

# A rhinological approach for the craniofacial resection of the ethmoid

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## SUMMARY

*The craniofacial resection of the ethmoid is a surgical procedure directed at total extirpation of tumours that extend through the floor of the anterior cranial fossa. We have developed an original approach of the anterior cranial fossa through an osteoplastic frontal flap that has been utilized in a variety of problems of the frontal sinus. The procedure is completed with a facial approach. Different from other types of craniectomy that have been proposed, this method avoids both cosmetic deformity and infectious complications.*

## INTRODUCTION

In the surgery of ethmoidal carcinomas recurrence in the base of the skull is one of the most common causes of failure and it is mainly due to an inadequate margin of healthy tissue in the roof of the nasal cavity.

Furthermore, frequently the tumour is found to have affected the medial portion of the anterior cranial fossa when the diagnosis is established. In order to resect this portion "en bloc" together with the remainder rhinosinusal tumour, a combined craniofacial approach has been proposed. For these purposes the following methods have been advocated, a small frontal triangular craniectomy (Sisson et al., 1976) or an enlarged frontal burr hole (Ketcham et al., 1973; Clifford, 1977), or a large bifrontal quadrangular craniotomy (Shah and Galicich, 1979). In addition, Bridger and Shaheen (1968) have described a transfrontal sinotomy approach to the ethmoids removing the anterior wall of the frontal sinus, but this method has the disadvantage of a residual cosmetic deformity. All these procedures are unsuitable because craniectomy goes partially through the frontal sinus or removes a portion of their anterior wall. When the bone is placed, or substituting silastic plate, there is a great possibility of bad viability because, on the one hand the bone is connected with a septic cavity and, on the other hand, the dura is not isolated from the nasal cavity.

In order to avoid these problems, we have developed a rhinologic approach, that up to the present has only been performed in the surgery of chronic diseases of the frontal sinus (Sessions et al., 1972; Montgomery, 1971), fronto-orbital fractures (Sessions, 1972; Montgomery, 1971; Newman, 1973) and cerebrospinal fluid rhinorrhea (Bremond et al., 1984).

### SURGICAL TECHNIQUE

The coronal incision is used and the flap is elevated inferiorly in a plane between the frontalis muscle and the periosteum over the frontal bone, exposing the supraorbital rims and the nasal process of the frontal bone. A X-ray template of the frontal sinus is taken and placed over the frontal periosteum. The template is positioned so that it accurately approximates the supraorbital rims on each side. An incision is made in the periosteum around the outline of the template except in its inferior horizontal part. The bone incision is made at such a level that it certainly enters the frontal sinus. The osteoplastic flap is then elevated by prying with a chisel at the superior aspect of the bone incision. As the flap reflects downward, there is a fracture across the floor of the frontal sinuses. After the osteoplastic flap has been reflected inferiorly the mucous membrane is removed from the frontal sinus and then a burr is used to remove the inner cortical lining. The next step is to remove the posterior wall of the frontal sinus with a cutting burr, because the dura of the frontal pole is exposed from the base of the skull. As the dura is progressively displaced backwards, the crista galli is exposed. Subsequent dissection will be easier if the crista galli is removed, because the dura is very adherent in the narrow cleft between the crista galli, its alar process and the orbital plate of the frontal bone. A small opening may be made in the dura during this stage and when the dissection enters in a horizontal plane along the superior surface of the cribriform plate. Dissection of the dura proceeds posteriorly until the ethmoidal spine of the sphenoid and the frontosphenoidal suture are uncovered and laterally over the orbital plate of the frontal bone (Figures 1 and 2). If the dura is involved, it should be resected, replacing it by fascia or lyophilized dura.

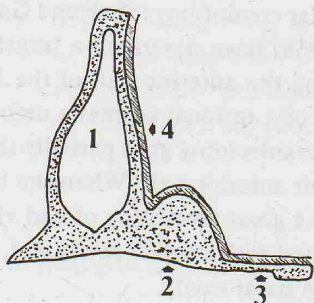


Figure 1. 1. Frontal sinus.  
2. Crista galli. 3. Cribriform plate.  
4. Dura.

