Intracranial arachnoid cyst on dental radiography: a diagnostic challenge

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Intracranial arachnoid cysts (IACs) can present as congenital asymptomatic lesions that may predispose them to present as an incidental finding during radiographic examination. On the other hand, IACs may also give rise to a series of neurologic symptoms depending on their size and location, such as vomiting, seizures, headache, and ataxia. Skull deformities, including macrocephaly, may occur and become remarkable on dental radiology. We report 2 patients who were identified with IAC before orthodontic treatment. The dental radiologic appearance of IAC is discussed and may constitute a diagnostic challenge to both the dentist and radiologist. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:e53-e59)

Intracranial arachnoid cysts (IACs) are nontumorous accumulation of cerebrospinal fluid (CSF) in the subarachnoid space that account for 1% of all intracranial space-occupying lesions.[1] IACs are regarded as a developmental anomaly deriving from a splitting or duplication deformity of the arachnoid membrane.[2,3] With progressive growth of the cyst, the skull can be prominently compressed and macrocephaly may result.[2] The symptoms of IACs are highly dependent on the location and size. They may frequently be asymptomatic throughout life or cause neurologic symptoms, such as headache and seizures.[1,4]

The middle cranial fossa is most frequently involved by IAC, and the sphenoid bone can be deformed.[1,4] The skull base morphology should be regularly scrutinized on dental radiographs for the risk of occult intracranial lesions.

We report 2 asymptomatic patients who were incidentally discovered with IAC during radiologic examination before orthodontic treatment. The manifestations of IAC on dental radiographs are analyzed.

CASE REPORTS

Case 1

A 24-year-old woman was referred to our hospital for routine examination before orthodontic treatment. No history of headache, seizure, vomiting, ataxia, or other major discomfort was reported by the patient. Physical examination also failed to find any remarkable head and facial deformity. No eye movement or visual disorder was found.

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Lateral and posteroanterior (PA) cephalometric and panoramic radiographs were taken. The projections of bilateral middle skull bases were asymmetric (Figure 1). The right middle skull base presented as a single-layered cortex and was remarkably expanded. Thorough observation of the lateral cephalometric radiograph (Figure 2) revealed an unusual opaque curved cortex line extending from the middle skull base to the orbit apex, being superimposed over the posterior-superior aspect of the maxillary sinus and the posterior aspect of the orbit. The PA cephalometric radiograph (Figure 3) revealed an extraordinarily widened superior orbital fissure on the right side, whereas the left counterpart was of normal size.

Potential intracranial mass was suspected on these images and subsequent head computerized tomography (CT) was performed, which revealed a 3.0 × 3.0 × 3.0 cm expansive cystic lesion in the right middle cranial fossa with compressive displacement of the adjacent temporal lobe (Figure 4). The expanded superior orbital fissure could be confirmed on the 3-dimensional CT images (Figure 5). The infratemporal and temporal sides of the greater wing of the sphenoid bone were thinned and expanded (Figure 6). The pterygopalatine fossa was not significantly involved and retained acceptable normal morphology.

Ray-sum projection technique was used on a GE CT Advantage Workstation (4.3) for further observation. The deformed skull base identified on multi-reformatted images could be synchronously observed on the simulated x-ray images, which helped to confirm the observations on the 2-dimensional panoramic and cephalometric images (Figures 6 and 7). A radiologic diagnosis of IAC was established and the patient was referred to the neurosurgery department. A regular radiologic follow-up and timely visit to a neurosurgeon was demanded for management.

Case 2

A 15-year-old girl was referred to our hospital for routine examination because of retrognathia. The patients reported no discomfort, such as headache, seizure, vomiting, or ataxia. Physical examination also failed to find any remarkable head and facial deformity. No neurologic signs were elicited during physical examination.

