Facial Growth Associated with a Cranial Base Defect - A Case Report

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A review of over 100 Indian skulls from the Smithsonian Institution revealed a rather consistent pattern of normal craniofacial form. A small number of skulls were identified which exhibited skeletal pathology. This report will discuss one such skull which initiated questions on the role of the cranial base in facial development and possible resultant secondary compensatory changes.

The skull was most likely from a 40 year old male of the Sioux tribe of North Dakota. The mandible was not available for examination. Figure 1 illustrates an inferior view of the skull with defects identified in the basilar process of the occipital bone. The fissure and foramen defects identified in the cranial base extended through the basilar process into the cranial cavity. Radiographic evidence shows enlargement of the fissure on the intracranial surface.

Fig. 1 Inferior view of the skull with three defects: (a) foramen, (b) fissure, and (c) accessory retrocondylar facet.

This defect does not appear to be of acquired origin but rather of a congenital nature. The palatal defect seen in the illustration probably occurred postmortem.

How does such a defect influence the over-all growth of the craniofacial structures? This has been an open question for decades.[1-8]

To attempt to assess the magnitude of this defect on the over-all craniofacial morphology, three midlines were constructed as illustrated in Figure 2. It is noted that there is a distinct directional difference between the sagittal plane of the palate, the posterior cranial base anterior to the foramen magnum, and the occipital bone posterior to foramen magnum. The palatal and the occipital sagittal planes are nearly parallel and deviate from the posterior cranial base anterior to the foramen magnum by 10°. By utilizing morphological landmarks A and B as shown, A-B distance on the unaffected side exceeds A'-B' on the affected side by approximately 4 mm.

Figure 3 illustrates the asymmetry as seen from the frontal view. The heights of the left zygomatic process of the maxilla and left alveolar process are greater than their right counterparts. The nasal bones deviate to the right as does the general facial growth pattern. The right mastoid is relatively larger than the left. Additionally, there is an accessory retrocondylar articular facet noted on the left side (Fig. 1).

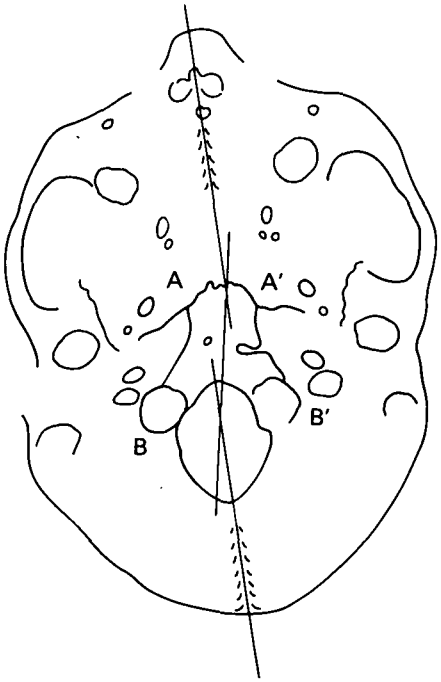

Fig. 2 Tracing of inferior view of skull. Midlines are constructed in the regions of the (1) palate, (2) cranial base anterior to the foramen magnum, and (3) occipital bone posterior to the foramen magnum. Points A and B represent skeletal landmarks on the right side of the skull and points A′ and B′ represent the counterpart landmarks on the left side. AB distance is greater.

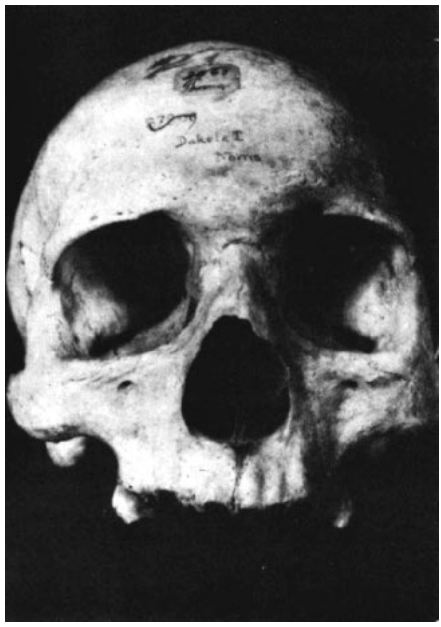

Fig. 3 Frontal view of the skull.

Discussion

The pattern of wear on the maxillary dentition suggests that oral function was essentially normal and symmetric. The defect within the posterior cranial base is located approximately 20 mm posterior to the spheno-occipital synchondrosis. While growth defects of the spheno-occipital synchondrosis are associated with severe craniofacial disfigurement, it would appear that the defect noted in the cranial base of this skull did not produce a severe deformity. Examination of the skeletal lesion suggests that it may be of vascular origin.

