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The Role of Functional Endoscopic Sinus Surgery (FESS) in the Management of Chronic Rhinosinusitis

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Abstract

Chronic rhinosinusitis (CRS) is a persistent inflammatory condition of the nasal and sinus mucosa, affecting over 10% of adults in Europe and the USA. Treatment primarily focuses on symptom management and improving quality of life, with initial approaches including saline irrigations, intranasal corticosteroids, and short-term antibiotics when necessary. When medical therapy fails, Functional Endoscopic Sinus Surgery (FESS) is considered. This minimally invasive procedure has been shown to effectively alleviate symptoms and enhance the quality of life in CRS patients, as demonstrated by various studies.

Aim

This study aims to gather and analyze the current knowledge on chronic rhinosinusitis (CRS), with a specific focus on the surgical treatment known as Functional Endoscopic Sinus Surgery (FESS) and its effectiveness in improving patient outcomes. By reviewing existing literature and clinical studies, this article seeks to provide a comprehensive overview of how FESS

impacts the quality of life in CRS patients, the factors influencing its success, and the associated risks and complications.

Methods

The study contains data available in freely accessible databases like PubMed, the National Library of Medicine and Google Scholar. The databases were searched using the keywords such as chronic rhinosinusitis, CRS, functional endoscopic sinus surgery, FESS.

Keywords: chronic rhinosinusitis, CRS, functional endoscopic sinus surgery, FESS

Introduction

Chronic rhinosinusitis

Chronic rhinosinusitis (CRS) is defined as a range of conditions characterized by persistent inflammation of the nasal and sinus mucosa lasting at least 12 weeks. It affects over 10% of adults in Europe and the USA and is often categorized into two types: with and without nasal polyps. Despite a shared symptom profile, including facial pain and loss of smell, these forms of CRS have distinct characteristics and treatment needs. [1,2]

In general the development of rhinosinusitis is mostly driven by three factors: narrowed sinus ostia, dysfunction of the ciliary mechanism, and thickened sinus mucus. When sinus ostia are constricted, often due to viral infections or allergic reactions, they can become blocked, leading to pressure changes that may pull bacteria into the sinuses, potentially triggering an infection. The ciliary mechanism, which helps clear mucus is often compromised during viral illnesses, further hindering the clearance process and raising the likelihood of sinusitis. Additionally, changes in the thickness of sinus mucus can block the ciliary function, contributing to the condition. Chronic sinusitis has also been associated with biofilms—groups of bacteria settled in a protective layer—that are highly resistant to antibiotics. [3]

Symptoms [1,4]

Major:

- Facial pain/pressure

- Nasal obstruction/blockage
- Nasal discharge/purulence
- Discolored postnasal drainage
- Hyposmia/anosmia
- Purulence in nasal cavity on examination

Minor:

- Headache
- Fever
- Halitosis
- Fatigue
- Dental pain
- Cough
- Ear pain/pressure/fullness

Diagnosis

The diagnosis of chronic rhinosinusitis (CRS) primarily relies on the persistence of specific symptoms for at least 12 weeks, with patients exhibiting two or more of the following: mucopurulent drainage (anterior, posterior, or both), nasal obstruction (congestion), facial pain/pressure/fullness, or a decreased sense of smell. [5] Additional symptoms may include fatigue, malaise, aural pressure, hoarseness, and cough. To confirm the diagnosis, physical examination findings should corroborate these symptoms. Physical examination through anterior rhinoscopy or nasal endoscopy can reveal critical signs of inflammation, such as edema, mucopurulent discharge, and nasal polyposis, which may obstruct the nasal cavity. This method is particularly useful in distinguishing between CRS with nasal polyps (CRSwNP) and CRS without nasal polyps (CRSsNP), as these subtypes can exhibit different symptom patterns and treatment responses. CT imaging further supplements the physical examination by providing a detailed anatomical assessment of the paranasal sinuses. [2] Non-contrast-enhanced CT is the preferred imaging method, providing detailed views of sinus pathology and confirming the presence of chronic inflammation. [6] MRI may be used additionally to evaluate soft tissue involvement when the pathology extends beyond the sinuses into the orbital or intracranial regions. [7] Early recognition and proper management of CRS symptoms and

complications are crucial for successful outcomes. When diagnosed promptly and treated appropriately, many of the complications associated with CRS can be effectively managed, minimizing long-term adverse effects and improving the patient's quality of life.

