

Where endoscopy fails: indications and experience with the frontal sinus fat obliteration*

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SUMMARY

Background: With the event of angled endoscopes, image guidance and the rapidly improving endoscopic techniques the previously used osteoplastic frontal sinus fat obliteration (FSO) becomes more and more a second line treatment option. The objective of our study is to describe the up-to-date indications for FSO based on our own experience.

Methods: Retrospective analysis including follow-up visits of 77 patients with frontal sinus fat obliteration at our clinic between 1991 and 2006 was undertaken and descriptive statistics were drawn.

Results: Thirty-six cases were operated by FSO as a first-line treatment, 41 had previous surgery. Eighty percent of all patients showed no postoperative residual complaints. Two patients required revision surgery. General complication rate was 36.4%, however these consisted in the vast majority of cases (90%) of minor complications

Conclusions: FSO still remains a valuable operation for specific indications. FSO is the gold standard for repeatedly failed endoscopic procedures. The operation should also target the following indications as a first-line treatment: large/lateral osteomas, malignant disease, lateral mucoceles, most fractures of the posterior sinus wall with CSF-leak, osteomyelitis, pathologies in small underdeveloped sinuses with narrow floor. It is associated with minimal complications and a good outcome.

Key words: frontal, sinus, fat, obliteration, indication

INTRODUCTION

Obliteration of the frontal sinus has been a widely used technique to treat frontal sinus diseases. First described in the mid eighteenth century the technique was steadily improved until Goodale and Montgomery widely popularized the frontal sinus fat obliteration (FSO), using an osteoplastic flap, in a large series published in the seventies⁽¹⁾. The procedure was from then on considered the gold standard surgery for most frontal sinus pathologies.

With the rapidly growing evolution and use of endoscopic endonasal sinus surgery, the morbidity of an external approach started to be questioned. Most pathologies of the frontal sinus could progressively be reached with new angled endoscopes and instruments. Frontal sinus drainage procedures such as the median drainage described by Draf⁽²⁾ and the modified Lothrop procedure⁽³⁾ gained popularity since the early nineties. Image guidance made this technically demanding surgery easier and hence the outcome of such procedures became comparable to the external approach, and with less morbidity.

Taking into account these upcoming new techniques we aimed to define current indications for fat obliteration procedures and to describe our experience.

MATERIAL AND METHODS

Data

Any patient having undergone open frontal sinus fat obliteration at the ENT department of the Zurich University Hospital by a transfacial or coronal approach in the period between February 1991 and August 2006 was included in the study; no other criteria had to be met.

Data of all patients were retrieved retrospectively from electronic or written patient charts. Where follow-up was not complete at time of evaluation data concerning complications, sequelae and postoperative complaints were recorded prospectively including follow-up visits. In patients with short follow up time telephone inquiries were performed.

Intra- and postoperative complications were assessed using an adapted grading system proposed by Rombout and de Vries⁽⁴⁾ for endoscopic procedures.

Data was stored in an Excel spreadsheet (Microsoft Deutschland GmbH, Germany). Descriptive statistics were drawn with the use of SPSS statistical software (Version 16, SPSS inc., Chicago, IL, USA)

Operation technique

All operations were performed by a well-trained surgeon of the ENT department, mostly by the senior author.

In patients with CSF-leak a lumbar drainage is put in place pre-operatively by the anaesthetist.

The procedure starts on the abdomen, where fat and rectus abdominis fascia is harvested through a paraumbilical cut. After thorough hemostasis, a small drain is placed and the wound closed in three-layer technique.

Transfacial approach is performed through the classical supra-orbital eyebrow incision, whereas coronal incision is done in usual manner via a bilateral preauricular cut up to the vertex. The cutaneous flap is then mobilized along the periosteum to the orbital rim, where the supraorbital and supratrochlear nerves are visualised and spared.

Using the preoperative CT-Scan a hole is drilled into the sinus, the borders are identified by illumination and the osteoplastic flap is removed by oscillating saw. The sinus mucosa is then removed together with any pathology and the whole sinus cleaned from remaining mucosa by diamond burr, under microscope. The frontal recess is identified and closed with a layer of the previously harvested fascia carefully. Fibrin glue is used for fixation.

The whole sinus is filled with abdominal fat, which again is fixed with fibrin glue. The bony flap is then put back in place and secured, when necessary, by mini titanium plates. In patients with osseous defects (e.g. bony erosions), a split calvarian replacement is used for reconstruction. The wound is closed and redon drains are put in place for at least 24 hours.

The Patient is discharged from hospital after 4-6 days, with prophylactic antibiotics.

