

CASE REPORT

Douglas S. Dixon,¹ M.D.

Pattern of Intersecting Fractures and Direction of Fire

REFERENCE: Dixon, D. S., "Pattern of Intersecting Fractures and Direction of Fire," *Journal of Forensic Sciences*, JFSCA, Vol. 29, No. 2, April 1984, pp. 651-654.

ABSTRACT: In gunshot wounds of the skull, the pattern of intersecting fractures may be used to verify the direction of fire. It may be the only indicator of direction, if overlying skin is destroyed or inconclusive and if bevelling is absent in gunshot defects of thin temporal bone.

KEYWORDS: pathology and biology, wound ballistics, ballistics, direction of fire, intersecting fractures

The pattern of skull fractures associated with gunshot wounds of the head has been previously discussed [1-4] from several standpoints.

Gonzales et al [1] present a case with an atypical exit defect of the left parietal bone caused by a preexisting fracture line with widely separated edges located at the precise point of exit. The exit defect involved only one of the edges of the fracture line. The authors make the observation that the fracture traversed the skull more rapidly than did the projectile.

A case is presented by Spitz and Fisher [2] in which the fracture pattern is used to determine which of two entrances in close proximity came first—the sequence of fire.

Adelson [3] and Tedeschi et al [4] discuss and illustrate radiating linear fractures associated with entrance and exit defects of the skull. They do not address the questions of direction or sequence of fire.

This paper presents two cases, each with a pattern of intersecting fractures permitting a verification of the direction of fire.

Case Material

Case 1

A 31-year-old male with marital problems shot himself in the right temple with a .22-caliber rifle. A suicide note was found at the scene.

A typical gunshot entrance measuring 0.5 cm ($\frac{3}{16}$ in.) in diameter was present on the right temporal scalp; no powder stippling of the skin was noted. The projectile perforated the brain in a track extending from the right frontal lobe to the left parietal lobe. The bullet then exited the

Received for publication 22 June 1983; accepted for publication 25 Aug. 1983.

¹Acting chief medical examiner, Office of Chief Medical Examiner, Washington, DC.

left parietal bone through a defect with external bevelling, measuring 1.6 cm ($\frac{5}{8}$ in.) in diameter internally and 3.8 cm ($1\frac{1}{2}$ in.) in diameter externally. A markedly deformed .22-caliber lead bullet was recovered within the left parietal lobe of the brain; there was no exit wound of the scalp.

In addition, there were two radiating linear fractures associated with the exit defect of the left parietal bone (Fig. 1). One of these extended inferiorly on the left parietal bone for a length of 3.8 cm ($1\frac{1}{2}$ in.) and terminated abruptly at a preexisting linear fracture extending circumferentially around the skull from the entrance defect.

Case 2

A 49-year-old male who had made a withdrawal of money and was exiting from a bank was the victim of a robbery; he was shot once in the head with a .38-caliber handgun.

There was a typical entrance wound measuring 1.0 cm ($\frac{3}{8}$ in.) in diameter on the left temporal scalp; no smoke was present on surrounding skin. Punctate contusions consistent with powder stippling were present around the defect, distributed in an area measuring $\frac{3}{8}$ cm ($1\frac{1}{2}$ in.) in maximum diameter. An underlying defect with internal bevelling measuring 1.0 cm ($\frac{3}{8}$ in.) in diameter was present in the left temporal bone.

The gunshot wound track perforated the brain, extending from the left temporal lobe to the right occipital lobe. The projectile exited the right parietal bone far posteriorly in a defect with external bevelling measuring 1.5 cm ($\frac{9}{16}$ in.) in greatest diameter (Fig. 2). There was no exit wound of the scalp; a slightly deformed .38-caliber lead projectile was recovered beneath the right parietal scalp.

Radiating from the exit defect were three linear fractures, two of which extended anteriorly on the right parietal bone for a length of 3 ($1\frac{1}{4}$) and 4 cm ($1\frac{5}{8}$ in.). They terminated abruptly at a preexisting linear fracture across the vertex of the skull associated with the entrance defect.

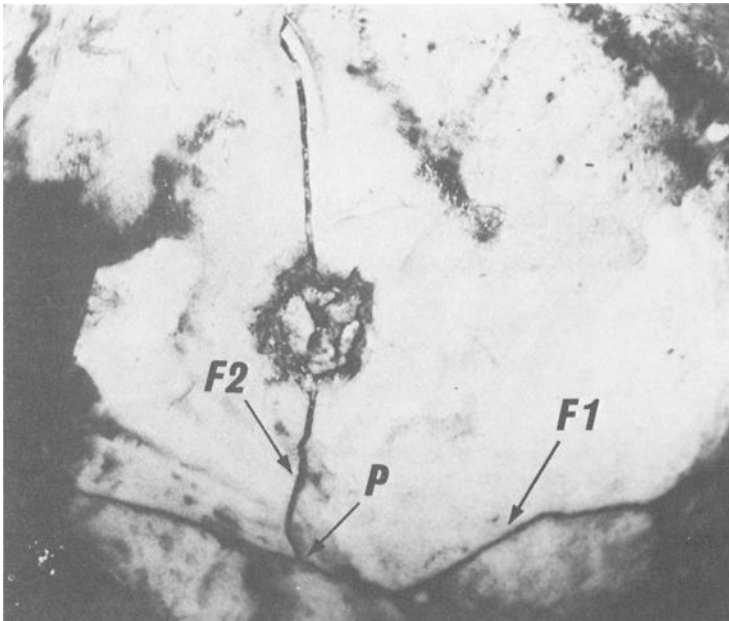


FIG. 1—Exit defect of left parietal bone with external bevelling. Note point of intersection (P) between the exit-related fracture (F2) and the preexisting entrance-related fracture (F1).