Treatment

The treatment of chronic rhinosinusitis focuses on symptom management and improving quality of life. Initial treatment includes medical management aimed at enhancing mucociliary clearance, improving sinus drainage, and reducing inflammation. Standard medical therapy for chronic rhinosinusitis includes isotonic saline irrigations, which are usually combined with an intranasal corticosteroid spray. A range of studies proved that this way of treatment can significantly reduce sinonasal symptoms which makes it the first-line treatment. [8,9,10]

The antibiotics have an uncertain role in treatment of chronic rhinosinusitis with limited evidence to support their effectiveness. However, short-term antibiotic therapy is recommended in patients with chronic rhinosinusitis and evidence of infection such as mucopurulent discharge seen during endoscopy. The antibiotic is chosen based on the culture of fluid collected through nasal endoscopy.

Another possible treatment is oral corticosteroids. Although the study showed that it can provide temporary relief, especially in patients with nasal polyps, their long-term benefits are not supported.When medical therapy is not effective the surgical management (endoscopic sinus surgery) should be considered. However it’s important to note that while endoscopic sinus surgery alleviates symptoms and enhances quality of life, it does not provide a cure. Patients still need ongoing medical treatment after the surgery to sustain the benefits. [5,6]

Complication of untreated chronic rhinosinusitis

Chronic rhinosinusitis (CRS) can lead to asthma, sleep-related breathing issues, and olfactory dysfunction, and is further complicated by the development of allergic fungal rhinosinusitis or deformities in the surrounding bony structures. These fungal complications significantly increase morbidity and mortality.

CRS is linked to respiratory issues such as asthma and sleep disorders. Up to 80% of asthma patients show radiological signs of CRS, leading to more severe symptoms, frequent exacerbations, and generally poorer asthma control. Additionally, CRS contributes to sleep

disturbances and apnea by increasing upper airway resistance and inducing inflammatory responses. When accompanied by nasal polyps, CRS often results in smell disorders like hyposmia or anosmia, significantly impacting quality of life. The condition can also lead to allergic fungal rhinosinusitis (AFRS) and invasive fungal infections. Acute invasive fungal rhinosinusitis (AIFRS), a life-threatening condition, occurs predominantly in immunocompromised individuals, such as those with hematologic malignancies, organ transplants, or uncontrolled diabetes. Furthermore, CRS can result in the formation of mucoceles, expansile cysts that opacify affected sinuses and erode surrounding bone§, potentially causing orbital changes and intracranial complications if they breach the skull base. [11] Intracranial complications, though less common due to modern antibiotics, remain serious and include meningitis and abscesses. Additionally, complications involving the orbit, such as pre- and postseptal infections, orbital cellulitis, and abscesses, arise due to the close anatomical relationship between the paranasal sinuses and the orbit. These complications can affect visual acuity, ocular mobility, and cause proptosis, necessitating further evaluation and possible surgical intervention. [4] Osteitis and bone erosion are also notable complications of CRS. Osteitis involves the rarefaction and demineralization of bone, leading to loss of normal bone architecture and structural integrity, and often correlates with disease severity. Bone erosion, particularly in patients with polypoid CRS and AFRS, can cause significant deformities and further complicate the disease process. [11]

FESS Functional endoscopic sinus surgery

Functional endoscopic sinus surgery (FESS) is a minimally invasive surgical procedure used to treat chronic sinus conditions, such as chronic rhinosinusitis but also pituitary tumors, skull base defects, sinonasal tumors, and complications of acute rhinosinusitis along with several other related pathologies. [12] The technique involves the use of an endoscope to open up the sinus air cells and the sinus ostia. [13] The aim of the procedure is to remove the infected tissue, restore proper drainage by opening obstructed pathways and preserve sufficient tissue to maintain the physiological function of the nose and sinuses. [14] It is now a well-established approach encompassing various techniques, for treating chronic rhinosinusitis that has not improved with medical therapy. [15]

