Type III frontal sinusotomy: surgical technique, indications, outcomes, a multi-university retrospective study of 120 cases


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Abstract. Type III frontal sinusotomy: surgical technique, indications, outcomes, a multi-university retrospective study of 120 cases. Draf type III is one of the advanced endonasal endoscopic surgeries for the frontal sinus. It was popularised by W. Draf in 1991. The procedure – which is also known as the modified endoscopic Lothrop procedure – aims to create a large opening between both frontal sinuses and the nasal cavities. This requires the resection of the medial floor of both frontal sinuses, the intersinus septum and the superior nasal septum. The authors present a retrospective study including a cohort of 120 patients who underwent surgery in six Belgian university ENT departments. Mean follow-up was 24.6 months (range: 5-36 months).

This paper describes the surgical procedure and reviews the indications, comorbidities, outcomes and complications of the type III frontal sinusotomy. Some correlations are also established with the data published in the worldwide literature.

The authors conclude that the Draf III is a demanding procedure requiring considerable expertise in endoscopic sinus surgery. The aim of the procedure is to create the largest possible anteroposterior and lateral to lateral diameters in the neo-ostium. The procedure is effective. After the drill-out, 12.5% of patients have a closed neo-ostium and 20% have unchanged or worse symptomatology. The percentage of post-operative complications is 7.5%. All complications were managed successfully.

Introduction

Until the advent of endonasal endoscopic sinus surgery, the osteoplastic flap (OPF) with or without obliteration popularised by Montgomery in 1960 was, for many years, the gold standard for refractory or complicated frontal sinusitis persisting after a complete ethmoidectomy.1 However, the procedure had a high failure rate (6% to 25%) and significant early and late morbidity.2-3 Potential problems included persistent frontal headache, frontal bossing, supra-orbital neuralgia, development of mucoceles, donor site complications after abdominal fat grafting, and difficulties with post-operative imaging.

The high number of complications justified the search for a less invasive procedure as an alternative to that external procedure.

In 1914, Lothrop described a procedure involving the creation of a large frontonasal opening between both frontal sinuses and the nasal cavities.8-9 This required the resection of the medial frontal sinus floors, the intersinus septum and the superior nasal septum. At that time the procedure was performed through an external approach. However, the external approach often resulted in the medial collapse of soft tissue and stenosis of the nasofrontal opening.10-12

In 1991, Wolfgang Draf of Fulda (Germany) described the same procedure performed in an exclusively endonasal approach using the operating microscope and drills.10

In 1994 and 1995, Close and Gross adapted the procedure to establish a purely endoscopic approach.11,12

In the English literature the procedure has different names such as “a modified endoscopic Lothrop procedure”, “a bilateral frontal drillout”, “a type III frontal sinusotomy” or ”a Draf type III sinus drainage or procedure”.

This paper looks at the surgical technique and reports on the experience of six Belgian university ENT departments. The authors review the indications, comorbidities, outcomes, and the
complications of the type III frontal sinusotomy in a cohort of 120 patients and establish some correlations with the data published in the worldwide literature.

Surgical procedure

The procedure is conducted under general anaesthesia with the patient in a supine and recumbent position. When used, the navigation system is set up before surgery.

Neurosurgical pledges soaked in a potent vasoconstrictor (adrenaline or naphazoline) are put in place in both nasal cavities fifteen minutes before the procedure starts. Infiltration with lidocain 1% and adrenaline is performed laterally in the region above the root of the middle turbinate and the nasal vault, and medially in the adjacent nasal septum anterior to the middle turbinate.

The first step of the procedure consists of a revision of the anterior ethmoid. Figure 1 shows this part of the procedure. All the polyps are removed and the surgeon checks that the upper part of the uncinate process has been completely removed and that, when present, the Agger Nasi cell, the supra-oral cell and frontal bullae (bulla frontalis, also known as Kuhn cells) have been completely opened. This is very important for the exact localisation of the frontal ostium but also to ensure that no persisting inflammation or purulence is left in place that could contribute to maintaining an inflammatory reaction in the post-operative period.13

The next step consists of cannulating the frontal ostium on both sides when possible. To do this, the surgeon must have a mental picture in three dimensions of the anatomy of this area and the relative positions of the different structures. In fact, the exact position of the frontal ostium depends on the pneumatisation of the Agger Nasi cell, the supra-oral cell and the Kuhn cells. When the Agger Nasi cell is well pneumatised, the frontal sinus will be in a more posterior position; when the Agger Nasi cell is small, the frontal sinus will be in a more anterior position. Moreover, the frontal sinus is located in a more anterior and median position than the supra-oral cell, which is more lateral.

