A Targeted Endoscopic Approach to Chronic Isolated Frontal Sinusitis

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OBJECTIVE: Chronic isolated frontal sinusitis occurs infrequently. In this condition, most of the ethmoid cells are well aerated and the frontal sinus is involved secondary to anatomical obstruction or inflammatory changes confined to the frontal recess. The purpose of this study was to evaluate a targeted endoscopic technique where standard anterior ethmoidectomy is unnecessary in the treatment of chronic isolated frontal sinusitis.

STUDY DESIGN AND SETTING: This retrospective study was conducted in a large university-affiliated hospital and included 11 patients with chronic isolated frontal sinusitis who underwent endoscopic sinus surgery limited to the frontal sinus outflow. The ethmoid bulla was untouched in all cases. Follow-up continued for 19 to 40 months (mean 28.6 months).

RESULTS: Frontal sinus outflow patency was verified in 9 patients (81.8%). Nine patients, including one with an apparent nonpatent frontal ostium, reported improvement. Two patients—one of whom had a patent frontal ostium—reported no improvement. There were no complications.

CONCLUSION: Chronic isolated frontal sinusitis can be effectively treated in selected cases by a targeted endoscopic procedure, limited to reestablishment of frontal sinus outflow.

EBM rating: C-4

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minal recess or the agger nasi or frontal cell, sparing the ethmoid bulla and the natural maxillary ostium. All 11 study patients underwent endoscopic debridement one week after surgery. They were followed up 6 weeks postoperatively and then every 3 months or as needed. During follow-up, frontal sinus outflow patency was assessed by flexible and 30° rigid endoscopes. Besides having a typical structural appearance, the patency of the frontal sinus was verified by transillumination, producing a bright red signal on the patient’s forehead. Absence of transillumination was assumed to indicate a nonpatent frontal sinus due to postoperative scarring.

**Surgical Technique**

We had earlier published a detailed description of our surgical approach to the frontal sinus. Frontal sinusotomy was routinely followed by standard anterior ethmoidectomy that inevitably included resection of the ethmoid bulla. In the current study, the ethmoid bulla was left intact in all cases.

In our currently described surgical approach to isolated frontal sinusitis, it is crucial to preoperatively evaluate the frontoethmoid connection by thin-section CT scans, paying special attention to the anatomy of the uncinate process. If, as it is in 88% of the cases, the uncinate process attaches superiorly to the lamina papyracea to create a terminal recess, the opening of the frontal recess is medial and posterior to the dome-shaped uncinate process. If the uncinate process attaches superiorly to the cribiform lateral lamella or to the middle turbinate (the remaining 12% of the cases), the frontal sinus outflow tract is lateral to the uncinate process. Throughout the operation, anatomical landmarks should be identified as precisely as possible before removal of the disease process, even though this contributes to the tediousness of the procedure. We employ a 0° endoscope for the initial steps of the procedure and angled endoscopes for the frontal recess and sinus vicinity. Microdebriders are used for the removal of the entire uncinate and agger nasi, and fine-curved forceps are used for the removal of bony fragments.

After the uncinate process is identified, it is medialized with the hooked end of a frontal ostium seeker. A 40° microdebrider is used to remove the visible anterior portion of the uncinate process (Fig 1A-D). The natural maxillary ostium is preserved if it is normal and free of mechanical obstruction. Resection of the inferior portion of the uncinate process generally exposes a dome-like structure that resembles an inferiorly opened anterior ethmoid ostium. This structure is the superior blind end of the ethmoidal infundibulum that is formed by the lateral bending of the uncinate process and is called “the terminal recess.” The latter is often mistaken for an agger nasi cell or for the frontal sinus itself when it is in a high position. The terminal recess is distinguished by having anterior and posterior walls. If a frontal sinus seeker is inserted postomerodially to the posterior wall and advanced upwards, the upper end of the instrument usually enters the frontal sinus. We now switch to a 30° endoscope and use the curved 40° microdebrider to completely remove the anterior wall of the terminal recess whose posterior wall is now clearly exposed. We trace it upwards and remove it with the curved microdebrider until resection of the superior attachment of the uncinate process is complete. Occasionally, this is sufficient to expose the frontal sinus, but more often it is necessary to remove the posteroemedial wall of a well-pneumatized agger nasi cell in order to achieve good visualization.

