



Endoscopic frontal sinus surgery - A tertiary hospital experience

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General Note



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ABSTRACT

Background: Chronic frontal rhinosinusitis (CFRS) is a condition in which there is a persistent frontonasal outflow tract obstruction that leads to impairment of the normal drainage. Frontal sinus surgery is known to be a challenging surgery due to the complex

frontal sinus anatomy, which is considered to have many anatomical variations from one patient to another. *Objective:* To present the different causes, diagnostic, and management plans to different frontal sinus pathologies in order to provide the best management strategies. *Methods:* This is a retrospective clinical study, which was conducted between 2010 to 2019. The study was conducted in the ENT department of King Fahad specialist Hospital in Saudi Arabia. It included only the patients with sole involvement of the frontal sinus managed endoscopically. *Results:* A total of 450 endoscopic sinus and skull-base procedures were performed at King Fahad Specialist Hospital-Dammam in the period from 2010 to 2019. Out of the total number of cases, 51.3% (231) of the cases fulfilled the criteria of endoscopic frontal sinus surgery. *Conclusion:* With the advantages of the state of art imaging, different angled endoscopes and intraoperative image guidance system, the different endoscopic approaches to different pathologies of the frontal sinus will result in a wide frontal outflow tract and a safe outcome while minimizing the need for the external approach to the frontal sinus with its morbidities and hence improves the patient's quality of life.

Keywords: Chronic frontal rhinosinusitis; sinus anatomy; quality of life; endoscopic approaches

1. INTRODUCTION

Chronic rhinosinusitis (CRS) is a mucosal inflammation of the nasal cavities, with the association of one or more paranasal sinus, resulting in chronic sinonasal symptoms that last for more than 12 weeks. It is a leading cause of a significant impairment of the quality of life. It is estimated to affect 15% of the adult population (Krings, 2014, Alanazy, 2018, Cham 2018).

Frontal sinus surgery is known to be a challenging surgery due to the complex frontal sinus anatomy, which is considered to have many anatomical variations from one patient to another, as well as the two sinuses within a patient can have differences (Javer, 2010).

Indications of surgical management include failure of medical therapy, presence of fungal disease, barotrauma, an osteoma causing obstruction with evidence of mucosal disease, disfigurement or exophthalmos, or other pathology as osteomyelitis and tumors (Thomas, 2008). Surgical management is believed to improve patient's quality of life, decrease patient morbidity, and give the advantage of combining surgical therapy with topical medical treatment (Abualnasr, 2017).

The main focus of this study is to present the different causes and Management strategies of endoscopic frontal sinus surgery. It was conducted at a tertiary referral center at King Fahad Specialist Hospital Dammam (KFSHD), Eastern region, Saudi Arabia.

2. MATERIAL AND METHODS

This is a retrospective clinical study which was conducted in the otolaryngology department of King Fahad specialist Hospital, Dammam, Saudi Arabia, from 2010 to November 2019. The clinical causes, radiologica images, operative findings, and clinical outcomes were retrospectively reviewed and analyzed in this report. Patients included were all patients diagnosed with different frontal sinus pathologies managed by the endonasal endoscopic approach. This study was reviewed and approved by the institutional review board (IRB) at our institution. IRB number: SUR0379.

3. RESULTS

A total of 450 endoscopic sinus and skull-base procedures were performed at King Fahad Specialist Hospital-Dammam in the period from 2010 to 2019. Out of the total number of cases, 51.3% (231) of the cases indicated the involvement of the frontal sinus.

All procedures were managed under general anesthesia and performed with the utilization of standard endoscopic sinus surgery equipment alongside the integrated instruments.