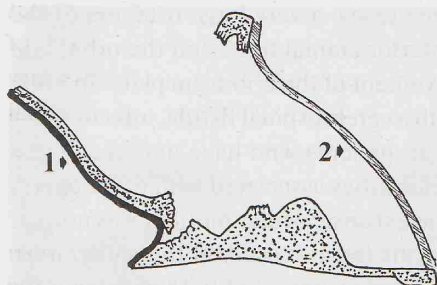


Figure 2. The osteoplastic flap has been fractured inferiorly and reflected forward (1). The posterior wall of the frontal sinus has been removed and the dura (2) displaced backward.

At this point we proceed to perform the osteotomies. The anterior line of section will be through the floor of the frontal sinuses, anterior to the base of the crista galli. Having completed the anterior section, sagittal cuts are made through both orbital plates of the frontal bone back to the frontal sphenoidal fissure. In the healthy side, the sagittal osteotomy is carried out more medially, directing the chisel towards the middle meatus instead of the orbital contents. The line of section of the posterior margin is made through the jugum sphenoidale, so that the anterior wall and part of the floor of the sphenoidal sinus are included. When a total ethmoidectomy without clearance of one orbit is required, a Moure's lateral rhinotomy incision is used. The orbital periosteum is elevated laterally, exposing the lacrimal sac, the lamina papyracea and, partially, the roof and the floor of the orbit. An osteotome is placed between the nasal bone and the ascending process of the maxilla, and the anterior osteotomy is performed. The superior osteotomy correspond to the endocranial sagittal osteotomy previously made. Subsequently, the ethmoid is transected behind the level of the posterior ethmoid artery, and inferiorly across the medial part of the roof of the maxillary sinus. Finally, the nasal septum is cut through its anterior and inferior borders with strong scissors. The specimen is then mobilized from the cranial cavity to the facial approach, and the entire ethmoid is removed "en bloc".

When the tumour has been resected, small dural tears are sutured and the defect created in the floor of the anterior cranial fossa is reconstructed with fascia lata or lyophilized dura. A split skin graft is used to cover the undersurface of the surgical defect. Subcutaneous adipose tissue is taken and fashioned so that it completely fills the gap between the anterior wall of the frontal sinus and the dura, obstructing the superior aspect of both nasofrontal ducts. The osteoplastic flap is returned to its original position, and the periosteum sutured.

## RESULTS

In the past we used a combined craniofacial approach by means of a conventional bifrontal craniectomy in six carcinomas of the ethmoid involving their roof and, partially, the anterior cranial fossa. Since then, we have performed a craniofacial



approach through the frontal sinus in three cases: a very large osteoma of the ethmoidal frontal region involving the anterior cranial fossa and the orbit, and two carcinomas of the ethmoid with involvement of the cribriform plate. In none of these three cases we have had to deal with a cerebrospinal fistula, infection nor any other complication. Facial deformity in patients who have undergone this operation has been no greater than the deformities associated with other operations in this area for different purposes. The extrinsic ocular motility was normal (Figures 3 and 4). All the patients tolerated the fat graft used for the obliteration well and remained asymptomatic after a follow-up period of 9–18 months. As a result of the olfactory nerves transection, anosmia is the only sequelae present in those patients.

#### COMMENTS

The rhinological approach through the frontal sinus in the craniofacial resection of the ethmoid offers many advantages. It allows an otolaryngologist to perform the entire operation by himself. Furthermore, the osteoplastic flap is covered by periosteum and has an excellent viability, much better than a replaced bone in the bifrontal craniectomy or their substitution by silastic. The obliteration of the frontal sinus avoids mucocoeles and infectious complications, and their spreading to the cranial cavity.



Figure 3. Postoperative radiography of one of the patients operated.

