AJNR

# Canalis basilaris medianus and related defects of the basiocciput.

G Currarino

*AJNR Am J Neuroradiol* 1988, 9 (1) 208-211
http://www.ajnr.org/content/9/1/208.citation

# Canalis Basilaris Medianus and Related Defects of the Basiocciput

Guido Currarino[1]

Anatomic variants and developmental defects of the basiocciput are uncommon. The best known include transverse segmentation, longitudinal segmentation, "key-hole defect," and canalis basilaris medianus (CBM). Transverse segmentation [1–3] may be complete or incomplete. In the complete form the basiocciput is divided by a transverse fissure into an anterior part, sometimes called os basioticum, and a posterior part. In the incomplete form there is a transverse cleft in the lateral aspect of the basiocciput on one or both sides. In a case of unilateral cleft of the basiocciput reported by Kruyff [2] there was an associated partial absence of the basiocciputal-exoccipital synchondrosis on the same side. In longitudinal segmentation [3], a longitudinal fissure divides the basiocciput in two lateral segments. The "key-hole" or delta-shaped ossification defect [4] consists of a deep cleft in the posterior margin of the basiocciput resembling a key-hole; the CBM [3, 5–16] is a channel through the basiocciput that may be complete or incomplete. This paper reports two presumed cases of the incomplete form of CBM defect with a review of the literature.

## Case Reports

*Case 1*

An 11-year-old girl with neurofibromatosis had been followed since the age of 1½ years for multiple problems related to this disorder, including delayed motor and mental development, seizures, scoliosis, a plexiform neuroma of the left side of the tongue, impaired vision, enlarged optic canals, and irregular swelling of the optic nerves associated with a small soft-tissue mass in the region of the chiasma demonstrated by CT. A follow-up scan of the orbits at the age of 11 included several cuts of the skull base that revealed a small, round defect in the center of the basiocciput (Fig 1). The defect could also be seen in skull films obtained in a submentovertical projection. A midline sagittal tomogram of the area showed that the defect was located on the pharyngeal surface of the basiocciput, that it was approximately 8 mm in length, and that it ended blindly superiorly.

*Case 2*

An 8-year-old boy with Apert syndrome had been followed since the age of 3 months for multiple problems and for surgical procedures related to this disorder, including release of the coronal suture and advancement of the frontoorbital complex first at age 2½ months and again at age 4 months. A follow-up CT scan of the head at age 8 years included several cuts of the basiocciput that revealed a small, round defect in the center of the basiocciput (Fig. 2). In a coronal reconstruction of the area the defect was found to be located on the pharyngeal surface of the basiocciput and to end blindly superiorly. It was not clearly demonstrated in a sagittal reconstruction and could not be identified in any of the available skull films. No submentovertical views or midline sagittal tomograms were obtained.

## Discussion

These two patients had a deep recess in the inferior surface of the basiocciput, a finding that is believed to be an anatomic variant related to the CBM and the cephalic end of the notochordal canal.

The CBM is an uncommon anatomic variant or mild anomaly of the basiocciput first described by Gruber in 1880 [8]. It consists of a well-defined channel, usually more than 2 mm in diameter, originating on the intracranial surface of the basiocciput, in the midline, and very close to the anterior rim of the foramen magnum. According to its course and termination, Gruber [8] distinguished three varieties of CBM: superior, inferior, and bifurcatus (Figs. 3A–3C). CBM superior extends forward in the substance of the basiocciput to exit a short distance more anteriorly on the same surface of this bone. CBM inferior courses forward and downward in the substance of the basiocciput to open on the inferior surface of this bone, in front of the pharyngeal tubercle at the level of the pharyngeal fossa. In CBM bifurcatus, a very rare defect, the tract extends in the basiocciput for a short distance and then bifurcates, with one branch opening on the superior surface and the other on the inferior surface of the basiocciput.

This classification has been widely accepted, but other variants have been added subsequently (Figs. 3D–3F). Perna [12], for instance, described an adult skull with a long, wavy tract extending through the substance of the basiocciput and part of the sphenoid and ending in the dorsum sellae without a second aperture. A long tortuous tract was also described by Oehmke [10]. Paravicini [11] and Perna [12] mentioned

Received December 11, 1985; accepted after revision February 24, 1986.

[1] Department of Radiology of the Children's Medical Center, 1935 Motor St., University of Texas Southwestern Medical School, Dallas, TX 75235. Address reprint requests to G. Currarino.

