

POSTERIOR PARIETAL FRACTURES IN INFANCY AND EARLY CHILDHOOD

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In a search through the English language literature on skull fractures in infancy and early childhood, we have noted a paucity of comment on the pattern of such fractures. John Caffey (1967) in his monumental classic on *Pediatric X-ray Diagnosis* made only passing mention on this aspect.

Another author, Walpole Lewin (1966) in his book on *The Management of Head Injuries* made the following statement. "In infancy linear fissures follow no definite plan and appear as local splits in the bone of varying shape and length. As the child grows, the skull base develops and the fracture tends to be directed more towards the base as it is in the adult."

In the routine study of skull fracture in paediatric casualty cases, however, we have frequently observed the occurrence of a linear fracture at a specific site in the parietal bone of the cranium. This finding has been associated with certain interesting clinical features. A detailed study is made in 50 unselected cases.

POSTERIOR PARIETAL FRACTURE

The fracture was linear, occurring in the posterior portion of the parietal bone and originating in the lambdoid suture at a point approximately equidistant from the lambda and the asterion (Figs. 1 and 2). It extended forward, running roughly parallel with the sagittal suture. It might be as short as 2 cm. or might even split the whole parietal bone reaching the coronal suture. The fracture line was usually under 1 mm. in breadth but wide separation of the fracture was also observed.

The fracture might also extend into the related lambdoid suture and diastasis of a significant degree was seen in a quarter of cases (Fig. 3). Multiple fractures, either affecting the squamous portion of the occipital bone or the opposite parietal bone, were present in 30% of cases (Fig. 4).

The right parietal bone was fractured slightly more frequently than the left, while bilateral fractures were noted in 4 patients (Fig. 4).

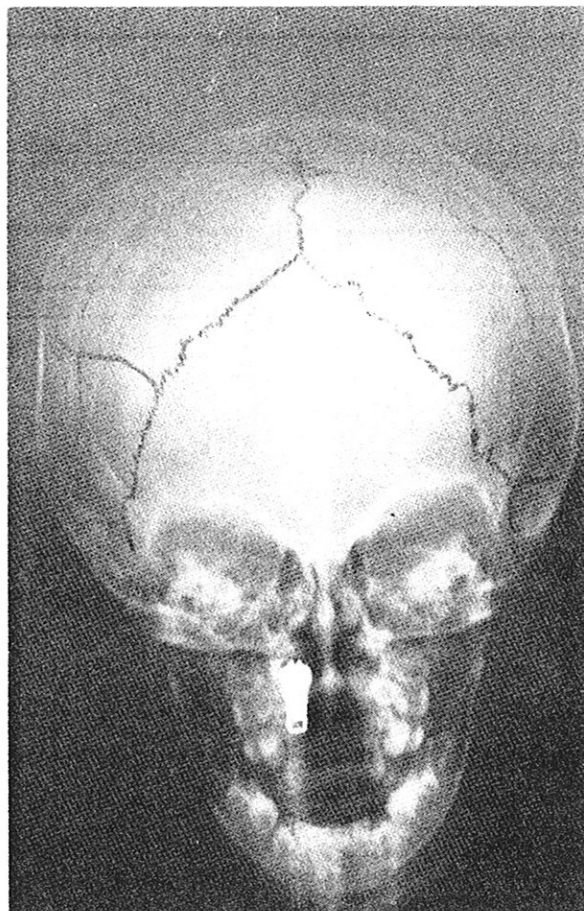


Fig. 1.

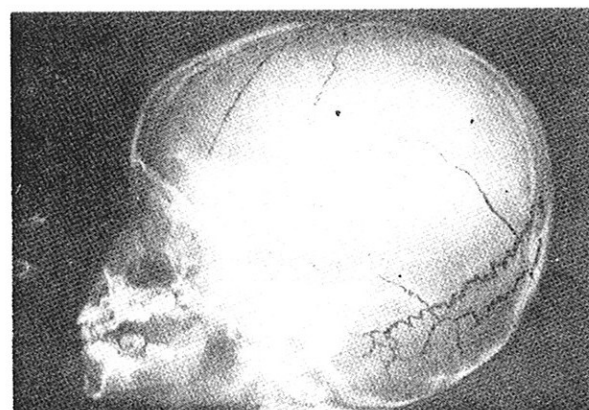


Fig. 2.