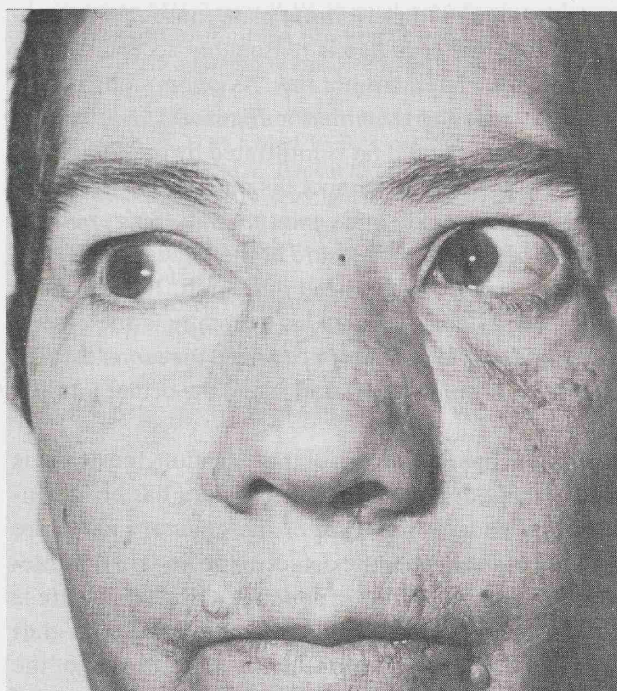


Figure 4. Cosmetic result of the operation in a patient.

The approach to the frontal sinus is usually accomplished by means of a supra-orbital or coronal incision (Montgomery, 1971). We prefer the coronal incision, because then the sensibility of the skin of the forehead is preserved and, mainly in women, the scar is hidden under the hair.

The main contraindication for the approach of the anterior cranial fossa through an osteoplastic frontal flap is a very small frontal sinus. If this is the case, a conventional bifrontal craniectomy is recommended. On the other hand, if the frontal sinus is extending far both superior and laterally, there may be some problems in removing the mucosa completely. However, this is not an absolute contraindication unless the complete removal proves to be impossible.

Both in the conventional bifrontal craniectomy and in the procedure that we advocate, a wide lateral and posterior exposure of the floor of the anterior cranial fossa is required. This exposure allows dural involvement to be assessed, excised and repaired under direct vision and provides enough room to perform the osteotomies. Whatever approach used, the separation of the dura covering the antero-inferior surface of the frontal lobes from the frontal bone and the transection en bloc of the ethmoid, result in a bilateral anosmia (Ketcham et al., 1973; Clifford, 1977; Som et al., 1986). Taking into account that a craniofacial resection of the ethmoid is performed only in case of oncological problems, and



also that in these cases the involvement of the cribiform plate causes a preoperative unilateral or bilateral anosmia, this sequelae is reasonably acceptable.

The facial stage is carried out through a lateral rhinotomy. As is common in carcinomas of the ethmoid with no extension to the anterior cranial fossa, an orbital exenteration is only required when the orbital fat is infiltrated by the tumour. If orbital exenteration is indicated a pediculated temporalis muscle flap is used to obliterate the orbit through an opening made in its external wall (Suárez Nieto, 1981). In this way the muscle will reinforce the closure of the bone defect in the base of the skull provided by a fascial or lyophilized dura graft. If it has been decided that clearance of the orbit is not indicated, as generally is the case in ethmoidal carcinomas (Elner and Koch, 1974), there is no need to reconstruct the internal orbital wall, being both the cosmetic appearance and the ocular motility normal.

If the dura has been included in the superior margin of the resection, the defect is repaired with a fascial or lyophilized dura graft. When the dura has been conserved, the small dural openings made at the level of the olfactory nerve are sutured. Septal cartilage has been used to cover the defect in the floor of the anterior cranial fossa (Sisson et al., 1976), but in our experience a perfect closure is obtained with a graft of lyophilized dura placed under the dura and a skin graft applied to the roof of the nasal cavity. The gap between the anterior wall of the frontal sinus and the dura need to be filled. This can be accomplished by means of a free graft of fat or muscle. Fat obliteration of the frontal sinus has been extensively used in the frontal sinus surgery and both clinically and experimentally has proved to be well tolerated even in an infected sinus (Montgomery, 1971; Sessions et al., 1972). Removal of the inner cortical lining of the sinus is an important factor in successful fat obliteration, and it is essential that a high speed burr be utilized for this purpose (Montgomery, 1971).

Finally, the long term follow-up of the fat implant has shown no signs of recurrent infection or any other problems in most of the patients (Session et al., 1972).

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