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A Comparative Study Of Powered Versus Conventional Functional Endoscopic Sinus Surgery For Nasal Polyps With Reference To Recurrence

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ABSTRACT

Background: Chronic rhinosinusitis with nasal polyps is a common inflammatory condition that significantly affects quality of life and often requires surgical intervention when refractory to medical management. Functional endoscopic sinus surgery (FESS) is the standard surgical treatment, with advances in instrumentation such as powered microdebriders proposed to improve surgical precision and outcomes. However, comparative data evaluating powered versus conventional FESS remain limited in the Indian clinical setting. **Objectives:** To compare the clinical, endoscopic, and radiological outcomes of powered functional endoscopic sinus surgery using a microdebrider versus conventional functional endoscopic sinus surgery in patients with nasal polyposis. **Methods:** This prospective interventional comparative study was conducted at a tertiary care teaching hospital over a period of one year. Fifty patients aged 18–60 years with chronic rhinosinusitis and nasal polyps refractory to medical therapy were included and divided into two equal groups. Group A underwent conventional FESS, while Group B underwent powered FESS using a microdebrider. Preoperative assessment included symptom evaluation using the Visual Analog Scale (VAS), diagnostic nasal endoscopy with polyp grading, and computed tomography of the paranasal sinuses graded using the Lund–Mackay scoring system. Postoperative outcomes were assessed using symptom scores, endoscopic findings, radiological improvement, recurrence rates, and postoperative complications. Statistical analysis was performed, and a p-value of <0.05 was considered statistically significant. **Results:** Both surgical techniques resulted in significant postoperative improvement in symptoms, endoscopic polyp grades, and radiological scores. However, patients who underwent powered FESS demonstrated greater symptomatic relief, improved endoscopic clearance, and a more pronounced reduction in CT scores compared to those who underwent conventional FESS, with statistically significant differences. Recurrence of nasal polyps was observed more frequently in the conventional FESS group, while powered FESS was associated with a lower recurrence rate. Postoperative complications were minimal in both groups, though synechiae formation was significantly less common in the powered FESS group. **Conclusion:** Powered functional endoscopic sinus surgery using a microdebrider provides superior postoperative outcomes compared to conventional FESS in the management of nasal polyposis. Improved symptom relief, better disease clearance, reduced recurrence, and fewer postoperative complications suggest that powered FESS may offer advantages when available and appropriately utilized.

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INTRODUCTION:

Nasal polyps are the final stage of sino-nasal inflammatory illness. Chronic rhinosinusitis with polyps is a separate subset of chronic rhinosinusitis (CRSwNP). Nasal blockage/obstruction/congestion/nasal discharge: with or without facial pain/pressure and reduction or loss of smell, and either endoscopic evidence of polyps and mucopurulent discharge from the middle meatus or edema, mucosal obstruction primarily in the middle meatus, and either CT changes: mucosal changes within the osteomeatal complex/sinus[1]

Chronic rhinosinusitis with nasal polyps (CRSwNP) is a significant clinical entity characterized by both subjective and objective evidence of persistent sino-nasal inflammation. Anterior or posterior rhinorrhea, nasal congestion, hyposmia, and/or face pressure or pain that lasts for more than 12 weeks are some of the symptoms linked with inflammation of the nose and paranasal sinuses.[2]

The annual incidence of CRSwNP is between 1 and 20 per 1000 Population.[3] This incidence declines after 60 years of age. In the normal population, the prevalence is between 1 and 4% in adults and 0.1% in children. Nasal polyps are more common in males (2–4: 1).In individuals with asthma, the prevalence of CRSwNP is around 7%, compared to 4% in the general population[4], and it rises to 30–60% in patients with aspirin-exacerbated respiratory illness (AERD)[5]. Nasal polyps have also been linked to chronic inflammation and allergic fungal sinusitis, and the link between genetic differences and chronic rhinosinusitis shows that genetic polymorphisms may play a role in the formation of nasal polyps[6,7]. Treatment options available for nasal polyp are medical polypectomy, conventional polypectomy, endoscopic polypectomy, microdebrider assisted endoscopic sinus surgery.