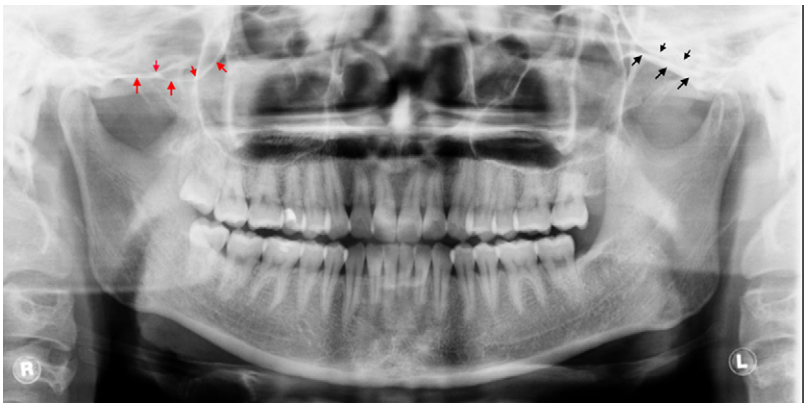

Fig. 1. Panoramic radiograph shows the expanded and thinned skull base of the middle cranial fossa on the right side (*red arrows*). Note the normal skull base of the middle cranial fossa on the left side (*black arrows*) presenting as double-layered cortex bone with the intervening diploë.

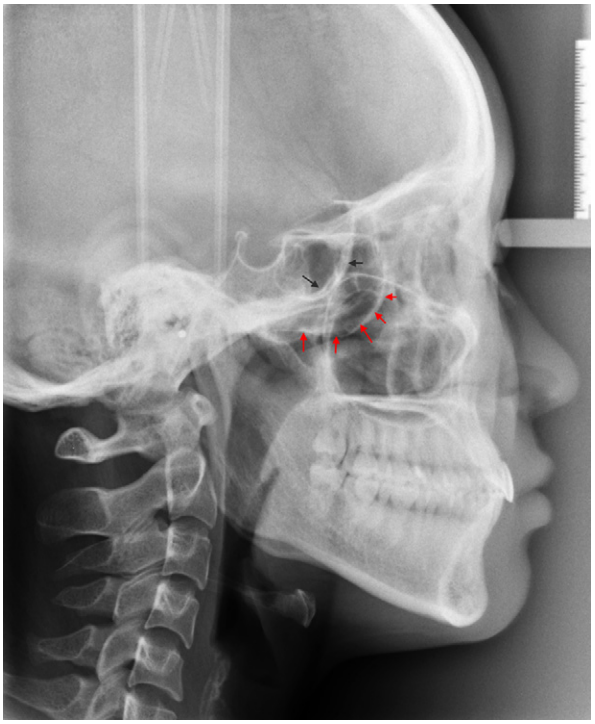

Fig. 2. Lateral cephalometric radiograph shows the remarkable asymmetry of bilateral skull bases of the middle cranial fossa. The skull base of the right middle cranial fossa appears as an accessory curved opaque line (*red arrows*). Note the normal projection from the left counterpart with the double cortex lines (*black arrows*) and the diploë.