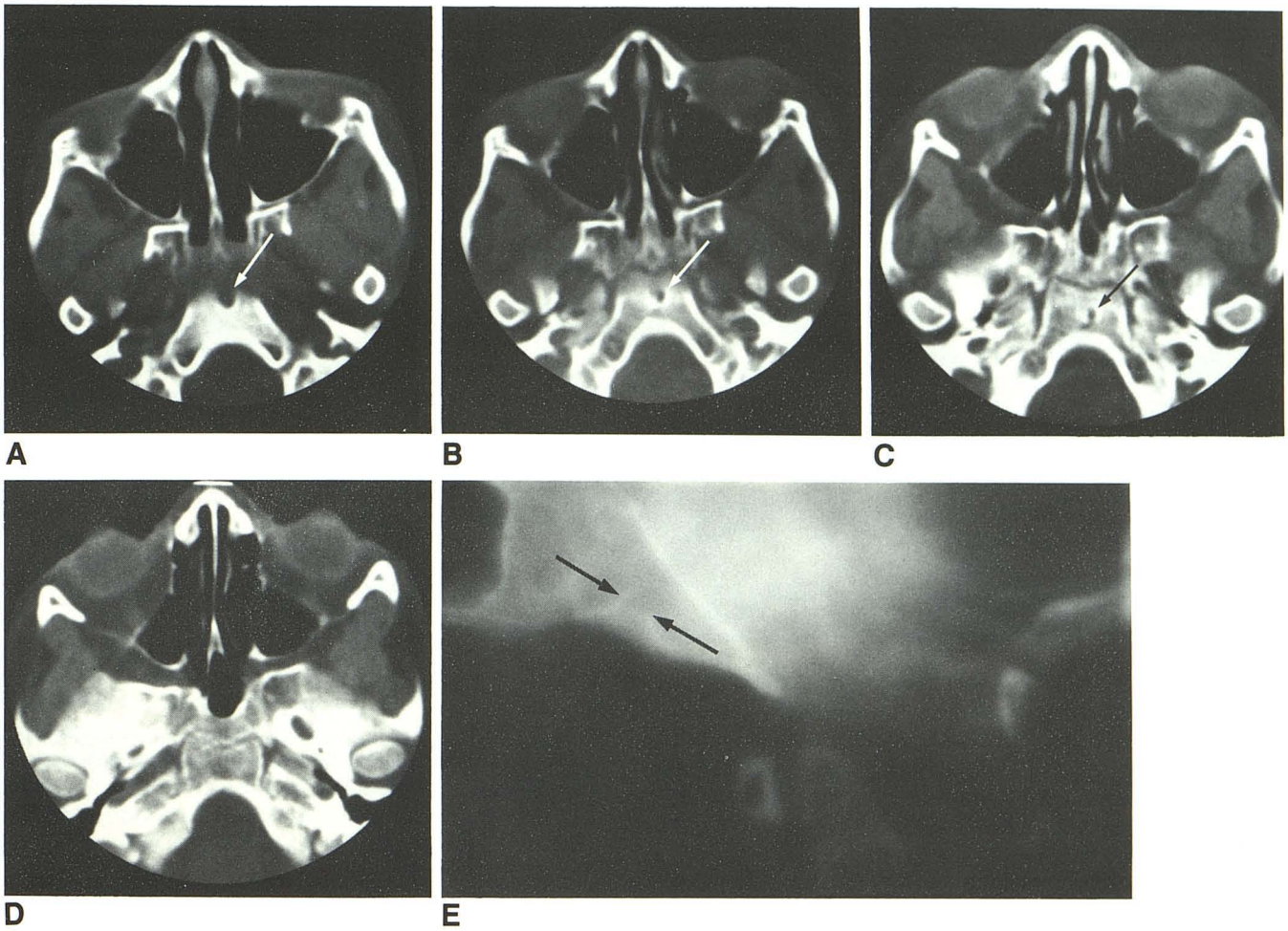


**Fig. 1.—Case 1.**
***A–D*, Consecutive CT sections of cranial base show round, radiolucent defect in basiocciput (*arrows*). Defect is not seen in most proximal section (*D*).**
***E*, Sagittal polytome tomogram of cranial base shows deep recess on pharyngeal surface of basiocciput (*arrows*). (Study obtained through the courtesy of Dr. Richard Suss, Dallas, TX).**

incomplete blind-ending canals or deep recesses on the superior and inferior surfaces of the basiocciput as additional variants of CBM.