Since the terminal recess and the agger nasi cell commonly share the same postomerodial wall, removal of the agger nasi amounts to removal of the posterior wall of the terminal recess, but at a higher and more anterior location. A 60° microdebrider blade is occasionally used to facilitate the resection of these cells, as are curved curettes and giraffe forceps. The frontal ostium is relatively wide: our measurements in a previous study yielded a mean anteroposterior diameter of 7.22 mm and a transverse diameter of 8.92 mm. Obstruction of the frontal sinus by a frontal cell can be managed by the same technique as described above. Frontal cells at the lateral extremity of the sinus may, however, be...
inaccessible to the currently available surgical instruments. The ethmoid bulla will need to be resected if the frontal recess is pneumatized by cells arising behind the bulla lamella, eg, suprabullar or frontal bullar cells.

For cases in which the superior end of the uncinate process is attached to the lateral cribiform lamella or to the middle turbinate, there is no terminal recess and the ethmoidal infundibulum and the frontal sinus share a common compartment. Here, too, the frontal sinus is exposed by complete removal of the uncinate process. In this situation, however, dissection medial to the superior attachment of the uncinate process is hazardous because it bears the danger of penetrating the thin lateral lamella of the cribiform plate.

The ethmoid bulla is left intact if it is not involved in the disease process. Since its anterior wall, the bulla lamella, is frequently attached to the skull base, it serves as an excellent posterior limit to the frontal recess dissection in the coronal plane. Sometimes, the upper portion of the bulla lamella is, in fact, the anterior wall of a suprabullar cell. Preservation of that attachment prevents injury to the anterior ethmoid artery that is located immediately behind it. Caution must be exerted when the suprabullar recess is confluent with the frontal recess, since the anterior ethmoid artery and the fovea are readily exposed to surgical manipulation in these cases.

Frequently, what appears to be the frontal sinus is, in fact, a high terminal recess, an agger nasi cell, a supraorbital cell, or a frontal cell. Verification of an opened frontal sinus is accomplished by transillumination using a 30° endoscope. Absence of transillumination indicates that there is no opening: when there is a wide opening, placing the endoscope in the frontal recess below the frontal ostium will produce a bright red signal on the patient’s forehead. Since transillumination can also occur through the roof of an intact agger nasi and even through polyps, it is important to double-check the presence of an opening by endoscopy or by an image-guided system.

RESULTS

Patient Characteristics

Between 2000 and 2004, 390 patients underwent ESS performed by RL. Twelve of them (3%) had chronic isolated frontal sinusitis and underwent targeted endoscopic surgery. The 11 patients whose follow-up was longer than 18 months comprise the present study cohort. These patients complained of persistent or recurrent symptoms that were refractory to medical treatment. Seven of them had been treated earlier with systemic steroids. In 4 cases we did not use systemic steroids; 1 patient had poorly controlled diabetes mellitus, 2 patients had a mucocele, and 1 patient refused this treatment. The symptoms included frontal pain (all patients), nasal congestion (2 patients), and postnasal drip (2 patients). None of the patients complained of thick nasal discharge. One patient who had a frontal mucocele had a unilateral telecanthus. Frontal pain was unilateral in 8 patients and their CT scans showed opacification on the same side. Two patients with unilateral disease and 1 patient with bilateral disease pointed to the glabella as the source of pain. Three patients had polyps that emerged from the mucosa of the uncinate process, the terminal recess, or the agger nasi cell and obstructed the frontal sinus outflow tract. Three patients had hyper-pneumatized agger nasi cell, the posterior walls of which had narrowed or obstructed the frontal recess. One of them showed this pattern of obstruction on both sides and had well-aerated concha bullosa bilaterally. One patient had a well-aerated type II frontal cell that obstructed the outflow tract high up in the frontal sinus. One 11-year-old patient had a frontal mucocele expanding into the suprabullar recess. Another patient had a mucocele confined to the frontal sinus. A polyp that emerged from the region of the frontal ostium and obstructed the frontal recess was detected in 2 patients (Fig 2). According to the Lund-MacKay CT staging, the mean score for the frontal sinus was 1.6 (1 = partial opacification, 2 = complete opacification).

