at the scene to have two gunshot wounds of the thorax and three of the head. Confirmed at autopsy, the condition of the remains precluded conclusions about the precise nature of the defects. Preparation and reconstruction of the skull disclosed seven large cranial defects and a series of fractures. This preparation allowed the application of well-known principles of gunshot wound analysis. Although the analysis of specific gunshot wound defects is well covered in the literature, there are few examples of the application of gunshot wound principles to complex wound cases. Three entrances and three exits were identified. A seventh defect resulted from bullet passage. Finally, the wounds were sequenced.

KEYWORDS: criminalistics, physical anthropology, gunshot wounds, homicide, beveling, caliber, entry wound, exit wound, forensic anthropology, projectile, skeleton, skull, trajectory, wound sequence

Gunshot wounds of the soft tissues have been accorded much attention in forensic science literature. Wounds of the hard tissues have been less extensively covered. Nevertheless, the principles of interpreting gunshot wounds of the skeleton (particularly the skull) are well known [*1*]. However, the literature offers few examples in which the principles elucidated are applied to a specific complex case. Since multiple gunshot wounds of the head are frequently encountered, this case offers an opportunity to apply these principles to a skull with multiple defects.

Preparation of the skull allowed analysis of the seven perimortem defects. Such a detailed workup may not be required in every case. Yet, the outcome at the trial may depend in part upon a demonstration of the precise nature of the wounds and their sequence. Such an analysis could provide an independent verification of an eyewitness account. It might also provide the jury with independently derived information about the nature of a homicide.

Received for publication 7 Aug. 1989; revised manuscript received 16 Oct. 1989; accepted for publication 17 Oct. 1989.

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Principles of Gunshot Wound Analysis

The principles of determination of entry and exit wounds are well known. Typically, as a missile passes into a skull, it pushes the bone table opposite the point of contact out, exceeding the elastic limits of the bone and creating a larger defect as it exits the bone. This "crater" or cone has its largest diameter in the direction of projectile travel. A typical missile will produce two such cones, the first being an internal bevel on the endocranial surface opposite the point of ectocranial entry, and the second an external bevel on the ectocranial surface where it exits the skull on the opposite side.

Depending upon the caliber, distance, and other variables, a projectile may remain in the head, producing no wound of exit on the skull. If the projectile exits, the wound of exit tends to be larger than the entrance wound [*1–4*].

In the recently deceased, the trajectory of a missile through the head is often clear in the postmortem X-rays. The bullet sheds a portion of its substance, leaving a radiopaque trace through the brain. When a decomposed body or a skull is found, other methods of establishing the trajectory must be used. As noted above, the passage of a missile creates a crater. If the trajectory of a missile is at right angles to the cranial surface, the cratering should be expected to be approximately symmetrical, given a constant bone thickness. Angulation of the missile on entrance will be expected to produce a corresponding asymmetry in the crater, the elongation of the bevel indicating the direction of the trajectory [*3*].

In principle, a fracture emanating from a second wound will cross neither a previously existing fracture nor a suture. But in practice, if the forces are of sufficient magnitude and the suture has at least partly fused, the fracture will not halt. In both instances, the stresses produced in the bone by the impact of a subsequent projectile tend to be dissipated down the previous fracture or along a suture [*3*]. Consequently, a fracture halted by another fracture must have been induced subsequently. Following this concatenation of interrupted fractures at both entrances and exits will, therefore, establish the order of the defects and hence of the gunshots.

We will explore four aspects of this case: (1) identification of the entrances, (2) identification of the exits, (3) discovering the trajectory of the missiles, and (4) determining the sequence of the wounds.

Case Report

A fully clothed, decomposed body was found near San Ignacio in Eastern New Mexico. This 37-year-old male Hispanic truck driver from California was reported at the scene as having two gunshot wounds of the thorax and three of the head. At autopsy, this finding was confirmed, and two missiles were recovered from the skull. But because of the confusion of the decomposing soft tissue and the jumble of fragmented bone, the character of the defects could not be precisely determined. The determination of entrances and exits is always made more difficult where decomposing soft tissue is present [*5*].

Anthropological Aspects

Forensic anthropologists are typically summoned to assess skeletonized, partly skeletonized, mummified, incinerated, decomposed, and commingled remains where questions of identification are at issue. The forensic anthropologist may also be of help in other instances, such as those involving the preparation and reconstruction of skeletal structures. With their experience on dried bone specimens, forensic anthropologists may also help to resolve questions relating to cause and manner of death.

