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AJNR Am J Neuroradiol 1994, 15 (1) 151-153

<http://www.ajnr.org/content/15/1/151>

This information is current as
of August 10, 2025.

Dehiscence of the Lamina Papyracea of the Ethmoid Bone: CT Findings

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PURPOSE: To describe the CT findings characterizing dehiscence of the lamina papyracea. **METHODS:** Axial and coronal CT scanning of the paranasal sinuses was performed on 783 patients. **RESULTS:** Dehiscence of the lamina papyracea was noted incidentally in six patients. In all cases dehiscence was characterized by protrusion of orbital fat through a gap in the anterior ethmoid. The posterior limit of the dehiscence was always the basal lamella. The anterior limit varied. **CONCLUSION:** CT scans are often taken to detect polyps or assess chronic sinusitis. Awareness of dehiscence of the lamina papyracea is important to avoid misdiagnosis as infectious or tumoral process and possible injury of the orbit during endoscopic surgery.

Index terms: Ethmoid bone; Paranasal sinuses, computed tomography; Orbits, abnormalities and anomalies

AJNR Am J Neuroradiol 15:151–153, Jan 1994

The ethmoid bone is frequently the site of anatomic variations (1). Dehiscence of the lamina papyracea is an anomaly of the ethmoid that was identified long ago on skull dissections (2, 3). In the present study we describe six cases noted incidentally in a successive series of 783 computed tomography (CT) scans of the paranasal sinuses. Because dehiscence of the lamina papyracea can be misdiagnosed as a infectious, tumoral, or posttraumatic lesion and constitutes a high risk for injury of the orbit during endoscopic surgery, these findings are of great practical import for therapeutic decision making.

Materials and Methods

Between May 1991 and April 1992, we performed CT scans of the paranasal sinuses in 783 patients (361 women, 422 men) for suspicion of tumor (n = 43) or chronic infection (n = 740) involving the ethmoid labyrinth.

CT scans in the axial planes were obtained in 2.5-mm sections. Images in the coronal plane were obtained either by reconstruction or by direct acquisition. Unilateral dehiscence

of the lamina papyracea was an incidental finding in six patients. In five cases the CT scan was carried out for symptoms suggesting chronic sinusitis. In the remaining subject, CT was done to study the local extension of a tumor in the contralateral nasal fossa. None of the six patients had a history of sinus surgery or facial or orbital trauma. In four subjects the anomaly was on the right and in two patients on the left. In five subjects dehiscence was not associated with acquired anomalies of the ethmoid bone; in the remaining patient polyps had developed in the ethmoid and nasal cavities.

Results

In all six patients dehiscence of the lamina papyracea was characterized by the same features on axial and coronal scans: protrusion of fatty material into the bulla cells through a gap in the right or left lamina papyracea. This fatty mass was always of the same density as, and in continuity with, the orbital fat.

Dehiscence always involved the external wall of the ethmoid bulla and spared the posterior ethmoid. The posterior limit of the fat mass was always the basal lamella. The anterior limit was variable. In four subjects it was the bulla lamella (Fig 1), in one case it was the anterior part of the dehiscent lamina papyracea which was concave laterally (Fig 2), and in a patient with polyps in the ethmoid and nasal cavities, dehiscence involved the lacrymal bone and fatty material filled

Received October 1, 1992; revision requested November 19; revision received and accepted December 30.

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AJNR 15:151–153, Jan 1994 0195-6108/94/1501-0151