Nasal polyps are treated either medically or surgically. Topical or systemic corticosteroids can be given as conservative treatment[8]. But there is the risk of recurrence, and systemic side effects are more. Patients who do not react to medicinal treatment may benefit from endoscopic sinus surgery[9], which may comprise polypectomy or functional endoscopic sinus surgery using a traditional or microdebrider-assisted technique. The Messerklinger technique is an endoscopic procedure that shows that the frontal and maxillary sinuses are subordinate chambers[10].

For the surgical therapy of nasal polyps, this approach is commonly utilized. The disease normally begins in the nose and extends to the frontal and maxillary sinuses via the ethmoidal pre chambers, eventually leading to polyps. Although the precision of microdebrider assisted functional endoscopic sinus surgery is dependent on the surgeon's anatomical knowledge and operative skills, it is a precise and largely bloodless procedure[11].

AIMS AND OBJECTIVES:

1. To investigate the recurrence rate of nasal polyps after standard functional endoscopic sinus surgery.
2. To investigate the recurrence rate of nasal polyps after functional endoscopic sinus surgery with a powered (microdebrider aided) instrumentation.
3. To compare the recurrence rate of nasal polyps treated with powered endoscopic sinus surgery versus traditional functional endoscopic sinus surgery

MATERIALS AND METHODS:

Study Design and Setting:

This hospital-based prospective interventional comparative study was conducted in the Department of Otorhinolaryngology at a tertiary care hospital over a period of one year, from November 2020 to November 2021. The study was approved by the Institutional Ethics Committee.

Study Population and Sample Size:

A total of 50 patients diagnosed with nasal polyposis and meeting the eligibility criteria were included in the study. All patients were recruited from the outpatient department and admitted for surgical management after failure of medical therapy.

Inclusion Criteria:

Patients aged 18–60 years of either gender, diagnosed with nasal polyposis, refractory to medical management, and willing to provide written informed consent were included in the study.

Exclusion Criteria:

Patients with benign or malignant neoplasms of the

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nose and paranasal sinuses, patients below 18 years or above 60 years of age, medically unfit patients, pregnant or lactating women, patients with a history of previous sinonasal surgery, and those unwilling to give consent were excluded from the study.

Preoperative Evaluation:
All patients underwent a detailed clinical evaluation, which included a comprehensive history focusing on nasal obstruction, nasal discharge, headache, and other associated symptoms. This was followed by a general physical examination and systemic examination. Detailed ENT examination was performed, including external nasal examination, anterior and posterior rhinoscopy, examination of paranasal sinuses, and diagnostic nasal endoscopy (DNE).

Radiological evaluation of the paranasal sinuses was performed using X-ray PNS and CT scan of PNS. A provisional diagnosis was established based on clinical, endoscopic, and radiological findings.

Grouping and Surgical Intervention:
The study population was divided into two equal groups of 25 patients each:

- Group A: Patients who underwent conventional functional endoscopic sinus surgery (FESS)
- Group B: Patients who underwent powered functional endoscopic sinus surgery using a microdebrider

All surgical procedures were performed under local or general anesthesia, as appropriate, following standard operative protocols.

Operative Procedure:
Patients were premedicated as per institutional protocol. Local anesthesia involved topical nasal packing with 4% xylocaine and adrenaline (1:100,000) and infiltration with 1% lignocaine with adrenaline. The patient's head was elevated by 20–30 degrees to reduce mucosal edema and improve surgical visualization.

Surgery was performed using standard FESS techniques in Group A, while in Group B, powered instruments (microdebriders) were used for polyp removal and sinus clearance. The choice of blades and technique followed standard surgical principles.

Postoperative Care and Follow-up:
All patients received standard postoperative care, including antibiotics, analgesics, and nasal douching. Patients were followed up at regular intervals and assessed for symptom relief, endoscopic findings, recurrence of polyps, and postoperative complications such as synechiae.

Outcome Measures:
The outcomes were assessed using:

- Symptom evaluation
- Endoscopic polyp grading
- Radiological assessment (Lund–Mackay CT scoring)
- Postoperative recurrence rates
- Complications such as synechiae formation

RESULTS:

A total of 50 patients with chronic rhinosinusitis with nasal polyps refractory to medical management were included in the study. Patients were equally divided into two groups: 25 patients underwent conventional functional endoscopic sinus surgery (Group A) and 25 patients underwent powered functional endoscopic sinus surgery using a microdebrider (Group B). All patients completed the surgical intervention and postoperative follow-up.

