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Brief Overview about Frontal sinus surgery

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Abstract: The ideal treatment for diseases of the frontal sinus is one that will provide complete relief of symptoms, eradicate the underlying disease process, preserve the function of the sinus, and cause the least morbidity and the least cosmetic deformity. Despite more than two centuries since the description of the first procedure on the frontal sinus, the optimal procedure remains unclear. Although frontal sinus surgery makes up only a small portion of all paranasal sinus surgery, the literature is filled with publications on this subject. Ellis in 1954 stated that "surgical treatment of chronic frontal sinusitis is difficult, often unsatisfactory, and sometimes disastrous. The many surgical techniques available are expressions of our uncertainty and perhaps our failure". The concept of FESS is the removal of tissue obstructing (OMC) and the facilitation of drainage while conserving the normal non-obstructing anatomy and mucous membrane. The rigid fiberoptic nasal telescope provides superb intra-operative visualization of the OMC, allowing the surgery to be focused precisely on the key areas. The image can be projected onto a television monitor through a small camera attached to the eyepiece of the endoscope. Micro debrides remove pathologic tissue while preserving normal mucosa

Keywords: *Frontal sinus surgery*

Introduction

The frontal sinus is a triangular, pyramid-shaped cavity extending between the anterior and posterior tables of the ascending portion of the frontal bone. The anterior wall of the frontal sinus forms the forehead and is by far the thickest of all sinus walls, measuring up to 12mm. The posterior wall is a plate of thin, compact bone (1–2 mm) whose upper part is vertical. It gradually curves downward and posteriorly until it is almost horizontal. The posterior wall of the frontal sinus also represents the anterior wall of the anterior cranial fossa and can extend as far posteriorly as to the lesser wing of the sphenoid bone. The medial wall of the frontal sinus is formed by the inter sinus septum. The inferior wall of the frontal sinus is formed by the orbital roofs on the lateral side and the Naso ethmoid floor on the medial side. The most anterior area of the frontal sinus floor is directly above the internal nasal spine [1].

Frontal sinusitis:

Frontal sinusitis is inflammation or infection of the sinuses. The sinuses are a system of connected hollow cavities in the face that contain air and a thin layer of mucus. All sinuses produce mucus that moisturizes the

airways and drains into the nasal passages. If the frontal sinuses are inflamed or infected, they cannot drain mucus efficiently, and this can make breathing difficult. It can also lead to a feeling of increased pressure around the eyes and forehead. When frontal sinusitis symptoms last for less than 4 weeks, it is defined as acute frontal sinusitis [2, 3, 4].

Mucociliary clearance in the frontal sinus occurs in a counter clockwise direction in the right sinus and in a clockwise direction in the left. Secretions are transported along the septal wall to the sinus roof and from there, laterally along the roof and then medially along the floor to reach the ostium. Secretions that are retained because of obstruction serve as a nidus and as growth media for infections. Given the close anatomic relationship of the ethmoid and frontal sinuses, obstruction of the ethmoid air cells often leads to acute frontal sinusitis. This obstruction may be caused by nasal polyps, tumour, severe septal deviation, trauma, chronic mucosal inflammation, or acute infection. Obstruction impedes the drainage of the frontal and ethmoid sinuses via the frontal recess and impairs mucociliary function [5, 6, 7].

Frontal sinusitis diagnosed after performing a physical examination and taking note of a person's symptoms and medical history. Imaging techniques, such as CT and MRI scan can show the extent of sinusitis and, in some cases, the most likely underlying cause. Scans are not usually required for cases of acute frontal sinusitis

If frontal sinusitis occurs frequently, a nasal endoscopy can be a useful diagnostic procedure, during which the doctor uses a thin tube with a light and imaging source to capture pictures of the inner sinuses. The doctor can then view these pictures on a computer screen and recommend appropriate treatment [2, 3, 4].

Radiology of the frontal sinus:

Computerized tomography (CT) scans:

In the 1980s, functional endoscopic Sinonasal surgery (FESS) supplanted external procedures (e.g., the osteoplastic flap and Caldwell-Luc operations) for the surgical management of rhinosinusitis, which has required much greater anatomic precision than is provided by plain film radiographs [8].

So, CT has become the primary imaging modality for assessing inflammatory sinus disease and replaced plain film radiographs as the mainstay in evaluating Sino nasal disease. Using helical CT scanners, high quality axial reformatted images may be created from coronal images. Alternatively, direct axial CT imaging may be performed with subsequent creation of coronal reformatted images [9].