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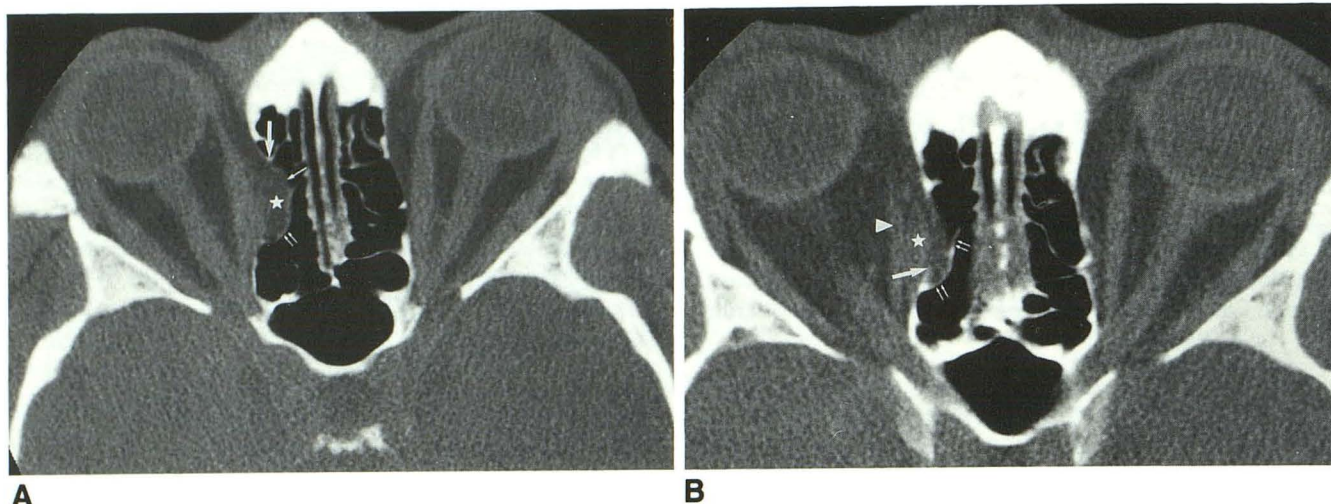


Fig. 1. Dehiscence of the right lamina papyracea, axial CT scans.

A, Protrusion of orbital fat through the ethmoid bulla (*star*) into the ethmoid bulla (*thick arrow*). The posterior limit of the fatty mass is the basal lamella (*double arrow*). The anterior limit is the bulla lamella (*large arrow*).

B, Section taken 1.5 mm above 1A. The basal lamella is well seen (*double arrows*). The *arrow* shows the posterior limit of the gap in the lamina papyracea. Right medial rectus muscle is indicated by the *arrowhead* and the right superior oblique muscle by a *star*.

the posterior third of the infundibular cells (Fig 3).

The bulla cells were never completely filled (Fig 2B). The medial and lower parts of the ethmoid bulla were never obscured. In five patients the normal part of the lamina papyracea surrounding the dehiscence was depressed on the medial side. The topography and morphology of the medial rectus muscle were normal in all subjects (Fig 1B).

Discussion

Dehiscence of the lamina papyracea is an anomaly of the paranasal sinuses that has been recognized for a long time. Skull dissections performed in 1869 by Hyrtl (2) and in 1893 by Zuckerkandl (3) revealed gaps in the internal orbital wall. A few years later in 1901, Sieur and Jacob (4) observed similar findings in five of 200 skull dissections. The reported incidence of this anomaly varies greatly. Takahashi and Tsutsumi (5) reported 10%, Kozlov (6) 5.6%, and Zuckerkandl 1.17% (14 of 1188 dissections). In the present study the incidence was only 0.76%. Involvement of the posterior ethmoid does not appear to have been described in the anatomic literature, and we did not observe it in our series.

The embryogenesis of this malformation is unclear. Terracol and Ardouin (7), reasoning that the ethmoid and lamina papyracea were of the same embryologic origin, speculated that it might be caused by a hyperaerated ethmoid. Indeed the ethmoid cells are formed by invagination of the

epithelium of the olfactory pit. It can thus be speculated that the hole in the future lamina papyracea results from overextension of this process beyond the lateral limit of the facial embryonic mesenchyma. However, the apparent inward concavity of the lamina papyracea observed in the present study and described by Zuckerkandl in his 14 dissections does not support this explanation.

In agreement with anatomic observations, the present study revealed that in all cases the ethmoid bullae were very small as if the lateral part had been filled by the fatty mass arising from the orbit (Fig 2B). On dissecting sections (3) it was shown that this fatty mass was separated from the aerated cavities only by the ethmoid mucosa. This anatomic finding may explain the development of spontaneous orbital or palpebral emphysema and play an important part in local spread of infections (3, 4, 7). This pathogenesis is different from the one associated with acquired dehiscence secondary to extensive nasosinus polyps in which the ethmoid is not filled by orbital fat (8).