Figs. 1 and 2. Chinese girl of 1½ years. The anteroposterior and lateral skull views show a typical posterior parietal fracture. The fracture has extended into the parietal bone for a distance of 7 cm.

Of particular interest was the frequency of association of the posterior parietal fractures with Wormian bones and other developmental

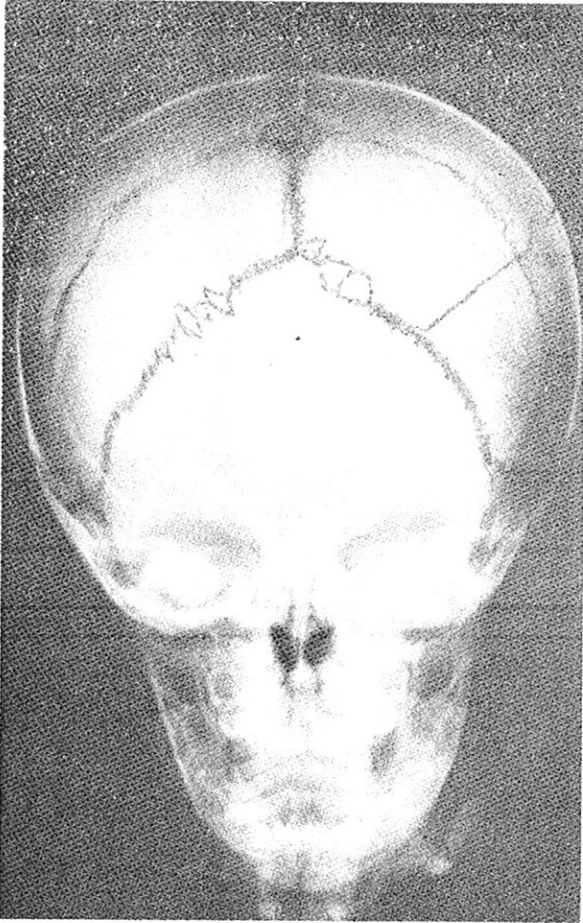


Fig. 3. Chinese boy of 1 year: A posterior parietal fracture is seen producing diastasis of the lambdoid suture on both sides to an extent of 2-3 mm. Note the association of multiple sutural or Wormian bones.

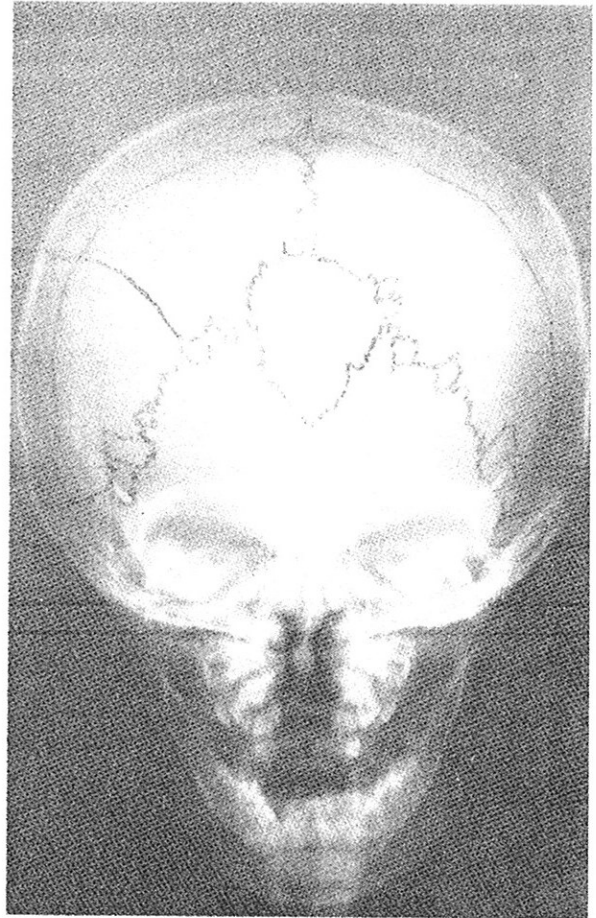


Fig. 5. Chinese boy of 6 months: A posterior parietal fracture is shown associated with a large interparietal or Inca bone and a cluster of Wormian bones.