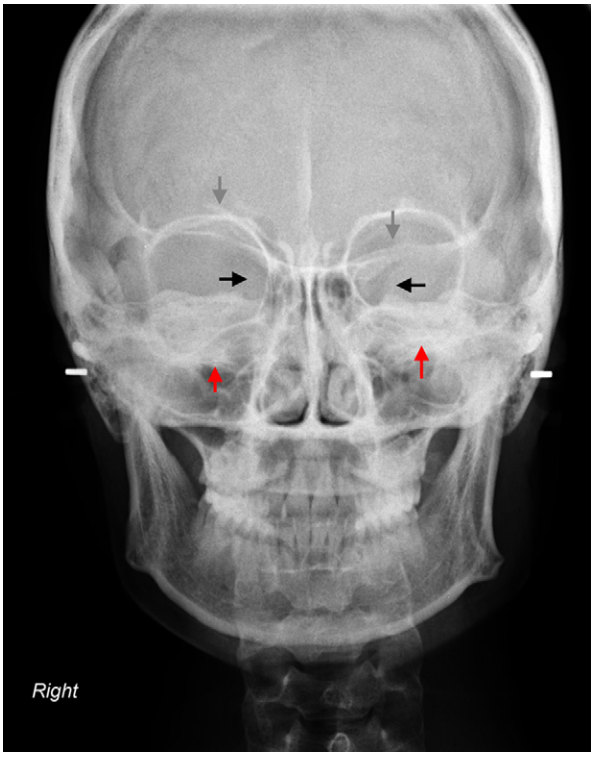

Fig. 3. Posteroanterior cephalometric radiography shows the lesser wing of the sphenoid (*gray arrows*), superior orbital fissure (*black arrows*), and skull base of middle cranial fossa. The lesser wing is elevated and the superior orbital fissure widened. The middle cranial base was expanded inferiorly on the right side (*red arrows*).

On panoramic radiography, the skull base of the right middle cranial fossa was expanded and thinned. Double-layered cortex of the skull base disappeared on the right side (Figure 8). Also remarkable was the erosion of bilateral mandibular condyles, which was diagnosed as temporomandibular joint osteoarthrosis. On the lateral cephalometric radiograph (Figure 9), bilateral skull base was remarkably asymmetric. An uncommon opaque curved line was observed, which located anterior and inferior to the normal middle cranial base. A cone-beam CT scan of bilateral cranial base confirmed the expanded changes of the right middle cranial fossa (Figure 10). Further magnetic resonance imaging (MRI; Figure 11) was performed, which revealed a well defined homogeneous mass with

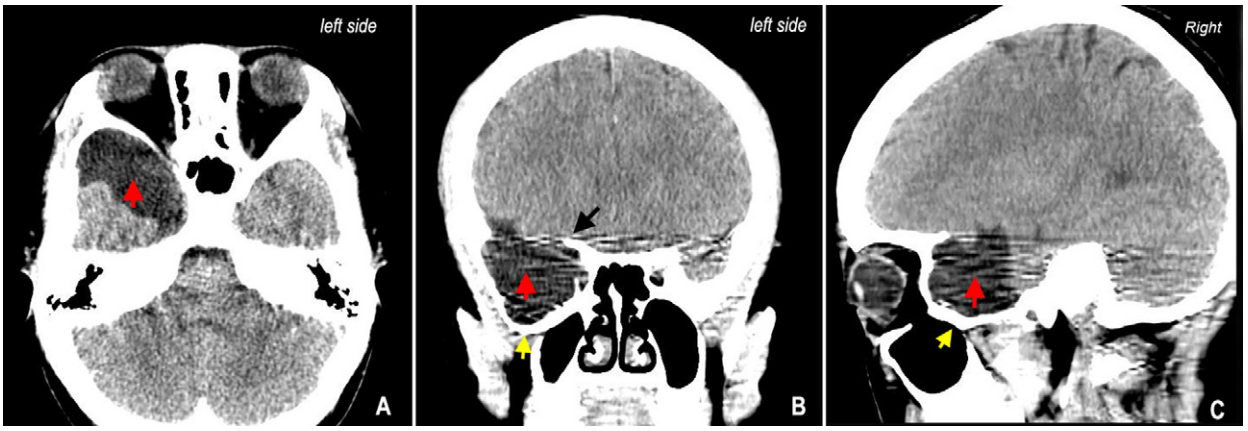

Fig. 4. Axial **(A)**, coronal **(B)**, and sagittal **(C)** CT images (2.5 mm thickness, cerebral tissue algorithm, window level 50 HU, window width 200 HU) show that an expansile and well circumscribed cyst with liquid attenuation is observed in the right middle cranial fossa (*red arrows*). The right temporal lobe is compressed. Also note the expanded middle cranial fossa (*yellow arrows* in B and C) and displaced sphenoid lesser wing (*black arrow* in B).

