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Endoscopic versus Caldwell-Luc approach in chronic maxillary sinusitis: Comparison of symptoms at one-year follow-up*

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SUMMARY

The aim of this prospective randomized study was to compare functional endoscopic sinus surgery (FESS) with the standard Caldwell-Luc (C-L) procedure in relieving the symptoms of chronic maxillary sinusitis. One hundred and fifty consecutive adult patients were operated after the failure of treatment with antimicrobials and repeated antral irrigations: 143 patients were available for the follow-up examination, at a median of 12 months after the operation. The patients' global evaluation showed marked improvement in 50.7% of the C-L group and in 76.7% of the FESS group. Overall subjective symptoms deteriorated in 5.5% of C-L operated patients, but not at all in the FESS group. Patients' compliance, asked post-operatively, was 80.2% in C-L patients and 93.0% in FESS patients.

Key words: chronic maxi/la,y sinusitis, FESS, Caldwell-Luc surgery

INTRODUCTION

The surgical modalities for treatment of chronic maxillary sinusitis have been changed in recent years. The radical Caldwell-Luc approach (C-L) has been replaced by more conservative functional endoscopic middle meatal surgery (FESS). Good clinical results for the FESS technique have been reported (Wigand et al., 1978; Stammberger et al., 1987; Kennedy et al., 1987), but only a few papers also give detailed data about the symptoms (Kamel, 1989; Levine, 1990; Stammberger, 1991; Lund et al., 1991). Prospective randomized studies comparing FESS with other techniques are rare. Before the introduction of FESS, conventional middle or inferior meatal antrostomies were compared in 38 patients with bilateral sinusitis; both procedures gave significant symptom relief compared with the pre-operative status, but no significant difference between the techniques was found (Ames et al., 1985). The aim of the present study was to compare the radical and functional surgical techniques with special reference being paid to the patients' pre- and post-operative complaints and sequelae.

MATERIAL AND METHODS

Between 1987 and 1989, 150 successive chronic maxillary sinusitis patients were randomized into two treatment groups, each comprising 75 patients. C-L operation was performed in 115 and FESS in 135 sinuses at the Department of Otolaryngology of Tampere University Hospital. The mean age of the patients was 48 years (range 14-88 years) in the C-L group, and 47 years (range 16-84 years) in the FESS group. All of them gave informed consent for the trial. The diagnostic criteria of chronic maxillary sinusitis was that treatment with antimicrobials and frequent antral irrigations had failed, with the duration of sinusitis being more than three months (Penttila et al., 1993). Cases of dental origin were excluded by standard orthopantomographic X-ray examinations and frequent dentist consultations, so all the cases fulfilled the requirement of rhinogenic sinusitis (Melen et al., 1986). Six antra in the C-L group and five in the FESS group had been operated on by a C-L approach earlier, and two and four antra by inferior meatal antrostomy, respectively.

C-L operations were performed by 16 different surgeons. They included sublabial anterior antrostomy opening, radical removal of thickened antral mucosa and a wide inferior meatal window. For the patients with nasal polyps, in addition to C-L operation a snare po]ypectomy was performed in four cases, and an intranasal ethmoidectomy in 13 cases. FESS was performed by one surgeon according to the principles described by Kennedy (1985) and Stammberger (1986).

The pre-operative symptoms were inquired on the day before surgery by the doctor using a 0-3 point scale (0: no; 1: slight; 2: moderate; 3: severe symptoms). The symptoms recorded were

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nasal obstruction, facial pain, nasal secretion and headache. The first three symptoms were asked bilaterally. Type of nasal secretion, sense of smell, occurrence of fever and possible other sinusitis symptoms were also recorded. The main presenting symptom of each patient was also asked as well as the number of antimicrobial treatments and antral irrigations during the year preceding surgery. In bilateral cases the side with worse symptoms was used as an "index sinus" when analyzing relief of symptoms, side effects, irrigations and overall efficacy.