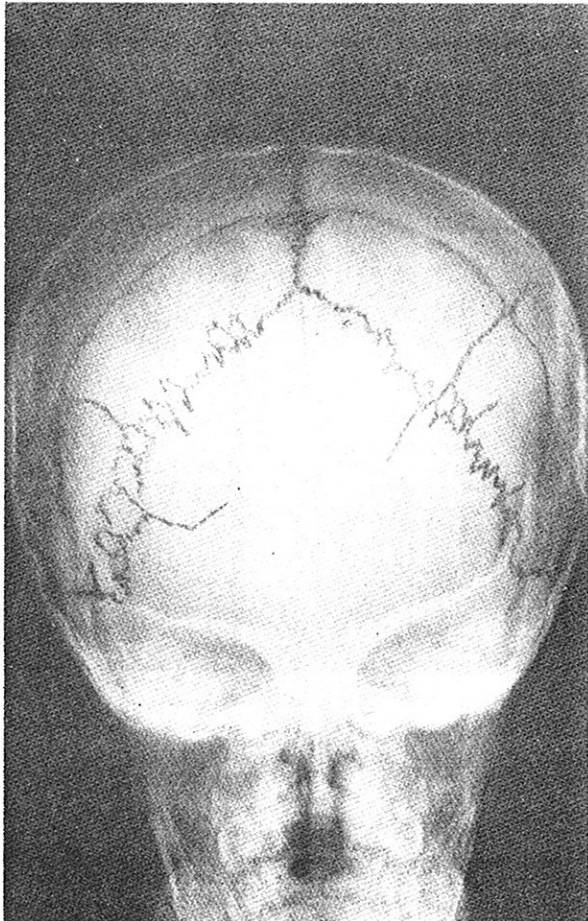


Fig. 4. Chinese boy 10 months old: Multiple splits are seen in the parieto-occipital area of the skull together with a posterior parietal fracture. A number of Wormian bones are present.

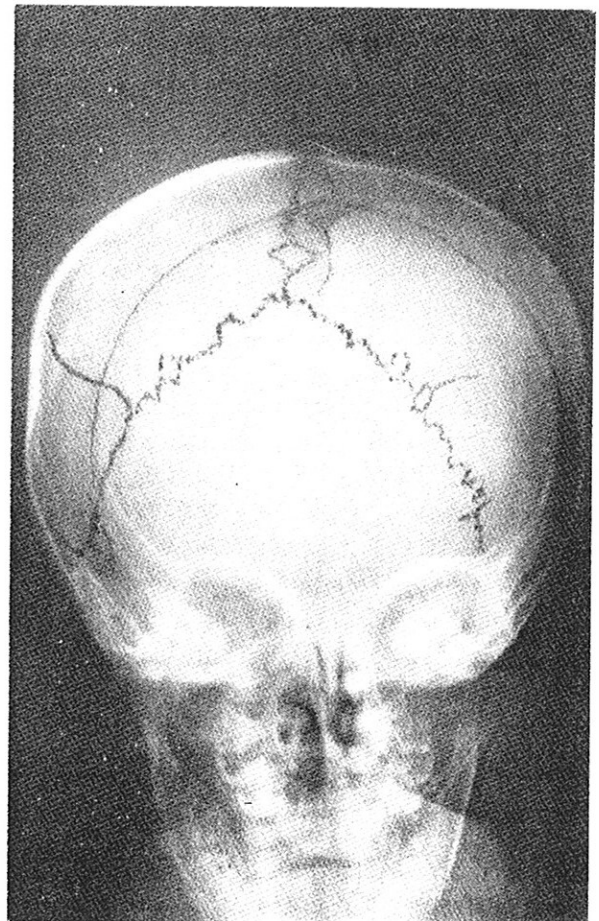


Fig. 6. Malay boy of 9 months: A typical fracture is seen in the posterior portion of the right parietal bone. An accessory posterior parietal suture is evident on the opposite side.

anomalies in the parieto-occipital area of the cranium. These Wormian bones, also called sutural bones, are small irregularly shaped islands of bone located in the lambdoid suture. They were found in 32 of the 50 children with posterior parietal fractures (Figs. 3, 4, 5 and 6).

In addition, 10 patients (which included 3 with Wormian bones) had a large persistent anomalous ossicle situated at the lambda. This bone is commonly referred to as the inter-parietal or Inca bone (Fig. 5) (De Beer, 1937; Dedick and Caffey, 1953; Shapiro and Janzen, 1960).

