Objective: To examine the long-term results of extended endoscopic frontal sinus surgery, including removal of the floor of the frontal sinus (Draf type II procedure) and the median drainage operation (Draf type III procedure or modified Lothrop procedure), for obstructive frontal sinusitis caused by postoperative scarring, with the emphasis on the long-term success of the median drainage procedure.

Design: Retrospective review of 22 consecutive cases of extended endonasal frontal sinus surgery in patients with obstructive frontal sinusitis caused by postoperative scarring.

Setting: The procedures were performed at a private surgicenter in Japan.

Patients: Twenty-two patients (15 males and 7 females) ranging in age from 14 to 61 years. All patients had scar formation in the anterior ethmoid, either with or without middle turbinate lateralization or ethmoiditis. Three patients underwent Draf type II procedure followed by Draf type III procedure because of surgical failure of the type II procedure.

Main Outcome Measures: Restoration of communication to the frontal sinus was evaluated by computed tomography. All patients were examined at least 12 months after surgery or stent removal.

Results: Of the 16 patients who underwent the type III procedure, in 14 (88%) the patency of the opening to the frontal sinus and an aerated sinus were confirmed. Of 12 sides in 9 patients who underwent Draf type III procedure, 5 sides (42%) were also confirmed as “cured.”

Conclusions: The median drainage operation (Draf type III procedure) on the frontal sinus showed excellent long-term results compared with the type II procedure. Extended endoscopic frontal sinus surgery, particularly the median drainage procedure, is useful in the functional treatment of obstructive frontal sinusitis caused by postoperative scarring.


Since the advent of the endoscope, surgical procedures for the management of chronic sinusitis have shifted dramatically from radical to functional. Functional surgery aims to cure inflammation in all of the sinuses by restoring ventilation and drainage without a total removal of the mucosa from the major sinuses. However, in the frontal sinus, the passage for ventilation and drainage can be compromised by polyposis in the ethmoid or by middle turbinate lateralization; the passage may also be occluded completely by postoperative scarring. Especially as seen in cases of severe polyposid lesions of the anterior ethmoid, which tend to cause extensive mucosal defects, the denuded bone surface induces excessive granulation tissue, resulting in scar formation in the anterior ethmoid.

Obstructive frontal sinusitis caused by scarring in the anterior ethmoid is one of the most difficult complications preventing complete surgical success. Until recently, an osteoplastic flap with obliteration of fat has been the recommended treatment for frontal sinusitis in patients who have failed to be cured by endoscopic sinus surgery (ESS).

Since the early 1990s, endoscopic transnasal frontal sinus surgery has been reported by Draf, May, May and Shaitkin, Becker et al, and Gross et al as a viable alternative to conventional surgical treatment as described by Lothrop. These endonasal techniques are used to remove the floor of the sinus and interfrontal septum to reestablish endonasal drainage for the frontal sinus. To our knowledge, there have been no reports in the literature describing the long-term results of endoscopic frontal sinus surgery for obstruc-
PATIENTS AND METHODS

From June 25, 1994, to October 31, 1997, 40 patients underwent extended endonasal frontal sinus surgery for obstructive frontal sinusitis caused by scar formation in the frontal recess. Before surgery, informed consent was obtained from all patients, whose ages ranged from 14 to 72 years. Each patient had scarring as a sequela of previous surgery, regardless of the condition of the ethmoid.

The Draf type II procedure was indicated mainly for patients whose frontal sinuses could be opened with greater ease during the operation, regardless of whether it was unilateral or bilateral. The Draf type III procedure was indicated in patients whose frontal sinus was occluded by thick osteogenic scars, even in unilateral involvement, to ensure success.

All the patients arrived at our surgicenter on the morning of their procedure and underwent general anesthesia. The patient was positioned supine on the operating table with the head slightly lowered and turned facing the surgeon, who was seated to the right of the patient. A rigid 4-mm, 25° endoscope with an irrigation system and a standard power drill with a 4- to 5-mm diamond burr were used almost exclusively.

The operative procedures were similar to those used in the previous reports on transnasal frontal sinus surgery.4-8 However, in all patients, the frontal recess was covered with scar tissue. In some cases, the scarring caused middle turbinate lateralization, which obliterated the frontal recess. In all of these cases, it was difficult to use a wire as a guide, as described by Becker et al7 and Gross et al.8 We used the anterosuperior attachment of the middle turbinate as the most reliable landmark throughout the procedure. Even in cases where the middle turbinate had been removed completely by previous surgery, a small remnant could usually be recognized, as indicated by May et al.10 After injection of 1% lidocaine with 1:100 000 epinephrine into the agger nasi, bone removal was begun with a diamond burr, lateral and a few millimeters posterior to the attachment of the middle turbinate. The frontomaxillary process was drilled out upward along the orbital plate of the ethmoid bone.

After the frontal sinus was identified, only the anterior wall of the sinus was removed between the orbital plate of the ethmoid bone and the nasal septum (Figure 1). In the median drainage operation (Draf type III procedure), the bone removal process proceeds toward the opposite side around the most anteroinferior point (clockwise when operating from the right side, counterclockwise when operating from the left side) of the opened frontal sinus. Even if the structure that appears to be the interfrontal septum is recognized, direct manipulation of this structure should definitely be avoided because of the risk of penetrating the cranial space. Until the most medial part of the contralateral frontal sinus has been opened, bone removal should be confined to the anterior surface of the sinus, not the interfrontal septum (Figure 2 and Figure 3). After the bilateral frontal sinuses and their posterior walls were confirmed, the interfrontal septum was removed posteriorly, superiorly, and inferiorly, as required. Then the anterosuperior portion of the nasal septum was removed in a downward direction (Figure 4). In some cases, a straight (in the type II procedure) or a V-shaped (in the type III procedure) silicone tube was placed as a stent after completion of the procedure as a trial.