Clinical Outcomes and Quality of Life Improvements

FESS has consistently proven to be an effective treatment for patients with CRS. Many studies have shown a high success rate in alleviating symptoms and enhancing the quality of life (QOL) for those who undergo this procedure. A study conducted by Behiry et al. on 60 patients demonstrated significant improvements in symptoms, with notable enhancements in nasal and extranasal symptoms, psychological well-being, ear and facial discomfort, and sleep-related issues. [16]. A prospective cohort study by Laababsi et al. involving 66 patients with chronic rhinosinusitis (CRS) who underwent FESS showed significant improvements in QoL, as measured by the Sino-Nasal Outcome Test-22 (SNOT-22). Notably, substantial reductions in nasal, extranasal, psychological, ear/facial, and sleep dysfunction symptoms were observed, although patients with lower preoperative SNOT-22 scores did not achieve clinically meaningful improvements. [17] Similarly, Plath et al. conducted a study using the SNOT-22 to assess health-related QoL in 89 patients before and after surgery. Their results showed a significant decrease in the mean SNOT-22 score from 47.35 pre-surgery to 27.16 six months post-surgery, with marked improvements in symptoms like nasal obstruction, reduced smell and taste, thick nasal secretions, and postnasal drip.[18] In a study conducted by Wardas et al. involving 100 patients, symptom severity and general health were assessed using a Visual Analogue Scale (VAS) both before and after undergoing Functional Endoscopic Sinus Surgery (FESS). Initially, nasal blockage and olfactory issues were the most severe symptoms, with nasal blockage averaging 8 points on the VAS. After surgery, the severity of all symptoms, especially nasal blockage, significantly decreased, with nasal blockage dropping to an average of 2 points. Overall, patients reported a substantial improvement in their general health, with the mean severity of symptoms reduced by approximately 4 to 5 points. All results were statistically significant.[19] Another study by Damm et al. involving 279 patients with chronic rhinosinusitis, preoperative questionnaires revealed that 94% of patients experienced significant quality of life restrictions, with 74% rating their condition as severe or intolerable. The most common symptoms were nasal obstruction (92%) and postnasal drip (87%), followed by dry upper respiratory tract syndrome (68%), hyposmia (66%), headache (64%), and asthmatic issues (34%). After an average follow-up of 31.7 months post-surgery, 85% of patients reported improved quality of life, 12% showed no change, and 3% experienced a deterioration. Quality of life improved significantly from "severe" to "mild" ($P < .01$), largely due to reductions in nasal obstruction (84%), headache (82%), and postnasal drip (78%) (all $P < .01$), which correlated strongly with better overall quality of life. These results indicate that functional endoscopic sinus surgery can greatly enhance long-term quality of life by addressing

key symptoms of chronic rhinosinusitis. [20] Netkovski et al. conducted a study in which 80 patients with chronic rhinosinusitis who underwent Functional Endoscopic Sinus Surgery (FESS) were surveyed to evaluate their symptoms before and after the procedure. The most common symptoms affecting quality of life were nasal obstruction, post-nasal discharge, and anterior nasal discharge. Following FESS, there was a significant improvement in these symptoms, leading to an overall enhancement in quality of life. The study confirms that FESS is particularly effective in treating nasal obstruction and nasal discharge, with moderate success in alleviating headaches and hyposmia. [21]

A study using the Sniffin' Sticks test measured olfactory function in patients with chronic rhinosinusitis without polyps before and after FESS surgery. The average TDI (threshold, discrimination, identification) score was 19.43 ± 7.32 before surgery, indicating hyposmia. Two weeks post-surgery, the score improved to 26.9 ± 5.78, still within the hyposmia range. By four weeks after the procedure, the score further increased to 33.25 ± 3.86, reaching the normosmia range. The findings show a significant improvement in olfactory function following FESS in these patients. [22] Saedi et al. conducted a study in which patients rated their sense of smell on a scale from 1 (no smell) to 5 (normal smell), and both pre- and postoperative olfactory function were assessed using the University of Pennsylvania smell identification test. Follow-up occurred at least one year after surgery, with data collected from 89 patients. Overall, 77% of the patients showed improvement in their sense of smell after sinus surgery. [23]

Functional endoscopic sinus surgery (FESS) has been shown to enhance the quality of life in chronic sinusitis patients, as indicated by disease-specific QoL instruments. However, certain preoperative factors like smoking, allergies, and asthma are associated with poorer QoL outcomes post-surgery. In contrast, gender, concurrent septoplasty, and the presence of sinonasal polyposis do not significantly affect the surgical outcome. Patients with higher preoperative endoscopy and CT scores tend to experience better QoL improvements after FESS. While most patients benefit from the surgery, understanding these negative predictors allows clinicians to provide more accurate prognoses and counseling regarding post-surgical expectations. [24]

Complications

Functional endoscopic sinus surgery (FESS) is a widely used procedure for managing chronic rhinosinusitis. Although FESS is generally considered safe and has been shown to effectively alleviate symptoms and enhance quality of life, it still carries the risk of various complications.