To identify the frontal ostium, the surgeon uses a ball probe, a Kuhn-Bolger curette or an olive-ended sucker very cautiously. He must not go too far in the posterior or direction because of the close relationship with the skull base and the anterior ethmoidal artery. When the frontal ostium is difficult to identify, a minitraphine with dye can be placed within the frontal sinus.8,14 The image-guided system can also be used but the system is usually not accurate enough. Its main use is to help the surgeon by confirming his or her position.15

Before going further, a flap should be created with the nasal mucosa in order to expose the bone of the anterior skull base (nasal vault and floor of the frontal sinuses) and the first olfactory fibres in the midline. Figure 2 shows this step.

The flap is U-shaped; the U is open to the bottom. The lateral incision starts above the root of the middle turbinate and continues under the nasal vault. The median incision involves the nasal septum. The incision is approximately 2 cm anterior to the vertical lamella of the middle turbinate. The dissection is then conducted in a subperiosteal plane using a Cottle elevator. The flap is pushed back. The bone is exposed very
Type III frontal sinusotomy

Figure 2
Creation of the nasal mucosal flap pushed backward (white arrows), exposing the bony structures of the frontal process and of the upper nasal septum.

Right nasal cavity – 30° rigid telescope.

Cautiously and the anterior ethmoidal nerve and the first olfactory fibres in particular appear in the surgical field. These are the posterior limits of the dissection in the midline at the level of the cribiform plate and the olfactory fossa.

This can be checked with the navigation system.

The nasal mucosal flap can be removed with powered instruments (microdebrider – tricut blade – Medtronic) or preserved for use as a free flap at the end of the procedure in order to cover the exposed bone.

Now that the bony structures have been exposed, the dissection can proceed. It progresses laterally, superiorly, and anteriorly with an angled and protected burr (Medronic-XPS-70°, 4 mm diamond burr or 3.2 cutting burr). Figure 3 shows this step on the right side.

Care is taken to ensure that drilling is done in a sagittal plane only, without drilling medially as this may endanger the skull base (the olfactory fossa). It is also important to accurately define the lateral extent of the dissection by exposing a small area of skin.

As long as the skin is exposed directly above the axilla of the middle turbinate, the drill will still be anterior to the orbit.

The floor of the frontal sinus is then entered and the frontal sinus appears. This step is performed bilaterally and alternately. Further removal of the frontal floor and of the beak of the frontal sinus is facilitated using an angulated telescope (30° or 45°).

The dissection then progresses medially. The surgeon must keep in mind that the skull base extends anteriorly in the midline. The dissection turns around the cribiform plate (anteriorly). Figures 3a and 3b show the drilling performed anteriorly to the first olfactory fibres. The olfactory fibres are the posterior limits. The drilling is done on both sides medially, anteriorly and superiorly in order to reach the intersinus septum.

Usually, the next step is to create a window in the nasal septum. This step can also be performed earlier, just after the elevation of the nasal mucosal flap, when access to the skull base is very narrow.

Figure 3
3a. Posterolateral and anteromedial drilling of the frontal floor
3b. Drilling turns around the skull base and the first olfactory fibres (white arrows). The figure compares the drawing with an intra-operative view.
Right nasal cavity – 30° rigid telescope
The mucosa of the septum anterior to the middle turbinate and adjacent to the roof of the nose is removed over an area of 3 × 2 cm. The posterior limits of the resection are the first olfactory fibres. The cartilage and the bone in the septal window are removed with a cutting Blakesley forceps, scissors or a diamond drill. The size of the septal window (perforation) must be large enough to visualise both frontal recesses from either nostril, to manipulate the instruments from one side to the other and to go under the axilla of the middle turbinates easily.\textsuperscript{13}

Figure 4 shows the endoscopic view when the septum has been perforated. The upper part of the septum and the intersinus septum are then resected as high as possible with a cutting instrument or a diamond drill. At this time, the frontal sinus opening is crescent-shaped. Figure 5 shows the surgical view when the septum has been resected and the drilling is complete on both sides.