One hundred and forty-three patients (71 in the C-L and 72 in the FESS group) were available for the 12-month follow-up examination (range 7-32 months). Three persons in the C-L group and one in the FESS group had died (from other causes), and three patients were lost from follow-up due to other reasons. A similar symptom inquiry as pre-operatively was performed, including also the "surgical" side effects, if they were still present. Patients were asked to make their own evaluation about the overall efficiency of the treatment, including side effects. Compliance to surgery was also asked. The number of antimicrobial remedies and antral irrigations during the post-operative year was counted excluding those during the immediate (one month) post-surgical recovery period.

Pre- and post-operative symptom scores were calculated for each symptom in both groups and the change in symptom scores was used in statistical analysis. Wilcoxon's test with one-tailed interpretation was used when the pre- and post-operative situation of the ordinal scale variables was compared inside the groups, because a decrease of symptoms after surgery was expected. In variables without order (type of rhinitis) the Chi-square test was used. Fischer's exact test was utilized in comparing two methods where the trend was expected. When pre-operative distributions showed no statistical differences the post-operative situations were compared. When C-L and FESS were compared, the pre- and postoperative symptom scores were arranged in a correlation matrix.

RESULTS

Symptoms

Nasal obstruction (in 30 of the C-L, and in 39 of the FESS patients), facial pain (in 34 of the C-L, and in 21 of the FESS patients) and nasal secretion were the most common main symptoms pre-operatively. Other symptoms, such as coughing, ear symptoms or fever, presented only occasionally as a chief complaint.

The frequency and severity of almost all pre-operative symptoms had decreased post-operatively in both groups. Nasal obstruction - the most common pre-operative symptom - was present in 83% of C-L patients and in 93% of FESS patients. The decrease of nasal obstruction was indisputable in both groups (Figure 1), but was clearly greater after FESS than after C-L ($p < 0.001$). Pre-operatively about half of the patients suffered from facial pain, which was reduced substantially after both operations, but intergroup difference was not significant (Figure 2).

Pre-operative rhinorrhoea was present in 61% of the C-L and in 79% of the FESS patients. It diminished in both groups, but significantly only in FESS patients (Figure 3). Purulent secretion

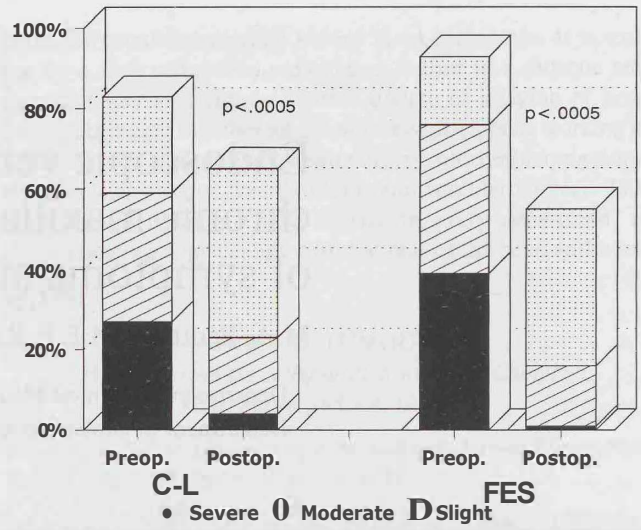

Figure 1. Nasal obstruction one year after C-L (n=71) or FESS (n=72) operations.

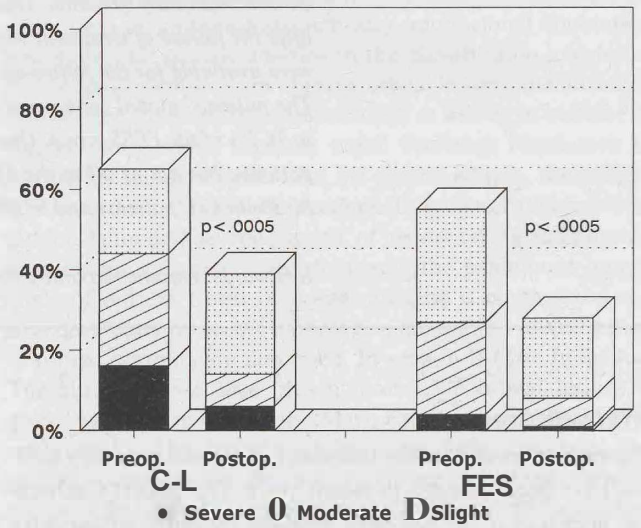

Figure 2. Severity of facial (sinus) pain before operation and one year post-operatively.

