ORIGINAL ARTICLE

Current Indications for the Osteoplastic Flap∗

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KEYWORDS
Osteoplastic flap; Frontal sinus; Neo-osteogenesis; Mucocele; Papilloma; Osteoma

Abstract
Introduction and objectives: Endoscopic sinus surgery is the technique of choice in most of the frontal sinus diseases, both inflammatory and tumour-related. This is why the external approach using osteoplastic flap (OF) would be limited to cases with a difficult endoscopic approach. Our aim was to review the current indications of the osteoplastic flap in the treatment of frontal sinus pathology, through a retrospective study of patients undergoing this technique.

Methods: We performed a retrospective study of 14 patients who were treated with the osteoplastic flap procedure. All the surgical indication criteria, type of sinus disease, presence or absence of prior endoscopic surgery, surgical findings, complications and recurrence were reviewed.

Results: The pathologies found were 1 osteoma (7.1%), 3 inverted papilloma (21.4%) and 10 mucoceles (71.4%). Nine patients had a prior endoscopic surgery and 10 patients had an orbital dehiscence (9 mucocele, 1 papilloma). Frontal osteoma was Grade IV and the papilloma cases were Krouse Stage III. Surgical revision was required for 21.4%.

Conclusions: The main indications for an OF in patients with inflammatory disease are lateral extension and frontal recess neo-osteogenesis. In osteoma cases, it depends on the size of the tumour. In inverted papilloma cases, the indication is multifocal implantation with origin in the anterior and lateral wall. In all cases, performing the osteoplastic flap must be individualised.

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Indicaciones actuales de la osteoplastia frontal

Resumen

Introducción y objetivos: La cirugía endoscópica nasosinusal es la técnica de elección en la mayoría de los procesos patológicos del seno frontal, tanto inflamatorios como tumurales, quedando relegadas las indicaciones del abordaje externo mediante osteoplastia frontal para casos con dificultades por vía endoscópica. El objetivo de este trabajo es revisar las indicaciones actuales de la osteoplastia frontal en la patología del seno frontal mediante un estudio retrospectivo de pacientes intervenidos de esta técnica.

Métodos: Se realiza un estudio retrospectivo de 14 pacientes intervenidos de osteoplastia frontal en el que se revisaron los criterios de las indicaciones quirúrgicas, tipo de patología del seno frontal, existencia de cirugía endoscópica previa, hallazgos quirúrgicos, complicaciones y recidiva.

Resultados: La patología del seno frontal fue de un osteoma (7,1%), 3 papilomas invertidos (21,4%) y 10 mucoceles (71,4%). Nueve pacientes habían sido intervenidos previamente de cirugía endoscópica. Diez pacientes presentaron una dehiscencia orbitaria (9 casos de mucocele y un caso de papiloma). El osteoma frontal era de grado III y los 3 casos de papilomas correspondían a un grado III de Krouse. El 21,4% requirieron una revisión quirúrgica.

Conclusiones: Las principales indicaciones son la extensión lateral y la neo-ostegónes del receso frontal en el caso de la enfermedad inflamatoria del seno frontal, el tamaño del tumor en el caso de los osteomas, y la implantación multifocal con origen en la pared anterior y lateral en el caso de los papilomas invertidos. En todos los casos la indicación de osteoplastia frontal debe hacerse de forma individualizada.

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Introduction

The osteoplastic flap (OPF) was described by Hoffman in 1904 and was then made popular by Goodale and Montgomery in 1956 with the obliteration of the frontal sinus with fat, which was then considered the gold standard surgical technique for frontal sinus diseases. Later on, in the middle of the 1980s, endoscopic sinus surgery (ESS) became the first choice for the majority of patients with chronic frontal sinusitis and tumours, using the approaches described by Draf. Extended endoscopic procedures, such as the one modified by Lothrop, have increased treatment options. All these advances have meant that OPF has been displaced by endoscopic techniques in the surgical indications for frontal sinus diseases.

The objective of this article is to review the current OPF indications for various types of frontal sinus diseases using a retrospective study on patients operated on with this technique.

Methods

This was a retrospective study on 14 patients who were treated with the OPF procedure from 2006 to 2013. To perform the study, the following data were reviewed: sex, age, follow-up, criteria that led to the performance of external approach using OPF, type of frontal sinus disease, existence or absence of prior endoscopic surgery, surgical findings and occurrence of complications and/or recurrence.