The final but important step of the procedure is now to widen the opening as much as possible. Indeed, the aim of the surgery is to transform this crescent opening into an oval opening, creating the largest possible anteroposterior and lateral diameters for the frontal neo-ostium.\textsuperscript{6,14}

Anteriorly, the anterior frontal bone (frontal beak) is drilled in a rolling, smooth, anteromedial direction, almost as far as the nasal skin. A thin (less than 0.7 cm) bone layer is preserved at the skin side to prevent the skin collapsing into the neo-ostium.\textsuperscript{13}

Posteriorly, the bone covering the anterior (forward) projection of the anterior skull base in the midline is removed very carefully. This forward projection forms the frontal T. The T comprises the two middle turbinates, which are attached to the septum. The T is lowered to within 1 mm of the olfactory fibres without exposing the dura.\textsuperscript{6,13,14} This can be done with a bone resector such as a Kerrison forceps or the Hosemann forceps. Figure 5 shows this very important step, as well as the close proximity to the olfactory fibres.

An important consideration during all the surgery is to preserve the mucosa at the lateral and posterior margins of the neo-ostium and to avoid drilling into the posterior wall of the frontal sinuses. This reduces the risk of circumferential mucosa denudation intra-operatively, as well as the risk of post-operative scarring.

At the end of the procedure, haemostasis is achieved with a bipolar forceps. The focus is on the posterior edge of the septal window and the anterior ends of the middle turbinates. The heads of the middle turbinates are trimmed but frequently the middle turbinates are completely resected. Some surgeons recommend putting a piece of the nasal mucosal flap back to epithelialise the nasofrontal opening and therefore to prevent stenosis.\textsuperscript{6,14,15}

When the frontal ostium cannot be canulated because of neo-osteogenesis, synechiae or sequelae of middle turbinectomy, the procedure starts in the midline by creating the nasal mucosal flap first, identifying the first olfactory fibres and drilling the frontal floor anteriorly to the first olfactory fibres. A 3.2 mm cutting Burr is then used to remove the frontal process of the maxilla above the axilla of the middle turbinate, and the procedure continues as described above.
Intra-operative view when the nasal septum and the intersinus septum have been resected and the drilling is complete on both sides – comparison between the drawing (5a) and an intra-operative view (5b). Figure 5c demonstrates the close relationship between the frontal opening and the first olfactory fibres (white arrows).

Figure 5

1. National multi-university survey
2. A. Pre-operative data
3. For this report we collected data for patients who underwent a type III frontal sinusotomy as “primary” surgery in six ENT university departments in both the North and South of Belgium: ULB Erasmus hospital (Brussels - Professor S Hassid), AZ Sint Jan hospital (Bruges - Dr S Vlaminck), CHR Citadelle (Liège - Professor J Daele), CHU Mont-Godinne (UCL – Professor Eloy), University Hospitals (Leuven – Professor Jorissen) and the ENT Department of Ghent University Hospital (Professor Bachert and T Van Zele). All these ENT surgeons had experience in endonasal endoscopic sinus surgery.
4. The patients’ charts were analysed retrospectively.
5. This survey includes a cohort of 120 patients. The contribution of each institution was as follows: four patients from the Erasmus Hospital who underwent surgery between 2005 and 2010, sixteen from Sint Jan Hospital who underwent surgery between 2007 and 2011, fourteen from Liège who underwent surgery between 2002 and 2011, fifty from Leuven (Professor Jorissen) who underwent surgery between 2005 and 2010, 23 from the CHU of Mont-Godinne (Professor Eloy) between 2005 and 2011, and thirteen from Ghent University between 2008 and 2011. The revision surgeries (Draf revision) were not included in this study.
6. There were 77 males and 43 females. The sex ratio (M/F) was 1.8. The mean age of the patients was 55.4 years (range: 40-53). The mean age of the males was 52.6 years. The mean age of the females was 55.4 years.
7. As comorbidities, we noticed that hypersensitivity to at least one aero-allergen was present in 26 patients out of 120 (22%).
8. Twenty patients were active smokers (17%).
9. Asthma was found in 30 patients (25%). Nasal polyposis was found in 21 of the 30 patients (70%). Conversely, 22 out of 57 nasal polyposis patients had asthma (38%).
10. COPD was associated with the sinus problem in only three patients (mostly suffering from CRS without polyps) (2.5%).
11. Aspirin sensitivity was present in 16 patients out of 120 (13%). Of these, 13 (81%) had nasal polyposis and 14 (87%) had some degree of asthma. These patients suffered from AERD (aspirin-exacerbated respiratory disease) or Samter triad.
12. The surgical indications are presented in Table 1.
13. – Unilateral or bilateral symptomatic frontal sinusitis persisting despite maximum medical
Table 1
Belgian cohort: indications for type III frontal drillout