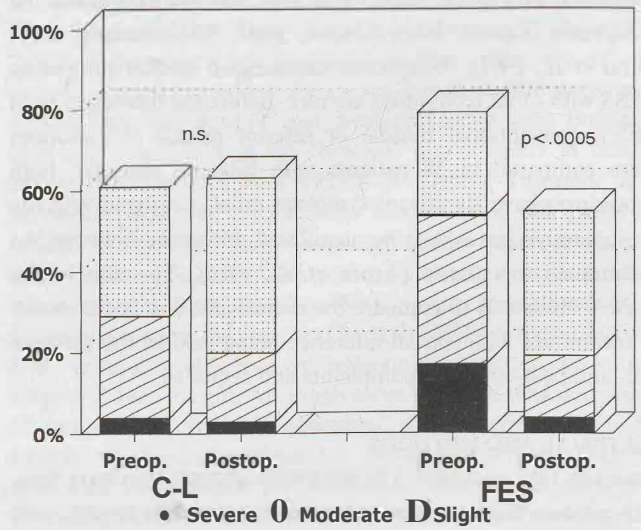

Figure 3. Pre- and post-operative rhinorrhoea in C-L and FESS patients.

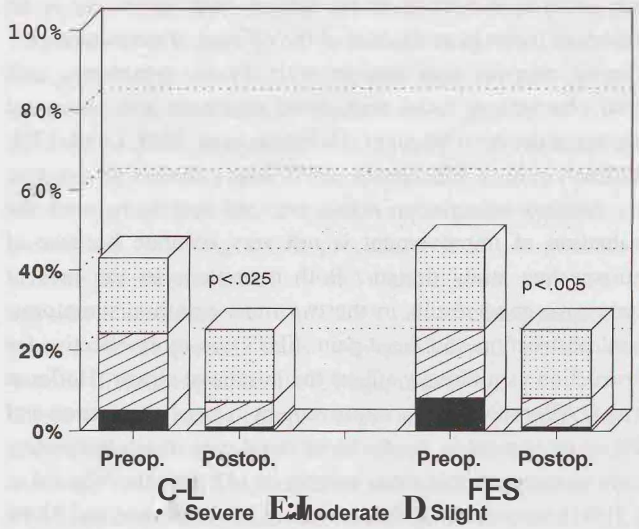

Figure 4. Tbe severity and occurrence of headache before and after C-L and FESS operations.

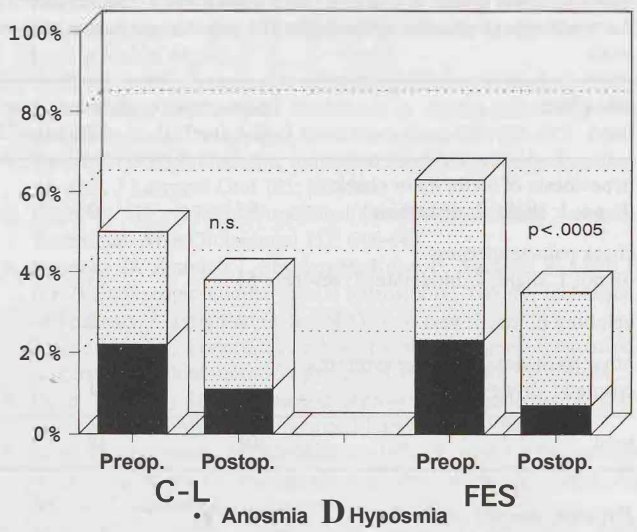

Figure 5. Alteration in sense of smell.