Eight children who sustained posterior parietal fractures showed what we have called the accessory posterior parietal suture (Fig. 6). This was noted in the opposite parietal bone which was usually intact. It is an unossified strip of membranous connective tissue extending from the lambdoid suture into the parietal bone and has been mentioned, though not named, by other workers (Shapiro and Janzen, 1960; Davis, 1961; Taveras and Wood, 1964; Chasler, 1967). 2 occurred as an isolated finding, another 2 were found in association with Inca bones and the rest with Wormian bones.

In summary, 41 out of 50 cases with fracture showed presence of developmental variants in the form of Wormian bones, Inca bone or accessory posterior parietal sutures, either separately or in combination. It is believed that these defects weaken the structural strength of the cranium and the significance will be further elaborated at a later stage.

CLINICAL PICTURE

The age of these paediatric patients was also noteworthy. Thirty-two were below the age of 1, the youngest being 3 months old. 15 fell into the 1-2 year age group. The remaining 3 were from 2-4 years old. Males outnumbered females 2 to 1. The significance of the ethnic distribution was not apparent in view of the small number of cases studied but is given in Table I.

The clinical picture also presented a number of interesting points. In most instances, a definite history of trauma was given. The babies usually suffered the injury as a result of a fall from the cot or while toddling or standing, or accidentally dropped while carried. In some, the injury was trivial or escaped notice but in a few, a history of trauma was firmly denied by the parents.

A scalp haematoma was present at the site of injury in all the victims, associated in 2 with a lacerated wound. The haematoma was usually

TABLE I
DISTRIBUTION OF THE 50 PATIENTS
IN ETHNIC GROUPS

Chinese	36
Malay	7
Indian-Pakistani	4
Eurasian	2
European	1

large, tending to increase in size and become fluctuant in the next few days. In a number of cases, it was the large haematoma which induced the parents of the child to seek medical advice, often after a lapse of some days, and in a particular case, as late as 2 weeks after the event.

Mild concussion, manifest as irritability, vomiting and drowsiness, was observed in 20% of the cases. There was no history of loss of consciousness in any of these children. A slight rise of temperature to about 100°F was also noted in some babies, presumably due to resolution of the scalp haematoma.

Most of the patients were admitted to hospital and closely watched and discharged in a couple of days. The clinical course was uneventful in all cases. No long-term follow-up was available but an X-ray examination was undertaken in a few children, 3 to 6 months after the incident. In these, the fracture line showed evidence of good healing though still faintly visible.

DISCUSSION

It is, of course, vital for the purpose of discussion to establish beyond a shadow of doubt that these lines of diminished density in the posterior area of the parietal bone are caused by fractures. The appearance of these sharply etched radiolucent lines are typical of linear fractures and the associated finding of a scalp haematoma at this site provides corroborative evidence of bone injury. An identical fracture is presented in Fig. 105 (page 67) of Caffey's (1967) *Pediatric X-ray Diagnosis* occurring "in an infant 15 months of age who fell from a high chair."

It is also important that these fractures are not confused with accessory sutures. One such suture occurs at the site of the fracture in question and we have named it the accessory posterior parietal suture. A study made of these has shown that they do not usually exceed 1 cm. in length.

It is our impression that they are common fractures in children below the age of 2. It is apparent that the back of the skull in this age group is subject to more insults than the front. A child falling forward avoids injury to his head with his outstretched arms, whereas with a backward fall, the head usually strikes the ground with quite a considerable force.

Gurdjian and Webster (1958) have studied in great detail the mechanism of fracture using the stresscoat and strain gauge technique. They have shown that linear fractures are produced by low-velocity blow which causes momentary inbending at the site of impact and outbending of the adjacent bone. A linear fracture begins in the outbended area and extends both toward and away from the point of impact.

These authors have shown that when a blow is delivered to the back of the head, splits occur either in the posterior portion of the parietal bone or in the squamous portion of the occipital bone.

It is our opinion that the presence of normal developmental variants in the form of accessory posterior parietal sutures, Wormian or Inca bones favours the formation of fractures in the posterior part of the parietal bone. This is statistically borne out as there is a significantly higher incidence of such anomalies associated with this type of skull injury. A control group of 100 normal infants between the ages of 6 months and 1 year and another study group of neonates (Henderson and Sherman, 1946) showing the relative frequency of the developmental variants are given in Table II.