RESULTS

Seventy-seven patients were included in the study and their charts consecutively reviewed. The age distribution was between 8.3 and 83.2 with a mean of 45.5 years and a female to male ratio of 1 : 3. Patients were followed up to 12.3 with an average of 2.7 years. Of all patients, 53% (41) were operated by the senior author; another 10% (8 patients) of all operations were supervised by him.

The underlying diseases were divided into four categories (Table 1). Forty-three patients (55.8%) were operated by coronal approach, whereas 34 (44.2%) had a transfacial eyebrow incision. Thirty-two individuals (41.6%) had no previous operations, 44.2% had one or two previous interventions to the

Table 1. Underlying diseases.

	Frequency	Percent
Mucocele or Pyocele	32	41.6
Mucocele and Trauma	2	2.6
Rhinosinusitis	16	20.8
Trauma	16	20.8
Other	11	14.3
Total	77	100.0

Table 2. Types of previous operations.

	Frequency	Percent	Combination
Frontal sinus fat obliteration	5	6.5	
Fat obliteration, transfrontal approach ¹ and endoscopic operation	2	2.6	
Fat obliteration and transfrontal approach ¹	2	2.6	13 (28%)
Fat obliteration and endoscopic operation	4	5.2	
Transfrontal approach ¹	12	15.6	
Transfrontal approach ¹ and endoscopic operation	3	3.9	15 (33%)
Endoscopic sinus surgery	17	22.1	17 (38%)
Total	45	58.4	

¹“Transfrontal approach” may also include subcranial neurosurgical operations.

frontal sinus and 11 patients (14.3%) underwent up to 7 procedures, mainly endoscopic Draf II-III drainage operations. There were a mean of 1.1 operations per patient (see Table 2). According to the applied sensitive grading system⁽⁴⁾ we found an overall complication rate of 37.4%, consisting of 13 (16.9%) grade A, 13 (16.9%) grade B and two (2.6%) grade C complications. Grade A complications mainly consisted of unusual pain (5/6.5%), which of course can be considered as a failure of the procedure or a complication of the operation (see below). Four patients had an abdominal hematoma or seroma that needed no further surgical intervention. Three had a local infection, one of which due to infected palacosplasty, treated with prolonged or newly administered antibiotics. One developed an asthma attack (inappropriate administration of NSAID in a patient with Samster's Triad), while one had post-lumbar-puncture syndrome.

The minor grade B complications consisted of three patients (3.9%) with dys-/hypo- or anaesthesia of the forehead, scar formation (2/2.6%) and impression of the frontal region (2/2.6%). Two epilepsies were caused by inappropriate cessation of medication. The remaining were single sided anosmia, dural injury and one significant blood loss necessitating transfusion.

Only two patients developed severe problems: one postoperative osteomyelitis needed revision surgeries, prolonged antibiotic treatment and has not yet recovered from pain; one cranial nerve palsy (N.III), that was due to subarachnoid bleeding probably caused by previous trauma. One patient died 3 years after the operation from recurrent meningitis (see below).

Table 3. Outcome.

	Frequency	Percent
No complaints	61	79.2
Frontal pain	5	6.5
Dys-/Anaesthesia	4	5.2
Frontal depression	2	2.6
Rhinorrhea	2	2.6
Scar	2	2.6
One sided anosmia	1	1.3
Total	77	100.0

General outcome revealed a total of 61 patients (79%) with no residual complaints after the operation (Table 3). Only two patients (3%) needed to undergo revision surgery, both had recurrent mucoceles and were again treated by FSO. Scar correction was done in one of two patients. None of the individuals with a frontal depression was treated surgically.

DISCUSSION

Although frontal sinus surgery with fat obliteration has often been replaced by endoscopic procedures such as the modified Lothrop or Draf type III drainage operations, it remains a valuable approach to the frontal sinus⁽⁵⁻¹⁶⁾. Draf type operations have been introduced to our institution in the early nineties and have been used extensively since. Today, many pathologies such as mucocele, osteoma and some posttraumatic CSF-leaks are approached endoscopically, particularly when located medial to the supraorbital nerves. Thus, along a learning curve in frontal sinus drainage procedures and with increasing surgical skill SFO was replaced by endonasal procedures. However not every pathology inside the frontal sinus can be reached by endoscopic means especially when located in the lateral aspect of the frontal sinus⁽⁹⁻¹¹⁾.

