Original Article

DOI: 10.17354/ijss/2015/546

Role of Functional Endoscopic Sinus Surgery in Sinonasal Diseases: A Case Study and Review of Literature

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Abstract

Background: Functional endoscopic sinus surgery (FESS) has revolutionized surgical care, opening new horizons in the management of chronic rhinosinusitis and other paranasal sinus disorders Messerklinger established and reinterated the importance of the sinus ventilation and pattern of mucociliary clearance. FESS was first described independently by both Messerklinger in German literature and Wigand.

Aim: To assess the efficacy, safety, and benefits of FESS in cases of chronic recurrent rhinosinusitis with or without nasal polyposis in terms of morbidity, mortality, and recurrent of disease.

Materials and Methods: This study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh from August 2012 to August 2015. A total of 80 patients with clinical evidence of sinonasal diseases were evaluated with nasal endoscopy and computed tomographic (CT) evaluation prior to FESS.

Results: Out of 80 patients; 45 were male and 35 were female in the present study. Male:Female ratio = 1.28:1. On CT-scanning, the sinonasal pattern was seen in 36 patients (45%) followed by ostiomeatal unit in 24 patients (30%). Infundibular pattern and unclassified/sporadic pattern was seen in 9 patients (11.25%) and 8 patients (10%), respectively. Septoplasty was done in association with FESS to get wide access for a nasal endoscope. Polypectomy were done in 37 (46.25%) out of which 19 (23.75) patients underwent bilateral polypectomy. Anterior ethmoidectomy were performed in 48 (60%) patients, of which 6 patients (7.5%) underwent unilateral and 19 patients (23.75%) underwent bilateral ethmoidectomy.

Conclusion: FESS provides an excellent and safe method for treating sinonasal disease. The success rates are encouraging but because of the nature and chronicity of the disease, longer follow-up may be necessary to truly assess the surgical effectiveness of the procedure.

Key words: Surgery, Sinonasal diseases, Uncinectomy

INTRODUCTION

Functional endoscopic sinus surgery (FESS) has revolutionized surgical care, opening new horizons in the management of chronic rhinosinusitis (CRS), and other paranasal sinus disorders.[1] Hirshman[2] was called the father of nasal endoscopy, who used only 4 mm diameter endoscope to examine the middle meatus and study the sinus ostea and also examined maxillary antrum via molar tooth socket, for diagnostic purpose in 1903, also by Maltz[3] in 1925. During 1950 Hopkins[2] working, to developed solid rod lens system and proximal "cold light" source allowing better optical view and the introduction of the nasal endoscopes of various viewing angles have revolutionized the way nasal and sinus diseases are approached and treated.[2]

Access this article online

www.ijss-sn.com

Month of Submission : 10-2015
Month of Peer Review : 11-2015
Month of Acceptance : 12-2015
Month of Publishing : 12-2015

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FESS technique was not brought into common use until the work of Messerklinger in 1978.[4] Messerklinger established and reinterated the importance of the sinus ventilation and pattern of mucociliary clearance. FESS was first described independently by both Messerklinger[5,6] in German literature and Wigand,[7] Steiner, and by Jaumann in the English literature in 1978. Moreover, it was introduced in the United States in 1984 by Kennedy *et al*.

The principle of the technique is limited resection of localized inflammatory disease or obstructive anatomical defect thus, restoring normal physiology by re-establishing normal mucociliary drainage and ventilation of sinuses.[1] It is the result of the acceptance of the pioneering work of Messerklinger[8] and Wigand *et al*.[9] on the importance of establishing drainage and preserving mucosa, as well as the development of special instruments, particularly compact, multi-angled endoscopes, which allow the precise, safe accomplishment of this goal. The term FESS was coined by Kennedy.[10]

The development of FESS makes it possible to diagnose more accurately and treat these inflammatory and infective conditions of the nose and paranasal sinuses refractory to non-invasive therapy.[11] The present study focuses on the assessment of the efficacy, safety, and benefits of FESS in cases of chronic recurrent rhinosinusitis, allergic, and non-allergic nasal polyposis in terms of morbidity, mortality, and recurrence of disease.

Aims and Objectives

To assess the efficacy, safety, and benefits of FESS in cases of chronic recurrent rhinosinusitis with or without nasal polyposis in terms of morbidity, mortality, and recurrent of disease.