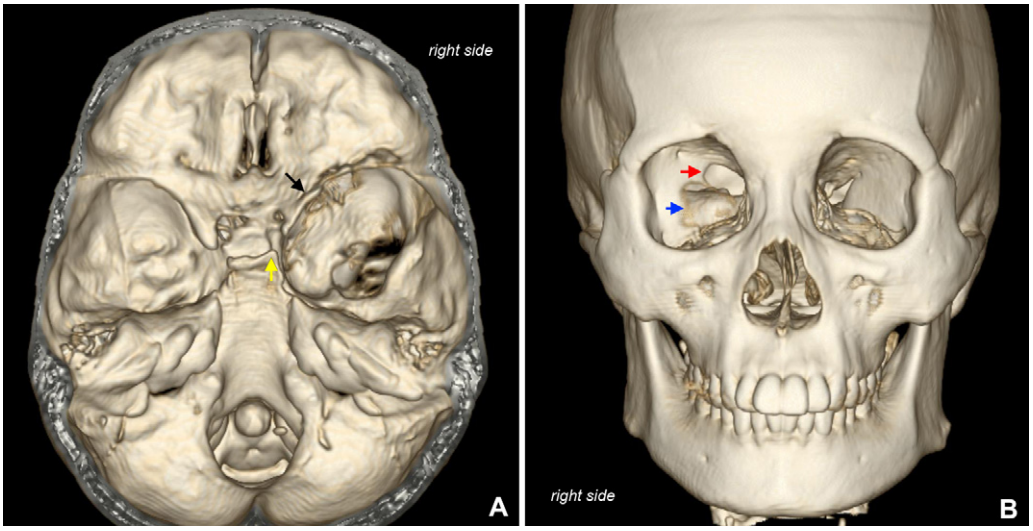

Fig. 5. Three-dimensional volume-rendering CT image. **A,** Superior view of the skull base shows the expanded middle cranial fossa on the right side. Note the deformed sphenoid lesser wing (*black arrow*) and the posterior clinoid process (*yellow arrow*). **B,** Frontal view shows the extraordinarily widened superior orbital fissure (*red arrow*) and the expanded orbital surface of the sphenoid of the right side (*blue arrow*).

signal intensity identical to the CSF on all pulse sequences. The temporal lobe was displaced. A radiologic diagnosis of IAC was established and the patient was referred to the neurosurgical department.

DISCUSSION

IACs are mostly congenital and caused by an impairment of CSF drainage generated by venous agenesis.[1] Secondary arachnoid cysts may result from trauma or infection. Arachnoid cysts are relatively common lesions encountered in neurosurgical practice. The clinical manifestations of IACs are variable and often nonspecific, depending on the size and location of involvement.[1] Asymptomatic IACs are also common and frequently discovered during incidental CT or MRI examination.[4] Arachnoid cysts are most commonly observed to remain of fixed volume over time.[5]

IACs most commonly present supratentorially, of which the most common site is the middle cranial fossa.[1] Skull deformities may be variable, depending on the lesion size. Severely deformed skull base or macrocephaly may be consequent to the increased accumulation of the CSF. Enlarged size of the lesion could

