

Variation in Drainage of Frontal Sinus: A Study on Cadavers

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Abstract

Background: The purpose of this prospective study was to investigate various drainage pathways of the frontal sinus.

Methods: For this, sagittal section of each specimen was made and the frontal sinus was exposed. From the frontal sinus, a probe was passed to demonstrate the opening of the duct into nasal cavity. Photographs were taken.

Results: In 18 cadavers (90%), both the sinuses opened into frontal recess on both the sides. We also found that sinuses were draining to infundibulum, bulla ethmoidalis.

Conclusions: These anatomical variations affect the drainage and ventilation of the paranasal sinus due to infection lead to stasis of secretion cause recurrent and chronic sinusitis.

Key words: Frontal sinus, Middle meatus, Paranasal sinuses

INTRODUCTION

The paranasal sinuses have been recognized from the time of Galen (130-201 AD).¹ There are two groups of paranasal sinuses: Anterior and posterior. Frontal sinus belongs to the anterior group.² The sinuses are divided into several recesses, which communicate with each other through incomplete bony septa. Occasionally, one or both sinuses may be absent.³ Normal average dimensions are height - 3.16 cm, breadth - 2.58 cm, depth - 1.8 cm. Frontal sinuses are drained by the frontonasal duct. The opening of the frontonasal duct is found on the anteromedial aspect of the floor of the sinus. The duct then continues through the ethmoidal labyrinth and enters the ethmoidal groove at the anterior end of the middle meatus. A good knowledge of anatomy will enable the surgeon to operate with more confidence, by improving one's ability to correctly interpret normal variants from abnormal or

pathological conditions, and determine an appropriate surgical treatment plan to reestablish mucociliary flow to the sinus.

METHODS

The protocol was approved by the Ethics Committee of Government Medical College and Hospital (GMCH), Chandigarh, and written informed consent was obtained from each patient. Around 20 adult male cadavers were dissected to see the drainage of the frontal sinus in Department of Anatomy, GMCH, Chandigarh. For this, sagittal section of each specimen was made and frontal sinus was exposed. The middle turbinate was removed. From the frontal sinus, a probe was passed to demonstrate the opening of the duct into nasal cavity.

RESULTS

All subjects had bilateral frontal sinus. In 18 cadavers (90%), both the sinuses opened into frontal recess on both the sides (Figure 1). In one cadaver (5%), the sinus opened into infundibulum on both the sides (Figure 2). In one case (5%), the sinus opened directly to the bulla ethmoidalis on both the sides (Figure 3).

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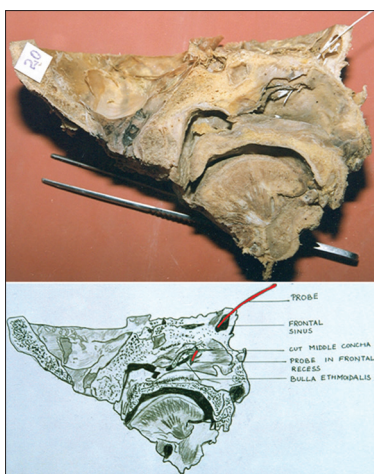