<table>
<thead>
<tr>
<th>Indication</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic frontal sinusitis persisting after at least one previous sinus surgery</td>
<td>89</td>
<td>74%</td>
</tr>
<tr>
<td>Frontal mucocele</td>
<td>17</td>
<td>14%</td>
</tr>
<tr>
<td>Eosinophilic fungal rhinosinusitis</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Inverted papilloma</td>
<td>3</td>
<td>2.5%</td>
</tr>
<tr>
<td>Osteoma</td>
<td>5</td>
<td>5%</td>
</tr>
<tr>
<td>Endoscopic craniofacial resection</td>
<td>1</td>
<td>0.5%</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>100%</td>
</tr>
</tbody>
</table>

Treatment and at least one previous sinus surgery in 89 patients (74%).

The average number of surgeries performed before the Draf procedure was two (range: 1 to 10).

Functional ethmoidectomy (60 patients) and nasalisation (20 patients) were the two most common procedures by far, followed by Draf IIb or external procedures (9 patients). In this group of patients, the initial diagnosis was chronic rhinosinusitis (CRS) without nasal polyps in 40 patients (45%) and CRS with nasal polyps in 49 patients (55%).

Neonosteogenesis was present in the frontal recess in 33 patients (37%).

- Marsupialisation of frontal mucoceles was performed in 17 cases (14%).

In nine cases, the mucocele was isolated and, in eight cases, it was associated with nasal polyps. In three cases, there was a defect of the posterior wall of the frontal sinus.

- Eosinophilic fungal rhinosinusitis was treated in five cases (4%).

- Draf III was performed to obtain access for the resection of an inverted papilloma or an osteoma extending to the frontal recess in three (2.5%) and five cases (4%) respectively.

- Finally, the procedure was used as the preliminary step in an endoscopic craniofacial resection for a sinus tumour in one case.

"Frontal pain" or "headache" was the major symptom presenting before the frontal sinusotomy in 98 patients (82%). In cases of mucocele, 13 patients out of 17 complained of headaches (76%).

The disease was unilateral in 50 patients (42%) and bilateral in 70 patients (58%).

A navigation system was used in 46 procedures (38%) but some teams used it in all cases (Eloy) while others never used it (Jorissen).

The procedure was conducted from lateral to median in 91 procedures (76%) and from median to lateral in 29 procedures (24%).

In eleven cases, a free flap of nasal mucosa was put back to cover the exposed bone.

B. Post-operative management

At the end of the procedure, no packing was put in place in 94 patients (78%). Merocel was used for one or two days in 18 patients (15%) and a vaseline gauze was used for 5 to 8 days in 8 patients (7%).

Seventy-eight per cent of the patients (n = 94) were discharged the day after the operation; the other 26 patients were discharged two days after the surgery (22%). All were seen in the outpatient clinic after seven days.

All the patients received broad spectrum antibiotics (amoxycycline plus clavulanic acid, doxycycline or clindamycin) for at least 5 to 7 days.

Patients with nasal polypsis also received tapered oral steroids (methylprednisolone) for at least 7 to 14 days.

Outpatient appointments for gentle debridement of the neo-ostium and removal of clots and crusts were made after one week and every week during the first post-operative month, and then every two weeks until healing was complete.