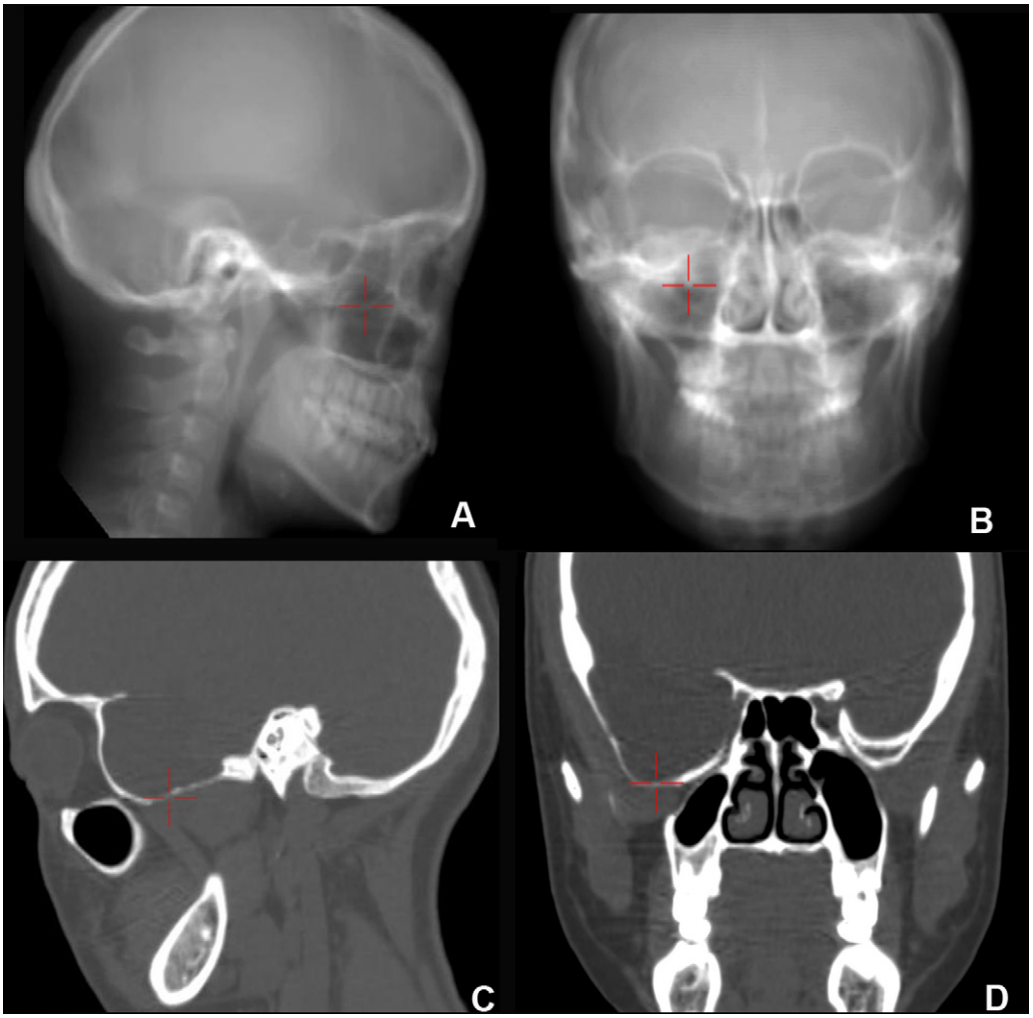

Fig. 6. Ray-sum postprocessing method was used for confirmation of the projection of the expanded skull base. Cursors were synchronously moved to indicate the same anatomic location in both the ray-sum windows **(A, B)** and the multireformatted windows **(C, D)** during the postprocessing. Thus, the abnormal radiologic signs of the expanded middle cranial base (*red crosses* in C and D) could be synchronously confirmed on the simulated x-ray images (*red crosses* in A and B), which resembles the 2-dimensional x-ray projections (Figures 2 and 3).

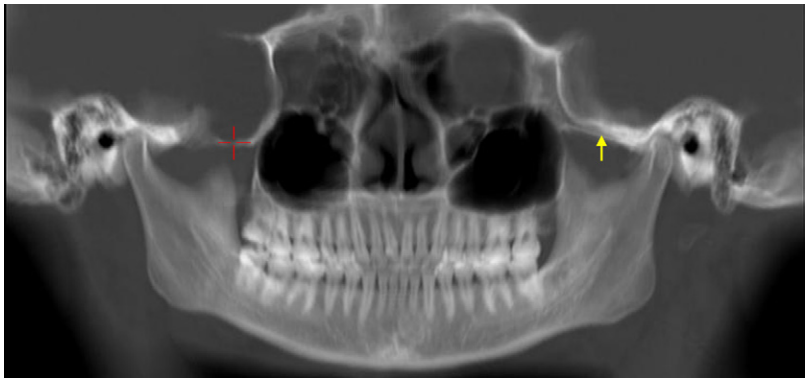

Fig. 7. Reformatted panoramic view based on CT volume data also simulates the true panoramic radiograph (Figure 1) to present the deformed middle cranial base (*red cross*). Note the normal middle cranial base on the left side (*yellow arrow*).