The occurrence of CBM in several large series of skulls [3, 5, 6, 8, 10, 12, 15] has been estimated to be in the neighborhood of 2–3% in adults and 4–5% in children. Most observations in the literature regarding the CBM and its variants have been made on dry skulls, but a few instances have been diagnosed during life by conventional radiography [7, 9, 10, 13, 14] or by CT scans of the skull base [5].

Two general theories have been suggested concerning the embryology of the defect. According to one theory [3, 5, 8, 10, 15] all channels and foramina seen on the surface of the basiocciput are vascular in origin (emissary canals) and are similar to the venous foramina that are seen normally on the surface of the vertebral bodies. According to the other theory [9, 12, 13, 16], which appears more likely, most if not all large channels and deep pits described above represent vestiges of the cephalic end of the notochordal canal (canalis chordae). The course of this segment of the notochord in early fetal life is shown diagrammatically in Figure 4. According to Staderini [16], the CBM bifurcatus has a double origin, the superior branch is vascular in origin and the rest of the defect is related to the notochordal canal.

The CBM has never been considered to be of clinical importance, except perhaps for the case reported by Martinez et al. [17] and Hemphill et al. [18]. These authors described a 19-month-old boy with several previous episodes of meningitis who was found to have a complete canal, 5 mm in diameter, transversing the basiocciput (similar to a CBM inferior) into which protruded the subarachnoid space. The lesion was interpreted as a basioccipital meningocele and was thought to be responsible for the recurring meningitis. After removal of the sac and surgical obliteration of the bony defect, the child had no further bouts of meningitis during a 36-month follow-up.

The recess on the under surface of the basiocciput observed in the two patients reported in this paper is interpreted

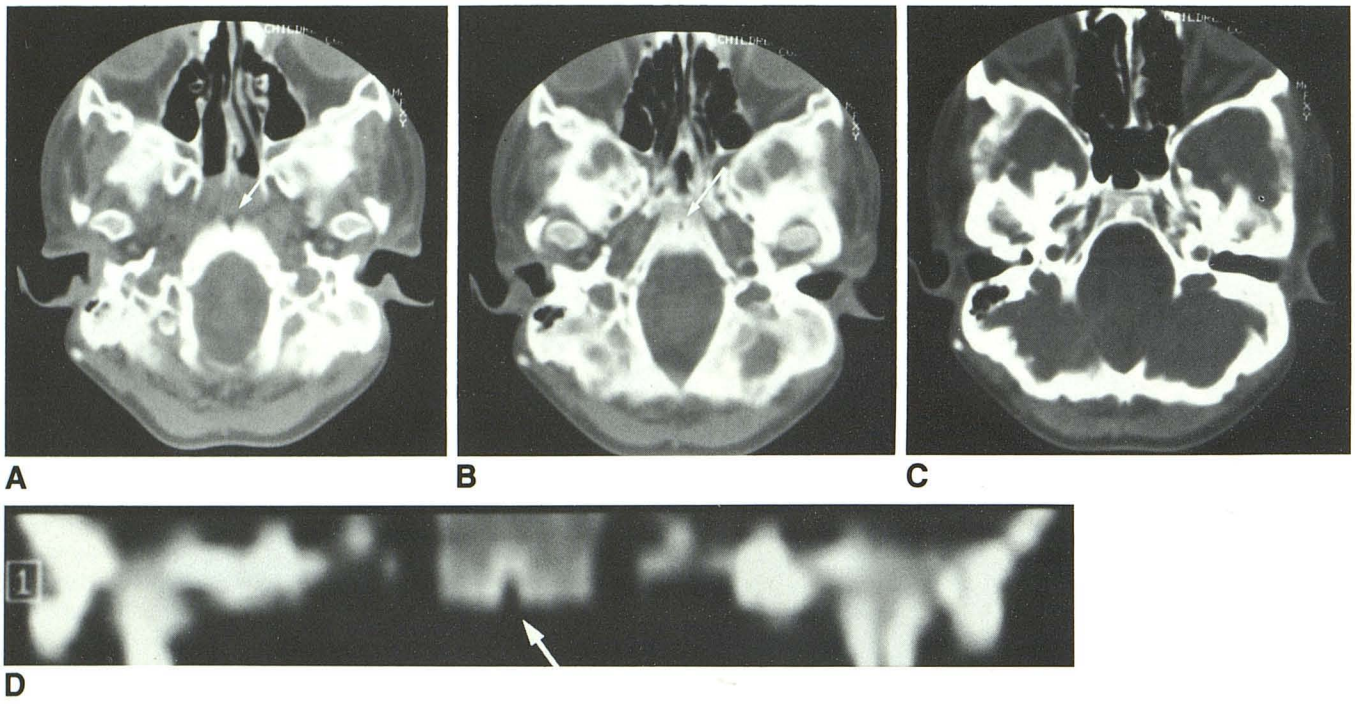


Fig. 2.—Case 2.
*A–C*, Consecutive CT sections of cranial base show round, radiolucent defect in basiocciput (*arrows*). Defect is not seen in most proximal section (*C*).
*D*, Coronal CT reconstruction of skull base at level of defect in basiocciput (*arrow*). Defect is located on pharyngeal surface of basiocciput and ends blindly superiorly as in preceding case.