The main criteria that established the indication of OPF instead of the endoscopic approach were:

- In the case of mucoceles, lateral extension (Fig. 1) or the existence of a frontal recess neo-ostegonés.
- In the case of osteoma, tumor size.
- In the case of inverted papilloma, the multifocal implantation, basically in the anterior and lateral walls.

The surgical technique was carried out through bicoronal approaches using of mould of the frontal sinus obtained by Caldwell occipitofrontal radiographic projection.

All the cases had prior radiographic study using computed tomography (CT) scans. If the CT scan revealed a unilateral tumour, magnetic resonance (MR) imaging was performed to differentiate making the sinus opaque through soft tissue from secretion accumulation, as some authors recommend.

Results

The data corresponding to the 14 patients are presented in Table 1. There were 11 male patients (78.5%) and 3 female patients (21.4%). The age ranged from 30 to 70 years, with a mean age of 48 years. Follow-up varied from 12 to 82 months.

The frontal sinus disease in these cases was: 1 osteoma (7.1%), 3 inverted papilloma (21.4%) and 10 mucoceles (71.4%) (Fig. 2). A prior ESS had been performed on 64.2% of the patients; these corresponded to 7 mucocele cases and 2 inverted papilloma cases. With respect to the mucoceles,
the endoscopic surgery was carried out using sinonasal polyposis. In all the cases in which a prior ESS had been performed, there was frontal recess neo-osteo genesis (to a greater or lesser degree), which made endoscopic access more difficult.

The surgical findings consisted of the following: orbital dehiscence in 9 mucocele cases and in 1 papilloma case. The osteoma was Grade IV (Frontal Sinus Grading System)\(^\text{6}\) (Fig. 3) and the papillomas were Krouse Grade III.\(^\text{7}\)

Fat obliteration was performed in all the cases, except in the cases of inverted papilloma. In the patients with inverted papilloma, a Silastic\(^\text{8}\) stent was left in the area of the recess and ostium for 1 week. In cases in which there was orbital dehiscence, reconstruction was only carried out with titanium mesh in 2 cases in which the erosion was very large. In the remaining cases, reconstruction was performed with fascia. One of these 2 cases involved a review OPF surgery that was performed at 12 months; in this case, there was also an erosion of the anterior wall of the frontal sinus, which was closed with bone cement.

As for the surgical complications, only an important facial oedema was found in 1 case and a sensation of cephalic pressure in another. Both complications were resolved in the following 48 h.

Surgical review was necessary in 21.4% of the patients. Specifically, there was an OPF review in 1 papilloma case and a review of navigator-assisted ESS in 1 mucocele case that had been performed in another centre.

**Discussion**

The principal indications for OPF are currently the cases that are inaccessible using the endoscopic approach. The most important considerations for various pathologies are as follows:

**Frontal Sinus Mucoceles**

The current indications for OPF in inflammatory frontal sinus diseases are frontal recess neo-osteo genesis and a very lateral location of the pathological mucosa.\(^\text{8}\) These conditions could lead to a failure in the endoscopic approach.

In our series, we found frontal recess neo-osteo genesis to a greater or lesser degree in the cases treated using ESS, which made endoscopic access more difficult in all of them. Other possible causes of neo-osteo genesis are trauma or cholesterol granulomas, which were not present in our series. It is sometimes necessary to carry out “above and below” combined approaches, in which the frontal duct is identified above and completed posteriorly below.\(^\text{8}\)\(^\text{,}\)\(^\text{9}\)

In all our mucocele cases, the OPF was not indicated for the frontal recess neo-osteo genesis alone. In addition, there was a very lateral location of the pathological mucosa that, as has already been mentioned, can be inaccessible with the endoscopic instruments.\(^\text{10-14}\)

The OPF is sometimes the main procedure. However, it can also be part of a procedure combined with endoscopy; an example is what happens with Kuhn Type 3 or 4 cells, located in the superolateral aspect of the frontal sinus. This location makes it impossible to resect with a single endoscopic approach.\(^\text{8}\) In our series, there were no cells of these characteristics.

Erosion of the anterior table by a mucocele is another of the indications for the OPF.\(^\text{13}\) In our series, this presented in 1 case, and bone cement was used for reconstruction.