MATERIALS AND METHODS

This study was conducted in the Department of Otorhinolaryngology and Head and Neck Surgery, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh from August 2012 to August 2015. A total of 80 patients with clinical evidence of sinonasal diseases were evaluated with nasal endoscopy and computed tomographic evaluation prior to FESS. The cases for the study were selected from the patients attending the ear nose and throat (ENT) outpatient department (OPD) with clinical evidence of chronic or recurring acute rhinosinusitis for more than 3 months non-responsive to appropriate medical therapy. All the patients in the study group were subjected to a detailed history of a wide spectrum of presenting symptoms *viz*. facial pain, headache, nasal discharge (whether it is watery, mucoid, purulent or blood mixed), nasal obstruction (its duration, whether it is continuous or intermittent and whether it is associated with any external nasal deformity). The presence of other symptoms, such as postnasal discharge, sneezing, acute/chronic/serous otitis media, was also noted in full details. The complete personal, past, and family history were also elicited in addition with past medical/surgical history to know about any chronic use of antihistaminic, steroid sprays, and other medications in the past.

All patients were subjected to thorough ENT examination with special emphasis on anterior and posterior rhinoscopy. Nasal Endoscopy was done using Hopkins rod endoscopes (0°, 30°, 45°, 70°, and 90°) computed tomography (CT) of paranasal sinuses was done in all the patients. After a detailed nasal endoscopy and CT-scan study, patients underwent surgery-FESS. The patients included in the present study were explained in details about alternative modes of treatment, nature of the surgery, outcomes of surgery including benefits as well as possible complications of surgery. They were also detailed with the need for regular post-operative follow-up to monitor healing and avoid post-operative complications.

The operative technique used was planned in accordance to the need of the individual case. Surgical endoscopic management of concha bullosa and surgery of deviated nasal septum (DNS) was always planned in concert with the treatment of inflammatory disease in adjacent osteomeatal complex, ethmoid, and maxillary sinus. In the case of presence of extensive inflammatory disease in ethmoids and maxillary sinus, coherent FESS was done after endoscopic excision of concha bullosa was carried out. In all the patient's concepts of the "Messerklinger technique" of FESS were followed. Post-operative medication included an oral course of broad spectrum antibiotic, analgesics, and antihistaminic. Depending on the intraoperative bleeding the pack was removed 24-48 h after surgery. Following which suction cleaning done to remove blood and fibrin clots from the operated cavity without creating new trauma to the mucosa. Antibiotic steroid ointment applied over raw areas. Patients were instructed to avoid nose blowing so as to avoid subcutaneous emphysema.

All patients were seen on a weekly basis in OPD until the turbinate and cavity healed completely. At each visit, local care consisted of suction of surgical cavities to remove discharge, clots, crusts to prevent synechiae formation between the middle turbinate and lateral nasal wall. If any adhesions were formed, they were released.

Statistical Analysis

The data from data collection forms were tabulated in a Microsoft Excel® spreadsheet. Data were then exported to SPSS, version 20.0 for statistical analysis. The level

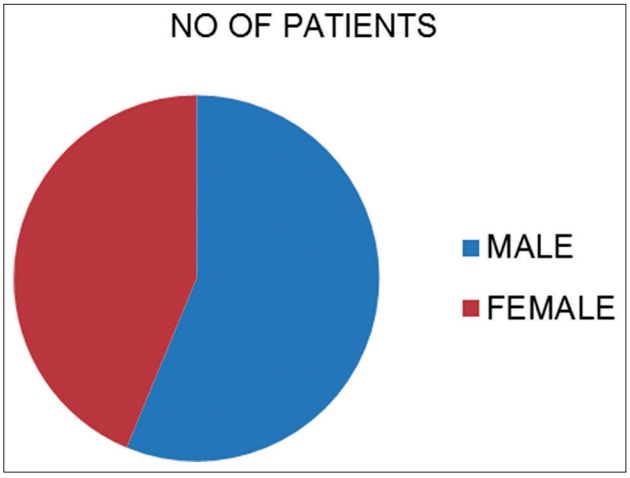
of agreement between CT and endoscopy findings was determined by calculating kappa statistics; considering kappa coefficient: ≤0 poor, 0.01-0.20 slight, 0.21-0.40 fair, 0.41-0.60 moderate, 0.61-0.80 substantial, and 0.81-1 almost perfect. Chi-square and Student's *t*-tests were used for statistical analyzes. $P < 0.05$ was considered statistically significant.