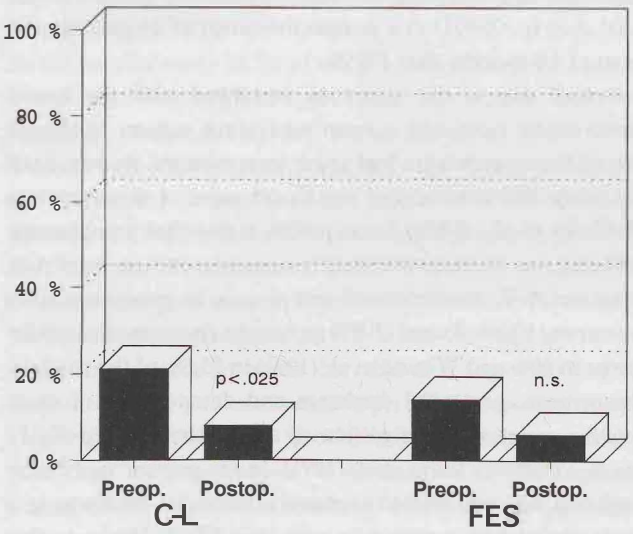

Figure 6. The occurrence of fever, pre- and post-operatively.

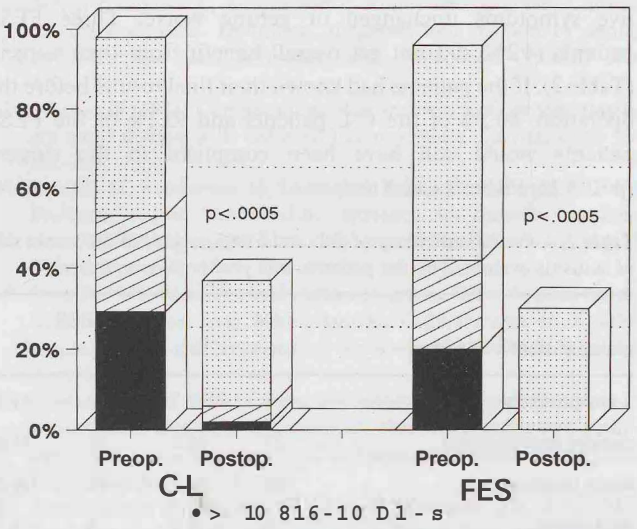

Figure 7. The number of antral irrigations during the pre- and post-operative year.

also decreased in both groups, but the change in the type of rhinitis was significant only in the FESS group ($p < 0.005$).

Headache decreased markedly after both operations, with a frequency equal in both groups (Figure 4). Although significant recovery of smell occurred only in the FESS group, post-operatively the groups were quite similar (Figure 5). The occurrence of fever periods decreased significantly only in the C-L group (Figure 6). Other sinusitis symptoms were rare with no statistical importance.

Other remedies

During the pre-operative year a total of 557 antral punctures with irrigations had been done to the worse sinus (mean 7.4 times per patient) in the C-L group, and 471 times with a mean of 6.4 per patient in the FESS group (not significant). During the post-operative year only 102 irrigations in the C-L patients (mean 1.4), and 42 irrigations in the FESS group (mean 0.6) had to be performed. The post-operative number of irrigations was significantly smaller after FESS than after C-L ($p < 0.001$; Figure 7). The number of positive antral irrigations also decreased markedly from pre- to post-operative year in both groups; in C-L from 55/75 to 12/30 ($p < 0.0005$) and in FESS from 50/74 to 5/24 ($p < 0.0005$). The average number of annual antimicrobial treatments per patient decreased from 3.4, pre-operatively, to 1.4, post-operatively, in the C-L group and from 3.0 to 1.1 in the FESS group, respectively.

Surgical sequelae

In 29 (40.8%) of the C-L patients, par- or hypesthesia of the cheek, lip and/or teeth was still present in one-year follow-up (Table 1). In 26 patients this complication was mild or moderate, but three patients reported severe numbness; 22.9% of the C-L antra were associated with continuous cheek pain and/or sensation to changes in temperature or pressure. In the FESS group two patients had slight hypesthesia of the upper lip and two others complained of cheek pain.