At the first outpatient visit the gauze, when present, was removed endoscopically from the neo-ostium and debridement of the operated cavity was performed.

The patients were advised to rinse their nose with saline and to use nasal steroids.

In case of polyps growing into the neo-ostium, topical steroids and antibiotic cream were applied under endoscopic guidance in the outpatient clinic and, if necessary, patients received 14 additional days of oral methylprednisolone.

C. Post-operative outcomes

When we consider the 98 patients who complained of facial pain before the surgery, 67 patients (68% in this group) had improved dramatically after the surgery but 31 patients (32% of this group)
still complained of pain. Of these patients, 18 (58%) had persistent significant headache whereas 13 (42%) had a feeling of pressure.

In the early post-operative period, all the patients presented with crusts. The mean crusting time observed by the examiner was 5.76 weeks (± 8.89).

The mucosa in the neo-ostium was polypoid in the early post-operative period particularly, but not exclusively, when the patient was known to have nasal polyposis. The mean duration of mucosal hyperplasia was 12.85 weeks (± 32.19). Twenty-one patients (17.5%) still had a polypoid mucosa in the frontal sinus at the last follow-up, see Table 2.

Shrinking and stenosis of the neo-ostium was common. Sixteen patients (13%) had a stenotic neo-ostium at the last follow-up.

The number of cases with closed neo-ostium was 15 (12.5%).

Based on the number of symptomatic patients whose symptomatology was “unchanged” or “worse” after the drillout procedure, the number of failures was 24 (20%).

When a nasal mucosal free flap was put in place at the end of the procedure the number of failures was 6 out of 11 procedures (55%).

Turning to the two major comorbidities allergy and asthma, the incidence of failures is 4 out of 26 (15%) and 4/30 (13%) respectively.

The number of failures in cases of aspirin intolerance was 4 out of 16 (25%).

The failure rate was 50% when the packing was in place for 5 to 8 days.

The number of intra-operative complications was 9 out of 120 procedures (7.5%). We observed four CSF leaks, four cases of epistaxis and one orbital haematoma.

The mean follow-up in this study was 24.6 months (median follow-up: 12 months; range: 5-36 months).

**Discussion**

Draf type III frontal sinus drainage is one of the advanced endoscopic surgeries that are performed exclusively transnasally. Even though it involves the major resection of the superior nasal septum, the frontal intersinus septum and the medial floor of both frontal sinuses, this is still considered to be minimally invasive, functional surgery. The aim of the procedure is to create a large frontonasal opening to the nasal cavities in order to restore the ventilation and the drainage of both frontal sinuses.

Compared with osteoplastic flap with obliteration, drillout procedures result in less blood loss, reduced morbidity, shorter hospital stay, better cosmesis avoiding facial incisions and, last but not least, it produces an open cavity that is easier to assess and follow-up in the clinic without the need for serial CT scans or MRIs.

Nevertheless, the drillout procedure has some limitations. This procedure requires a high level of endoscopic expertise and dedicated instruments for the frontal sinus surgery, including specific spoons and curettes, bone resectors and mushroom forceps, but also powered instruments with different types of burrs, and a navigation system (optional). Yet it is not free of complications such as CSF leak, orbital haematoma and epistaxis. This will be discussed below.

This study looked at 120 patients with an average age of 55 years, who underwent surgery in six different Belgian university ENT departments in both the North and South of the country. There was a slight male preponderance with a sex ratio (M/F) of 1.8. Mean follow-up was 24.6 months.

Although all the surgeons who participated in this survey had experience with endonasal endoscopic surgery, the respective contribution of each centre was heterogeneous. For example, ULB
Eosinophilic fungal rhinosinusitis (EFRS) was a rare indication (N = 5 cases). This can be explained by the fact that EFRS in Europe is far less common than in the USA or India.

With experience, a Draf III frontal drainage can be performed as primary surgery in some cases. Indeed, it was performed for the removal of benign tumours such as osteomas (N = 5) or inverted papillomas (N = 3) extending into the frontal recess. Contra-indications for an indication of this kind are tumours that extend well beyond the supra-orbital neurovascular bundle. In these cases an open procedure (OPF) is recommended.

