

## MINIREVIEW

# ETHMOIDECTOMY – PROCEDURES AND COMPLICATIONS

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### ABSTRACT

Ethmoid sinusitis is one of the most complicated pathologies in ear, nose, and throat (ENT) practice. Because of its anatomical particularities, ethmoid sinusitis can easily become a dangerous pathology, difficult to treat. The first method of treatment is usually proper medication, but sometimes it can be difficult to manage without surgery. Surgery may be performed, the most used being the intranasal (endoscopic) ethmoidectomy. Other types of surgical interventions are external ethmoidectomy and transantral ethmoidectomy. Each approach has advantages and disadvantages. The potential complications of endoscopic surgery are: orbital injury, blindness, orbital hematoma, epiphora, and postoperative epistaxis. Skull base injury and cerebrospinal fluid leak are very rare complications that should be discussed with patients undergoing endoscopic sinus surgery. Regardless of the approach used, the surgeon must be familiar with the anatomy and aware of all pertinent landmarks to reduce the risk of complications. Attention must be paid to avoid violating the cribriform plate or inadvertently entering the orbit.

**Key-words:** ethmoid sinusitis, ethmoidectomy, orbital injury, external ethmoidectomy.

### RÉSUMÉ

#### L'ethmoïdectomie: procédés et complications

La sinusite ethmoïdale est l'une des pathologies les plus compliquées dans la pratique d'ORL. En raison de ses considérations anatomiques, la sinusite ethmoïdale peut facilement devenir une pathologie dangereuse qui peut être difficile à traiter. La première méthode de traitement est généralement un médicament approprié, mais parfois la pathologie est difficile à gérer sans intervention chirurgicale. La chirurgie peut être effectuée, la plus utilisée étant l'ethmoïdectomie intranasale (endoscopique). D'autres types de chirurgie sont: l'ethmoïdectomie externe et l'ethmoïdectomie transantrale. Chaque approche présente des avantages et des inconvénients. Les complications potentielles de la chirurgie endoscopique sont: les lésions orbitales, la cécité, l'hématome orbitaire, l'épiphora et l'épistaxis postopératoire. Les blessures à la base du crâne et la fuite de liquide céphalo-rachidien sont des complications très rares qui devraient être discutées avec les patients soumis à une chirurgie endoscopique des sinus. Indépendamment de l'approche utilisée, le chirurgien doit connaître l'anatomie et tous les repères pertinents pour réduire le risque de complications. Il faut veiller à ne pas violer la plaque cribriforme ou à entrer par inadvertance sur l'orbite.

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## ANATOMICAL CONSIDERATIONS

The ethmoid sinuses develop during infancy and expand during the early childhood. The ethmoid sinuses are paired and they are divided into anterior and posterior ethmoid air cells. This division is provided by the basal lamella of the middle turbinate. The ethmoid sinus in adults has an average length of 4.5 cm and a height of approximately 3 cm<sup>1</sup>.

The walls of the ethmoid sinus are composed of the maxillary, palatine, lacrimal, frontal and sphenoid bones. Medially to the sinus we find the lamina papyracea – the medial wall of the orbit and superior the fovea ethmoidalis. The ultimate pathway for the secretions from the anterior ethmoid air cells is the osteomeatal complex, in the middle meatus. The posterior air cells drain into the superior meatus. The infundibulum of the ethmoid represents a cleft that is demarcated by the uncinat process on its medial side and the lamina papyracea on its lateral side<sup>2</sup>.

## INDICATIONS FOR SURGERY

The main indication is reserved for patients who have not responded to medical therapy of 3-6 weeks of antibiotics, nasal steroids, and nasal saline irrigations. Ethmoid sinusitis can spread outside of the borders of the sinus and cause an orbital cellulitis, orbital subperiosteal abscess, orbital abscess, superior orbital fissure syndrome, or cavernous sinus thrombosis. This last condition can result in limited ocular motility, proptosis, and loss of vision and can be life threatening. If any of these complications appears, surgery is required. Intracranial complications from sinusitis are fortunately rare, but can have high morbidity and mortality. These complications include meningitis, thrombophlebitis of the superior sagittal sinus, and abscess formation<sup>3</sup>.

In order to perform surgery, confirmatory computed tomography (CT) scans are necessary. CT scans should be obtained to determine the extent of the ethmoidectomy needed. The degree of surgery required is determined by the extent of the disease. The use of image-guidance systems, that correlate the intraoperative position of the instrumentation with the CT-scan anatomy, may reduce complications in adjacent structures during the more posterior dissection<sup>4</sup>. Findings may include significant mucosal thickening, air-fluid levels, osteomeatal complex obstruction, polyposis, or calcification suggestive of fungal sinusitis.