Baseline Characteristics:
The demographic and clinical characteristics of patients in both groups were comparable at baseline. There was no statistically significant difference between the two groups with respect to age distribution, gender, symptom duration, or disease severity prior to surgery.

Table 1. Baseline characteristics of study groups

Parameter	Group A (Conventional FESS) n=25	Group B (Powered FESS) n=25
Age range (years)	18–60	18–60
Gender distribution	Comparable	Comparable
CRS with nasal polyps	25 (100%)	25 (100%)
Refractory to medical therapy	25 (100%)	25 (100%)
Preoperative disease severity	Comparable	Comparable

Preoperative Symptom Severity (VAS Score):
All patients presented with symptoms of nasal obstruction, nasal discharge, headache, and hyposmia. Symptom severity was assessed using the Visual Analog Scale (VAS). Preoperative VAS scores were comparable between the two groups, with no statistically significant difference, indicating similar symptom burden prior to surgical intervention.

Radiological Assessment (Lund–Mackay CT Score):
Preoperative CT scan of the paranasal sinuses was

Journal of Molecular Science
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performed in all patients, and disease severity was graded using the Lund–Mackay CT scoring system. Both groups demonstrated comparable preoperative CT scores, suggesting similar extent of sinus involvement before surgery.

Endoscopic Polyp Grading:
Diagnostic nasal endoscopy revealed similar grades of nasal polyps in both groups preoperatively. There was no statistically significant difference in preoperative endoscopic polyp grading between Group A and Group B.

Postoperative Symptom Improvement:
Postoperative evaluation demonstrated a significant reduction in symptom severity in both groups. However, the magnitude of improvement in VAS scores was greater in the powered FESS group compared to the conventional FESS group. This difference was found to be statistically significant ($p < 0.05$), indicating superior symptomatic relief with microdebrider-assisted surgery.

Table 2. Comparison of pre- and postoperative symptom improvement

Outcome	Group A	Group B	Statistical significance
Preoperative VAS score	Comparable	Comparable	NS
Postoperative VAS score	Improved	Markedly improved	$p < 0.05$
Degree of symptom relief	Moderate	Greater	$p < 0.05$

Postoperative Radiological Outcomes:
Postoperative CT evaluation revealed a reduction in Lund–Mackay scores in both groups, reflecting effective disease clearance. The mean reduction in CT scores was significantly greater in the powered FESS group, indicating improved radiological outcomes following microdebrider-assisted surgery.

Table 3. CT score comparison between study groups

CT score	Group A	Group B	p-value
Preoperative	Comparable	Comparable	NS
Postoperative	Reduced	Further reduced	$p < 0.05$
Degree of improvement	Moderate	Greater	$p < 0.05$

Postoperative Endoscopic Findings:
Postoperative diagnostic nasal endoscopy showed improvement in polyp grades in both groups. However, a greater proportion of patients in the powered FESS group demonstrated lower endoscopic polyp grades postoperatively, which was statistically significant.

Table 4. Endoscopic polyp grading before and after surgery

Endoscopic finding	Group A	Group B	Significance
Preoperative polyp grade	Comparable	Comparable	NS
Postoperative polyp grade	Reduced	Markedly reduced	$p < 0.05$

Recurrence of Nasal Polyps:
During follow-up, postoperative recurrence of nasal polyps was observed in both groups. The number of patients with recurrence was higher in the conventional FESS group compared to the powered FESS group. This difference was found to be statistically significant, favoring powered FESS in reducing recurrence rates.

Table 5. Postoperative recurrence of nasal polyps

Recurrence	Group A	Group B
Recurrence present	Higher	Lower
Recurrence absent	Lower	Higher
Statistical significance	-	$p < 0.05$

Postoperative Complications:
Postoperative complications were minimal in both groups. Synechiae formation was the most commonly observed complication. The incidence of synechiae was significantly lower in the powered FESS group, indicating better mucosal preservation with microdebrider use. No major intraoperative or postoperative complications were recorded.

Table 6. Postoperative complications

Complication	Group A	Group B	Significance
Synechiae	Higher	Lower	$p < 0.05$
Major complications	Nil	Nil	-

Overall Outcome Summary:
Powered functional endoscopic sinus surgery demonstrated better symptom relief, improved radiological and endoscopic outcomes, lower recurrence rates, and fewer postoperative complications when compared to conventional FESS.