An alternative to the OPF is the endoscopic technique as modified by Lothrop.\(^\text{4}\) With this technique, the possibility of scabs, polyps or granulomas forming makes it necessary to maintain the permeability of the frontal sinus duct. This can be handled with a silicone Silastic\(^\text{8}\) stent or by using mitomycin C. It can be an intermediate step between the ESS and the OPF,\(^\text{15}\) although we did not feel it was indicated in any of the cases in our series.

According to some authors,\(^\text{16,17}\) the index of recurrences in inflammatory frontal sinus disease that require review surgery is 10%. In our series, there was a recurrence of the disease in 2 of the 10 mucocele cases, representing 20%, somewhat greater than that found in the literature.

**Frontal Sinus Osteoma**

In the case of frontal sinus osteomas, the OPF is indicated in Grade III and IV osteomas (Chiù\(^\text{8}\) grading system for frontal sinus osteomas). However, not all authors agree with this
<table>
<thead>
<tr>
<th>Patient</th>
<th>Indication</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Prior surgery</th>
<th>Follow-up (months)</th>
<th>Findings/Extension</th>
<th>Complications</th>
<th>Reconstruction</th>
<th>Review surgery</th>
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<tbody>
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<td>1</td>
<td>Osteoma</td>
<td>F</td>
<td>48</td>
<td>No</td>
<td>82</td>
<td>FSOGS Type IV, with lateral extension, without orbital invasion</td>
<td>No</td>
<td>SOF</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Mucocele</td>
<td>M</td>
<td>50</td>
<td>ESS</td>
<td>79</td>
<td>Thinning of the anterior and inferior wall, with lateral extension and dehiscence of the right orbital roof</td>
<td>No</td>
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<td>No</td>
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<td>3</td>
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<td>M</td>
<td>43</td>
<td>ESS</td>
<td>58</td>
<td>Grade IV, Krouse Stage III, Nasal fossa Polyps</td>
<td>No</td>
<td>TR</td>
<td>Review ESS</td>
</tr>
<tr>
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<td>F</td>
<td>64</td>
<td>No</td>
<td>56</td>
<td>Expansive mass in the left frontal sinus, with orbital roof erosion</td>
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<td>SOF, fascia</td>
<td>No</td>
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<tr>
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<td>34</td>
<td>ESS</td>
<td>55</td>
<td>Occupation of the frontal sinus with lateral extension and super-medial orbital dehiscence</td>
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<td>SOF, fascia</td>
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<td>M</td>
<td>70</td>
<td>ESS</td>
<td>52</td>
<td>Complete occupation of the right frontal sinus and ethmoids with lateral expansion of the frontal sinus</td>
<td>Cephalic pressure</td>
<td>SOF</td>
<td>No</td>
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<tr>
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<td>ESS</td>
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<td>Occupation of both frontal sinuses, with lateral expansion of the right sinus and focal dehiscence of the orbital roof</td>
<td>No</td>
<td>SOF, fascia</td>
<td>No</td>
</tr>
<tr>
<td>Patient</td>
<td>Indication</td>
<td>Sex</td>
<td>Age (years)</td>
<td>Prior surgery</td>
<td>Follow-up (months)</td>
<td>Findings/Extension</td>
<td>Complications</td>
<td>Reconstruction</td>
<td>Review surgery</td>
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<td>71</td>
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<td>No</td>
<td>SOF, fascia</td>
<td>Recurrence (3 m) navigator-assisted ESS</td>
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<tr>
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<td>F</td>
<td>49</td>
<td>ESS</td>
<td>39</td>
<td>Bulging of the left medial and lateral sinus wall with rupture of the orbital roof</td>
<td>Facial oedema</td>
<td>SOF, fascia</td>
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<td>M</td>
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<td>ESS</td>
<td>36</td>
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<td>No</td>
<td>SOF, fascia</td>
<td>No</td>
</tr>
<tr>
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<td>Mucocele</td>
<td>M</td>
<td>30</td>
<td>No</td>
<td>28</td>
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<td>No</td>
<td>SOF</td>
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</tr>
<tr>
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<td>15</td>
<td>Krouse Stage III Papilloma with orbital invasion</td>
<td>No</td>
<td>TR</td>
<td>No</td>
</tr>
<tr>
<td>13</td>
<td>Inverted papilloma</td>
<td>M</td>
<td>46</td>
<td>ESS</td>
<td>12</td>
<td>Krouse Stage III Papilloma with erosion of the medial and lateral orbital walls</td>
<td>No</td>
<td>TR</td>
<td>No</td>
</tr>
<tr>
<td>14</td>
<td>Mucocele</td>
<td>M</td>
<td>58</td>
<td>No</td>
<td>12</td>
<td>Lateral extension, erosion of the anterior sinus wall, rupture of the superior orbital wall</td>
<td>No</td>
<td>SOF, reconstruction with titanium plate</td>
<td>No</td>
</tr>
</tbody>
</table>