The ethmoid bulla was left intact in all 11 patients and served as the posterior boundary of dissection. The middle turbinate was preserved in all but 1 patient who underwent bilateral middle turbinoplasty. Three patients underwent a limited septal submucus resection in which a piece of cartilage or bone was resected at the level of the middle turbinate in order to facilitate surgical access to the middle meatus.

Figure 2  (A,B) Preoperative coronal CT sections. (A) The ethmoid bulla is well aerated bilaterally. Arrowhead: anterior ethmoid artery. (B) A polypoid lesion limited to the right frontal recess. Arrowhead: uncinate process, superiorly attached to the lamina papyracea and forms the terminal recess. (C,D) CT sections one year after surgery. (C) Axial section: the space anterior to the ethmoid bulla and the anterior ethmoid artery on left side (arrowhead) are free of disease. The operative side lacks the fine septa of the frontal recess, seen on the right. (D) Coronal section: the uncinate process has been completely removed. The frontal recess is wide open and free of disease.
Outcome
Follow-up ranged from 19 to 40 months (mean: 28.6 months). Nine patients (81.8%) reported improvement (7 significant and 2 mild) and 2 patients reported no change in their preoperative symptoms (facial or frontal pain/pressure, nasal congestion, postnasal drip). One of the latter two underwent resection of an aerated but obstructive agger nasi cell. He had a symptom relief for 2 months postoperatively and then reported recurrence of frontal headache. Endoscopy in the office failed to reveal either a patent frontal sinus or transillumination. A review of the operative report and the preoperative CT demonstrated a narrow frontal recess. This patient is planned for image-guided revision surgery. The second patient who reported no symptomatic change underwent complete resection of hyper-pneumatized agger nasi, and subsequent endoscopies and transilluminations clearly showed a patent frontal ostium. Frontal sinus outflow patency was verified in 9 (81.6%) patients. Two patients had a nonpatent frontal ostium: in addition to the above-described patient with re-stenosis, another patient with an apparently nonpatent frontal recess reported significant improvement in his symptoms; a CT scan at 25 months postoperatively was negative and excluded the presence of evolving mucocele.

There were no complications. Two patients had small synechiae between the middle turbinate and the lateral nasal wall, which had no apparent effect on subjective outcome or on frontal ostium patency.

DISCUSSION

Circumscribed forms of chronic sinusitis usually originate from microanatomic anomalies, especially narrow passages or clefts with areas of pathological mucosal contact. These occur mainly in the middle nasal meatus, in the region of the ostiomeatal unit. They impair mucociliary clearance and ventilation of the functionally dependent paranasal sinuses. CT studies reveal that most of the cases demonstrating frontal or maxillary sinus opacification have anterior ethmoid opacification as well.

The functional term “ostiomeatal unit” refers to the anatomic region lateral to the anterior two-thirds of the middle turbinate. It includes the uncinate process, the hiatus semilunaris, the maxillary ostium, the ethmoid bulla, the remaining anterior ethmoid cells, and the frontal recess. Because the frontal sinus is subordinate to this complex, routine surgical management of chronic frontal sinusitis consists of anterior ethmoidectomy that includes removal of the ethmoid bulla and the remaining anterior ethmoid cells. The present study involved a subgroup of patients with chronic isolated frontal sinusitis. These patients had typical symptoms of frontal sinus disease. Their CT studies showed mucosal swelling in the frontal sinus and in structures directly related to its natural outflow, but none of them had pathology posterior to the bulla lamella (the anterior wall of the ethmoid bulla).