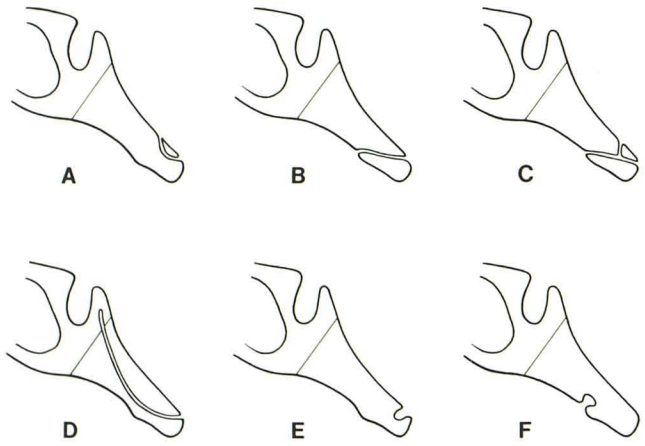


Fig. 3.—Diagram of various types of canalis basilaris medianus (CBM) and variants: complete and incomplete forms of CBM. Complete forms include CBM superior (*A*), CBM inferior (*B*), and CBM bifurcatus (*C*). Incomplete forms include a long channel in basiocciput and postbasisphenoid (*D*), a superior recess in basiocciput (*E*), and an inferior recess in basiocciput or large foveola pharyngica (*F*).

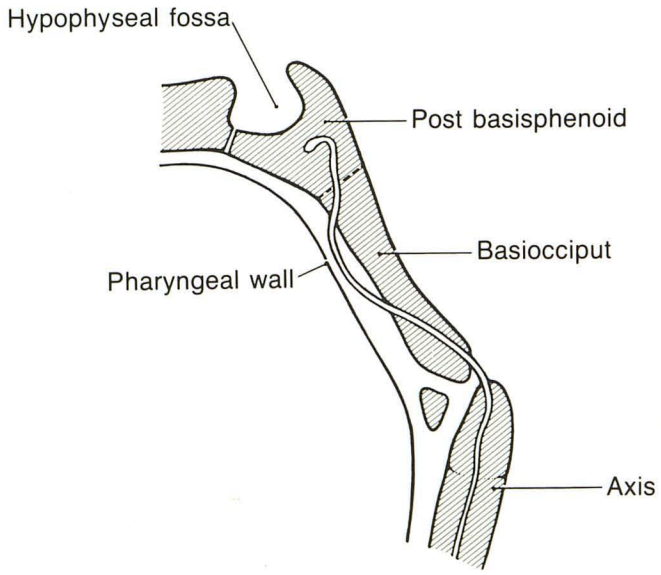


Fig. 4.—Midplane sagittal section of base of head in a human embryo of approximately 3 months shows position of notochordal remnants in proximal cervical spine, basiocciput, and sphenoid. Entire cephalic end of notochord may be imbedded in cartilage of basiocciput and postbasisphenoid; but, more often, as shown here, a segment of notochord at level of basiocciput extends forward and lies free in pharyngeal wall. The course of the notochordal canal in caudal part of basiocciput corresponds to that of canalis basilaris medianus. (Redrawn from various sources [12, 20, 21]).

as an incomplete form of CBM inferior, in which only the lower portion of the canal has remained patent. It may represent the site of exit of the notochord on the pharyngeal surface of the basiocciput. It may also be interpreted as an unusually deep pharyngeal fossa (foveola pharyngica), but this structure

is probably also related developmentally to the notochordal canal and the CBM. The pharyngeal fossa is a round or oval recess found occasionally in the bottom of an inconstant bony excavation, the fossa navicularis, located immediately in front of the pharyngeal tuberosity [19]. It corresponds in location to the site exit of the notochord at the base of the basiocciput in early fetal life, and according to some authors [12] it indeed represents the persistent cephalic end of the CBM (see Fig. 4 for normal course of the cephalic end of the notochord).