Decomposed bodies offer a particular challenge to the forensic pathologist, as the soft tissues have lost most of their value. Further, the diminished organization of soft tissues allows fragmented bones to shift from their normal anatomical positions. It is therefore difficult to recover all of the bone fragments from the gelatinous mass of decomposing soft tissue and to reestablish their relationships.

In this case, a meticulous cleaning of the bones, reconstruction of the fragments, and stabilization of the completed anthropological reconstruction revealed a skull with seven major defects, as is shown in the accompanying illustrations. This reconstruction allowed a full and proper evaluation of the defects and their significance to be made.

Defects Present in the Skull

The major postmortem defects were the following: (A) *left parietal:* a 14-mm circular defect, with a mostly inward bevel, and with slight outward bevel as well; (B) *left sphenotemporal area:* a 15 by 19-mm rectangular defect; despite the thinness of the bone, an inward bevel may be detected (Fig. 1); (C) *left lateral occipital:* a 20-mm circular defect, inwardly beveled, with associated damage to the inferior and medial portion of the left mastoid process (Fig. 2); (D) *left basal sphenotemporal area:* irregular defect with jagged borders, including damage to the anterior petrosal part and adjacent portion of the sphenoid; (E) *inferior right occipital:* an approximately 15-mm circular, incomplete exit, reconstructed in Fig. 2; (F) *right midparietal:* an approximately 15-mm circular incomplete exit with an incomplete external bevel. It has also been reconstructed. This is a variety of the concentric heaving fracture described by Smith et al. [5]; and (G) *right frontal:* a 14 by 23-mm ovoid defect, with internal and external beveling and keyholing [*6*] (Fig. 3).

In addition to these defects, the nasal bones had been fractured antemortem and well healed. Note also the presence of an incomplete autopsy saw cut (Fig. 4) running from Defect G around the frontal into the left parietal and on into the occipital. Also visible is a series of bilaterally comminuted fractures of the sphenotemporal regions, the occipital and the frontal bones, and the medial orbits.

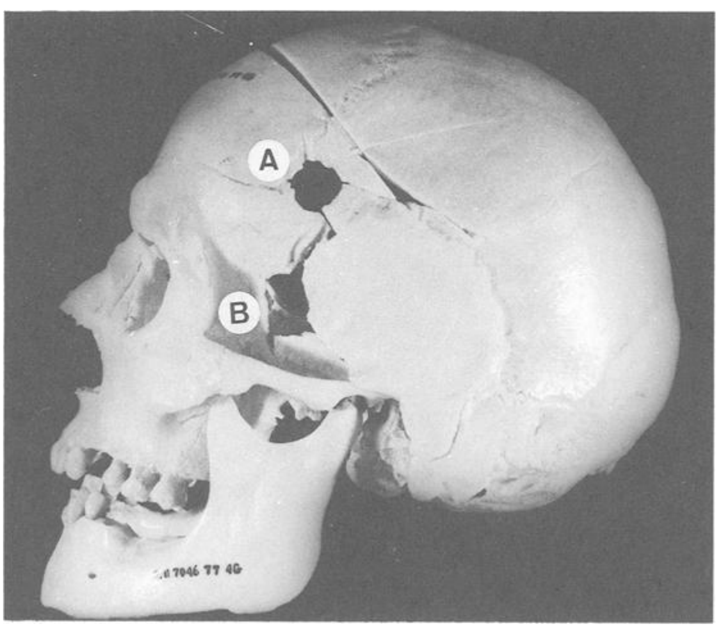

FIG. 1—*Left side of the skull, showing entrances A and B.*

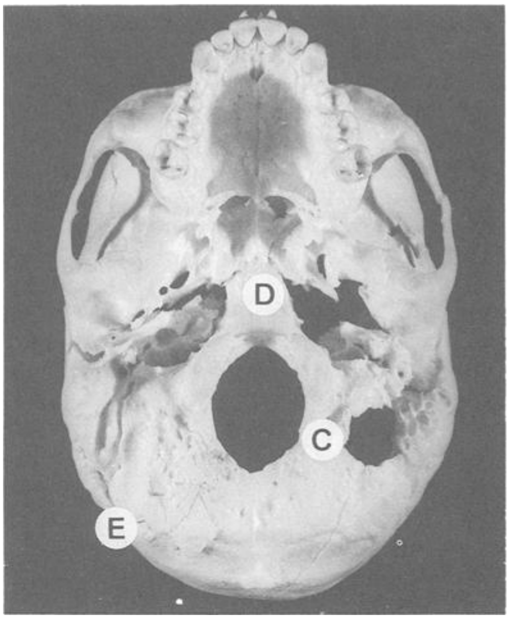

FIG. 2—*Inferior view of the skull showing entrance C, destruction at D, and an incomplete exit at E.*