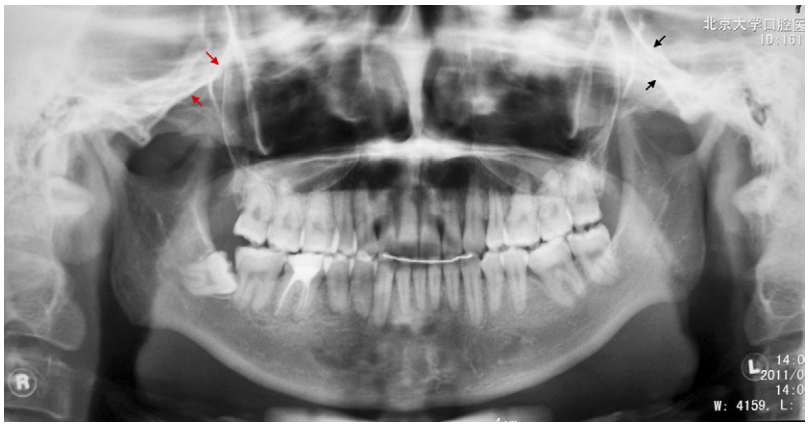

Fig. 8. Panoramic radiograph shows that the right middle cranial base (*red arrows*) was expanded and thinned, compared with the normal double-layered cortex lines on the left side (*black arrows*).

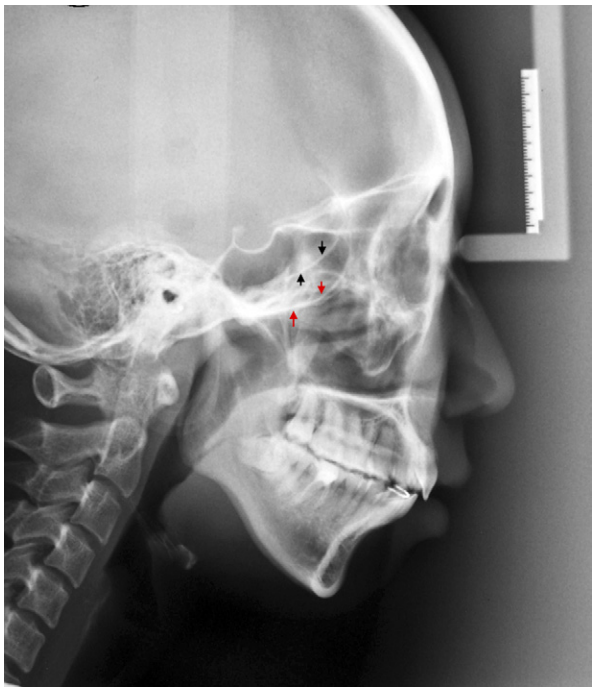

Fig. 9. Lateral cephalometric radiograph shows the asymmetry of bilateral middle cranial base. An abnormal cortex line is observed arising from the expanded right middle cranial base (*red arrows*), compared with the normal projection from the contralateral side (*black arrows*).

possibly increase the intracranial pressure and cause related neurologic signs.[6] There is still controversy regarding whether they originate directly from the meninges adjacent to the temporal pole or whether partial agenesis of the temporal lobe favors secondary formation of IAC.[7] Long-standing pressure effects may cause maldevelopment of the temporal lobe and may produce obstruction at the level of the third or fourth ventricle. Cysts of the middle cranial fossa are susceptible to trauma.[8] Therefore, although asymptomatic, the patients should be referred to a neurosurgeon for further consultation.

These 2 cases added to our knowledge in that IACs can be reasonably suspected if an extraordinarily expanded and thinned cortex of the middle cranial skull base is observed on panoramic or lateral cephalometric radiographs. Asymptomatic IAC patients may be incidentally encountered in dental practice. Loss of the normal double-layered cortex projection of the middle cranial base could indicate intracranial pathology. On the PA cephalometric radiograph, the expanded skull base may not be easily identified, but the widened superior orbital fissure can be appreciated. However, these radiographic signs are not specific to IAC and may indicate other intracranial pathologies with space-occupying effect.