Neither the axial nor the coronal images provide complete evaluation of the complex anatomy of the ostio meatal unit, frontal nor sphenoid recesses. For example, the relationship between the four primary lamellas of the Sino nasal cavity (Uncinate process, anterior wall of the bulla, basal lamella, and anterior wall of the sphenoid) are best appreciated in sagittal images [10].

Complications of frontal sinusitis:

Complications of frontal sinusitis include mucocele, recurrent sinusitis and orbital sequelae including cellulitis, subperiosteal abscess, intra orbital abscess and optic neuritis.

Progression to frontal sinus osteomyelitis with erosion of the anterior sinus wall and subperiosteal abscess formation results in the classic doughy forehead swelling described by Sir Percival Pott in 1763 (Pott's puffy tumor)

Intracranial complications include meningitis, epidural abscess, subdural empyema, intracerebral abscess and, rarely, cavernous, or superior sagittal sinus thrombosis.

Acute or progressive headache is the most important indicator of an intracranial complication. Intracranial abscesses may be silent or present with serious neurological symptoms and signs (Nausea, vomiting, alteration of mental status, subtle affective changes, convulsions or even coma may be encountered) [11, 12].

In 1997, the American Academy of Otolaryngology Head and Neck Surgery Foundation assembled the Rhinosinusitis Task Force (RSTF) to develop clinical definitions of rhinosinusitis. Rhinosinusitis as defined by the RSTF is "inflammation of the nasal cavity and paranasal sinus".

The RSTF subclassified rhinosinusitis into three major clinical categories based on duration of symptoms: acute, with symptoms lasting less than 4 weeks; subacute, between 4 and 12 weeks; and chronic, greater than

12 weeks. By RSTF guidelines, patients with rhinosinusitis must meet a variety of symptomatic major and minor criteria.

Frontal sinus surgery:

Despite more than two centuries since the description of the first procedure on the frontal sinus, the optimal procedure remains unclear. Although frontal sinus surgery makes up only a small portion of all paranasal sinus surgery, the literature is filled with publications on this subject. Ellis in 1954 stated that “surgical treatment of chronic frontal sinusitis is difficult, often unsatisfactory, and sometimes disastrous. The many surgical techniques available are expressions of our uncertainty and perhaps our failure” [13].

The ideal treatment for diseases of the frontal sinus is one that will provide complete relief of symptoms, eradicate the underlying disease process, preserve the function of the sinus, and cause the least morbidity and the least cosmetic deformity.

Characterized by the Ogston–Luc procedure in 1884, which involved dilatation of the nasofrontal duct. Despite initial success, this method of frontal sinus management often failed due to duct stenosis.

In 1898, Riedel advocated complete removal of the anterior table and floor of the frontal sinus, while simultaneously stripping the mucosa in a patient with osteomyelitis. The posterior wall was retained to separate intracranial contents. The major postoperative issue involved gross forehead deformity [14].

Killian attempted to modify the procedure by retaining a 1 cm bar of supraorbital rim but faced multiple complications including stenosis, supraorbital rim necrosis, postoperative meningitis, and mucocele formation [14].

A variety of surgical procedures had been described for the treatment of chronic frontal sinus disease before the introduction of endoscopic sinus surgery [15].

However, recurrent or persisted frontal sinus disease caused by scarring and stenosis has continued to challenge the surgeons. The high degree of anatomic variability presenting in the frontal recess (The optimal imaging planes for identifying each type of frontal recess cell are summarized in the table (1)) and sinus or distorted intranasal landmarks by failed endoscopic surgery makes visualization difficult to this area from an intranasal approach [16, 17]. Therefore, alternative procedures are required to treat difficult frontal sinus diseases

In the early 1990s, Draf procedures and endoscopic modified Lothrop procedure were found to be useful for management of difficult frontal sinus diseases with high success rates. Endoscopic anatomic observation showed that the anterior-upper attachment of uncinat process can be clearly demonstrated after bone drill out of the fronto maxillary process, and the floor of frontal sinus can be observed after the careful removal of uncinat process and agger nasi air cells, This encouraged to modify the Draf IIb procedure and carry out endoscopic frontal sinus surgery trans-Fronto maxillary Process-Agger nasi approach (FPA) for patients with recurrent chronic frontal sinusitis (RCFS) in whom previous surgery has failed. It is a brief, less invasive revision endoscopic technique to create an adequate drainage of the frontal sinus [18, 19, 20].