TABLE II
INCIDENCE OF DEVELOPMENTAL ANOMALIES FOUND IN THE STUDY GROUP AND TWO CONTROL GROUPS

	Cases of posterior parietal fractures	Control group of 100 normal infants between 6 mth. and 1 year (Oon and Yu)	Control group of 100 normal neonates (Henderson and Sherman, 1946)
Wormian bones	64%	40	51
Interparietal bone	20%	9	15
Accessory posterior parietal suture	16%	5	1

Why are the posterior parietal fractures mainly confined to children below the age of 2 years? The answer can only be conjectural but it is probably related to two factors. A growing child becomes more steady on his feet and less likely to topple over. The other possible reason is that these developmental variants, referred to, show a propensity, with growth of the subject, to merge with the surrounding bone and disappear.

While radiological detection of skull fractures serves as a good medico-legal record and alerts the surgeon to the possibility of complications, the extent of injury to the underlying brain is the all-important governing factor in the management of head injuries. In the group of posterior parietal fractures, brain injury was found to be absent or minimal, even when extensive or multiple fractures were seen in the parieto-occipital area of the skull. This finding is in keeping with the general observation that simple skull fractures in infancy are associated with little or no brain damage. The latter has been ascribed to thinness and elasticity of the cranium which allow considerable deformity and absorption of energy from a blow (Guttman and Horder, 1943; Ingraham and Matson, 1954).

SUMMARY

Infants and young children seem peculiarly liable to fracture the posterior part of the parietal bone. 50 unselected cases are presented in this study. It would appear that this site of affliction as well as the clinical picture has not been adequately documented before.

The fracture is sustained as a result of a fall, usually of a minor nature, in most cases. Occasionally, the child is brought for medical advice, sometimes days or weeks later, because the parents are concerned about the scalp haematoma, often large, characteristically in the parieto-occipital area.

The fracture originates from the lambdoid suture approximately at its midpoint extending forward into the parietal bone. It measures, on an average, 4-6 cm. long though a few extend to the coronal suture.

A high percentage of these children shows the presence of Wormian bones, often multiple, while in others, there is an association of an interparietal ossicle or a short accessory suture in the opposite parietal bone. The occurrence of these developmental anomalies is believed to contribute to the inherent weakness of this part of the cranium.

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REFERENCES

1. Caffey, J. (1967): "Pediatric X-ray Diagnosis." 5th Ed., p. 11-14, p. 66-67. Chicago: Year Book Medical Publishers.
2. Chasler, C. N. (1967): "The Newborn Skull. The Diagnosis of Fracture." *Amer. J. Roentg.*, 100, 92-99.
3. Davis, L. A. (1961): "Pediatric Radiology." Pp. 15. 114. Baltimore: Williams & Wilkins Co.
4. De Beer, G. R. (1937): "The Development of the Vertebrate Skull." p. 367. Oxford: Clarendon Press.
5. Dedick, A. P. and Caffey, J. (1953): "Roentgen Findings in the Skull and Chest in 1030 Newborn Infants." *Radiology*, 61, 13-17.
6. Gurdjian, E. S. and Webster, J. E. (1958): "Head Injuries." p. 62-76. Boston and Toronto: Little, Brown & Co.
7. Guttman, E. and Horder, H. (1943): "Head Injuries in Children and their After-effects." *Arch. Dis. Child.*, 18, 139-145.
8. Henderson, S. G. and Sherman, L. S. (1946): "Roentgen Anatomy of Skull in Newborn Infant." *Radiology*, 46, 107-118.
9. Ingraham, F. D. and Matson, D. D. (1954): "Neurosurgery of Infancy and Childhood." p. 165. Springfield: Charles C. Thomas.
10. Lewin, W. (1966): "The Management of Head Injuries." p. 241. London: Bailliere, Tindall and Cassell.
11. Shapiro, R. and Janzen, A. H. (1960): "The Normal Skull." p. 20. New York: Paul B. Hoeber, Inc.
12. Taveras, J. M. and Wood, E. H. (1964): "Diagnostic Neuroradiology." p. 1. 759. Baltimore: Williams & Wilkins Co.