OBSERVATION AND RESULTS

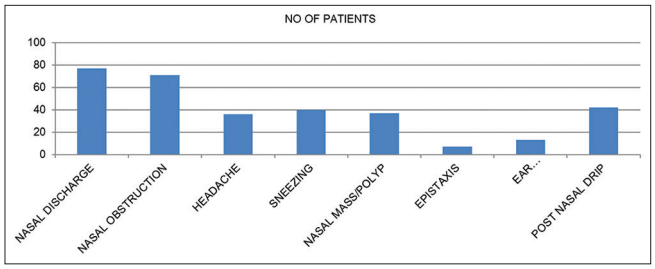
In our present study, 7.5% of the cases belonged to 0-10 years age group, 27.5% were in age group 11-20; 32.5% cases in the age group 21-30; and 18.75% cases in group 31-40 years age. 7.5% were seen in the age group 41-50 years, 5.0% were seen in 51-60 years age group, and 1.25% were above 60 years of age. Out of 80 patients; 45 were male and 35 were female in the present study. Male: Female ratio = 1.28:1 (Graph 1).

In the present study, the chief presenting symptoms were nasal discharge in 96.25% cases and next were nasal obstruction in 88.75%, post nasal discharge in 52.50%, followed by sneezing in 50%, nasal mass (polyposis) in 46.25%, headache in 45%, ear problem (discharge/heaviness) in 16.25%, and epistaxis present in 8.75%, cases (Graph 2).

On anterior rhinoscopic, the most obvious abnormality found was DNS, which was seen in 56 cases, i.e. 62.50%. Inferior turbinate hypertrophy was seen in 44 (55%) while middle turbinate hypertrophy was present in 03 (03.75%) cases. Nasal discharge present in of the patients 77 (96.25%), in which most of discharge was mucopurulent. unilateral discharge in 41 (51.25%) and 36 (45%) was bilateral. 37 (46.25%) patients had clinical evidence of polyps in the nasal cavity. Unilateral polyp were found 13 (16.25%) and bilateral in 24 (30%) cases (Table 1).



Graph 1: Male:female ratio



Graph 2: Symptoms of the patients

X-rays Paranasal Sinuses (PNS) (Water View) Findings

In the present study, out of total 80 cases, 76% patients show haziness of maxillary sinus on X-ray PNS with 50% unilateral and 50% bilateral. While 18% involvement of frontal sinus in which 44.44% were unilateral and 55.56% bilateral (Table 2).

CT-scan Evaluation: Anatomic Variations

More than 50% of the patients showed soft tissue hypertrophy in either one or in both of the inferior turbinates. DNS was found in 51 (63.75%) cases. The nasal septum was predominantly found to be deviated on the left side. Paradoxical middle turbinate was seen in 23 (28.75%) out of 80 patients, 17 (21.25%) patients had agger nasi cells while Haller's cell was found in 11 (13.75%) cases and over pneumatized ethmoidal bulla was seen in 16 cases (20%).

In the present study, we observed the various type of mucosal pattern on the pre-operative screening of paranasal sinuses coronal CT revealed SNP pattern in 36 patients (45%) followed by an ostiomeatal unit (OMU) in 24 patients (30%). Infundibular pattern and unclassified/sporadic pattern were found in 9 patients (11.25%) and 8 patients (10%), respectively. with the least found pattern being the sphenoethmoidal recess pattern in 3 patients (3.75%) (Table 3).

Mucosal abnormality detected on CT-scan coronal view ranged from minimal mucosal thickening to total sinus opacification. As shown in Table 4, the most frequently involved sinus area was the maxillary sinus 76.25%, in which 55.73% were bilateral, and 44.46% were unilateral. Followed by anterior ethmoid involvement 53.75%, in which 48.83% were bilateral, and 51.16% were unilateral sphenoid sinus was the least commonly involved 15%. The most frequent anatomical variation seen on nasal endoscopy was DNS in 51 patients (62.50%) in which 76.75% were in the left side deviation while in right side 23.52%. Paradoxical middle turbinate was found in 8 patients (10%). The most common pathological abnormality detected by nasal endoscopy was inferior turbinate hypertrophy seen in 55% cases with 65.9% unilateral and 34.1% bilateral. Polyp in middle meatus and at anterior ethmoid region (i.e., osteomeatal complex area) was seen in 46.25% cases with 35.13%