Stankiewicz and Wachter in [21] reported a 90% success rate with the endoscopic approach for patients who had an osteoplastic approach and failed.

Functional endoscopic sinus surgery (FESS):

The term FESS was coined by [15]. The concept of FESS is the removal of tissue obstructing (OMC) and the facilitation of drainage while conserving the normal non-obstructing anatomy and mucous membrane. The rigid fiberoptic nasal telescope provides superb intra-operative visualization of the OMC, allowing the surgery to be focused precisely on the key areas. The image can be projected onto a television monitor through a small camera attached to the eyepiece of the endoscope. Micro debrides remove pathologic tissue while preserving normal mucosa [22].

An important challenge in CRS is the recurrence of the disease and the need for re-surgery. In cases of frontal sinusitis, anatomical studies demonstrate that the underlying problem is rarely limited to the frontal sinus

itself, but rather its drainage pathway through and around a labyrinth of anterior ethmoidal cells termed the frontal recess [23].

Frontal sinus surgery has evolved from radical, morbid procedures to minimally invasive endoscopic mucosal preserving techniques. There is still controversy regarding the most appropriate surgical approach because multiple endoscopic approaches have been described and the long-term efficacy of these approaches is debated [23, 24].

To improve healing and subsequent postoperative results, surgeons today try to preserve the mucosa in the sinuses by using through-cutting instruments, powered micro debrides, and balloon dilation technique [24].

Contraindications of FESS:

Contraindications for FESS include patients who have general contraindications for general or local anesthesia. Also, contraindications for purely endoscopic surgery include lesions/ pathologies extending into the palate, skin/soft tissues, laterally into or above the orbit, lateral recesses of the frontal sinus, or advanced intracranial involvement [25].

Frontal Sinus Surgery Outcome

Although sinus surgery was first introduced by the ancient Egyptians, it was not until 1750 where we encountered the first modern description of frontal sinus surgery [26].

The first frontal sinus surgery was described in 1750 by Runge, who performed an obliteration procedure. An external and intracranial drainage procedure for a frontal sinus mucocele was described in 1870, and in 1884, the era of trephination was born (Ogston-Luc procedure) but abandoned due to the high rate of nasofrontal duct stenosis and surgical failure.

Osteoplastic anterior wall approaches to the frontal sinus had been described over 150 years prior, but it was not until the 1950s that successful reports with no complications and no cosmetic deformity were reported in the literature; this technique became the standard in the 1960s and onward for several decades. In the 1990s, the problem of poor visualization was solved with the introduction of endoscopic and microscopic approaches to the sinuses, including the frontal sinus. This adaptation of technology changed a difficult, disfiguring, relatively unsuccessful surgical challenge into one that could be adopted and used in a widespread fashion [27]. Surgical interventions of the frontal sinus offer a unique surgical challenge because of the idiosyncrasies of the frontal sinus outflow tract anatomy. The frontal sinuses rest above the frontal beak in the frontal bone with an outflow tract nestled between the orbits laterally and skull base medially. These fundamental limits of dissection provide what is frequently the narrowest sinusotomy as well as the highest risk for major complications and stenosis. Historical approaches to the frontal sinuses, including the Lynch and Lothrop procedures, had high short-term patency rates, but overtime developed 30% failure rates in the long-term. These failure rates elevated the osteoplastic flap with frontal sinus obliteration to the putative gold-standard [28]. However, the osteoplastic flap can be associated with significant morbidity including supraorbital neuralgia, frontal bossing, abdominal fat donor site complications and difficulty with surveillance of the sinus [29].

The chronicity and recurring nature of chronic rhinosinusitis (CRS) pose a challenge to the patient and the doctor alike. Surgical treatment is often required with the main aims being the removal of disease and to establish ventilation and drainage [30].

The positive results of functional endoscopic sinus surgery (FESS) depend on wound healing in the postoperative phase [31]. The best postsurgical outcome depends on the care of mucosa during surgery and the postoperative care accorded to the patient [32].

The frontal sinus remains one of the most complex regions to operate on, with a wide array of anatomic variations between patients and even between 2 sides in the same patient. The frontal sinus surgeon needs to be extremely learned in the different anatomic challenges that may present during surgery in this area. There is no substitute for knowing the anatomy of this region in detail. Performing an adequate functional frontal

sinusotomy while minimizing the risk of a complication requires proper planning that starts before the patient enters the operating room [22].

When looking at the patients requiring revision surgery, synechia have been implicated as a foremost cause for recurrence [22, 33].

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