Figure 1: Frontal sinus opened into frontal recess



Figure 3: Sinus opened directly to the bulla ethmoidalis

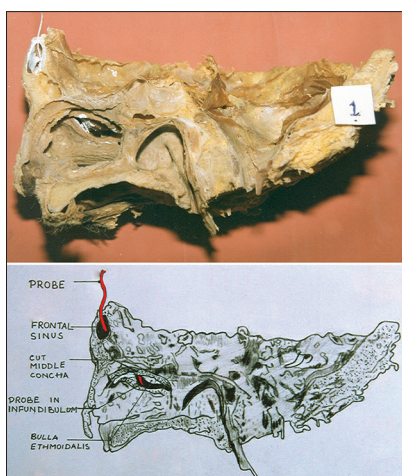


Figure 2: The sinus opened into infundibulum

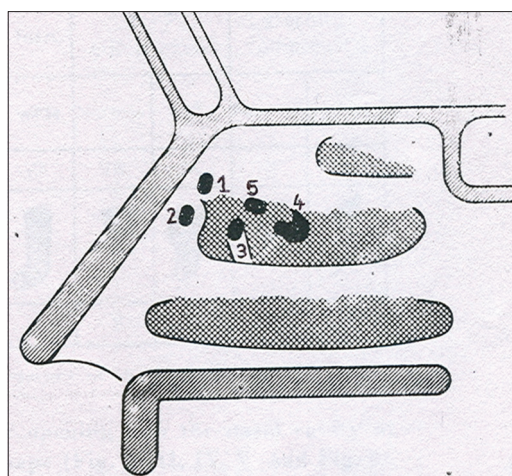


Figure 4: Topography of the opening into middle meatus, according to Laszl'o and Szab'o.

DISCUSSION

The frontal sinus originates as an outgrowth of the cephalic end of the middle meatus in an area termed as frontal recess. Frontal sinus, as well as anterior ethmoidal cells, develops in this area. This area, operculated by the middle turbinate, is identifiable in the late third to the early 4th fetal month. By the age of 6 years, the sinus grows sufficiently large to be just visible in the frontal bone in radiographs. The upward extension continues, with the cell lying at first closer to posterior table before it finally rests in the cancellous bone midway between the two tables. The frontal sinus does not attain its adult size and form until 15-20 years. The frontal sinus and anterior ethmoidal cells develop in this area. At birth, the area has only pits and furrows in the frontal area. It is from one or more furrows that frontal sinus develops. It may develop (1) By direct extension of the whole frontal recess (2) From one or more of the anterior ethmoidal cells, which originate in the frontal furrows or (3) Occasionally, from the ventral end of the ethmoidal infundibulum. In the first instance, there is no true frontonasal duct. Instead,

a wide communication exists with the nasal cavity, anterior and superior to the hiatus semilunaris, which is the most common finding. In the latter two instances, a frontal duct will develop. The tortuosity of the duct will depend on the cells from which the sinus originated and the degree of development and disposition of the neighboring cells. According to Lee variations in the opening of frontal sinus in the middle meatus are (1) Drainage into frontal recess anterior to infundibulum (55%) (2) Drainage above but not into infundibulum (30%) (3) Drainage into infundibulum (14%) (4) Drainage above the bulla (1%).⁴

According to Laszl'o and Szab'o, topography of the opening into middle meatus (50 cases) is as follows: (1) Above the anterior pole of the middle nasal concha in one case (2%) (2) Before the anterior pole of the middle concha opening directly into middle meatus in 2 cases (4%). (3) On the lateral wall of the anterior third of middle meatus in 15 cases (30%) (4) In the middle third of middle meatus together with the orifice of the maxillary sinus, and

a few ethmoidal cells in 2 cases (4%). (5) At the top of the anterior third of middle meatus in 22 cases (44%). (6) Rest of specimens was not included in the study as they showed ossification at the lower end of duct or double orifices (Figure 4).⁵ Basmajian says the most common site of opening is into superior aspect of hiatus semilunar is. In most of the cases of present study, the sinus opened into frontal recess explaining the development of the frontal sinus from the extension of frontal recess.⁶ This is similar to the observations of Lee and Basmajian.^{4,6} In two instances, the frontal sinus appears to have developed either from one or more of the anterior ethmoidal cells, which originate in the frontal furrows or from the ventral end of the ethmoidal infundibulum explaining their opening into infundibulum and onto the bulla ethmoidalis similar to the description given by Lee.⁴

CONCLUSION

We found in 90% of cases, both the sinuses opened into frontal recess on both the sides. In 5% cases, the sinus opened into infundibulum on both the sides. In other 5% cases, the sinus opened directly to the bulla ethmoidalis on

both the sides. It is important for the surgeon to be aware of variations that may predispose patients to increased risk of intraoperative complications and help to avoid these to improve success of management strategies. These anatomical variations affect the drainage and ventilation of paranasal sinus due to infection lead to stasis of secretion cause recurrent and chronic sinusitis. In view of the presence of these significant variations, we reemphasize the need for proper preoperative assessment in every patient to accomplish a safe and effective endoscopic sinus surgery.

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