**Mots-clés:** sinusite ethmoidale, ethmoidectomie, lésion orbitale, ethmoidectomie externe.

When looking on a preoperative CT scan, attention should be paid to<sup>5</sup>:

- The insertion of the uncinat process.
- The dehiscence of lamina papyracea.
- The dehiscence of the skull base.

## SURGICAL CONTRAINDICATIONS

Surgical intervention for acute ethmoid sinusitis is contraindicated in candidates who are unable to undergo the risks of anesthesia. Bleeding dyscrasias may also be a relative contraindication to surgery. Lawson stated that patients with a defect in the lamina papyracea, fovea ethmoidalis, or the cribriform plate should not have an ethmoidectomy from the intranasal approach. However, not all surgeons agree with this<sup>6</sup>.

## PREOPERATIVE STEPS

- Written consent should be obtained prior to any surgical procedure. The possible risks of this surgery are: orbital injury, blindness, nasolacrimal duct injury, epiphora, epistaxis, cerebrospinal fluid leak, meningitis and brain abscess, and, of course, persistent rhinosinusitis.
- If an active infection is present, a preoperative antibiotic course may be administered during the weeks prior to surgery. A preoperative steroid course may be administered if significant edema or polyps are observed on clinical examination<sup>7</sup>.

## SURGICAL OPTIONS

### Ethmoidectomy

An ethmoidectomy is performed using one of 3 major approaches: the external ethmoidectomy, the intranasal (endoscopic) ethmoidectomy, and the transantral ethmoidectomy. Each approach has its advantages and disadvantages. Usually, the decision on which method to be used is based on the surgeon's preference and the extent of the disease. Sometimes, because of the extent of the disease, more than one approach may be combined during the surgical intervention<sup>8</sup>.

Regardless of the approach used, the surgeon must be familiar with the anatomy and aware of all pertinent landmarks to reduce the risk of complications. The most frequent complications are violating the cribriform plate or inadvertently entering the orbit. It is important to avoid injury of the septal

mucosa, because bleeding would obscure the view. If bleeding appears, it must be controlled using cautery, thrombin, Gelfilm, Gelfoam, Surgicel, or Merocel, or with packing containing cocaine, adrenaline, phenylephrine, or oxymetazoline<sup>9</sup>.

### EXTERNAL APPROACH

This surgery can be performed under monitored anesthesia sedation or general anesthesia. General anesthesia may be preferred, because manipulating the globe can be uncomfortable for the patient. An incision approximately 2.5-3 cm long is made, in a curvilinear manner. It is positioned at the midpoint between the medial canthus and the middle of the anterior nasal bone. The skin is incised, and the dissection is carried down to the periosteum. If the angular artery is transected, it is cauterized or ligated. Dissection is carried subperiosteally to the posterior lacrimal crest, avoiding damage to the lacrimal excretory structures<sup>10</sup>.

The medial canthal tendon may need to be released, to allow an easier access to this area; if this is done, care must be taken to reposition it correctly. The posterior crest may need to be removed. Care must be taken not to extend the dissection superiorly to the frontoethmoid suture, as this demarcates the cranial fossa<sup>11</sup>.

### Intranasal ethmoidectomy

Achieve topical decongestion by inserting ribbon gauze or neurosurgical patties, soaked in 2 ml of 1:1000 adrenaline, between the inferior turbinate and the nasal septum and in the middle meatus, if possible. Carefully inspect the nose with the endoscope; this is an essential step before beginning any procedure. Always examine the postnasal space for lesions or adenoidal tissue. Pay careful attention to the inferior and middle turbinates, including the axilla of the middle turbinate (conchae, hypertrophy, paradoxical turbinates), the nasal septum (deviation, spurs which may impede surgical access to middle meatus), uncinat process (may be everted) and ethmoid bulla (most constant landmark)<sup>12</sup>. Inject local anaesthetic and adrenaline, using a dental syringe into the nasal septum (if septoplasty required) middle turbinate, and inferior turbinate (very slow injection into turbinates). In- and outfracture the inferior turbinate, to improve access to the uncinat process and middle meatus. Care must be taken not to manipulate the middle turbinate too vigorously, as this might cause a cerebrospinal fluid (CSF) leak. It is important to mobilise the middle turbinate only at its posterior aspect, where it is more mobile, and not anteriorly. Identify the free posterior edge of the