As noted in Figures 2 and 4a, the distance A-B exceeds A′-B′ by 4 mm. This view was compared with a similar illustration of a simple geometric model of a normal skull. The defective skull and the model cranium were divided into three sections anteroposteriorly (Figs. 4a and 4b). The posterior cranial base of the model was made asymmetric (4b-2) to correspond to the asymmetry in the defective skull, 4a-2. The alteration of 4b-2 caused the facial compartment of the model (4b-1) to rotate clockwise whereas the face of the skull (4a-1) is not rotated relative to the occipital bone (4a-3).

It is apparent that the simple model in Figure 4b with asymmetric growth in the posterior cranial base is not valid for this subject skull. For the anterior structures to maintain a nearly normal anteroposterior directional growth, additional growth control was required.

As for the pathogenesis of this skull deformity, it may be hypothesized that a restraining component, or force system, which may reside in the overlying soft tissues within the periosteal interface, has prevented the clockwise rota-

tion of the facial components. The above discussion constitutes one theory about the developmental circumstances of this skull. There are several other explanations, such as the role of atypical nerves or blood vessels and genetic control of developing tissues, which may be important to the formation of this asymmetric skull.

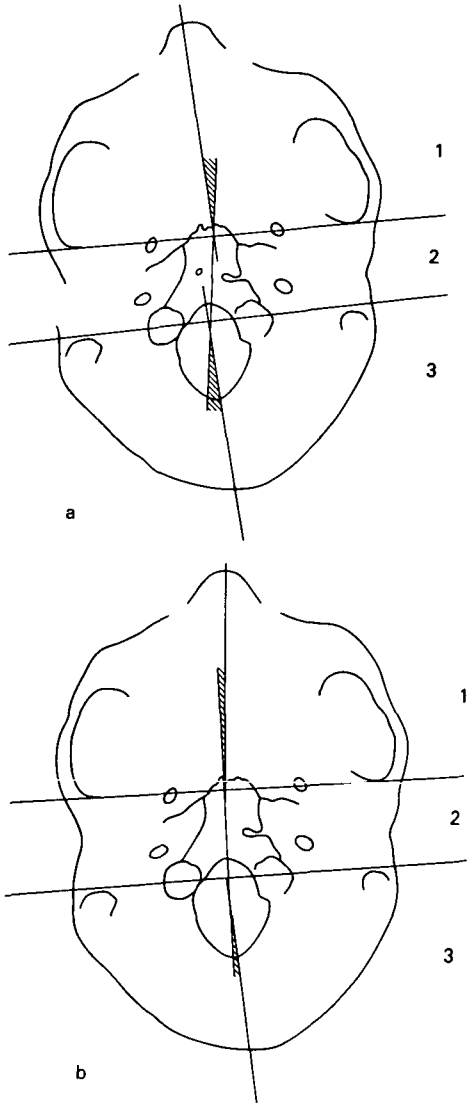

Fig. 4 a) Inferior view of the skull with asymmetric growth illustrated in compartment 2 with less anteroposterior growth on the left side of the skull. b) Inferior view of a model of a normal skull which was modified with an asymmetric alteration of compartment 2 to match the defect in the study skull (4a).

Summary

A skull was described possessing a posterior cranial base defect and resultant asymmetric growth of this structure. It was hypothesized that compensatory restraining influences of surrounding soft tissues prevented a more severe facial malformation from occurring.

Nat'l. Inst. Dental Research
Bethesda, Md. 20014

Acknowledgment

Special thanks is given to Dr. J. Lawrence Angel, Curator, Physical Anthropology, Smithsonian Institution, Washington, D.C., for his assistance in studying this skeletal material.

References

1. Björk, Arne: Sutural growth of the upper face studied by the implant method, *Acta Odont. Scand.* 24:119-27, 1966.
2. Dahl, Eric, Kreiborg, Sven, and Björk, Arne: A morphologic description of a dry skull with mandibulofacial dysostosis, *Scand. J. Dent. Res.*, 83:257-266, 1975.
3. Dullemeijer, P.: A comparative functional-anatomical study of the heads of some viperidae, *Gegenbaurs Morph. Jahrb.*, 99:881-985, 1958.
4. Hoyte, D.: Experimental investigations of skull morphology and growth, *Inter. Rev. Gen. Expl. Zool.* 2:345-407, 1966.
5. Moss, M. L.: Correlation of cranial base angulation with cephalic malformations and growth disharmonies of dental interest, *N.Y. State Dent. J.* 21:452-4, 1955.
6. Moss, M. L., and Greenberg, S. N.: Postnatal growth of the human skull base, *Angle Orthod.* 25:77-84, 1955.
7. Moss, M. L., and Young, R. W.: A functional approach to craniology, *Am. J. Phys. Anthrop.* 18:281-92, 1960.
8. Scott, J. H.: Craniofacial regions, *Dent. Pract. Dent.* Rec. 5:208-14, 1955.