[25] Common issues include intraoperative and postoperative bleeding [26], infection [27], and the formation of synechiae (scar tissue) leading to nasal obstruction. [28]

The risk of ophthalmological complications arises from the anatomical proximity of the paranasal sinuses to the orbit and critical structures such as the optic nerve and ophthalmic artery.[29] Potential complications include orbital hemorrhage, orbital cellulitis and abscess, orbital emphysema, extraocular muscle injury, the lacrimal drainage system and damage to the optic nerve [29,30], which can result in blindness. [31] Another potential orbital complication during endoscopic sinus surgery is a retrobulbar hematoma. This type of hematoma can be categorized into spontaneous, traumatic, and iatrogenic forms. Iatrogenic hematomas are more likely to originate from an arterial source. [32] Fortunately, if these complications are identified promptly and managed appropriately, they can often be successfully managed, minimizing long-term adverse effects.

Table 1. [33,34,35,]

Orbital Complications	**Intracranial Complications**	**Hemorrhagic Complications**	**Other Complications**
Orbital infection	Cerebrospinal fluid (CSF) rhinorrhea/leak	Anterior ethmoid artery injury	Complete loss of smell
Orbital emphysema	Encephalocele	Sphenopalatine artery (SPA) injury	Toxic shock syndrome (TSS)
Orbital hematoma	Tension pneumocephalus	Internal carotid artery (ICA) injury	Slight bronchial asthma attacks / Acute bronchial asthma exacerbation
Decreased visual acuity	Meningitis	Major bleeding requiring a blood transfusion	Paraffinoma

Blindness	Cerebral abscess	Minor hemorrhage without the need for blood transfusion, controllable with nasal packing	Osteitis bacterial infection
Tear duct trauma	Brain tissue direct trauma	Epistaxis/nasal hemorrhage	Methicillin-resistant Staphylococcus aureus (MRSA) infection after surgery
Diplopia	Subarachnoid hemorrhage		Chronic atrophic rhinitis
Paralytic strabismus	Intracerebral hemorrhage		
Optic nerve injury	Bacterial meningitis		
Epiphora	Dural tear		
Orbital hemorrhage	Brain abscess		
Subcutaneous periorbital emphysema			
Periorbital ecchymosis			

Conclusion

Chronic rhinosinusitis (CRS) is a complex condition that significantly impacts patients' quality of life through persistent symptoms such as nasal obstruction, facial pain, and olfactory

dysfunction. The development and progression of CRS are influenced by factors like sinus ostia blockage, ciliary dysfunction, and biofilm formation, making it a challenging condition to treat effectively.

Functional Endoscopic Sinus Surgery (FESS) has emerged as a valuable treatment option for CRS, especially in cases unresponsive to medical management. Numerous studies demonstrate that FESS can substantially alleviate symptoms and improve quality of life, with significant reductions in nasal obstruction, postnasal drip, and other associated symptoms. However, the success of FESS is influenced by preoperative factors such as smoking, allergies, and asthma, which can impact postoperative outcomes.

While FESS offers considerable benefits, it is not without risks, including potential complications involving the orbit and surrounding structures. Therefore, patient selection, careful surgical planning, and postoperative management are critical to achieving optimal outcomes. Continued medical therapy remains essential after surgery to maintain the benefits and prevent recurrence.

Overall, FESS represents a key component in the multidisciplinary management of CRS, providing significant symptom relief and enhancing patient quality of life when appropriately applied.

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Author's contribution:

Julia Lipska: Conceptualization, Writing- rough preparation, Methodology, Investigation, Resources, Formal analysis, Supervision

Julia Hamerska: Conceptualization, Writing- rough preparation, Methodology, Investigation, Resources, Formal analysis, Supervision

Laura Hamerska: Conceptualization, Writing- rough preparation, Methodology, Investigation, Resources, Formal analysis, Supervision

Joanna Antczak: Investigation, Writing - review and editing

Anna Kajka: Investigation, Writing - review and editing

Urszula Fenrych: Formal analysis, Writing - review and editing

Karolina Wojtczak: Supervision, Resources

Olga Skupińska: Visualization, Investigation

Bogumił Bocianiak: Investigation, Resources

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