uncinat process in front of the ethmoid bulla. The uncinat process always lies posterior to the anterior aspect of the middle turbinate<sup>13</sup>. Do not confuse the uncinat process with the maxillary line (frontal process of maxilla). Insert a ball probe through the hiatus semilunaris, behind this free edge. The natural ostium of the maxillary sinus lies at the level where the inferior edge ethmoid bulla intersects with the free posterior edge of uncinat process. Gently elevate the uncinat process anteriorly, thus creating some space behind it; the ball probe is now in the infundibulum. Take care not to overmanipulate or overmedialise the middle turbinate, as fracturing the superior attachment of the middle turbinate at the lateral lamella of the cribriform plate may cause a CSF leak. Use a 45° backbiter / side-biter to complete the uncinectomy. Insert a closed 45° backbiter up to face of ethmoid bulla in middle meatus. It is important to resect the uncinat with all its three layers (mucosa/bone/mucosa). After uncinat process has been removed, the agger nasi, ethmoid bulla can be seen. The lateral attachment of the ethmoid bulla represents the 2<sup>nd</sup> lamella. The straight curette and 45° Blakesley are the most important instruments for ethmoidectomy; the curette is used to break the bony lamellae and the 45° Blakesley is used to remove the cells. First, open the bulla ethmoidalis by placing a straight curette behind the ethmoid bulla, into the retrobullar recess or into the bulla from below, and breaking the bulla down by moving the instrument towards yourself. Other anterior ethmoid air cells are similarly opened. Once the cell walls are fractured, remove them with a 45° Blakesley<sup>14</sup>. Remember never to pull on any tissue; the basal lamella of the middle turbinate now comes into view. The lateral insertion of the middle turbinate to the lamina papyracea is called the basal lamella. It is posterior to the bulla ethmoidalis and separates the anterior from posterior ethmoid air cells, and represents the 3<sup>rd</sup> lamella. An Onodi cell is associated with an increased risk of optic nerve injury (15% dehiscence in Onodi cell) as it is often closely related to the optic nerve and care needs to be taken not to injure the optic nerve within this cell. It is also associated with carotid artery injury (20% dehiscence in Onodi cell) or brain injury. Use a straight curette to break down the posterior ethmoid cells, working from posteriorly to anteriorly and away from the skull base. Once the frontal recess area is reached, care needs to be taken to avoid injury to the anterior ethmoid artery<sup>15</sup>.

### Transantral approach

This surgery can be performed under monitored anesthesia sedation or general anesthesia. A Caldwell-Luc approach is used. Once the maxillary

sinus has been entered, the medial and superior walls of the maxillary sinus are identified. At the midpoint of the medial wall, the bulla ethmoidalis may be seen bulging into the maxillary sinus<sup>16</sup>. A curette is used to enter this area and this allows access to the anterior cells, but the most anterior cells may be difficult to reach. The posterior cells of the ethmoid sinus can also be reached.

### Postoperative steps

The stomach and nasopharynx should be suctioned prior to extubation. After extubation, the patient is taken to the postoperative care unit for recovery. Once the patient is awake, he or she is examined, to check extraocular motility and to look for evidence of excessive bleeding or proptosis. If the patient is doing well, he may be discharged home, after all post-anesthesia protocol parameters have been applied<sup>17</sup>.

### Postoperative follow-up

Postoperative care of the patient with chronic sinusitis is essential for long-term success. The patient is discharged with appropriate pain medications and instructions for nasal saline irrigations. The patient returns for the first postoperative visit 3-5 days after surgery. At this time, the middle meatus packing is removed and all crusts and dried blood clots are carefully débrided. Weekly follow-up may be needed for the first month; biweekly follow-up with débridements may be indicated for the second month<sup>18</sup>.

Further follow-up is then determined by the severity of the patient's disease, healing, and symptoms.

Further medical management after surgery, using antibiotics, nasal steroids, antihistamines, allergy medications, and oral steroids, is individualized based on the patient and further flares of sinusitis<sup>19</sup>.

### SURGICAL COMPLICATIONS

Overall, the complication rate for ethmoid sinus surgery has been reported to be 2-17%<sup>20</sup>. External approach complications may be:

- cutaneous scar that could lead to medial canthal webbing, telecanthus, and medial canthal dystopia, especially if the medial canthal tendon is released and not properly repositioned.
- periorbital edema, injury to the extraocular muscles with diplopia, paresthesias in the distribution of the supraorbital, supratrochlear and infratrochlear nerve distributions, and blepharoptosis can also occur<sup>21</sup>.
- the globe also can be injured.
- blindness can occur, from either a hematoma or excessive pressure on the globe, occluding the central retinal artery during the surgery.

Endoscopic approach complications are<sup>22</sup>:

- orbital hematoma and blindness;
- diplopia can occur if an extraocular muscle, usually the medial rectus, is injured;
- blindness due to resection of the optic nerve;
- synechia and ostial closure;
- CSF leaks.

Most of these complications will solve with conservative treatment; however, if a leak is extensive and noted at the time of surgery, it should be addressed and repaired with dura, fat, mucosa, and/or fibrin glue.

Transantral approach complications are<sup>23</sup>:

- damage to the dentition, oral-antral fistula formation;
- paresthesias in the distribution area of the infraorbital nerve;
- paresthesias in the gingivobuccal sulcus and alveolar ridge.

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