CASE REPORT

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Positive Identification By Post-Surgical Defects from Unilateral Lambdoid Synostectomy: A Case Report

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ABSTRACT: The comparison of pre- and postmortem radiographs as a method of identification of unknown human remains is well established in the forensic and radiologic literature. Identification can be based on a single bony feature when there is evidence of prior surgery, trauma or unusual anatomic variation. We present a case in which a positive identification was made using bony changes in the skull secondary to prior surgery for correction of unilateral lambdoid craniosynostosis. The unusual radiographic appearance of the bony defect initially raised the question of trauma and foul play.

KEYWORDS: forensic science, human identification, X-ray, radiographic identification

Comparison of pre- and postmortem radiographs is an accurate means of determination of the identity of unknown human remains and is well established as an investigative method in the forensic and radiographic literature [*1–14*]. The bony details of the individual skeleton have been likened to that of a fingerprint [*1*] and enable a positive identification to be made when there are multiple points of comparison present. The presence of a rare anatomic variant or evidence of prior surgery, metallic prostheses, or unique trauma makes the task of the forensic team much easier and permits a positive identification based on a single unique feature. We present a case in which bony changes in the calvaria related to prior surgery for correction of a rare anomaly, unilateral lambdoid craniosynostosis, allowed for positive identification to be made. The radiographic appearance simulated a stab wound of the calvaria raising the possibility of foul play although none had been previously suspected.

Case Report

In February 1987 a five year old white male, his father and another adult male were reported missing by a family member when they failed to return from a canoeing trip on the Potomac river. In May 1987 the decomposed remains of a male child washed ashore in the Potomac river. Post-mortem examination of the skeletonized remains disclosed the presence of the cranium, the mandible, the complete spine including the sacrum, the sternum, bilateral twelve ribs, the bones of the right forearm and hand, the right femur and both tibiae, fibulae, and the bones of the feet. The left femur, both humeri, the bones of the left forearm and hand and remaining bones of the pelvis were absent.

At autopsy the skull showed flattening of the left parieto-occipital region with two narrow rectangular bony defects with smooth edges in the left posterior parietal bone. The lateral defect measured $1^1/_4 \times {}^1/_4$ inches and the medial defect measured $1^3/_{16} \times {}^3/_{16}$ inches. The lateral defect had been sawed and showed smooth healed edges. The left lambdoid suture showed a defect measuring $1^5/_{16} \times {}^1/_8$–$^3/_8$ inches. Lateral to this was another defect measuring $1^1/_{16} \times {}^5/_{16}$ inches which was also within the suture line (Fig. 1). Both findings were considered compatible with healed surgical defects. Sutured on the inner table of the skull along the craniectomy site was a $1^1/_2 \times {}^1/_2$ inch transparent plastic strip with an acrylic-like white opaque material at the lateral edge (Fig. 2). There was also a $^3/_8$ inch in diameter surgical burr hole. There was no evidence of other perimortem trauma, fracture or injury other than the results of prolonged immersion.

Postmortem frontal and lateral radiographs of the skull and frontal radiographs of the remaining bones were taken. The skull radiographs revealed flattening of the parieto-occipital region with linear and rectangular lucencies in the left parietal bone as well as a burr hole in the left occipital region (Fig. 3). The appearance of the defect raised the suspicion by the radiologist of a penetrating stab wound. Further investigation of the incident did not corroborate this suspicion however.

The presumed identity was established based on a missing person report filed earlier in the year and medical records were obtained from the hospital where the deceased had undergone a left lambdoid synostectomy at the age of seven months for a congenital craniosynostosis. The operative report described a burr hole and rongeuring of the prematurely fused left lambdoid suture. A strip of silastic had been molded over the inferior craniectomy edge and sutured to the bone.