unilateral and 64.8% bilateral. Ethmoidal polyp was 67.56% out of total cases of polyposis in which 24% were unilateral and 76% bilateral, antrochoanal polyp were 32.43% out of total cases of polyposis in which 100% were unilateral. The next most frequent finding which was seen during nasal endoscopy was mucopurulent discharge in nose/middle meatus were 41.25%, of which 63.63% had unilateral, and 36.36% had bilateral.

After complete pre-operative evaluation, FESS was performed. Septoplasty was also done in association with fess to get wide access for a nasal endoscope. Polypectomy were done in 37 (46.25%) out of which 19 (23.75) patients underwent bilateral polypectomy. Anterior ethmoidectomy were performed in 48 (60%) patients, of which 6 patients (7.5%) underwent unilateral and 19 patients (23.75%) underwent bilateral ethmoidectomy. Posterior ethmoidectomy was carried out in 2 patients (2.5%). Uncinectomy done almost all patients (Table 5).

No major per-operative complication occurred in this; however, 2.5% (2 patients) presented post-operative synachia formation, 2.5% echymosis, one patient presented diplopia and blurring in vision, 1 patient presented with the headache, one with orbital subacute emphysema, 3 patients with the headache.

DISCUSSION

The concept of FESS is the removal of tissue obstructing the osteo metal complex (OMC) and the facilitation of drainage and ventilation while conserving the normal non-obstructing anatomy and mucous membrane, which is essential for mucosal regeneration. The rigid fiberoptic nasal telescope provides superb intraoperative visualization of the OMC, allowing the surgery to be focused precisely on the key areas to achieve the main goal: Adequate and permanent post-operative patency of ethmoid sinus.[12]

Use of microdebriders further improved to remove the pathologic tissue while preserving normal mucosa. Moreover, with the combination of suction with powered dissection has revolutionized endoscopic sinus surgery. FESS, like all minimally invasive surgery, is designed to combine an excellent outcome with minimal patient discomfort.[13] As mentioned, the main advantage of FESS compared with traditional techniques is that it is less invasive, resulting in minimal post-operative discomfort. Scars and damage to the nerve supply of the teeth are also avoided. The use of the endoscope permits a better view of the surgical field, and this is probably responsible for the lower rate of complications. The long-term success rate of FESS for symptomatic improvement in patients with CRS is approximately 90%. With the advent of more sophisticated endoscopic surgical experience and instrumentation.[14,15]

The study group consisted of 80 patients with chronic sinonasal diseases and nasal polyposis, in which conservative management had failed. They underwent complete clinical evaluation and routine screening by pre-operative nasal endoscopy, X-rays (water's view), CT-scan coronal section (Axial and sagittal when required). All patients included in the present study were having symptoms for more than a month duration, and all were treated medically first. The patients who were symptomatic even after medical treatment were operated on by FESS approach. Moreover, Messerklinger technique was used in all the surgery.

In this study, we found ranged from 7 to 65 years. The majority of patients 10-40 years were affected which constitute a total of (62 patients) 77.5% and overall Male: Female ratio was 1.28:1. Mustafa Golam *et al*., (2011)[3] in his study, total 60 cases in which maximum (44 cases) 73.33% of patients were in age group of 20-40 years, the male patients were (42 cases) 70% and female patients were (18 cases) 30%. The Male:Female ratio was 2.3:1. They also found that nasal discharge 50%, nasal obstruction 70%, headache/facial pain 65%, post nasal drip 33%, sneezing 25%, and the chief complaint, in his study, was nasal obstruction followed by the headache while in our study the chief complaint is nasal discharge followed by nasal obstruction. we also in our study found that the most common symptoms were nasal discharge 96.25% and next were nasal obstructions 88.75%, post nasal discharge 52.50%, followed by sneezing 50%, nasal mass 46.25%, headache 45%, ear problem 16.25%, and epistaxis 8.75%. Kennedy *et al*.[15] also show the similar finding in his study, nasal discharge, headache and nasal obstruction or congestion as the most frequent symptoms in patients with CRS.