CT of the paranasal sinuses is frequently performed especially before endonasal surgery for chronic sinusitis (1, 9–12), and awareness of dehiscence of the lamina papyracea is important. Teatini (13) in 1987 published a CT scan showing a small gap in lamina papyracea but no fat. Chow (12) observed in one case prolapse of the medial rectus muscle into the ethmoid, but this was not the case in our patients. Based on our experience

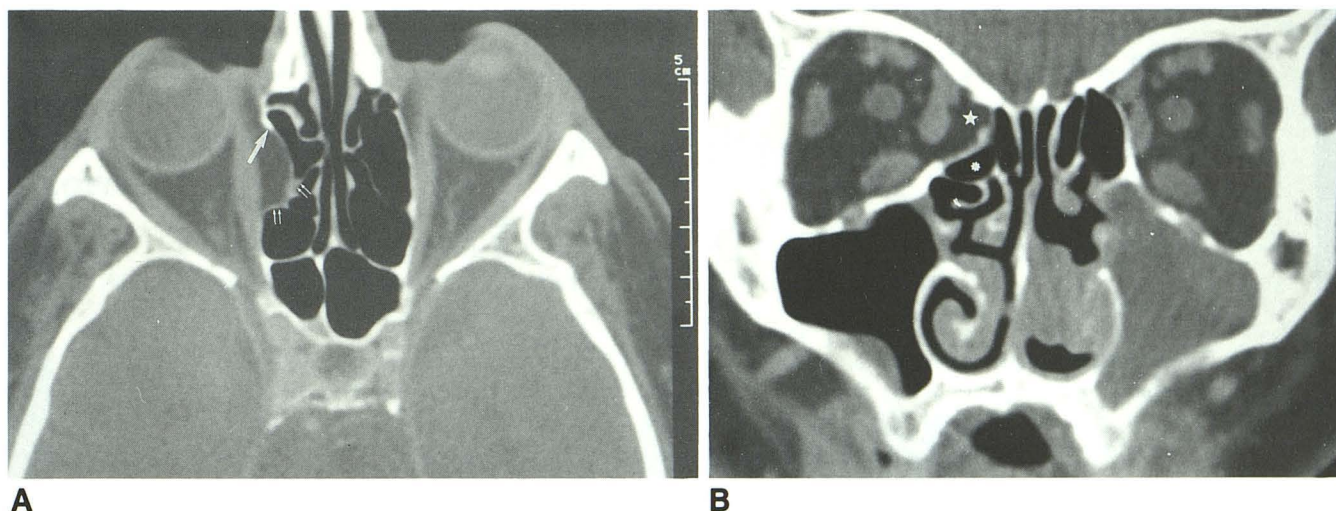


Fig. 2. Dehiscence of the right lamina papyracea.

A, Axial CT scan. The *double arrows* correspond to the basal lamella, which is the posterior limit of the fatty mass protruding into the ethmoid bulla. The anterior limit is part of the lamina papyracea beyond the zone of dehiscence which is depressed medially (*arrow*).

B, Coronal CT scan showing orbital fat (*star*) partially filling the ethmoid bulla. The *asterisk* shows the uninvolved lower part of the ethmoid bulla.



Fig. 3. Axial CT scan. Dehiscence of the right lamina papyracea in a patient with polyps in the ethmoid and nasal cavities. Orbital fat in the ethmoid bulla is shown by the *large arrow*. The internal partition of the infundibular cells and thick inflammatory mucosal lining is indicated by the *thick arrow*. The posterior limit of the fatty mass is the basal lamella (*arrowhead*). Anteriorly dehiscence involves the posterior part of the lacrymal bone and fat fills the posterior third of the infundibular cells (*curved arrow*).

the key diagnostic features are the gap in the bone wall and presence of fat in the bulla cells.

In case of misdiagnosis the major risks are unnecessary medical treatment and, above all, perforation of the orbital wall during surgery. Damage of the ocular muscles (medial rectus and superior oblique), hematoma, and ocular infections are classical complications of ethmoidal surgery (13, 14).

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