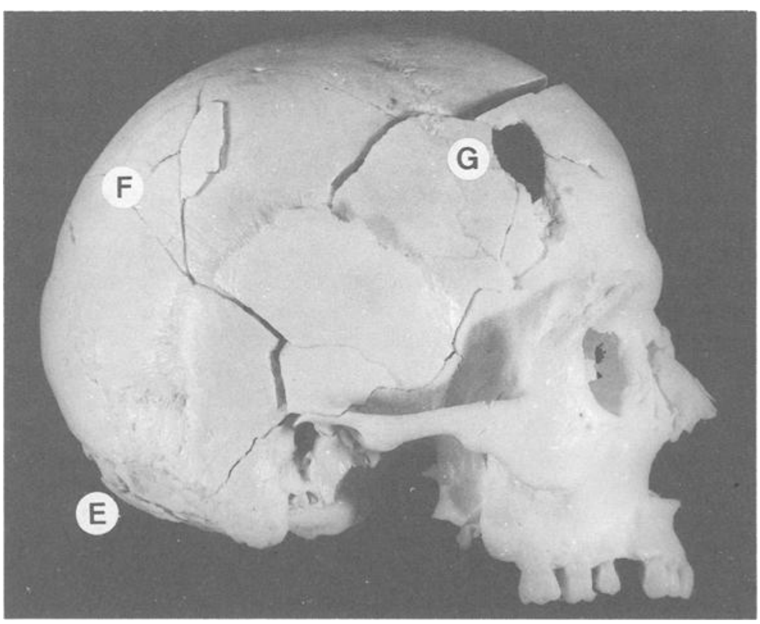

FIG. 3—*Right side of the skull showing exit G and incomplete exits E and F.*

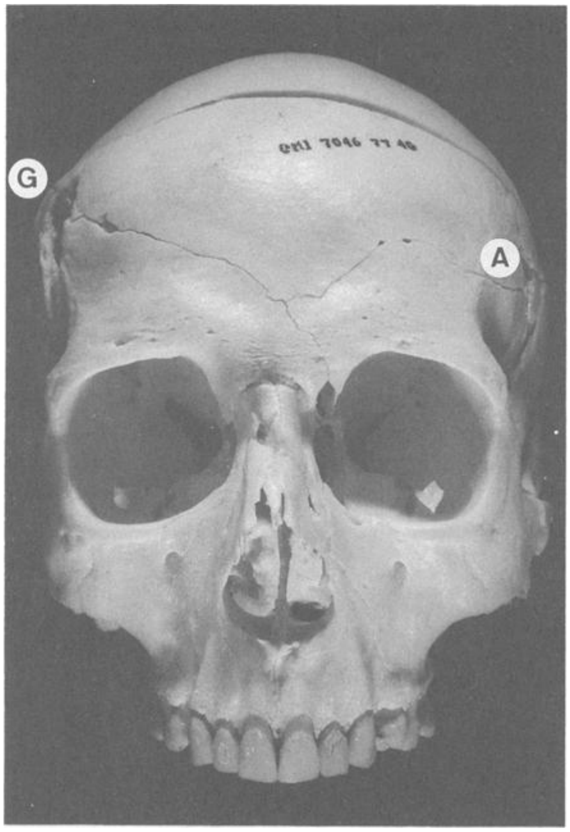

FIG. 4—*Anterior view of the skull showing the through-and-through wound A through G.*

Applying the Principles

The "textbook" gunshot wound of the skull is a neat, internally beveled, circular entrance defect paired with an unambiguous externally beveled exit which is larger than the entrance wound [*2–4*]. Yet, Coe [*7*] has also observed that an outward bevel may also be seen at entrances, which generally are smaller than the amount of inward beveling.