Premortem AP and lateral skull radiographs which had been taken six months post-operatively were procured. These revealed a burr hole and linear and rectangular lucencies in the left parieto-occipital region that were identical to the postportem finding

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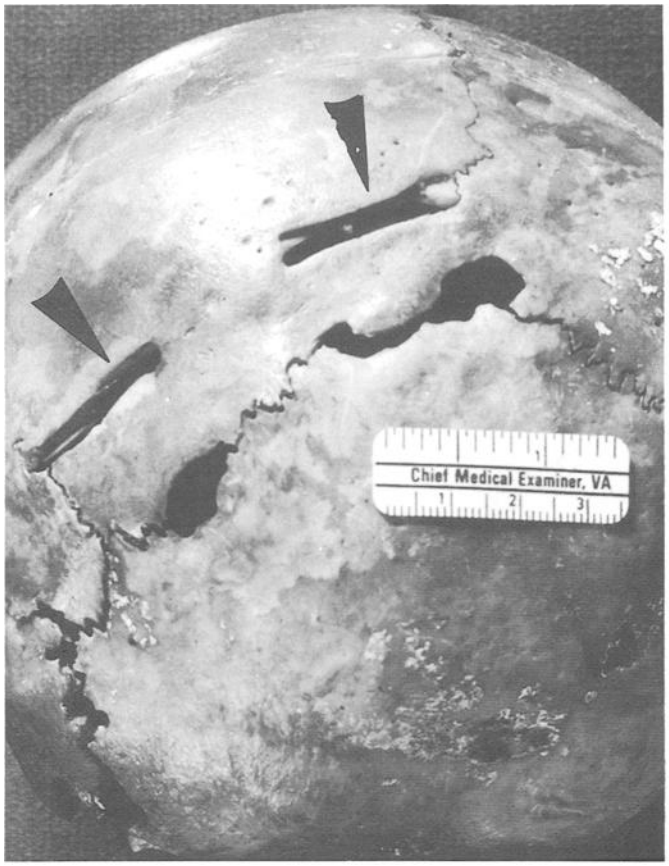

FIG. 1—*Postmortem view of the external calvaria demonstrates the surgical defects* (arrowheads).

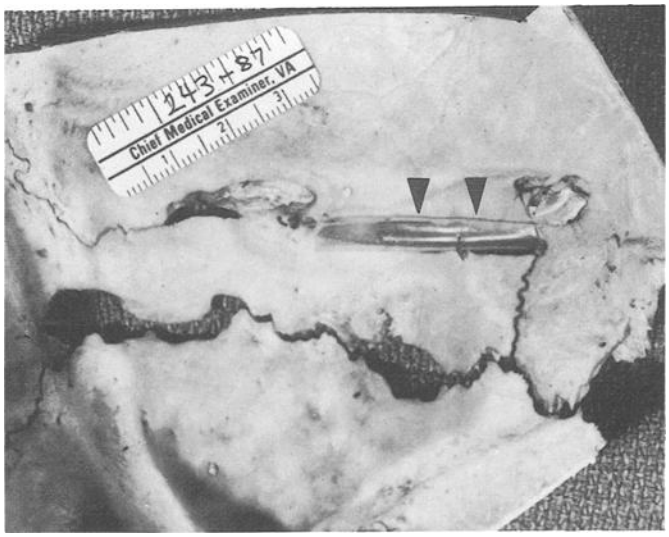

FIG. 2—*Postmortem view of the internal calvaria demonstrates the silastic tubing* (arrowheads) *used as part of the surgical repair.*

(Fig. 4). Positive identification was made, and the cause of death was determined to be probable drowning.

Discussion

Craniosynostosis is the premature fusion of one or more sutures of the skull. The etiology of craniosynostosis is unknown but has