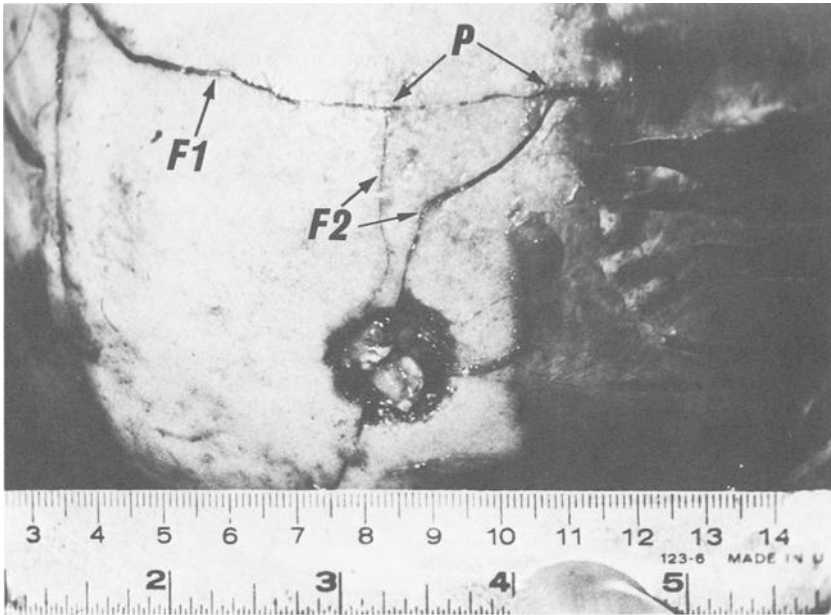


FIG. 2—Exit defect of right parietal bone with external beveling. Note points of intersection (P) between the exit-related fractures (F2) and the preexisting entrance-related fracture (F1).

Discussion

These two cases demonstrate linear fractures associated with typical exit defects of bone with external beveling. All of these fractures terminate abruptly at a preexisting linear fracture caused by the entering bullet. This observation supports the contention of Gonzales et al [7] that the linear fracture related to the entrance wound travels faster than the bullet which formed it. The observation can also be used to verify the interpretation of a particular bony defect as an exit based on the external beveling and the appearance of the overlying skin exit wound (if one is present).

By extension, the principle may be used to determine which bony defect is an exit in more complicated, atypical cases. In some instances, the overlying skin indicators may be absent or equivocal, such as might be true in a decomposed body or in one with confounding fire or animal or insect damage. The typical pattern of beveling may not be present, if both bony defects are located in thin temporal bone with a lack of substantial diploe. There may also be confusing atypical beveling as described by Coe [5]. If present, however, the characteristic pattern of intersecting fractures may be the only reliable indicator of direction of fire when an atypical case lacks the standard indicators of skin wound configuration or bony beveling.

Conclusions

The pattern of intersecting fractures in gunshot wounds of the skull may be used to verify the interpretation of direction of fire in typical cases based on skin wound configuration and beveling. In atypical cases, this pattern may be the only indicator of direction of fire.

Acknowledgments

The following individuals aided in the preparation of this manuscript: Dr. Leroy Riddick, Mobile, AL, for the photograph presented in Fig. 1 and Ms. Rita Shorter for manuscript preparation.

References

- [1] Gonzales, T. A., Vance, M., Helpern, M., and Umberger, C. J., *Legal Medicine: Pathology and Toxicology*, 2nd ed., Appleton-Century-Crofts, New York, 1954, figure 16-50, p. 424.
- [2] Spitz, W. U. and Fisher. R. S., *Medicolegal Investigation of Death*. 1st ed., Charles C Thomas, Springfield, IL, 1980, figure X-44, p. 221.
- [3] Adelson, L., *The Pathology of Homicide*, Charles C Thomas, Springfield, IL. 1974. pp. 285-287.
- [4] Tedeschi, C. G., Eckert, W. G., and Tedeschi, L. G., *Forensic Medicine: A Study in Trauma and Environmental Hazards*, Vol. 1 (Mechanical Trauma), W. B. Saunders, Philadelphia, 1977, p. 518.
- [5] Coe, J. I., "External Bevelling of Entrance Wounds by Handguns," *The American Journal of Forensic Medicine and Pathology*, Vol. 3, No. 3, Sept. 1982, pp. 215-219.

Address requests for reprints or additional information to
Douglas S. Dixon, M.D.
Acting Chief Medical Examiner
Office of the Chief Medical Examiner
District of Columbia
19th St. and Massachusetts Ave., S.E.
Washington, DC 20003