Given that they are incomplete and externally heaved, Defects E (Fig. 5) and F (Fig. 6) can be recognized as exits. With their inward bevels, Defects B and C may easily be perceived as entrances. The mostly inward bevel at Defect A suggests that it is also an entrance. This leaves Defect G (Fig. 7) as a keyholed exit with an angulation [*6*]. None of these defects has an elongation of the type noted by Frazer [*8*], so that the passage of two projectiles would not seem a likely prospect.

Defect D (Fig. 8) is an artifact of skull fragmentation and, as will be seen, was caused by the passage of a missile. Defect D cannot be an exit; no other defect provides an acceptable trajectory. Nor can D be an entrance; a weapon would have to have been placed medial to the left mandibular ascending ramus. This is possible, but inconvenient. Moreover, such a shot could be expected to fracture both the mandible and to produce an exit on the top of the skull. Neither of these defects is seen. Thus Defect D remains an artifact of the passage of a bullet between entrance and exit.

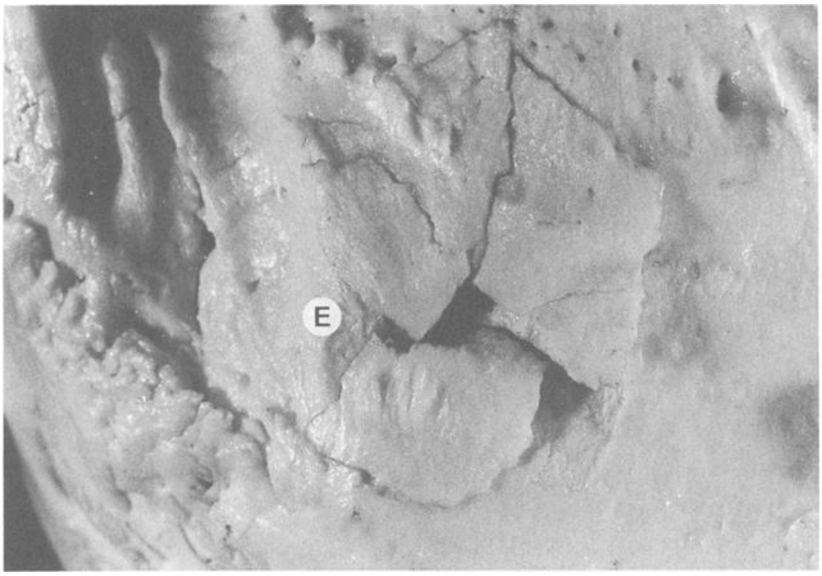

FIG. 5—*Close-up of incomplete exit E.*

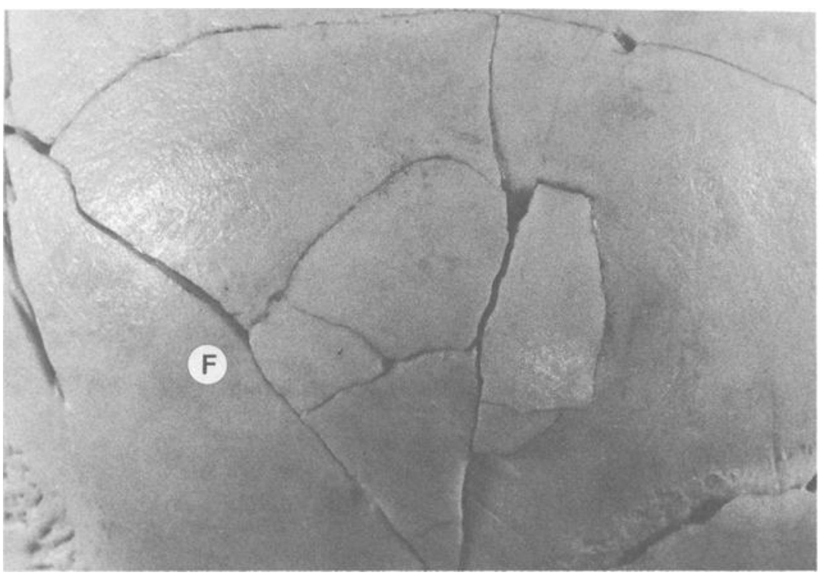

FIG. 6—*Close-up of incomplete exit F.*

Di Maio [*4*] cautions against using the size of the entrance to determine the caliber of the weapon in soft tissue. This caution also applies to bone, as pointed out by Fischer and Nickell [*9*]. Nevertheless, if Defects A, B, and C are indeed entrances, their minimum dimensions (between 14 and 19 mm) suggest a medium-to-large handgun. This is consistent with the absence of massive shattering characteristic of a high velocity weapon [*10*].