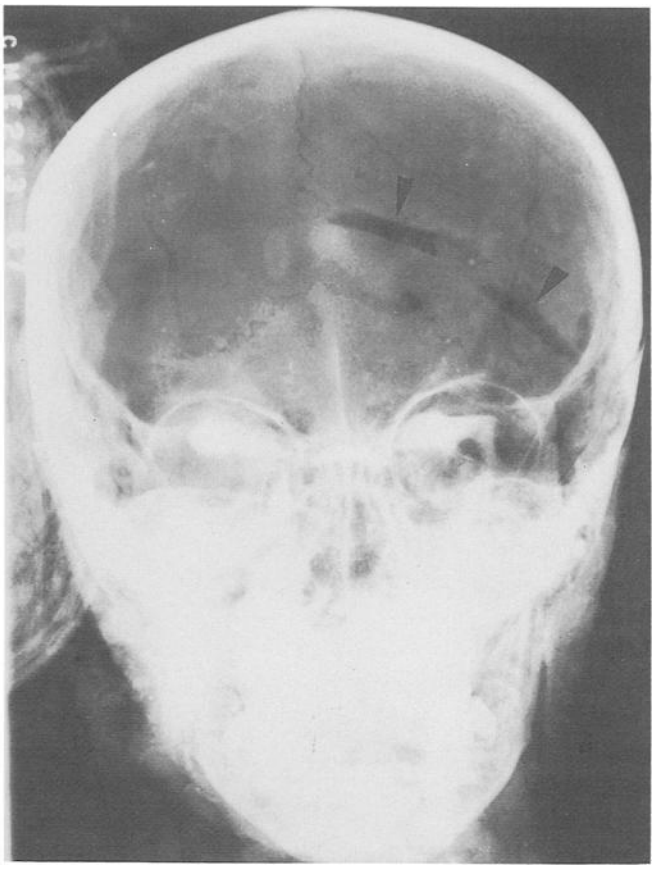

FIG. 3—*Postmortem frontal radiograph of the skull demonstrates the two surgical defects* (arrowheads) *superior to the left lambdoid suture.*

been categorized in terms of primary and secondary associations. Primary craniosynostosis occurs most commonly as a sporadic event, however, familiar modes of inheritance have been described including autosomal dominant, autosomal recessive and X-linked recessive patterns [*24*]. Primary craniosynostosis occurs as a feature of many recognized syndromes and chromosomal aberrations as well as a teratogenic effect [*1,16*]. Prenatal head constraint has also been suggested as an etiology. The secondary form of craniosynostosis is found in association with metabolic and hematologic disorders, head trauma and following neurosurgical shunting procedures for severe hydrocephalus [*1,15*].

The lambdoid suture is the least common of the major sutures to be affected in isolated craniosynostosis with an incidence of 0–4% in reviews of craniosynostosis for which surgery was performed [*1,21–23*]. Lambdoid suture synostosis, unilateral or bilateral, is diagnosed most commonly as a component of multisutural involvement. Isolated unilateral lambdoid suture synostosis is rare. Unilateral lambdoid synostosis causes plagiocephaly, an asymmetric flattening of the ipsilateral parieto-occipital calvaria and results in an abnormally small ipsilateral posterior fossa. When the deformity is severe, anteroinferior displacement of the ipsilateral pinna occurs, but, unlike synostosis involving any other of the major sutures, there is little to no effect on the bony structures of the face [*17–24*]. It has been speculated that the absence of facial deformity has resulted in underdetection and under-reporting of the true incidence of unilateral lambdoid synostosis [*19*].

Surgery is performed for cosmetic reasons and to prevent the

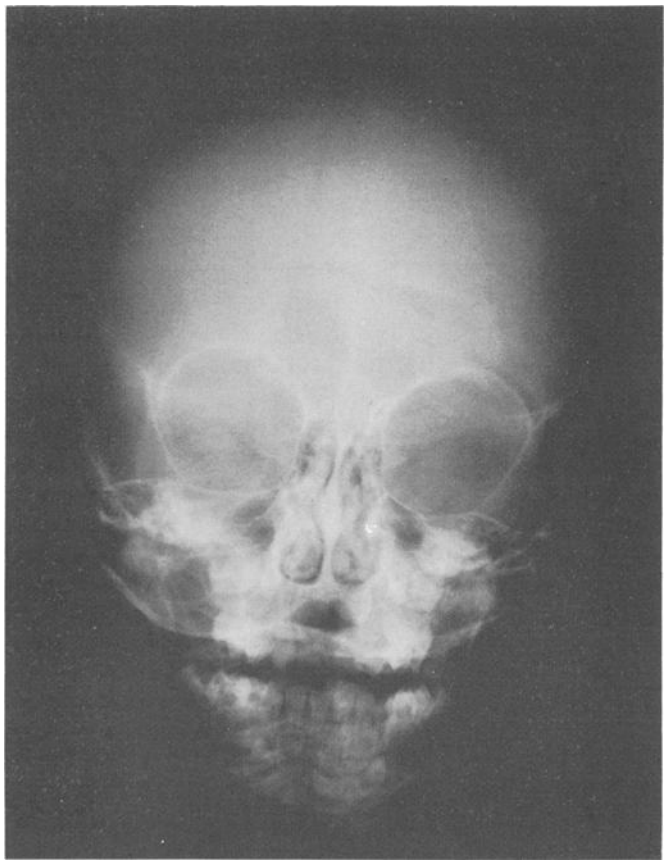

FIG. 4—*Premortem frontal radiograph of the skull demonstrates one of the surgical defects* (arrowheads). *The second defect is partially obscured by the left superior orbital rim.*