Table 1 endoscopic frontal sinus surgery

1.	Recurrent sinusitis with and without polyposis	80
2.	Revision sinusitis with distorted lost anatomical landmarks (Samter's triad)	60
3.	Fungal sinusitis (allergic fungal, chronic granulomatous and invasive)	40
4.	Complicated sinusitis with intracranial and/or intraorbital extension	20
5.	Benign sinonasal tumors (osteoma, inverted papilloma)	15
6.	Frontal mucocoeles and mucopyocoeles.	10
7.	Frontal CSF leaks and meningoencephalocoeles	3
8.	Endoscopic drainage of frontal lobe abscess	3
	Total	231

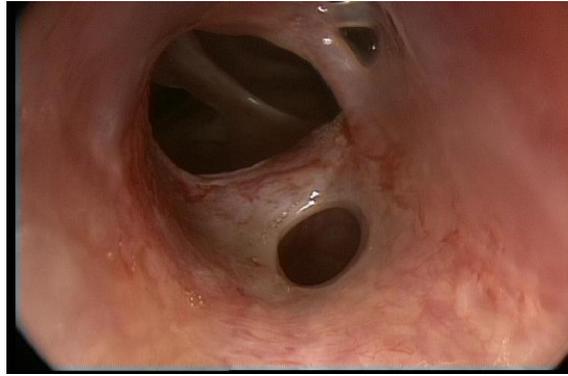


Figure 1: endoscopic view of frontal draf 1 procedure



Figure 2: endoscopic view of frontal draf 2A procedure

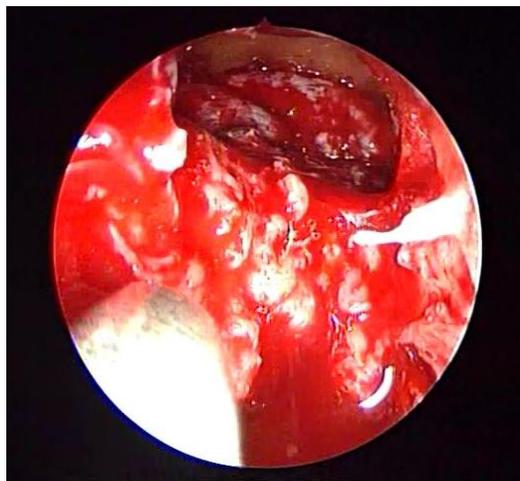


Figure 3: 30 degree endoscopic view left frontal draf 2B procedure

The clinical diagnosis and indications of endoscopic frontal sinus surgery in our study were mostly due to recurrent sinusitis (34.6%), Revision sinusitis with distorted lost anatomical landmarks (26%), fungal sinusitis (17.3%), and Complicated sinusitis with intracranial and/or intraorbital extension (8.7%). Other unusual indications were benign sinonasal tumors (6.5%), and Frontal mucocoeles and mucopyocoeles (4.3%). In addition, we report some rare indications such as, Frontal CSF leaks, meningoencephalocoeles and Endoscopic drainage of frontal lobe abscess. (Table 1), summarize the indications of endoscopic frontal sinus surgery in our study.

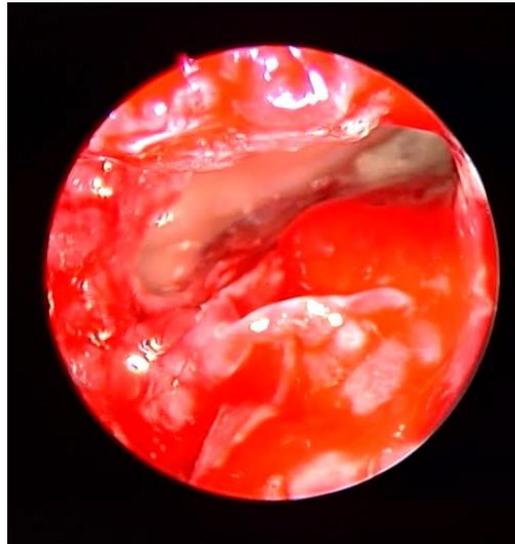


Figure 4: 45 degree endoscopic view rt frontal draf 2B procedure



Figure 5: endoscopic view frontal draf 3 median drainage procedure



Figure 6: image guided intraoperative view for safe entry to frontal sinus

4. DISCUSSION

Chronic frontal rhinosinusitis (CRS) is a condition in which there is a persistent frontonasal outflow tract obstruction that leads to impairment of the normal drainage. Several causes can be attributed to causing this condition, including inflammatory causes such as a polyp, and structural causes such as agger nasi cells, frontal cells, or scar tissue (Chiu 2006, Chiu 2015, Han 2009).