Another indication for Draf III as primary surgery is the endoscopic craniofacial resection for a malignant tumour. In this case, a Draf III procedure can be used to delineate the anterior margin for the endoscopic skull base resection. We had only one case. Another reason for using this procedure is to prevent blockage of the frontal sinuses by the postoperative radiotherapy.

Hypersensitivity to at least one aero-allergen was a comorbidity found in 22% of our cases (26 patients out of 120). This incidence seems very high but it confirms the paper published in 2004 by Bauchau et al. showing 28.5% of prevalence of allergic rhinitis in Belgium, 24.5% in France and 16.5% in Italy.

Nasal polyposis was present in 57 patients out of 120 (47.5%). The exact prevalence of nasal polyposis in the general population remains poorly documented but European publications report it in 1% to 4.5% of the population. In a French study by Klossek et al., asthma was associated with nasal polyps in 26%.

in this study, 38% of nasal polyposis cases were associated with asthma. Conversely, we found that 70% of the asthmatic population had nasal polyposis. This is explained by the fact that patients undergoing several surgical procedures are a selected group of patients with a more severe inflammatory disorder that is recalcitrant to the medication.

Aspirin sensitivity was present in 16 patients out of 120 (13%). Of these, 13 (81%) had nasal polyposis and 14 (87%) had some degree of asthma. These patients suffered from AERD (aspirin-exacerbated respiratory disease) or Samter triad.

The procedure was conducted from lateral to median in 91 procedures (76%) and from median to lateral in 29 procedures (24%). The way dissection was performed had no impact on the outcome but the identification of the first olfactory fibres is of paramount importance. Indeed, the procedure must create the largest possible anteroposterior diameter for the neo-ostium. Anteriorly, there is no risk of drilling the nasal beak as far as the nasal skin. Posteriorly, the surgeon must lower the anterior projection of the skull base in the midline as much as possible and, at this site, the olfactory fibres are the most relevant landmarks.

At the end of the procedure, 78% of the patients (N = 94) did not need nasal packing and 15% (N = 18) had nasal packing for 1 or 2 days. Care must be taken to achieve good haemostasis, particularly at the level of the posterior septum and the heads of the middle turbinates.

A vasoconstrictor was used for 5 to 8 days in eight patients (7%).
The failure rate was 50% in this subgroup of patients.

Stents are rarely used after the endoscopic modified Lothrop procedure. The stent consisted, for example, of a rolled sheet of soft silastic. In the early post-operative period, stents facilitated post-operative care but, at the last follow-up, they did not appear to reduce the rate of post-operative stenosis of the neo-ostium.

In the early post-operative period, all the patients presented with crusts. This could last from one month to more than one year in some cases, whatever the initial disease. Infection by Staphylococcus aureus could play a role in prolonging the crusting but not all the centres included this data and so we cannot state any definitive conclusion about the role of Staphylococcus aureus infection. Nevertheless, regular follow-ups with gentle suction and cleaning of the operated cavities are necessary to keep the neo-ostium open until the healing process is complete.

The mucosa in the neo-ostium was polypoid in the early post-operative period particularly, but not exclusively, when the patient was known to have nasal polyposis. This hyperplasia could persist for more than six months. Despite this hyperplasia, patients may remain asymptomatic or feel their condition has improved after the procedure. In this series, 21 patients (n = 17.5%) had persistent hyperplasia of the mucosa in the frontal sinuses but two-thirds (14 patients) considered themselves to be asymptomatic or improved. When symptomatic, hyperplasia usually resulted in the administration of topical steroids or tapered oral steroids.

Finally, shrinking and stenosis of the neo-ostium was the third common finding. In this series, 16 patients out of 120 had a stenotic neo-ostium (N = 13%). The diameter of the neo-ostium was reduced by 30% or even more.

The number of neo-ostium closures was 15 out of 120 patients (N = 12.5%). The reason why a complete closure of the opening occurs in some patients and not in others was not clear. Banhiran did not find any correlation with the intra-operative findings. Wormald found that the only factor that could influence the final diameter of the opening was the size of the surgical opening, which must be as wide as possible. Gross et al. found that patients with a wide intranasal vault, shallow nasion, less extensive osteitic bone, thinner nasofrontal beak and frontal sinus floor diameter of 1.5 cm tend to have a more favourable outcome.