possibility of brain damage or hydrocephalus that may result from compression of underlying neural structures. Synostectomy is recommended in the first few months of life as this is the period of most rapid brain growth [*18,22,23*]. Several operative procedures for correction of unilateral lambdoid synostosis have been described in the neurosurgical literature and include the strip craniectomy that was performed in the present case. The procedure entails excision of the prematurely fused lambdoid suture as well as a short segment of the adjacent sagittal suture and the ipsilateral asterion, leaving the underlying dura mater intact [*17,21,22*]. Silastic material is sutured along the margin of the craniectomy to retard regeneration of bone and reduce the possibility of resynostosis [*22,23*]. This surgical method removes the least amount of bone of any of the described operative procedures but does not allow for complete resolution of the parieto-occipital flattening as was documented in the present case [*18*].

Positive identifications utilizing comparison of pre- and postmortem skull radiographs have been based upon the unique individual pattern of calvarial vascular grooves [*5,10*] and the paranasal sinuses—in particular, the frontal sinus [*4,7,8,11*] the mastoid air cells [*4,6*], the sella turcica [*4,8*], and the normal lambdoid suture [*4,6*]. However, many authors have stated that while normal anatomic variability is often sufficient for a positive identification to be established, skeletal changes from prior surgery or trauma or the presence of a rare congenital anomaly are most conclusive [*2,4,6,12,14,15,25*]. Salgado et al. reported a case of personal identification based upon the presence of healed stab wounds in the calvaria [*15*] and two authors have reported cases of identification based upon healed neurosurgical burr holes [*25*].

Conclusion

Bony changes secondary to neurosurgery for a rare congenital anomaly allowed for a conclusive personal identification in our case. The unique appearance of the post-mortem and radiographic findings should alert the forensic examiner to the possibility of previous surgery and that medical records and radiographs should be sought for identification. The unique changes should not be confused with stab wounds. Any unique post-surgical findings should also be entered as a physical descriptor in the Federal Bureau of Investigation-National Crime Information Center (FBI-NCIC) Unidentified Person File to hasten identification.

References

[*1*] Murphy, W. A., Spruill, F. G., and Gantner, G. E. "Radiologic Identification of Unknown Human Remains," *Journal of Forensic Sciences,* Vol. 25, No 4, October 1980, pp. 727–735.

[*2*] Murphy, W. A. and Gantner, G. E. "Radiologic Examination of Anatomic Parts and Skeletonized Remains from Radiograph Comparison," *Journal of Forensic Sciences,* Vol 27, No. 1, January 1982, pp. 9–18.

[*3*] Ubelaker, D. H. "Positive Identification of American Indian Skeletal Remains From Radiographic Comparison," *Journal of Forensic Sciences,* Vol. 35, No. 2, March 1990, pp. 466–472.

[*4*] Jablonski, N. G. and Shum, B. S. F. "Identification of Unknown Human Remains By Comparison of Antemortem and Postmortem Radiographs," *Forensic Science International,* Vol. 42, 1989, pp. 221–230.

[*5*] Messmer, J. M., and Fierro, M. F., "Personal Identification by Radiographic Comparison of Vascular Groove Patterns of the Calvarium," *The American Journal of Forensic Medicine and Pathology,* Vol. 7, No. 2, 1986, pp. 159–162.

[*6*] Rhine, S. and Sperry, K. "Radiographic Identification of Mastoid Sinus and Arterial Pattern," *Journal of Forensic Sciences,* Vol. 36, No. 1, January 1991, pp. 272–279.