The management of CRS, in particular, has represented a challenge to physicians due to its tendency of recurrence and its sensitive anatomical site (Folbe, 2014). CRS management consists of medical management and surgical management, in the medical management long-term use of antibiotics is believed to benefit the patient not only by their antibacterial effect but as an anti-inflammatory effect as well (Chiu, 2015). Other treatment options like nasal saline irrigation, topical intranasal steroids, and oral corticosteroids are used to improve patient's symptoms, endoscopic findings, and maintain or enhance patient quality of life (Cham 2018). Medical management can frequently treat chronic frontal rhinosinusitis, but surgery is reserved for persistent cases despite medical treatment (Thomas, 2008). The main goal of surgical management is to improve the patient's quality of life after failed medical treatment, which is reported by the patient subjectively (Korban, 2016).

Open surgical approaches to the frontal sinus have been described earlier in the management of chronic frontal rhinosinusitis. Lynch's and Lothrop's procedures were both reported to achieve short-term patency for most of the cases successfully, but about 30% of the cases failed to achieve long-term patency (Chiu 2006). Osteoplastic flap was introduced because of the high failure rates of the other open approaches (Wormald, 2003), and it is associated with some other complications such as supraorbital neuralgia and frontal bossing (Wormald, 2003).

Endoscopic Frontal Sinus Surgery (EFSS) is now the surgical technique of choice in the management of frontal sinus diseases. EFSS have developed after the introduction of the high-resolution video-assisted technologies. They characterize by a better recovery and improvement of the quality of life as they are minimally invasive. The evolve of technology and the decrease in morbidity with sustainable efficacy of the (EFSS) compared to the previous surgeries resulted in the adoption of Draf techniques (Chiu, 2015).

Draf was the first to describe a precise classification of the endoscopic frontal sinus surgery into three types. Draf type I (Figure 1) is used to treat the diseases not extending to the frontal sinus, but the frontal recess, the procedure is done through the endonasal approach as a complete ethmoidectomy with the removal of the bulla and suprabullar cells and ensuring no disruption of the frontal recess mucosa. Secondly, Draf type II is further divided into two types. Draf IIa (Figure 2), which is indicated in persistent symptoms in patients treated previously with Draf I approach, and this involves expanding the frontal sinus outflow tract in addition to the removal of all occupying cells ensuring intact mucosa. Draf IIb (Figure 3 and 4) is indicated in situations that necessitate treatment beyond the frontal recess to the frontal sinus such as polyposis and scarring, and this procedure involves expanding the frontal sinus ostium by drilling of the frontal sinus floor to making a sizeable unilateral outflow tract. Lastly, Draf III (Figure 5), which is indicated in patients with failure previous Draf II, or cases that require approaching complex areas such as the lateral recess, and that involves complete bilateral drilling of the floor of the frontal sinus, frontal beak, intersinus septum, and a portion of the nasal septum. In sum, each one of these procedures presents a choice of a treatment that is dependent on the patient evaluation of the condition from a minimally invasive in Draf I to maximal in Draf III (Chiu, 2015, Folbe 2014). Due to the complex anatomy of frontal sinus, which is considered to have many anatomical variations from one patient to another Image-guided surgery is one of the most significant advances in endoscopic sinus surgery (Figure 6).

Several causes of frontal sinusitis indicating draf procedure have been found, and the most common one appears to be chronic recurrent frontal sinusitis refractive to medical treatment (Korban ZR, 2016). Bent et al. also found that chronic recurrent frontal sinusitis refractive to medical treatment is the most common causative indication (16 cases; 44.4%) followed by sinusitis with sinus polyp (15 cases; 41.6%), and the least one is acute sinusitis refractive to medical management (2 cases; 5.5%), (Bent, 1994). However, our results showed that the most common indication was recurrent sinusitis with and without polyposis (80 cases; 34.6%). And the least one was endoscopic drainage of frontal lobe abscess, frontal CSF leaks, and meningoencephaloceles (3; 1.3%).