Kamel[16] noted in his study of 50 cases of the nasal polyp; nasal endoscopy finding were most of the patients 76% had an ethmoid polyp. 8% were suspected to have an antochoanal polyp and 14% presented with a non-specific polypoidal nasal mass. In our study, total (37 cases) 46.25% cases were seen with nasal polyps out of which 67.56% ethmoidal polyps, and antrochoanal polyp cases 32.43%, of all cases of nasal polypi. For FESS CT-scan evaluation of the patients who have to undergoing FESS is essential. Most of the anatomical abnormiliteis can be studied on by CT-scan, but however, endoscopy also gives other valuable information Sheetal *et al*.[17] High-resolution CT evaluates the extent of the inflammatory disease and assesses important anatomical landmarks and their variations. These variations include nasal septal deviation, septal spur, paradoxical middle turbinate, concha bullosa, haller cells, and abnormal

deviation of the uncinate process. These variations can result in narrowing of the infundibulum or the maxillary ostium Gupta *et al*.[18]

Comparison with other study

Anatomical variant	Our study (%)	Naimi 2006 (%)	Dua 2005 (%)	Maru *et al*., 2001 (%)	Zinreich 1993 (%)	Bolger 1991 (%)
Agger nasi cells	21.25	8	50	88.5	Nearly all	98.5
Concha bullosa	47.50	24	15	42.6	33	53
Haller cells	13.75	12	17.5	36.1	10	45.1
Septal deviation	62.5	40	65	55.7	28	18.8
Paradoxical MT	28.75	4	-	11.5	-	27

Five basic radiological patterns of sinonasal inflammatory disease were identified among 80 patients. These were (I) OMU 30% (II) infundibular 11.25% (III) sinonasal polyposis 45% (IV) sphenoethmoidal 3.75% (V) unclassified 10%.

After the complete pre-operative evaluation and confirmation by nasal endoscopy and CT-scan paranasal sinuses, FESS was performed using Messerklinger technique, according to need and minimal surgery was done to preserve the normal physiology and anatomy of sinus as much as possible. Septoplasty was done in (23 cases) 28.7%, and polypectomy was done in (37 cases) 46.25%, of which (19 patients) 51.35% underwent bilateral polypectomy and the remaining (18 patients) 48.64% patients underwent unilateral polypectomy.

The anterior ethmoid region is known for being the main source of infection and reinfection of maxillary and frontal sinuses. Anterior ethmoidectomy was performed in (43 cases) 53.7%, of which (21 patients) 48.83% underwent unilateral and (22 patients) 51.16% underwent bilateral ethmoidectomy. Posterior ethmoidectomy was carried out in (6 patients) 7.5%. Uncinectomy was done in almost all patients. Uncinectomy also known as infundibulotomy alone can clear the disease from the maxillary and frontal sinuses as the uncinate process makes the medial wall of ethmoid infundibulum which is most important transition space. Uncinectomy serves the purpose of opening of infundibulum for normal drainage and ventilation of sinuses. Uncinectomy was done in total (78 cases) 97.5% in which (38 cases) 48.7%, were bilateral and (40 cases) 51.28% were unilateral. Concha bullosa was exteriorized in 5% cases. Frontal recess clearance was done in total 5% patients.[19]

In the hands of the experienced clinician, reported complications are surprisingly few and similar to those reported by other approaches. In a series of over 4000 cases reported only two cases of CSF rhinorrhea, no intracranial complications and no ophthalmic problems.[20] Stankiewicz[21] suggested that the complication rate decreases with increasing experience, reporting a rate of 29% in the first 90 cases which he performed compared with only 2.2% in the subsequent 90. Most of the cases were minor, such as adhesions, but there were two cases of CSF rhinorrhea and one case of temporary blindness.