All patients stayed in the hospital for 2 to 3 days. Nasal packings were removed on discharge. All patients were seen approximately once a week for cleaning of the operative cavity during the early postoperative period. There were neither intraoperative nor postoperative complications.
Figure 2. Same patient as in Figure 1. A, Bone removal proceeds clockwise to the anterior wall of the frontal sinus, around the most anteroinferior point of the interfrontal septum (star). B, Illustrated view showing the anterior wall of the right and the left frontal sinus to be removed in the next step (shaded portion). DB indicates the diamond burr.

Figure 3. Same patient as in Figure 1. A, The most anterior part of the left frontal sinus has been opened. After the bilateral frontal sinuses are confirmed, these anterior walls are removed as necessary, and the interfrontal septum is removed posteriorly, superiorly, or inferiorly, as required. B, Illustrated view showing the anterior wall of the left frontal sinus (darker shaded portion) and interfrontal septum (lighter shaded portion) to be removed in the next step. LF indicates left frontal sinus; MT, middle turbinate.

Figure 4. Same patient as in Figure 1. A 25° view of both frontal sinuses, from the right nasal cavity (A) and from the left nasal cavity (B), immediately after completion of the medial drainage procedure. NS indicates the most superior part of the nasal septum.
RESULTS

The surgical results for the 16 patients undergoing the Draf type III procedure and the 9 patients (12 sides) undergoing the Draf type II procedure were assessed by computed tomographic scan a minimum of 12 months after the operation or removal of the stent. Patients whose stent had been removed before the 12-month minimum period were excluded, even though their postoperative period of care exceeded 12 months. Patients who underwent the type II procedure and then underwent the type III procedure because of failure of the former procedure were assessed for both procedures separately, when both postoperative periods exceeded 12 months (Table and Figure 5).

DRAF TYPE III PROCEDURE

In the Draf type III procedure, the overall rate of patency of the opening to the frontal sinus was 88% (14 of 16 patients). In 13 patients who underwent the Draf type III procedure without a stent, all were confirmed to have aerated frontal sinuses by computed tomographic scan. However, in 2 of these 13 patients, the removed interfrontal septums regenerated, resulting in separation of the restored frontal sinuses.

A silicone tube was used as a stent in the Draf type III procedure in 3 patients for 6 to 12 months. In 2 patients who had the stent for a duration of 6 and 12 months, respectively, the frontal sinus was restored completely. Restoration was also confirmed 12 months after the stent removal. In 1 patient who had undergone the Draf type II procedure 17 months before the Draf type III procedure, the surgically created opening had closed again because of scarring after removal of the stent from the latter, which had been in place for 7 months.

DRAF TYPE II PROCEDURE

In the Draf type II procedure group of 12 sides (9 patients), the overall rate of patency of the opening to the frontal sinus was 42% (5 of 12 sides). Among the 10 sides (8 patients) in which a stent was not used, 4 sides (3 patients) were restored to normal. On 1 side of a patient who...
underwent Draf type II procedure followed by placement of a stent, the frontal sinus patency was restored to normal after removal of the stent 3 months postoperatively.

**COMMENT**

External osteoplasty with obliteration of fat has been the most recommended surgical procedure for obstructive frontal sinusitis caused by scarring after failure of the initial endoscopic procedure. External osteoplasty of the frontal sinus is considered radical surgery, and it is not consistent with the concept of ESS. However, endonasal frontal surgery can be viewed as an extension of the principle of ESS, and can be used as the second-step procedure for achieving the goal of ESS.

Endonasal frontal sinus surgery has been divided into 3 types of procedures by Draf and 4 types by May and Shaitkin. Because of the lack of reports on long-term results, it has been difficult to judge the procedure most appropriate for each case.

In the case of obstructive frontal sinusitis caused by postoperative scarring in the anterior ethmoid, establishing patency of the frontal sinus has been difficult. In our experience, the Draf type I procedure is considered unsuitable therapy for the preceding condition. As reported in this study, extending drainage by resecting the floor of the frontal sinus from the lateral orbital border to the nasal septum, and from the anterior to the posterior wall of the frontal sinus (Draf type II procedure), was successful in less than 50% of the cases. This suggests that, where the frontal sinus had once been occluded by thick scars, a newly created wide passage is likely to occlude again.

On the other hand, the success rate of the median drainage (Draf type III procedure) was significantly high. We think that this technique, which removes the interfrental septum and seeks an alternate passage to the opposite side, is the most reliable method for restoring the frontal sinus. The median drainage procedure can cure obstructive frontal sinusitis caused by osteogenic scarring regardless of whether the occluded frontal sinus is unilateral or bilateral.

Because a stent was used only on a trial basis in randomly selected patients, definitive conclusions regarding patient selection and timing of stent removal cannot be drawn from this series. However, in our experience, the sinus, after stent removal, occluded again secondary to scar formation in some patients. In patients who had persistent inflammation around the stent, the passage tended to narrow or occlude shortly after stent removal. Therefore, we recommend meticulous cleaning of the areas operated on without using a stent, until regeneration of the mucosa occurs (Figure 6).

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Reprints: Toru Kikawada, MD, Hamamatsu Ear, Nose and Throat Surgicenter, Tenno-cho 1696, Hamamatsu, Japan 435-0052 (e-mail: hents@tb3.so-net.ne.jp).

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