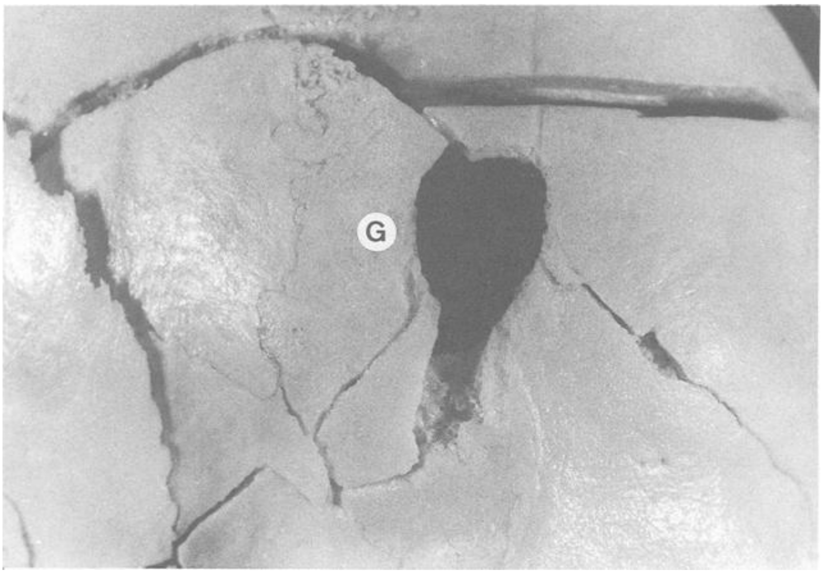

FIG. 7—*Close-up of exit G.*

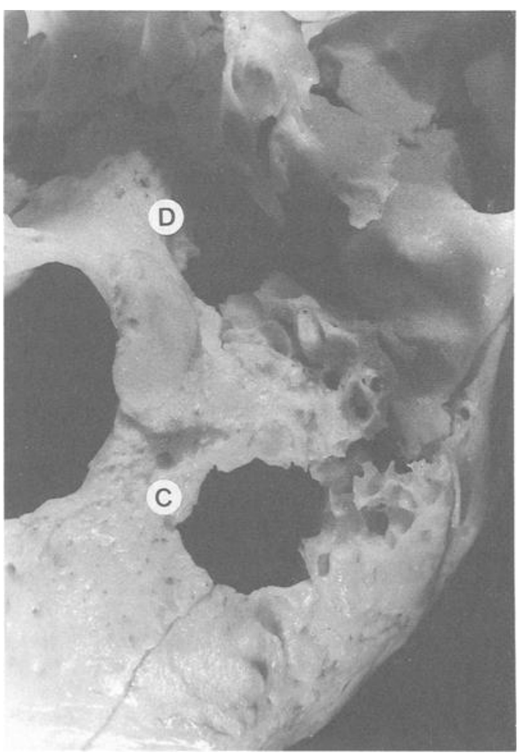

FIG. 8—*Close-up of entrance C and damage at D on the base of the skull.*

Resolution

Various scenarios may be proposed to account for the damage seen, but all call for additional projectiles, atypical wounds, or a suspension of the laws of physics. The trajectories from B through D to E and from C to F, disrupting the mastoid, would appear to be unequivocal. The directions of B to D and C to F are consistent with both the beveling and the incomplete nature of the exits. The A to G trajectory is somewhat ambiguous because of the presence of both internal and external beveling on both.

G resembles a "gutter wound" [*11*], the bullet striking tangentially, perforating the skull, and damaging both inner and outer table. To exit at A, the trajectory must describe an arc within the brain. This would be atypical behavior. Alternatively, if it did not exit, three projectiles should have been recovered from within the skull rather than two. Indeed, if G is an entrance and A is not its exit, then A must be a fourth entrance, meaning that no bullet exited the head. Or, if the projectile from A exited, it must have done so at precisely through "entrance" G without elongation [*8*].