Table I. Side effects of C-L and FESS operations. Symptom scores in the worse side of sinusitis evaluated by the patients one year postoperatively.

side effect (key)	post-operative symptom scores C-L (n=71)	FESS (n=72)
hypesthesia of teeth, lip or cheek (0: no; 1: slight; 2: disturbing)	35	2
cheek pain/tenderness (0: no; 1: slight; 2: moderate; 3: severe)	54	3
epiphora (0: no; 1: yes)	2	2
other (post-nasal drip, eye symtoms, cosmetic, dryness, etc.)	10	11
total	101	18

Patients' overall evaluation

In global evaluation 50.7% of the C-L patients and 76.7% of the FESS patients reported marked overall improvement (of the worse sinus). Ten C-L patients (14.1%) reported the pre-operative symptoms unchanged or getting worse. Three FESS patients (4.2%) did not get overall benefit from their surgery (Table 2). If the patients had known their final results before the operation, 80.3% of the C-L patients and 93.1% of the FESS patients would still have been compliant to the surgery ($p < 0.022$, Fisher's exact test).

Table 2. Overall efficiency of C-L and FESS surgery in the worse side of sinusitis evaluated by the patients, one year post-operatively.

global patient evaluation	C-L n	%	FESS n	%
a-symptomatic	9	12.7	30	41.1
distinct improvement	27	38.0	26	35.6
slight improvement	25	35.2	14	19.2
unchanged	6	8.5	3	4.1
worse	4	5.6	0	0

DISCUSSION

Evaluation of sinus surgery efficacy between different studies is not easy because of the lack of a commonly used staging system or proper definition of chronic sinusitis. One bias is the patient population that is operated on. The strict requirement of over three-months' duration of antral effusion despite active medical and irrigation treatment resulted in a seiection of rather difficult cases for the present study material. High pre-operative irrigation frequency reflected well the chronic nature of sinusitis and "irreversibility" of the diseased antral mucosa. Differences in the pre-operative occurrence and severity of certain symptoms probably depended on interviewer bias. Many of the post-operative changes were so apparent that the expression $p < 0.001$ is in fact misleading. Randomization of our patients gave reasonably comparable study groups in relation to age, sex, underlying diseases, and previous treatments. Every patient gave informed consent for the study. The number of lost patients in the follow-up was small and had a negligible effect on the results. Although it is clear that symptoms can not be the only criteria, subjective improvement post-operatively is an important factor in evaluation of the efficacy of sinus surgery.

Chronic sinusitis may present with diverse symptoms, with nasal obstruction, facial pain, nasal discharge and post-nasal drip being the most frequent (DeFreitas et al., 1988; Lund, 1988; Hoffman et al., 1989; Kamel, 1989). Many studies do not give any detailed information about patients' symptoms, and the evaluation of improvement is. not very accurate because of retrospective study designs. Both operations in the present study gave good results in the two most common symptoms: nasal obstruction and facial pain. FESS was more effective for obstruction as it directly affects the intranasal airway. Hoffman et al. (1989) reported 90% improvement in nasal obstruction and 85% improvement in headache or facial pain in a retrospective study of conventional sinus surgery in 142 patients. Wigand et al. (1991) reported 93.3% improvement of obstruction and 93.4% decrease of headache or facial pain in 220 patients after an average follow-up of 4.3 years. Lund et al. (1991) reported highly significant improvement of nasal obstruction, headache and facial pain ($p < 0.001$) in a prospective study of 24 patients at a mean of 4.6 months after FESS.

Post-nasal drip is the symptom associated with the lowest improvement rates with conventional sinus surgery. Although 80% of the respondents had some improvement in post-nasal drip, only 28% experienced significant relief of this symptom (Hoffman et al., 1989). Lund (1988) stated that troublesome discharge was the most commonly persisting or even worsening symptom after inferior meatal antrostomy. In previous studies concerning FESS, Kamel (1989) reported a decrease of nasal discharge in 90% and Wigand et al. (1991) in 85.5% of the patients. Rhinorrhoea, post-nasal discharge and deterioration of smell were the symptoms less significantly affected by FESS ($p < 0.01$, also in a study by Lund et al. (1991). In the present study post-nasal drip was not studied separately, but nasal discharge as a whole diminished significantly only after FESS. However, this result can be biased by the fact that pre-operative occurrence of rhinorrhoea was also higher in the FESS group. Purulent secretion decreased in both groups slightly, but not significantly. So, this study could not confirm the statement that better sinus drainage after FESS would lead to less nasal secretion.