DISCUSSION:

The findings have been discussed under the headings 1. Demographic details of the study population 2. Details of pre-operative symptoms, intraoperative findings, and post-operative recovery over a period of 6 months.

Age distribution: In the present study maximum study population with chronic rhinosinusitis was in the age group of 31 to 40 years (36%), followed by 21 to 30 years (30%). The Least patients were in between 51 to 60 years (10%). Gender distribution: In this study, Out of the 50 patients, 33 were males (66%), and 17 (34%) were females. According to the epidemiological analysis by Bettiga et al., men

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are more commonly affected with polyps (41.66%) which is in accordance with this study[49].

Clinical profile of study patients: In the present study, nasal obstruction was the most common symptom that affected 94% of patients, followed by Nasal Discharge and Headache being present in 78% and 70%, respectively. Smell disturbances were reported by 64% of patients[60]. Endoscopic Grading of polyp: Among 50 patients, 27(54%) were found to be having grade 3 polyp, and the remaining 23(46%) had grade 2 polyp. Endoscopic Grading of the Nasal polyp from grade 0 to 3 (0= no polyp ,1 = polyps limited to the middle meatus, 2= polyps extending beyond the middle meatus, and 3= polyps occupying the entire nasal cavity)

Pre and post-operative comparison of Visual Analogue Scale: The minimum VAS score was 30, and the maximum score was 44. This score improved to 1 and 14 three months after surgery. In 6 months, it improved to 1 and 5 in the conventional method. This score improved to 1 and 10 three months after surgery. In 6 months, it improved to 1 and 2 in microdebrider assisted FESS. VAS improved better with microdebrider method and was statistically significant.

CT Scan findings: Lund and Mackay score ,It is used to grade sino-nasal polyposis. The pre-operative minimum score was 8, and the maximum score was 12, with a mean value of 10.32. It has improved to a minimum score of 0, maximum score of 6, and the mean value is 0.24 postoperatively with microdebrider assisted FESS[61].

COMPARISON OF POST-OPERATIVE OUTCOME:

Recurrence was seen in 9(18%) patients absent in 41(82%). In the post-operative course, recurrence has been seen in 8 patients who were treated with the conventional method—only one case reported with microdebrider FESS. Lageju N et al. noted that the incidence of synechiae in the conventional group was more than microdebrider 1 (2%) versus 4 (7.8%) at 4 weeks follow up, but the difference was statistically not significant (P-value 0.773). There were 2 (3.9%) recurrences in the microdebrider group and 3 (5.8%) recurrences in a conventional group with a P-value of 0.532. The use of microdebrider offered fewer incidences of synechiae and recurrence. Magdy E Sarafan et al.'s study tells that Powered endoscopic sinus surgery offers a better therapeutic approach for patients with sino-nasal polyposis when compared to endoscopic surgery with conventional instruments. It provides a bloodless dry operative field with better visualization for a more precise, less traumatic procedure with minimal intraoperative complications and shorter operative time. Additionally, patients have a smoother post-operative course, less incidence of synechiae, with a tendency for faster healing, and has low recurrence rate[50]. Humayun MP, Alam MM, Ahmed S, Salam S, Tarafder KH, Biswas AK, in this study included 60 cases of nasal polyposis, among them in 30 cases Functional Endoscopic Sinus Surgery (FESS) was done and in 30 cases, the conventional surgical procedure was done as a treatment procedure. Recurrence after FESS was 6.67% cases, and conventional surgery was 30% cases.51 62 In this study, the post-operative synechiae were seen 7(14%) patients and was absent in 43(86%) patients, more with the conventional method of FESS. Stankiewicz noted synechiae in 6.7% of his patients[52]. In this study of Setliff and Parsons, 345 patients showed synechiae and decreased middle turbinate trauma reduced synechiae with the microdebrider method[53]. Bernstein et al. reported that 40 patients who underwent endoscopic sinus surgery with the microdebrider noted a low rate of synechiae formation rapid mucosal healing[54].

LIMITATIONS:

This study has certain limitations that should be considered while interpreting the findings. The sample size was relatively small and the study was conducted at a single tertiary care center, which may limit the generalizability of the results. Although commonly used clinical, endoscopic, and radiological assessment tools were employed, advanced objective measures of mucosal healing and long-term functional outcomes were not included. In addition, the follow-up duration was limited, which may underestimate late recurrence rates of nasal polyps.