The simplest explanation is that three projectiles were fired into the victim's head. Here the orientation of the beveling [*12*] is of help in suggesting trajectories, which are A through G, B to E, and C to F. Tracing the trajectory from B to E places the path of the projectile at D, resulting in that peculiar destruction. Similarly, the path from C to F accounts for the damage of the mastoid process.

Sequence of Wounds

A fracture runs from Defect A across to the midfrontal (Fig. 4), then dissipates some of its force in the coronal suture (Fig. 1) and most of the rest in a short fracture into the left squamosal suture. The fracture from Defect B (Fig. 1) follows the squamosal suture upward to meet the fracture from A, downward along the sphenotemporal suture, disrupting it, and posteriorly through the temporal and the base of the zygomatic arch into the area of destruction surrounding Defect C.

The entrance at C (Fig. 6) produces destruction of the anterior, medial, and inferior portions of the left mastoid process, from which a fracture moves across the petrosal part of the temporal to the end of the squamosal suture at asterion. It also sends out a fracture to the lambdoid suture just to the left of the midline of the skull.

The exit of a projectile at G (Fig. 4) creates a fracture to the frontal which meets the fracture from A and continues into the left orbit. Another fracture extends downwards into the right sphenotemporal area (Fig. 3), across the temporal and into the zygomatic process. A third fracture runs posteriorly, crosses the coronal suture, and terminates in the right squamosal suture.

From exit F, a complex of fractures runs into the right squamosal suture and the sagittal suture. A branch terminates in the fracture line from G. Since this fracture from F terminates in the fracture from G, G precedes F, which makes entrance A prior to entrance C.

Local fracturing extends from Defect E (Fig. 5), along with a lateral extension toward the right mastoid process, terminating in the fracture from F. Other fractures of the lower part of the right temporal and mastoid process are logically extensions of G.

Therefore, as seen in Fig. 9, A to G is the first shot, extensively fracturing the right side of the skull. More damage is likely to be seen at an exit than an entrance [*5*], consistent with the facts demonstrated by the photographs and the determination made here. Given the nature of the fracturing recounted above, we would suggest that C to F is the second bullet path and that B to E is the third. By the time the third shot is fired, the skull is so disrupted as to dissipate the forces without further major fracturing.

The production of a scenario that would suitably explain the observed defects is not without its risks. However, one possible reading of these defects would result if the victim

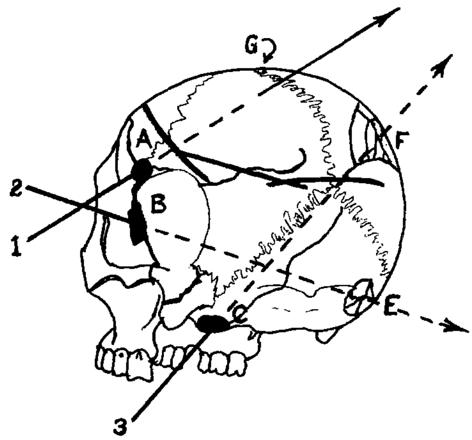

FIG. 9—*Sketch of the posterior of the skull showing entrances A, B, and C and exits E, F, and G.*

fell with his right side to the ground following the two thoracic wounds noted in the case report. The assailant then would have launched three projectiles into the left side of the victim's head. The first produced a through-and-through wound, while the second struck the right side of the skull, which was in contact with the ground. The third, owing to prior fragmentation of the skull and pressure of the nuchal musculature, like the second, produced an incomplete exit.

Conclusions

In this case, multiple gunshot wounds of the head resulted in seven major defects of the skull, along with a large number of associated fractures. Application of accepted techniques of defect interpretation led to the recognition of three trajectories: one through-and-through wound and two additional entrances and their associated incomplete exits. One major defect resulted from the trajectory of the missile fragmenting the skull incidental to the wounds of entrance and exit. Use of the principle of interruption of fracture lines allowed a sequence of wounds to be seen. This application of standard interpretive techniques on a prepared skull thus clarifies confusion surrounding the defects and their nature.

Acknowledgments

We gratefully acknowledge the cooperation of the New Mexico Office of the Medical Investigator in making autopsy data available and the Maxwell Museum of Anthropology for providing access to the specimen. We also thank Lawrence Budd for the excellent photographs, Dr. Kris Sperry for his thoughtful review and useful suggestions, and the reviewer for pertinent comments and additions.

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