Post-operative recovery of olfactory function is often only temporary. Wayotf et al. (1988) found that after endonasal surgery of nasal polyps the sense of smell improved in more than 80% of the cases during the first trimester, but diminished to 50% in one year. Although only part of the patients in the present study had nasal polyps, a significant subjective improvement in the sense of smell was achieved at least for one year after FESS. Wigand et al. (1991) reported long-term improvement of smell after FESS in 84.9% of chronic sinusitis patients. The lower need of post-operative irrigations after FESS might reflect the better recovery of mucociliary clearance. Radical C-L operation including inferior meatal antrostomy leads to more severe antral mucosa! scarring with more profound deterioration of this essential property of respiratory mucous membranes.

The sequelae rates after C-L differ considerably in various studies (Flemming et al., 1967; Rink, 1972; Pfeifer et al., 1973;

Majapuro, 1976; DeFreitas et al., 1988). The high paresthesia frequency of 41% among C-L patients in the present study is in line with Stefansson et al. (1988), who reported post-operative complaints, mainly sensory disturbances, in 43% of 65 C-L patients 4-7 years post-operatively, although 72% were satisfied with the operation in spite of minor sequelae. Murray (1983) has stated that all patients, if asked, report some numbness or paresthesia following a C-L procedure. It is not possible to remove the anterior maxillary wall without some damage to the superior alveolar nerves. The 22.9% rate of cheek pain or tenderness in the present study is in parallel with earlier observations (Flemming et al., 1967; Majapuro, 1976).

There were no major complications in FESS patients and the minor adverse events resemble those observed by others. Kennedy et al. (1987) reported two post-operative epiphora in 75 FESS patients. The lachrymal drainage system is at risk of damage during enlargement of tne natural ostium anteriorly. However, FESS is a relatively safe procedure in well-trained hands (Kennedy et al., 1987; Kamel, 1988; Levine, 1990; Stamrnberger, 1991).

In the present study 50.7% of the C-L patients reported marked overall improvement, 85.9% got some improvement and 14.1% remained unchanged or got worse. However, 80.3% of the patients were still compliant for surgery after one year. Majapuro (1976) reported successful overall results in 85.8% of 448 C-L patients, and Macbeth (1968) reported good results in 88% of 360 C-L patients. Post-operative global evaluation of the FESS patients in the present study indicated "marked improvement" in 76.7%, "some improvement" in 95.9% and "no improvement" in 4.1%. This is distinctly better than that ofC-L patients and very similar to other studies. Stammberger (1991) reported "marked long-term improvement" in 85.0%, "some improvement" in 95.2% and "no improvement" in 4.6% out of 500 FESS patients. Kamel (1989) had similar results in 66 FESS patients. Slightly worse results have also been presented. In the study of Kennedy et al. (1987) one-third of 75 FESS patients were a-symptomatic, 92% had some improvement of symptoms, but 8% remained unchanged after 4-32 months of follow-up (mean 9 months). In a well-documented study by Levine (1990), with a 12- to 42-month follow-up of 250 FESS patients, the success rate was 80.2%. Wigand's technique (1989) gave a 9% rate of subjective "no change" or worse compared to pre-operative results in 234 procedures, while Hoffman et al. (1989) also reported 9% frequency of no improvement after conventional sinus surgery of 142 patients. Comparison of the results of different surgical techniques is heavily affected by many confounding factors such as different study populations, inaccurate diagnostics and unequal follow-up times. In the present study the superiority of FESS over the C-L was clear as evaluated by the patients' satisfaction. This is true for the better cure rates of sinusitis, as well as markedly less post-operative sequelae. However, both radical as well as functional methods gave satisfactory results for relief of the patients' main symptoms.