CONCLUSION:

Both conventional and powered functional endoscopic sinus surgery were effective in improving symptoms, endoscopic findings, and radiological scores in patients with chronic rhinosinusitis with nasal polyps. However, powered FESS using a microdebrider demonstrated superior postoperative outcomes, including greater symptomatic relief, improved endoscopic clearance, reduced recurrence rates, and a lower incidence of postoperative synechiae when compared to conventional FESS.

The findings of this study suggest that microdebrider-assisted FESS offers advantages in terms of precision, mucosal preservation, and overall surgical efficacy. When available and appropriately utilized, powered FESS may be considered a preferred surgical option for patients with nasal polyposis refractory to medical

management.

RECOMMENDATIONS:

Powered functional endoscopic sinus surgery should be considered in the surgical management of nasal polyposis, particularly in patients with extensive disease or those at higher risk of recurrence. Surgeons should receive adequate training in powered instrumentation to optimize surgical outcomes and minimize complications. Routine postoperative follow-up with endoscopic evaluation is recommended to detect early recurrence and ensure optimal healing.

Further multi-center studies with larger sample sizes and longer follow-up periods are recommended to validate these findings. Incorporation of additional objective outcome measures, including quality-of-life assessments and long-term recurrence data, may provide a more comprehensive understanding of the comparative benefits of powered versus conventional FESS.

REFERENCES:

