Anatomic Considerations in Frontal Sinus Surgery

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KEYWORDS

• Frontal sinus surgery • Frontal sinus outflow tract • Frontal sinusitis • Agger nasi cell • Endoscopic sinus surgery • Frontal sinusotomy

KEY POINTS

- The three-dimensional anatomy of the frontal sinus and its outflow tract is complex and demonstrates a great degree of variability among patients. Consequently, careful examination of preoperative computed tomography and familiarity with each individual's anatomy are crucial for performance of a safe and successful surgical intervention.
- Familiarity with the presence and location of the anterior ethmoid artery, uncinate bone, agger nasi cells, suprabullar cells, and frontal cells is critical before frontal sinus surgery; furthermore, knowledge of the extent of pneumatization and development of each frontal sinus is mandatory.
- Visualization of the frontal sinus recess through a sagittal view allows for appreciation of the agger nasi cell (anteriorly), suprabullar cells (posteriorly), vertical lamella of the middle turbinate (medially), fovea ethmoidalis (posteriorly), lateral lamella (posteromedially), and the orbit (laterally).
- For patients in whom the agger nasi cell comprises a large portion of the frontal recess, endoscopic visualization of this cell can be confused with the frontal recess itself. The use of image guidance, switching to a 70° endoscope, and palpation of the middle turbinate can assist in making this distinction.

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- External procedures, including trephination and osteoplastic flap with obliteration, harbor potential morbidities including scarring, persistent pain, and the risk of intracranial/orbital injuries; nonetheless, these procedures may have utility in certain situations, including inaccessible lateral disease, patients with severe scarring, and other anatomic variations.

Abbreviations

BCD	Balloon catheter dilation
CT	Computed tomography

Comprehension of the complex anatomic variants comprising the frontal sinus outflow tract is essential for successful surgical intervention. Similar to consideration of the other paranasal sinuses, familiarity with the surrounding anatomy in both virgin and revision cases is critical, because deviation from sound technique has the potential to result in a variety of sequelae ranging from recurrent disease to catastrophic intracranial and orbital injury. Furthermore, the frontal sinus outflow tract is typically a tight space where even a small amount of mucosal disruption can lead to the failure of any intervention. Consequently, a detailed understanding of the surgical anatomy is paramount.

Frontal sinus surgical intervention has evolved since the era of trephination and obliteration. Nonetheless, although rarely performed, these open procedures still arguably have a role in the otolaryngologist's surgical repertoire.[1] Hence, a thorough understanding of both endoscopic visualization and anatomic considerations relating to external techniques may be valuable for the practicing otolaryngologist. This review aims to cover the key anatomy encountered, further illustrating these concepts through a description of several advanced dissection techniques.

SURGICAL PLANNING

As in any operative procedure, appropriate preoperative assessment and exhausting all nonsurgical options as appropriate are critical. Comprehensively reviewing medical management of frontal sinus disease as well as indications and contraindications for surgical intervention is beyond the scope of this review, but its importance cannot be overemphasized. With regard to frontal sinus anatomical considerations, close examination of preoperative imaging is mandatory. Nowadays, this almost exclusively encompasses computed tomography (CT), preferably involving fine cuts with axial, coronal, and sagittal views. Key structures to examine include the location of the anterior ethmoid artery (**Fig. 1**), the presence and amount of suprabullar cells (**Fig. 2**), the presence of the agger nasi cell (and its degree of pneumatization) (see **Fig. 2**; **Fig. 3**), the depth and pneumatization of the frontal sinuses, the uncinate bone attachment, and middle turbinate anatomy.[2] Each of these landmarks is discussed in further detail later. Visualization of the frontal sinus recess through a sagittal view allows for appreciation of its basic anatomic features (see **Fig. 2**). In relation to the frontal recess, the agger nasi cell is often present anteriorly, suprabullar cells posteriorly, fovea ethmoidalis posteriorly (see **Fig. 2**), the middle turbinate (vertical lamella) medially (see **Fig. 1**), lateral lamella posteromedially, and the orbit laterally.[1–4]