Patients were completely satisfied with the result (CS) of surgery in 48.51% cases. Out of 80 patients under

Table 1: Clinical findings on anterior rhinoscopy

Findings	Total cases *n* (%)
Inferior turbinate hypertrophy	44 (55)
Middle turbinate hypertrophy	03 (03.75)
Polyp or mass in nasal cavity	37 (46.25)
Discharge in nasal cavity	42 (52.5)
Sinus tenderness	15 (18.15)
DNS	51 (63.75)

DNS: Deviated nasal septum

Table 2: X-ray PNS waters view findings

Sinus Involved	Number of cases	Percentage
Maxillary sinus haziness	72	90
Frontal sinus haziness	22	27.5

PNS: Paranasal sinuses

Table 3: Pattern of sinonasal inflammatory diseases

Mucosal pattern	Number of cases	Percentage
Infundibular pattern	9	11.25
OMU pattern	24	30
Sphenoethmoidal recess pattern	3	03.75
Sinonasal polyposis	36	45
Unclassified/sporadic	8	10

OMU: Ostiomeatal unit

Table 4: CT-scan detection of sinus involvement (mucosal changes)

Site of involvement	Number of patients	Percentage
Frontal	21	26.25
Anterior ethmoid	43	53.75
Posterior ethmoid	23	28.75
Maxillary	61	76.25
Sphenoid	12	15

CT: Computed tomography

Table 5: Surgical procedure used in present study

Surgery	Number of cases	Percentage
Polypectomy	37	46.25
Uncinactomy	78	97.5
Anterior ethmoidectomy	43	60
Middle meatus antrostomy	78	97.5
Posterior ethmoidectomy	6	7.5
Partial middle turbinectomy	8	10
Septoplasty	23	28.7

study, 41.67% patients were generally satisfied with their result (GS) after surgery 9.95% patients did not have improvement after surgery (NI). The overall satisfactory rate can be calculated just by adding the 1st and 2nd points mentioned above which comes as 85.49%.

CONCLUSION

CRS usually affects mostly the people of age group ranging from 20 to 40 years with the common mode of presentation being nasal obstruction, nasal discharge, headache, and post nasal drip. Endoscopically allow an exceptionally clear and well-illuminated field with the added advantage of the ability to inspect the recess with angled distal lenses. It helps in diagnosis of sinonasal pathology by revealing structural details and anatomical variation in the nasal cavity to a greater extent. It allows accurate definition of the extent of the lesion and early diagnosis of recurrence is also possible. It can also serve as an excellent teaching tool and source of photo documentation.

Coronal CT-scan accurately defines micro anatomical locales in and around the OMU and also identifies dangerous anatomical variants such as dehiscent optic nerve canal and carotid artery canal. Thus, it seems to be a variable guide to the surgeon in the planning of the operative procedure, avoiding intraoperative complications and assessing programs, and the success thereof. FESS provides an excellent and safe method for treating sinonasal disease. The success rates are encouraging but because of the nature and chronicity of the disease, longer follow-up may be necessary to truly assess the surgical effectiveness of the procedure. FESS has proven to be a better surgical, and therapeutic technique means over the conventional methods and has opened a new horizon for possibilities of positive results in further studies and more complicated cases work to be performed in the hands of further inquisitive workers.