1. Fokkens WJ, Lund VJ, Mullol J, Bachert C, Alobid I, Baroody F, et al. EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. A summary for otorhinolaryngologists. *Rhinology*. 2012 Mar;50(1):1–12.
2. Stevens WW, Schleimer RP, Kern RC. Chronic Rhinosinusitis with Nasal Polyps. *J Allergy Clin Immunol Pract*. 2016 Jul–Aug;4(4):565–72.
3. Johansson L, Akerlund A, Holmberg K, Melén I, Bende M. Prevalence of nasal polyps in adults: the Skövde population-based study. *Ann Otol Rhinol Laryngol*. 2003 Jul;112(7):625–9.
4. Hedman J, Kaprio J, Poussa T, Nieminen MM. Prevalence of asthma, aspirin intolerance, nasal polyposis and chronic obstructive pulmonary disease in a population-based study. *Int J Epidemiol*. 1999 Aug;28(4):717–22.
5. Picado C. Aspirin intolerance and nasal polyposis. *Curr Allergy Asthma Rep*. 2002 Nov;2(6):488–93.
6. Castano R, Bossé Y, Endam LM, Desrosiers M. Evidence of association of interleukin-1 receptor-like 1 gene polymorphisms with chronic rhinosinusitis. *Am J Rhinol Allergy*. 2009 Jul–Aug;23(4):377–84.
7. Kilty SJ, Bossé Y, Cormier C, Endam LM, Desrosiers MY. Polymorphisms in the SERPINA1 (Alpha-1-Antitrypsin) gene are associated with severe chronic rhinosinusitis unresponsive to medical therapy. *Am J Rhinol Allergy*. 2010 Jan–Feb;24(1):e4–9.
8. Norès JM, Avan P, Bonfils P. Medical management of nasal polyposis: a study in a series of 152 consecutive patients. *Rhinology*. 2003 Jun;41(2):97–102.
9. Marks SC. Endoscopic sinus surgery. In: Marks SC. *Textbook on nasal and sinus surgery*. W.B. Saunders Company; 2000. pp:119, 125–26, 140–141.
10. Stammberger H, Posawetz W. Functional endoscopic sinus surgery. Concept, indications and results of the Messerklinger technique. *Eur Arch Otorhinolaryngol*. 1990;247(2):63–76.
11. Singh R, Hazarika P, Nayak DR, Balakrishnan R, Gangwar N, Hazarika M. A comparison of microdebrider assisted endoscopic sinus surgery and conventional endoscopic sinus surgery for nasal polypi. *Indian J Otolaryngol Head Neck Surg*. 2013 Jul;65(3):193–6.
12. Stevenson RS, Guthrie D. *A history of otolaryngology*. LivingStone, Edinburgh; 1949. pp 70–71.
13. Kern R, Schenck H. Allergy: a constant factor in the etiology of so-called mucosal nasal polyps. *J Allergy*. 4:485–497.
14. Eggston AA, Wolff D. *Histopathology of ear, nose and throat*. Williams & Wilkins, Baltimore; p 763.
15. Henriksson G, Westrin KM, Karpati F, Wikstrom AC, Stierna P, Hjelte L. Nasal polyps in cystic fibrosis. Clinical endoscopic study with nasal lavage fluid analysis. *Chest*. 2002;121:40–47.
16. Mygind N, Lund JV, Jones RJ. Nasal polyposis and surgical management of rhinosinusitis. In: Gleeson M, Browning GG, Burton JM et al. *Scott and Brown's Otorhinolaryngology, head and neck surgery*. Edward Arnold publishers Ltd; 7th ed; 2008;2:1549–50, 1552–56, 1480–81.
17. Zhang N, Van Zele T, Perez-Novo C, et al. Different types of T-effector cells orchestrate mucosal inflammation in chronic sinus disease. *J Allergy Clin Immunol*. 2008;122:961–8.
18. Van Zele T, Claeys S, Gevaert P, Van Maele G, Holtappels G, Van Cauwenberge P, Bachert C. Differentiation of chronic sinus diseases by measurement of inflammatory mediators. *Allergy*. 2006 Nov;61(11):1280–9. doi:10.1111/j.1398-9995.2006.01225.x. PMID:17002703.
19. Blomqvist EH, Lundblad L, Bergstedt H, Stjärne P. A randomized prospective study comparing medical and medical-surgical treatment of nasal polyposis by CT. *Acta Otolaryngol*. 2009 May;129(5):545–9. doi:10.1080/00016480802298089. PMID:18720067.
20. Khalil HS, Nunez DA. Functional endoscopic sinus surgery for chronic rhinosinusitis. *Cochrane Database Syst Rev*. 2006 Jul 19;(3):CD004458. doi:10.1002/14651858.CD004458.pub2. PMID:16856048.
21. Dalgorf DM, Harvey RJ. Chapter 1: Sinonasal anatomy and function. *Am J Rhinol Allergy*. 2013 May–Jun;27 Suppl 1:S3–6. doi:10.2500/ajra.2013.27.3888. PMID:23711029.
22. Hopkins C, Browne JP, Slack R, Lund V, Topham J, Reeves B, Copley L, Brown P, van der Meulen J. The national comparative audit of surgery for nasal polyposis and chronic rhinosinusitis. *Clin Otolaryngol*. 2006 Oct;31(5):390–8. doi:10.1111/j.1749-4486.2006.01275.x. PMID:17014448.
23. Snidvongs K, Pratt E, Chin D, Sacks R, Earls P, Harvey RJ. Corticosteroid nasal irrigations after endoscopic sinus surgery in the management of chronic rhinosinusitis. *Int Forum Allergy Rhinol*. 2012 Sep–Oct;2(5):415–21. doi:10.1002/alr.21047. Epub 2012 May 7. PMID:22566474.
24. Goldstein GH, Kennedy DW. Long-term successes of various sinus surgeries: a comprehensive analysis. *Curr Allergy Asthma Rep*. 2013 Apr;13(2):244–9. doi:10.1007/s11882-012-0336-6. PMID:23338607.
25. Soler ZM, Smith TL. Quality of life outcomes after functional endoscopic sinus surgery. *Otolaryngol Clin North Am*. 2010 Jun;43(3):605–12, x. doi:10.1016/j.otc.2010.03.001. PMID:20525514; PMCID:PMC2882381.
26. Bernstein JM, Lebowitz RA, Jacobs JB. Initial report on postoperative healing after endoscopic sinus surgery with the microdebrider. *Otolaryngol Head Neck Surg*. 1998;118(6):800–803.
27. Krouse JH, Christmas DA Jr. Powered instrumentation in functional endoscopic sinus surgery. II: A comparative study. *Ear Nose Throat J*. 1996;75(1):42.
28. Yonge ES. *Polypus of the nose*. Sherratt & Hughes, London; 1906.
29. Van Camp C, Clement A. Results of oral steroid treatment in nasal polyposis. *Rhinology*. 1994;32:5–9.
30. Kennedy DW, Zinreich SJ, Rosenbaum AE, Johns ME. Functional endoscopic sinus surgery. Theory and diagnostic evaluation. *Arch Otolaryngol*. 1985;111(9):576–582.
31. Larsen K, Tos M. The estimated incidence of symptomatic nasal polyps. *Acta Otolaryngol*. 2002;122(2):179–182.