The skull base of the middle cranial fossa is mainly made up of the infratemporal side of the greater wing of the sphenoid. Normally, the greater wing presents with double-layered cortex with intervening diploë. On panoramic radiograph, the middle cranial skull base presents as double-layered cortex lines superior to the projections of the sigmoid notch and zygomatic arch. On lateral cephalometric radiography, bilateral greater wings of the sphenoid superimpose together with the projection of 1-4 opaque cortex lines. On PA cephalometric radiography, identification of the middle cranial skull base is not easy, owing to the frequently superimposed projection of petrous pyramid. Deformed middle cranial base may be expansive, thinned, and single-layered, which could be identified on panoramic and lateral cephalometric radiographs.

CT or MRI scans are diagnostic and helpful in follow-up management for arachnoid cysts.[8,9] Differential diagnoses may include other cystic lesions, such as craniopharyngioma, epidermoids,[10] ependymal cysts, astrocytoma, cystic meningioma, and chronic subdural hematoma. On CT and MRI, the combination of ex-

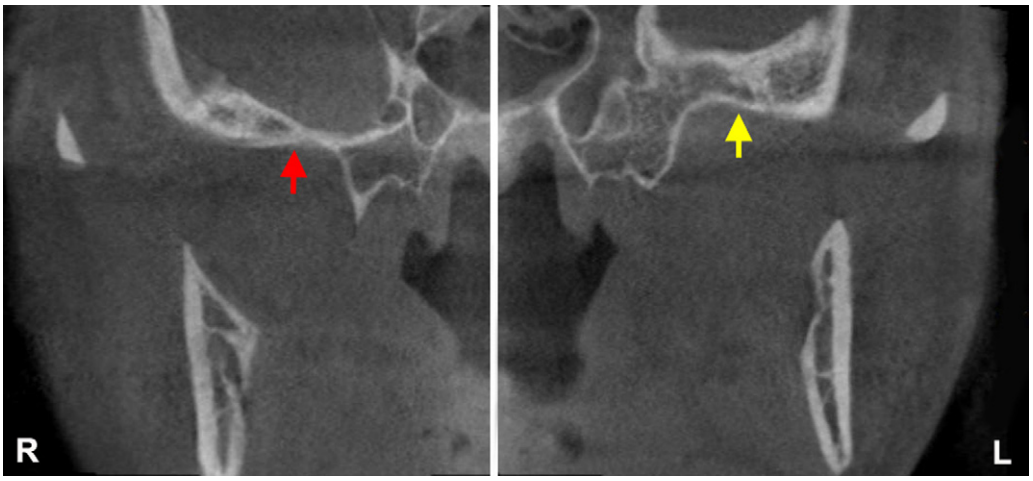

Fig. 10. Cone-beam CT of bilateral skull bases (coronal views through bilateral mandibular foramina) shows the thinned and expanded middle cranial base on the right side (*red arrow*). Note the normal appearance of middle cranial base on the left side (*yellow arrow*) featured by 2 layers of cortex and intervening diploë.