Unprecedented details of the basic structures and spaces of the paranasal sinuses have recently emerged. The frontoethmoid connection, in particular, has been the subject of intensive anatomical studies during the past 3 years. In a computer-assisted anatomical study of the frontal recess, the authors (RL, MF) investigated variations in the superior attachment of the uncinate process, the prevalence of agger nasi, and the dimensions of the frontal ostium. A simplified endoscopic surgical approach to the frontal sinus was designed by applying this knowledge. This approach emphasizes complete removal of the superior attachment of the uncinate process, including the terminal recess, if frontal sinusotomy is indicated. In our earlier practice, as soon as frontal sinusotomy was accomplished, the ethmoid bulla and the remaining ethmoid cells had been surgically treated even in the absence of anterior ethmoid disease. We have changed this routine since we now regard the ethmoid bulla and the anterior wall of the suprabullar recess as being an effective posterior boundary of frontal recess dissection in the coronal plane and as a barrier between the surgical instruments and the anterior ethmoid artery. Moreover, unnecessary dissection posterior to the bulla lamella increases the risk of penetrating the fovea ethmoidalis or the lateral lamella of the cribiform plate. We have also noticed that anterior ethmoidectomy may induce middle turbinate lateralization if the basal lamella is accidentally injured. Therefore, we believe that the approach described herein is safer than the traditional approach.

In experienced hands, the 40° and 60° microdebriders are safe in the frontal recess region: the rotating teeth of the debrider are operated on the frontal recess–related cells toward the frontal “beak” while the smooth curvature is kept away from the frontal sinus’ posterior table. Still, extreme caution must be exerted since the debrider is a powerful instrument and inadvertent intracranial or intraorbital injury is possible. It is certainly not recommended for the inexperienced surgeon to embark upon frontal sinus surgery by using mainly microdebriders: removing of fragments with forceps and careful use of microdebriders in a nonprobing fashion should be encouraged.

We had noted in our earlier operations that the ethmoid bulla had no anterior opening to the ethmoid infundibulum in most cases. This observation was supported by Setliff et al, who found that 68% of the ethmoid bullae have a single posterior opening into the hiatus semilunaris superior. This may explain the occasional presence of frontal recess and sinus disease without spread of infection into the ethmoid bulla and the other anterior ethmoid cells. Hence, in certain cases, the frontal sinus is subordinate only to the most anterior compartment of the ostiomeatal unit, namely, the frontal recess.

The concept of “intact bulla sinusotomy” was introduced by Louri in 1993. We further developed and refined the technique and were encouraged by the frequent absence of communication between the frontal recess and the ethmoidal bulla. The combined circumstances inevitably paved
the way to treatment of chronic isolated frontal sinusitis by sinusotomy alone, as described in the present trial.

A well-aerated but obstructing agger nasi was found to be the most common cause of isolated frontal recess obstruction (present in 4 out of the 11 study patients). In only 2 patients was frontal sinus mucosal disease associated with agger nasi mucosal disease. This is consistent with a previous radiological finding in which frontal sinus or recess mucosal disease was associated with agger nasi mucosal disease in only 31% of cases. We therefore suspect that these cells may develop clinical significance more often by obstructing the frontal sinus outflow than by spreading infection.

In our present study, 9 of the 11 patients (81.6%) reported improvement after surgery. In one patient, this was in spite of apparent re-stenosis, as interpreted from the absence of frontal transillumination or the typical endoscopic picture. It is likely that a narrow channel had been retained and continued to provide air to the sinus. Long-term frontal sinus patency was achieved in 9 patients (81.6%). One of them reported continued frontal pain in spite of negative endoscopy and apparently patent frontal sinus. We speculate that the persistence of pain in this instance is due to preexisting or postoperative neuralgia.

In several anatomic variations, such as frontal recess pneumatization originating behind the plane of the bulla lamella, the described technique may be insufficient. Supraorbital ethmoid cells, suprabullar cells, and frontal bullar cells are not accessible if the ethmoid bulla is not dissected. Hence, the ethmoid bulla should be resected if these cells appear preoperatively or intraoperatively to be involved in the inflammatory process. Thus, the “intact bulla” technique is applicable in selected cases, when these anatomical variants are not present.

The number of skilled surgeons practicing ESS is rapidly growing and the surgical technique becomes more sophisticated as more experience is gained. Each case should be individually planned and, where possible, ESS should be minimally invasive. Standardized surgery for different disease patterns should be avoided. Just as maxillary sinusitis can be treated without antrostomy and sphenoid sinusitis without ethmoidectomy, isolated frontal sinusitis can be treated without complete anterior ethmoidectomy.

CONCLUSION

Chronic isolated frontal sinusitis develops secondary to frontal recess inflammatory changes and, in selected cases, can be surgically treated by a targeted endoscopic procedure limited to the reestablishment of frontal sinus outflow.

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REFERENCES