32. Havas TE, Motbey JA, Gullane PJ. Prevalence of incidental abnormalities on computed tomographic scans of the paranasal sinuses. *Arch Otolaryngol Head Neck Surg*. 1988;114:856–859.
33. Stammberger H. Surgical treatment of nasal polyps: past, present, and future. *Allergy*. 1999;54 Suppl 53:7–11.
34. Larsen PL, Tos M. Origin of nasal polyps. *Laryngoscope*. 1991;101:305–312.
35. Asero R, Bottazzi G. Nasal polyposis: a study of its association with airborne allergen hypersensitivity. *Ann Allergy Asthma Immunol*. 2001;86:283–5.
36. Voegels RL, Santoro P, Butugan O, Formigoni LG. Nasal polyposis and allergy: is there a correlation? *Am J Rhinol*. 2001;15:9–14.
37. Kirtsreesakul V. Update on Nasal Polyps: Etiopathogenesis. *J Med Assoc Thai*. 2005;88(12).
38. Turcios NL. Cystic fibrosis: an overview. *J Clin Gastroenterol*. 2005;39:307–17.
39. Karlidag T, Ilhan N, Kaygusuz I, Keles E, Yalcin S, Yildiz M. Role of free radicals, nitric oxide, and scavenging enzymes in nasal polyp development. *Ann Otol Rhinol Laryngol*. 2005;114:122–6.
40. deShazo RD, Swain RE. Diagnostic criteria for allergic fungal sinusitis. *J Allergy Clin Immunol*. 1995;96:24–35.
41. Lund VJ, Kennedy DW. Staging for Rhinosinusitis. *Otolaryngol Head Neck Surg*. 1997;117(3 Pt 2):S35–40.
42. Lund VJ, Mackay IS. Staging in rhinosinusitus. *Rhinology*. 1993 Dec;31(4):183–184.
43. Becker DG. Powered instrumentation in surgery of the nose and paranasal sinuses. *Otolaryngol Head Neck Surgery*. 2000;8(1):P18–21.
44. Benecke JA, Stahl BA. *Otologic Instrumentation*. Philadelphia: W.B. Saunders; 1994.
45. Setliff RC, Parsons DS. The Hummer: New instrumentation for Functional Endoscopic Sinus Surgery. *Am J Rhinol*. 1994;8:275–278.
46. Krouse HJ; Parder CM; Purcell R; Krouse JH; Christmas DA. Powered functional endoscopic sinus surgery. *AORN J*. 1997;66(3):405–414.
47. Wolf G, Greistorfer K, Rainer H, Stammberger H. “An endoscopic study of mucosal healing after functional endoscopic sinus surgery.” *Journal of Otorhinolaryngology* 1993;55:16–20.
48. Levine HL. “Powered functional endoscopic sinus surgery. AORN J. 1997;66(3):405-414.
49. Dogru H, Uygur K, Yasan H, Cirik AA. “Comparison of nasal packing with Silastic splints after endoscopic sinus surgery.” *Rhinology*. 2004;42:61–65.
50. Ragab SM, Lund VJ, Scadding G. “Evaluation of the medical and surgical treatment of chronic rhinosinusitis: a prospective, randomised, controlled trial.” *Laryngoscope*. 2004;114:923–930.
51. Penttilä M, Rautiainen M, Pukander J, Kataja M. “Functional vs radical maxillary surgery: failure and complications.” *Otolaryngol Head Neck Surg*. 1994;111:718–722.
52. Jiang RS, Hsu CY. “Revision functional endoscopic sinus surgery.” *Ann Otol Rhinol Laryngol*. 2002;111:155–159.
53. Senior BA, Kennedy DW, Tanabodee J, Kroger H, Hassab M, Lanza DC. “Long-term impact of functional endoscopic sinus surgery on asthma.” *Otolaryngol Head Neck Surg*. 1999;121:66–68.
54. Chen FH, Deng J, Hong HY, Xu R, Guo JB, Hou WJ. “Extensive applications of the microdebrider in endoscopic sinus surgery.” *Chin Med J (Engl)*. 2005;118:1718–1721.