Our patients were grouped into four major categories according to their indication for operation (Table 1): mucoceles or pyoceles, that were either inaccessible by endoscopic approach, refractory to previous procedures or being complicated by additional pathologies built up the first group. We subdivided another group of two subjects, who suffered from a mucocele caused by previous trauma. Patients with rhinosinusitis were almost exclusively operated for revision purposes by open surgery. Trauma patients, whether having CSF-leaks or complicated multifragment fractures of the frontal sinus posterior wall underwent fat obliteration and reduction as a first line treatment. Endoscopic transnasal approach would have only been used, if the fracture could have been followed by this route safely. The last group of "others" consisted of a variety of indications that were as followed: carcinoma (1), mycetoma (1), osteoma (2), previous neurosurgical transfrontal/subcranial approach with following com-

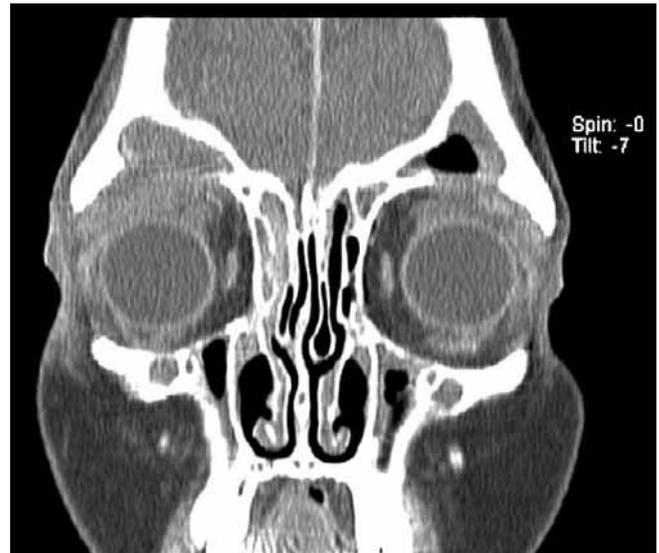


Figure 1. Lateral mucocele inaccessible by endoscopy.

plication (2), old trauma with late occurrence of a CSF-leak, osteomyelitis following an obliteration with palacos-cement (1) elsewhere and one spontaneous CSF-leak.

To further investigate the indication for an open approach we had to split the group in revision surgeries and in first-line procedures: 42% of our study population had no preceding procedures. Half of them had frontal sinus fractures and the other half consisted of laterally located osteomas, carcinomas or mucoceles that could not have been managed primarily by an endonasal approach, on the basis of their anatomic location (Table 4)^(11,17). Only the medial part of the posterior frontal sinus wall can be visualised endoscopically. Fractures of the lateral parts therefore with CSF-leaks or bony pathologies hence cannot be exposed by endoscopic means (Figure 1 shows an example).

Careful preoperative evaluation including CT-Scan findings allows the identification of patients with unfavourable anatomy that need to undergo FSO as a first line operation, such as an underdeveloped sinus, narrow floor-diameter of the frontal sinus allowing only a small opening to the sinus^(5,11,18). Contraindications for FSO on the other hand could include an eroded posterior sinus wall with mucosa tightly adherent to the dura. If mucosa cannot be completely removed obliteration should be avoided⁽⁵⁾.

Osteomyelitis as a complication of frontal sinus diseases requires a combination of therapies. Long-Term antibiotics need to be administered in combination with surgical removal of non-vital bone^(19,20). In cases where endoscopes get to their physical limits FSO is the only solution.

Similar to other studies^(9,10,11,14,21-23) 58% of the procedures were done in patients who had undergone previous operations (Table 2) and thus were salvaged by the open approach. Thirteen patients (28%) had failed previous FSO; 15 (33%)

Table 4. First-line FSO indications.

	Frequency	Percent
NCarcinoma	1	3.1
Mucocele after trauma	1	3.1
Mycetoma	1	3.1
Osteoma	1	3.1
Spontaneous CSF leak	1	3.1
Mucocele	2	6.2
Pyocele	2	6.2
Old trauma with late CSF leak	2	6.2
Rhinosinusitis with osteomyelitis / bony arrosion	2	6.2
Mucocele with bony arrosion / orbital complication	4	12.5
Fracture	15	46.9
Total	32	100.0

were previously operated transfrontally/subcranially without fat obliteration and the remaining had failed endoscopic procedures (Table 2). Some authors have described ESS as a revision procedure for failed FSO^(5,7,8,15). In our series only one previously operated patient had again a failure of the FSO. Therefore we state that revision-FSO is not only safe but also effective, with no additional risk of further scarring or other morbidity. Whether endoscopic transfrontal sinus fat obliteration can even improve morbidity needs to be shown in greater series⁽²⁴⁾. Compared to other studies, where failure-rate of the FSO procedures were reported to be from 0% up to 10%^(8,9,21) our success rate was well comparable, most likely due to meticulous removal of all mucosa under microscopic visualisation. This is not only the most time consuming part of the operation but also the key to minimize recurrences.