ESS: endoscopic sinus surgery; F: female; FSOGS: frontal sinus osteoma grading system; M: male; OPF: osteoplastic flap; SOF: sinus obliteration with fat; TR: tract recanalization.
indication, considering the Lothrop neuronavigator-assisted technique sufficient. The OPF is only indicated if there is erosion of the posterior table by the osteoma, with intracranial extension. In our series, there was only 1 case of Grade IV osteoma; we elected to perform an OPF because of the great difficulty involved in the endoscopic approach. For this case, we performed a fat obliteration, although some authors consider that this could be avoided if the frontal sinus mucosa is very carefully conserved.

**Inverted Papilloma of the Frontal Sinus**

From 1% to 16% of the inverted papilloma originate in the frontal sinus. In these cases, the OPF is only indicated for papillomas with multifocal implantation that mainly affects the anterior and lateral walls. In our series, all 3 inverted papilloma were Type III according to the Krouse classification system, with affectation of all the walls of the frontal sinus.

Some authors, such as Skolnik et al. and Krouse, recommend the Lothrop technique for tumours located in the medial wall, reserving the OPF for the cases with lateral and superior extension. However, other authors consider that, with the accumulated experience in endoscopic techniques and with the help of the navigator-guided techniques, the first choice in all cases should be an endoscopic technique. Lombardi et al. and Carta et al. believe that the combined approach should be selected in only the case of hyper-pneumatized frontal sinus, in which there is a massive extension of the tumour or when there are extremely pneumatized supra-orbital cells.

Some authors question the use of the Lothrop technique in the approach to the frontal sinus papilloma. Their opinion is that the greatest difficulty lies in the limited accessibility for properly delimiting the tumour in a highly pneumatized supra-orbital recess, especially if there is dehiscence and the tumour extends and affects the peri-orbital. The anteroposterior frontal sinus being less than 1 cm can also be a limiting factor. Another argument against using this technique is the possibility of extending the disease to the contralateral when the interfrontal septum is drilled in a unilateral case of the disease. However, an advantage of this technique in bilateral cases of the disease is the creation of a single conduct through which both sinuses can be drained, in addition to facilitating endoscopic control in the postoperative follow-up.

In all the papilloma cases in our series, a CT scan and MR imaging were performed to differentiate a tumour from obstructed secretions. However, it was difficult to define tumour origin, which was handled primarily at the intraoperative level. This situation is very similar to the one that we found in other publications.

Some studies present a recurrent rate of 15% for the papillomas treated with OPF. In our case, there was a recurrence in 1 of the 3 papilloma cases treated with the external approach. However, in our series the presence of this type of pathology was limited.

We should also mention that there is a generalised consensus that the frontal sinus should not be obliterated in the inverted papilloma treated with the OPF.

To close this discussion, we cannot forget that the OPF is a technique that is not free from complications. Some authors, such as Hardy and Montgomery, present a general rate of complications of 19% whatever the underlying pathology of the frontal sinus, and they include hematomas, abscesses, abdominal infections and cerebrospinal fluid fistulas. There were no important intra- or postoperative complications in our series.

**Conclusions**

The OPF still has some indications in the current period in which the endoscopic approach dominates. Its main indications are lateral extension and frontal recess neo-osseogenesis in the case of inflammatory frontal sinus disease, the size of the tumour in osteomas, and multifocal implantation with origin in the anterior and lateral wall in the case of the inverted papilloma. In all of these cases, using the OPF should be individualised.

**Conflict of Interests**

The authors have no conflicts of interest to declare.
References