The success of the procedure can be evaluated on the basis of patient symptomatology and/or the endoscopic examination.

In a meta-analysis published in 2009 by Anderson et al., 82% of the subjects reported a significant improvement or the total resolution of their frontal symptoms, 16% reported no significant change, and 1.2% reported a worsening of their symptoms. In our series, the different respective percentages were as follows: 73% of the patients (n = 88) reported a significant improvement or the total resolution of their symptoms, 17.5% (n = 21 patients) reported unchanged symptomatology and 9.5% (n = 11) said their symptoms had worsened.

The improvement of the symptomatology was usually, but not exclusively, correlated to the size and shape of the neo-ostium. However, it is not rare to find a polypoid or stenotic neo-ostium in an asymptomatic or improved patient (c.f. Table 3). Figure 6 shows different shapes and sizes of the neo-ostium found during nasal endoscopy. Figure 7 shows different post-operative patterns.

Based on the endoscopy, the number of patients with neo-ostium closure was 15 (12.5%) in follow-up lasting more than one year (24.6 months). In the literature, the percentages vary from less than 10% to 30%. Schlosser recorded a 32% revision rate in 44 patients with a mean follow-up of 40 months. Samaha et al. – 100 patients with a mean follow-up of 4.1 ± 1.53 years (range, 1.4-6.9 years) – had a revision rate of 20%, while Tran and Wormald – 77 patients followed up for an average of 29 months – had a 13% revision rate. Fokkens had a revision rate of 30% in a series of 100 patients. Stankiewicz reported a failure rate of 23% in 2007 in a cohort of 97 patients.

In our series, the majority of the failures occurred within the first nine months. This feature was found by Anderson in 2009 and Wormald, who pointed out that stenosis of the neo-ostium can occur within the first post-operative year. Draf III therefore requires a long follow-up.

Turning to “facial pain” or headache, we found these to be the predominant symptom before frontal sinusotomy in 98 patients (82%). Post-operatively, 68% of these patients experienced a significant improvement in their pain symptoms, but 32% still complained about pain to varying degrees. The pain was significant and poorly tolerated in 58%.

These “headaches” may result from non-sinogenic pain (tension
headache, migraine) or from persisting inflammatory reaction within the sinuses despite a patent neo-ostium. It should also be borne in mind that the patients included in this study had already undergone several surgeries. Scarring could therefore certainly play a role in the pathogenesis of the pain.

The percentage of complications was low at 7.5% (9 out of 120 procedures). We observed four cases of intra-operative CSF leak, two orbital haematomas and two cases of epistaxis. All these complications were managed intra-operatively without any persisting sequellae.

A navigation system was used in 38% of all the procedures only. All the complications occurred when the navigation system was not used. Because of the small number of complications it is difficult to recommend using a navigation system routinely but, as drillout procedures are commonly performed after several previous surgeries, a navigation system can be very helpful in facilitating the identification of the remaining anatomical structures in a distorted anatomy and to check that all the recesses have been completely opened. We must also point out that the surgeon always has the last word during the surgery because the accuracy of the system is sometimes suboptimal. Expertise in endonasal surgery and knowledge of the surgical
anatomy are prerequisites for performing a Draf III in order to avoid complications and manage them intra-operatively.

Conclusion

The Draf III procedure is safe and effective. In most cases, it is a salvage procedure for patients with symptomatic frontal disease persisting despite prior, more limited, attempts to open the frontal recess. It is a good alternative to an open procedure. In this series, the success rate was high (87.5%) after a follow-up of 24.6 months. The complication rate is very low. The procedure aims to create the largest possible anteroposterior and lateral diameters in the frontal neo-ostium.

The procedure requires expertise in endonasal endoscopic sinus surgery. Identification of the first olfactory fibres is an importance step in the procedure in order to visualise the anterior projection of the skull base. A navigation system can be of great help. However, ultimately, the surgeon’s experience, judgment and knowledge of the surgical anatomy are of paramount importance when it comes to avoiding major complications.

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