As opposed to complete canals, which may be of clinical significance as mentioned above, the incomplete canals or recesses in the basiocciput are undoubtedly benign anatomic variants. Complete canals and recesses are not seen in routine radiographs, in which the basiocciput is generally obscured by overlying bony structures, but they may be seen in a submentovertical view, or a Water's projection through the open mouth, or on sagittal tomograms of the cranial base. They can also be seen very clearly on CT scans of the skull base with thin contiguous sections. The differentiation between complete and incomplete canals may require sagittal polytome tomograms or a CT scan with multiple thin sections and reformatting.

In summary, two children are described in whom a deep recess in the inferior surface of the basiocciput was discovered as an incidental finding during a CT scan of the skull. The finding is interpreted as an incomplete form of canalis basilaris medianus and is possibly related to the cephalic end of the notochordal canal. It is considered to be an anatomic variant of no clinical significance and may be differentiated from a complete canal through the basiocciput only by sagittal polytome tomography or by a CT scan of the area with reformatted images.

## REFERENCES


1. Johnson GC, Israel H. Basioccipital clefts. *Radiology* **1979**;133:101–103
2. Kruyff E. Transverse cleft in the basi-occiput. *Acta Radiol* **1967**;6:41–48
3. Le Double A-F. *Traité des variations des os du crâne chez l'homme et de leur signification au point vue de l'anthropologie zoologique.* Paris: Vigot Frères Éditeurs, **1903**
4. Di Chiro G, Anderson WB. The clivus. *Clin Radiol* **1965**;16:211–223
5. Fiegler W. Der Canalis basilaris medianus im Röntgenbild und Compter-tomogramm. *Fortschr Röntgenstr* **1980**;133:416–419
6. Fusari R. Delle principali varietà presentate dalle ossa del tronco e della testa esistenti nel Museo Anatomico della R. Univ di Messina. *Sicilia Medica* **1899**; anno 1, fasc 4
7. Goettsch HB. Canalis Chordalis Persistens. *J Belge Radiol* **1964**;47:772–773
8. Gruber W. Ueber den anomalen Canalis basilaris medianus des Os occipitale beim Menschen. *Mém Acad Imp Sci St-Petersburg* **1880**; sér VII, tome 27, no. 9
9. Neiss A. Nachweis des Canalis Chordae (Canalis basilaris medianus) im Röntgenbild. *Fortschr Röntgenstr* **1956**;84:206–208
10. Oehmke HG. Die Bedeutung des Canalis basilaris und seine Darstellung im Röntgenbild. *Morphol Jb* **1963**;104:458–476
11. Paravicini G. Fori e canali del basioccipitale nei 296 crani del Manicomio di Milano in Mombello. *Rend Istit Lombardo Sci Lett* **1903**; ser 2, vol. 36, fasc 9
12. Perna G. Sul canale basilare mediano e sul significato della fossetta faringea dell'osso occipitale. *Anat Anz* **1906**;28:379–392
13. Ravelli A, Rückensteiner E. Der persistierende Chordakanal in der Schädelbasis (Canalis basilaris medianus). *Radiol Austriaca* **1956**;9:59–65
14. Reinhardt K. Eine runde Aufhellung in der Pars basilaris ossis occipitalis, verursacht durch die Foveola pharyngica. *Röntgenblatter* **1972**;25:181–182
15. Romiti G. Canale basilare mediano dell'osso occipitale. *Verb Soc Tosc Sci Nat Pisa* **1881**; 219
16. Staderini R. Il canale basilare mediano e il suo significato morfologico. *Monit Zool Ital* **1900**;11:4–131
17. Martinez CR, Hemphill JM, Hodges FJ III, et al. Basioccipital meningocele. *AJNR* **1981**;2:100–102
18. Hemphill M. Freeman JM, Martinez CR, Nager GT, Long DM, Crumrine P. A new, treatable source of recurrent meningitis: basioccipital meningocele. *Pediatrics* **1982**;70:941–943
19. Testut L, Latarjet A. *Traité d'anatomie humaine.* Paris: G Doin & Cie, **1948**: tome 1, 151–161
20. Goss CM, ed. *Gray's anatomy of the human body*, 29th Am ed. Philadelphia: Lea & Febiger, **1973**:98
21. Huber GC. On the relation of the corda dorsalis to the anlage of the pharyngeal bursa or median pharyngeal recess. *Anat Rec* **1912**;6: 373–404