Endoscopic sinus surgery has a very high success rate 76% to 98%, with only 2% to 24% of patients need to undergo revision ESS using more aggressive techniques due to the failure of primary ESS. These failures include systemic illness, anatomic obstruction, surgical techniques, failure treatment, and in some cases, patients have diseases before the primary ESS such as cystic fibrosis, Samter's triad, primary ciliary dyskinesia, and gastroesophageal reflux (Moses 1998, Richer 2008, Jiang 2002, Musy 2004). In this study, the second most common diagnosis was revision sinusitis with distorted lost anatomical landmarks (Samter's triad).

20 cases in our study were suffering from complicated sinusitis with intracranial and/or infraorbital extension. It is rare to have Sinusitis with intracranial complications due to the ability to treat it with antibiotics without any surgical intervention if the antibiotic treatment was started early (Nicoli, 2016). Sinusitis with intracranial complications considered a life-threatening condition that includes subdural empyema, epidural and intracerebral abscess, meningitis, and venous sinus thrombosis (Germiller, 2006, Kombogiorgas 2007, Clayman 1991).

As motioned earlier, benign tumors, mucoceles, cerebrospinal fluid leak, meningoencephaloceles, and abscess formation were among the least common indications of FESS. Benign sinonasal tumors such as osteoma and inverted papilloma (IP) was an indication of FESS in only 15 of the subjected cases. This is consistent with another study that was held in the United States of

America, which showed that only 5.4% of their patients were found to have osteomeatal complex (Han 2009). Osteoma can be removed endoscopically by shelling out the tumor, then removing its walls or fracturing them inwards combined with Draf III or by combined open and close techniques. A grading system was developed to classify the tumors based on its size, thus providing a suitable approach depending on the size of the tumor (Chiu, 2015).

Inverted papilloma (IP) is the second most common benign tumor of the frontal sinus after osteoma. That been said, even though it is the second most common, only less than 15 patients were diagnosed with IP in this study which confirms what was found in a European study which showed that IP of the frontal sinus is rare and represents only 1.6% to 15% of the cases. Draf IIa is usually sufficient to achieve complete removal because inverted papilloma rarely attaches to the frontal sinus. However, when the tumor is attached to the frontal recess or the frontal sinus, Draf IIb or Draf III might be necessary to achieve complete root resection via drilling. If the pathology involves the lateral recess of the frontal sinus supraorbitally, a combined above and below technique may be warned (Chiu, 2015).

In our study, FESS due to mucocoeles and mucopyocoeles formation was indicated in only 10 of our sample. This finding can be attributed to the preventive measurements applied by the surgeon like adequate mucosal handling during the ESS and adequate imaging ahead of surgical intervention (Eloy, 2016). Endoscopic maximal marsupialization is the most accepted preferred method to treat mucocoeles using a Draf IIa or a Draf IIb (Chiu 2015).

Three of our subjected patients suffered CSF leakage. Management of CSF leaks depends on both times of discovery, and the amount of CSF leak. Intra-operative discovery and high output leaks can be managed surgically by multilayer repair using nasoseptal or turbinate- based flap, temporalis fascia, or allogeneic materials, sometimes Draf III procedures may be necessary to reach the leak (Eloy, 2016). Sometimes subperiosteal abscess accumulates in the frontal bone due to frontal sinusitis resulting in what's called Pott's Puffy tumors. This condition is associated with a high risk of intracranial complications. Fortunately, it's a rare complication. Only three patients were indicated to have FESS in this study due to this condition, which is supported by the previous researches (Chiu 2015).

There are some limitations to this research, which include the usage of a data from a single health center, the sample representing patients with severe sinusitis requiring surgical intervention, and some subjective patient-related measures of the quality of life improvement post-surgery.

5. CONCLUSION

With the advantages of the state of art imaging, different angled endoscopes and intraoperative image guidance system, the different endoscopic approaches to different pathologies of the frontal sinus will result in a wide frontal outflow tract and a safe outcome while minimizing the need for the external approach to the frontal sinus with its morbidities and hence improves the patient's quality of life.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Informed consent

Oral informed consent was obtained from all individual participants included in the study.

Ethical approval

The study was approved by the Medical Ethics Committee of King Fahad Specialist Hospital-Dammam (ethical approval code: SUR0379).

Data and materials availability

All data associated with this study are present in the paper.

Abbreviation

Chronic rhinosinusitis (CRS), Chronic frontal rhinosinusitis (CFRS).

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