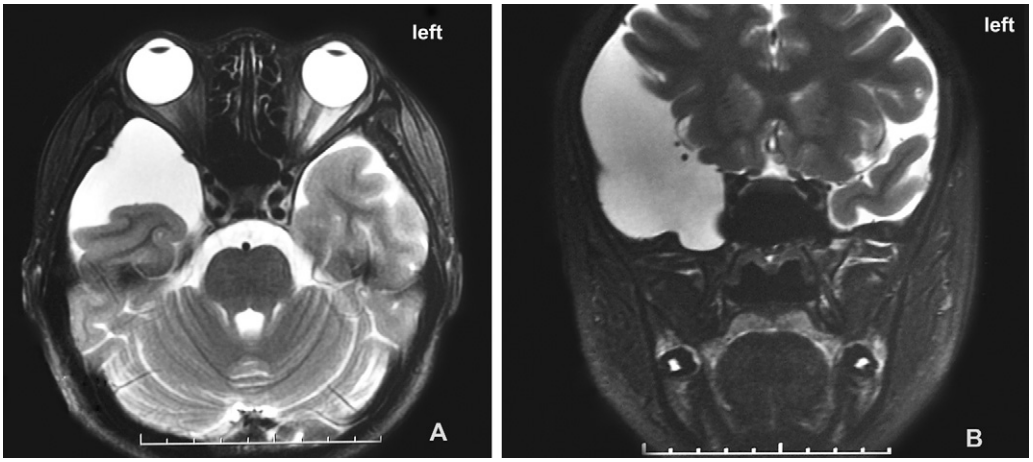

Fig. 11. Axial **(A)** and coronal **(B)** fat-suppressed T2-weighted MR images shows a well defined extracerebral lesion at the right temporal region with a mass effect to the brain parenchyma. The collection is isointense to the cerebral spinal fluid.

traaxial location, morphologic features, CT attenuation, and MRI signal intensity identical with that of CSF allows one to make the diagnosis of an uncomplicated arachnoid cyst accurately.

Because IACs are sometimes quiescent and dormant throughout life, conservative management has been proposed for patients who do not demonstrate signs of increased intracranial pressure or focal neurologic disorders.[1] Surgical treatment, when indicated, may include cystoperitoneal shunting, cyst fenestration or excision of the cyst membrane.[11,12] The role of surgery remains controversial and needs to be individualized. Prophylactic surgery is generally not recommended.[4]

In conclusion, the deformed skull base due to IACs of the middle cranial fossa may be observed incidentally during dental radiographic examination. Therefore, it is important that the dentist thoroughly evaluate the morphology of the skull base on conventional 2-dimensional radiographic examinations.

REFERENCES

1. Cincu R, Agrawal A, Eiras J. Intracranial arachnoid cysts: current concepts and treatment alternatives. Clin Neurol Neurosurg 2007;109:837-43.
2. Wang PJ, Lin HC, Liu HM, Tseng CL, Shen YZ. Intracranial arachnoid cysts in children: related signs and associated anomalies. Pediatr Neurol 1998;19:100-4.
3. Rengachary SS, Watanabe I. Ultrastructure and pathogenesis of intracranial arachnoid cysts. J Neuropathol Exp Neurol 1981;40:61-83.
4. Gosalakkal JA. Intracranial arachnoid cysts in children: a review of pathogenesis, clinical features, and management. Pediatr Neurol 2002;26:93-8.
5. McDonald PJ, Rutka JT. Middle cranial fossa arachnoid cysts that come and go. Report of two cases and review of the literature. Pediatr Neurosurg 1997;26:48-52.

6. Callaway MP, Renowden SA, Lewis TT, Bradshaw J, Malcolm G, Coakham H. Middle cranial fossa arachnoid cysts: not always a benign entity. Br J Radiol 1998;71:441-3.
7. García Santos JM, Martínez-Lage J, Gilabert Ubeda A, Capel Alemán A, Climent Oltrá V. Arachnoid cysts of the middle cranial fossa: a consideration of their origins based on imaging. Neuroradiology 1993;35:355-8.
8. von Wild K. Arachnoid cysts of the middle cranial fossa. Neurochirurgia (Stuttg) 1992;35:177-82.
9. Galassi E, Piazza G, Gaist G, Frank F. Arachnoid cysts of the middle cranial fossa: a clinical and radiological study of 25 cases treated surgically. Surg Neurol 1980;14: 211-9.
10. Dutt SN, Mirza S, Chavda SV, Irving RM. Radiologic differentiation of intracranial epidermoids from arachnoid cysts. Otol Neurotol 2002;23:84-92.
11. Fewel ME, Levy ML, McComb JG. Surgical treatment of 95 children with 102 intracranial arachnoid cysts. Pediatr Neurosurg 1996;25:165-73.
12. Levy ML, Wang M, Aryan HE, Yoo K, Meltzer H. Microsurgical keyhole approach for middle fossa arachnoid cyst fenestration. Neurosurgery 2003;53:1138-44; discussion 1144-5.

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