REFERENCES

1. DeFreitas J, Lucente F (1988) The Caldwell-Luc procedure: Institutional review of 670 cases: 1975-1985. Laryngoscope 98: 1297--1300.
2. Flemming I, Hommerich KW, Osterland U (1967) Katamnestische Untersuchungen nach Kieferhohlen-Siebbein-Operationen. Z Laryng Rhinol 46: 271.
3. Hoffman S, Dersarkissian R, Buck S, Stinziano G, Buck G (1989) Sinus disease and surgical treatment: A results-oriented quality assurance study. Otolaryngol Head Neck Surg 100: 573-577.
4. Kamel R (1989) Endoscopic transnasal surgery in chronic maxillary sinusitis. J Laryngol Oto! 103: 492-501.
5. Kennedy D (1985) Functional endoscopic sinus surgery. Technique. Arch Oto!aryngol 111: 643-649.
6. Kennedy D, Zinreich J, Shaalan H, Kuhn F, Naclerio R, Loch E (1987) Endoscopic middle meatal antrostomy: Theory, technique, and patency. Laryngoscope, Suppl 43: 1-9.
7. Levine H (1990) Functional endoscopic sinus surgery: Evaluation, surgery, and follow-up of 250 patients. Laryngoscope 100: 79-84.
8. Lund V (1988) Inferior meatal antrostomy. Fundamental considerations of design and function. J Laryngol Oto! Suppl 15.
9. Lund V, Holmstrom M, Scadding G (1991) Functional endoscopic sinus surgery in the management of chronic rhinosinusitis. An objective assessment. J Laryngol Oto! 105: 832-835.
10. Macbeth R (1968) Caldwell-Luc operation 1952-1966. Arch Otolaryngol 87: 630-636.
11. Majapuro T (1976) Results from the Caldwell-Luc operation. Acta Univ Oul D 13.
12. Melen l, Lindahl L, Andreasson L, Rundcrantz H (1986) Chronic maxillary sinusitis. Definition, diagnosis and relation to dental infections and nasal polyposis. Acta Otolaryngol (Stockh) 101: 320-327.
13. Murray JP (1983) Complications after treatment of chronic maxillary sinus disease with Caldwell-Luc procedure. Laryngoscope 93: 282-284.
14. Penttilii M, Rautiainen M, Laranne J, Pukander J, Karma P (1993) Endoscopic and Caldwell-Luc approach in chronic maxillary sinusitis: Intraoperative and early post-operative results. Arn J Rhinology 7: 5-9.
15. Rink B (1972) Klinische und ri:intgenologische Befunde nach operativem Verschluss von Mund-Antrum-Verbindungen in Kombination mit der Radikaloperation der Kieferhi:ihle. Dtsch Stomata! 22: 251.
16. Stammberger H (1986) Endoscopic endonasal surgery Concepts in treatment of recurring rhinosinusitis. Part I. Anatomic and pathophysiologic considerations. Part II. Surgical technique. Otolaryngol Head Neck Surg 94: 143-156.
17. Stammberger H, Zinreich SJ, Kopp W, Kennedy DW, Johns ME, Rosenbaum AE (1987) Zur operativen Behandlung der chronisch-rezidivierenden Sinusitis. Caldwell-Luc versus funktionelle endoskopische Technik. HNO 35: 93-105.
18. Stammberger H (1991) Functional Endoscopic Sinus Surgery: The Messerklinger Technique. BC Decker, Toronto.
19. Stefansson P, Andreasson L, Janner! M (1988) Caldwell-Luc operation: Long term results and sequelae. Acta Otolaryngol (Stockh) 449: 97-100.
20. WayoffM, Dellandrea M, Gaugain E (1988) Pre- and post-operative olfactory status after surgery for nasal polyps. ORL (Tokyo) Suppl 7: 104-106.
21. Wigand M, Steiner W, Jaumann M (1978) Endonasal sinus surgery with endoscopical control: From radical operation to rehabilitation of the mucosa. Endoscopy 10: 255-260.
22. Wigand M (1989) Endoskopische Chirurgie der Nasennebenhi:ihlen und der Vorderen Schadelbasis. Georg Thieme Verlag, Stuttgart.
23. Wigand M, Hosemann W (1991) Results of endoscopic surgery of the paranasal sinuses and anterior skull base. J Otolaryngol 20: 385-390.
24. Arnes.E, Anke I, Mair I (1985) A comparison between middle and inferior meatal antrostomy in the treatment of chronic maxillary sinus infection. Rhinology 23: 65-69.

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