REFERENCES

1. Kennedy DW, Zinreich SJ, Rosenbaum AE, Johns ME. Functional endoscopic sinus surgery. Theory and diagnostic evaluation. Arch Otolaryngol 1985;111:576-82.
2. Mustafa G, Ahmed K, Hasan M. Endoscopic sinus surgery: Experience of 60 cases. Bangladesh J Otolaryngol 2011;17:104-9.
3. Maltz M. New instrument: The Sinuscope. Laryngoscope 1925;35:805-11. (Quoted by- Huerter JV Jr. Functional endoscopic sinus surgery and allergy. Otolaryngol Clin North Am 1992;25:231-8).
4. Messerklinger W. Endoscopy of the Nose. Baltimore, Munch: Urban & Schwarzenberg; 1978. (Quoted by- Huerter JV Jr. Functional endoscopic sinus surgery and allergy. Otolaryngol Clin North Am 1992;25:231-8).
5. Messerklinger W. Endoscopy of the Nose. Baltimore, Munch: Urban & Schwartzenberg; 1978. (Quoted by- Zinreich SJ, Albayram S, Benson ML, Oliverio PJ. The Ostiomeatal Complex and Functional Endoscopic Surgery).
6. Messerklinger W. Endoscopy technique of the middle nasal meatus (author's transl). Arch Otorhinolaryngol 1978;221:297-305. (Quoted by- Zinreich SJ, Albayram S, Benson ML, Oliverio PJ. The Ostiomeatal Complex and Functional Endoscopic Surgery).
7. Wigand ME, Steiner W, Jaumann MP. Endonasal sinus surgery with endoscopical control: From radical operation to rehabilitation of the mucosa. Endoscopy 1978;10:255-60. (Quoted by- Zinreich SJ, Albayram S, Benson ML, Oliverio PJ. The Ostiomeatal Complex and Functional Endoscopic Surgery).
8. Messerklinger W. Urban die Drainage der menschlichen Nasennebenhohler unter normalen und pathologischen Bandingunger; Die Stirnhohole and ihr Ausfuhrungssystem. Monatsschr Oxrenheilhd 1967;101:313. (Quoted by- Rice DH. Basic surgical techniques and variation of endoscopic sinus surgery. Otolaryngol Clin North Am 1989;22:713-26).
9. Wigand ME, Steiner W, Jaumann MP. Endonasal sinus surgery with endoscopical control: From radical operation to rehabilitation of the mucosa. Endoscopy 1978;10:255-60. (Quoted by- Rice DH. Basic surgical techniques and variations of endoscopic sinus surgery. Otolaryngol Clin North Am 1989;22:713-26).
10. Kennedy DW, Zinreich SJ, Rosenbaum AE, Johns ME. Functional endoscopic sinus surgery. Theory and diagnostic evaluation. Arch Otolaryngol 1985;111:576-82. (Quoted by- Al-Mujaini A, Wali U, Alkhabori M. Functional endoscopic sinus surgery: Indications and complications in the ophthalmic field. Oman Med J 2009;24:70-80).
11. Rice DH, Schaefer SD. Endoscopic Paranasal Sinus Surgery. 2nd ed. New York: Lipinncort; 1995.
12. Al-Mujaini A, Wali U, Alkhabori M. Functional endoscopic sinus surgery: Indications and complications in the ophthalmic field. Oman Med J 2009;24:70-80.
13. Setliff RC, Parson DS. The "Hummer" new instrumentation for functional endoscopic sinus sinus surgery. Am J Rhinol 1994;8:275-8.
14. Cohen NA, Kennedy DW. Revision endoscopic sinus surgery. Otolaryngol Clin North Am 2006;39:417-35, vii. (Quoted by- Maragos CS, Aprn BC, Corln MS. Improving quality of life with FESS. Otolaryngol Clin North Am 2009;3:24-8).
15. Kennedy DW. Prognostic factors, outcomes and staging in ethmoid sinus surgery. Laryngoscope 1992;102:1-18.
16. Kamel RH. Nasal endoscopy in chronic maxillary sinusitis. J Laryngol Otol 1989;103:275-8.
17. Sheetal D, Devan PP, Manjunath P, Martin P, Satish Kumar K, Sreekantha S. CT-Do really require before FESS? J Clin Diagn Res 2011;5:179-81.
18. Gupta A, Gupta B, Gupta N, Tripathi N. Computerized tomography of paranasal sinuses: A roadmap to endoscopic surgery clinical rhinology. Int J 2012;5:1-10.
19. Lloyd GA, Lund VJ, Scadding GK. CT of the paranasal sinuses and functional endoscopic surgery: A critical analysis of 100 symptomatic patients. J Laryngol Otol 1991;105:181-5.(Quoted by- Ashok Gupta, *et al*).
20. Wigand ME. Endoscopic Surgery of the Paranasal Sinuses and Anterior Skull Base. Stuttgart: Georg Thieme Verlag; 990. (Quoted by- Valerie J Lund and Julian Rowe-Jones, surgical management of rhinosinusitis; Scott Brown. 7th ed., Vol. 2. Ch. 117. p. 1478-99).
21. Stankiewicz JA. Complications of endoscopic intra nasal ethmoidectomy: An update. Laryngoscope 1989;99:686-90. (Quoted by - Valerie JL, Julian RJ, editors. Surgical Management of Rhinosinusitis. Scott Brown. 7th ed., Vol. 2. Ch. 117. p. 1478-99).

How to cite this article: Srivastava M, Tyagi S, Chaudhary R, Kumar L. Role of Functional Endoscopic Sinus Surgery in Sinonasal Diseases: A Case Study and Review of Literature. Int J Sci Stud 2015;3(9):14-19.

Source of Support: Nil, **Conflict of Interest:** None declared.