[*7*] Marlin, D. C., Clark, M. A., and Standish, S. M. "Identification of Human Remains by Comparison of Frontal Sinus Radiographs: A Series of Four Cases," *Journal of Forensic Sciences,* Vol. 36, No. 6, November 1991, pp. 1765–1772.

[*8*] Ubelaker, D. H. "Positive Identification from the Radiographic Comparison of Frontal Sinus Patterns," *Human Identification,* T. Rathbun and J. Buikstra, eds., Springfield, IL, Charles C Thomas, pp. 399–411.

[*9*] Martel, W., Wicks, J. D., and Hendrix, R. C. "The Accuracy of Radiologic Identification of Humans Using Skeletal Landmarks: A Contribution to Forensic Pathology," *Radiology,* Vol. 124, September 1977, pp. 681–684.

[*10*] Sanders, I., Woesner, M. E., Ferguson, R. A., and Noguchi, T. T. "A New Application of Forensic Radiology: Identification of Deceased From a Single Clavicle," *AJR,* Vol. 115, July 1972, pp. 619–622.

[*11*] Atkins, L. and Potsaid, M. S. "Roentgenographic Identification of Human Remains," *JAMA,* Vol. 240, No. 21, 1978, pp. 2307–2308.

[*12*] Gee, D. J. "Radiology in Forensic Pathology," *Radiography,* Vol. XLI, No. 485, May 1975, pp. 109–114.

[*13*] Sinclair, J. T. "Radiography in Forensic Investigations," *Radiography,* Vol. XLVI, No. 544, April 1980, pp. 88–92.

[*14*] Simpson, K. "The Use of Radiography in the Investigation of Crime," *Radiography,* Vol. XLVI, No. 541, January 1980, pp. 14–16.

[*15*] Salgado, M. S. L., DeAlwis, L. B. L., and Perera, L. "Identification from Skeletal Remains," *Forensic Science International,* Vol. 42, 1989, pp. 221–230.

[*16*] Cohen, M. M., "Etiopathogenesis of Craniosynostosis" in *Neurosurgery Clinics of North America,* Vol. 2, No. 3, July 1991, pp. 507–513.

[*17*] Fernbach, S. K. and Feinstein, K. A., "Radiologic Evaluation of the Child with Craniosynostosis," in *Neurosurgery Clinics of North America,* Vol. 2, No. 3, July 1991, pp. 569–585.

[18] McComb, J. G. "Treatment of Functional Lambdoid Synostosis," in *Neurosurgery Clinics of North America,* Vol. 2, No. 3, July 1991, pp. 665–672.

[19] Fernbach, S. K. and Feinstein, K. A. "The Deformed Petrous Bone: A New Plain Film Sign of Premature Lambdoid Synostosis," *AJR,* Vol. 156, June 1991, pp. 1215–1217.

[20] Delashaw, J. B., Persing, J. A., and Jane, J. A. "Cranial Deformation in Craniosynostosis: A New Explanation," in *Neurosurgery Clinics of North America,* Vol. 2, No. 3, July 1991, pp. 611–619.

[21] Fernbach, S. K. "Radiological Evaluation of Craniosynostosis," in Cohen, M. M., Jr., ed., *Craniosynostosis: Diagnosis, Evaluation and Treatment,* Raven Press, NY, 1986, pp. 191–214.

[22] Anderson, F. M. and Geiger, L. "Craniosynostosis: A Survey of 204 Cases," *Journal of Neurosurgery,* Vol. 22, 1965, pp. 229–240.

[23] Shillito, J. and Matson, D. D. "Craniosynostosis: A Review of 519 Surgical Patients," *Pediatrics,* Vol. 41, No. 4, April 1968, pp. 829–853.

[24] Gellad, F. E., Haney, P. J. Sun, J. C. C., Robinson, W. L., Raok, C. V. G., and Johnson, G. S. "Imaging Modalities of Craniosynostosis with Surgical and Pathological Correlation," *Pediatric Radiology,* Vol. 15, 1985, pp. 285–290.

[25] Sauer, N. J. and Dunlap, S. S. "The Asymmetric Remodeling of Two Neurosurgical Burr Holes: A Case Study," *Journal of Forensic Sciences,* Vol. 30, No. 3, July 1985, pp. 953–957.

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