For the reconstruction of the frontal wall the use of cement such as Palacos (Heraeus Kulzer GmbH, Hanau, Germany) was widely used. In our experience reconstruction of bony defects of the anterior frontal sinus wall with tabula externa was the most effective, palacos cement plasty was also used but showed in accordance to other studies⁽²³⁾ to be prone to infection and scar formation. The use of a pericranial vascularized flap was not needed in our series, can however be useful in selected cases⁽¹⁾, where vital and vascularized tissue is of great need. Using vascularized pericranium also can help to minimize perioperative morbidity.

Neither patency to the nose nor persistent surviving fat in the frontal sinus are essential to control symptoms or disease. In fact vital fat cells find to have a half-life of 15.4 months and patients mainly stay symptom free for longer than that^(12,23). Therefore we did not need to analyse CT or MR findings in this study but rather relied on the patients' symptoms.

Complications

According to the system previously published by Rombout and de Vries complications were segregated into four groups: Grade A adverse events with spontaneous resolution or simple bedside/outpatient procedure, Grade B minor complication necessitating an extra intervention but no residual disability, Grade C major complications with residual or lasting disability and finally Grade D: death.

Almost fifty percent of our patients had no complications during and after the operation whatsoever. Ninety-two percent of all complications in our series were minor complications and graded either A or B. The intracranial hemorrhage that occurred after a FSO, one of the grade C complications, was most probably not linked in any way to the operation itself but rather a complication of the previously acquired skull fracture.

One young patient died 3 years after the procedure due to meningitis. As we could not find the pathophysiological pathway of infection, haematogenous or by any bony dehiscence caused by the previous skull fracture we did not count it as a complication.

The grading system that was developed initially for endoscopic procedures needed to be adapted to our needs. Changes in skin sensations of the forehead were downgraded to "B" although the disability was lasting, but adaptation of the patient to the new situation is usually very good, patients rarely complain actively of the deficiency. On the other hand the two epileptic seizures were graded also "B" although no additional surgical procedure needed to be undertaken, but since the impact to the patient is quite large this complication could not be rated "A".

All in all complications do occur but almost exquisitely consist of minor complications. Severe sequelae are rare and could in our series not be fully linked to the FSO operation.

Our FSO experience shows acceptable complication rates, well comparable to endoscopic procedures^(6-9,14,15,22).

Outcome

Three patients have been lost to long-term follow-up, however in the remaining group outcome was excellent with only two revision surgeries. Although follow-up time is not long enough to see all late complications in this series there has been no tendency toward more discomfort in time after surgery. Pain was the predominant complaint after surgery with 6.5% of all patients, however mostly only temporary after the operation and controllable by non-invasive means. However two of these complications have to be viewed as failures and thus led to the above-mentioned revisions.

Dys- or anaesthesia of the forehead was present in 4 patients postoperatively, however already pre-existent in one case. Three (including the one above) occurred in patients that had supraeyebrow incision, whereas only one appeared with a coronal approach. Statistical analysis of course shows non-significant figures in this small population. Neither sequelae nor complications correlate with the chosen incision. We therefore cannot recommend the use of one of the approaches although a trend towards more changes of forehead sensation was noted in the supra eyebrow-group.

Even aesthetic results rarely seem to distract, as only one scar had to be removed and treatment of frontal depressions were declined. One single sided anosmia caused no disability in every-days-life. In accordance to other studies we therefore conclude FSO to cause less morbidity than its reputation⁽²⁵⁾.

There is no doubt that a mean follow up of just more than 2 ½ years might be insufficient especially when discussing recurrences of mucoceles. Indeed one of the two recurrences occurred 4 years after the first obliteration. However patients with the slightest signs of recurrence or other complaints in our population were also followed by imaging rather by MRI than CT scan. Fifty percent of the mucocele patients underwent follow up imaging in contrast to 43% in the whole study population and would have led to early detection of recurrence. The presented results may therefore underestimate recurrences and lead to falsely good results. However, an asymptomatic persistence of an osteoma or a mucocele may

not be indicated to operate on. Hence, the role of routine scanning after FSO in absence of clinical signs remains controversial^(9,23,26). To our knowledge there are no recommendations as to whether and when follow-up imaging should be performed.

CONCLUSION

Even nowadays, where most pathologies of the frontal sinus can be reached endoscopically, the open frontal sinus fat obliteration stays a valuable operation with excellent outcome and acceptable morbidity in chosen situations:

1. The majority of frontal sinus posterior wall fractures can only be reached by external approach in order to reconstruct the posterior wall and remove herniated mucosa and/or other material.
2. FSO remains the gold standard for repeatedly failed endoscopic procedures.
3. Revising a previous FSO does not cause additional morbidity
4. The following criteria support the need for an open approach:
 - i. Large/lateral osteomas
 - ii. Malignant disease
 - iii. Lateral mucoceles
 - iv. CSF leak / fractures beyond the most medial aspect
 - v. Osteomyelitis
 - vi. Small underdeveloped sinus with narrow floor

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