

COMPARATIVE ANALYSIS OF EFFECTIVENESS AND ADVERS EFFECTS OF FESS AND CALDWELL-LUC PROCEDURE IN MAXILLARY CYST CASES: ARETROSPECTIVE STUDY

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Abstract

Functional endoscopic sinus surgery (FESS) and Caldwell-Luc operation are both maxillary sinus cyst surgical procedures, and comparison between them regarding effectiveness and status of morbidity is still poorly documented. The retrospective cohort of 75 adults (60 patients underwent FESS and Caldwell-Luc operation was done in 15 patients) operated between 2017 and 2023 due to isolated maxillary sinus mucous retention cysts compared postoperative outcomes such as infraorbital nerve impairment (paresthesia or numbness) and pain (on Visual Analog Scale, VAS) facial edema, operation time, and hospitalization duration. Statistically (compared continuous variables by independent t-test and categorical variables by χ^2 or Fisher's exact) analysis at an alpha level of $p < 0.05$ was carried out.

FESS patients fared much better compared to patients who underwent Caldwell-Luc surgery. Specifically, infraorbital nerve impairment occurred in only 3 of 60 (5.0%) of the FESS patients versus 4 of 15 (26.7%) of those in the Caldwell-Luc group ($p = 0.010$). Postoperative pain VAS scores were decreased in the FESS group (3.2 ± 1.1) versus those of the Caldwell-Luc group (5.8 ± 1.3 ; $p < 0.001$). Hospital stays of the FESS group were less (mean 1.8 ± 0.5 days) than those of the Caldwell-Luc group (3.1 ± 0.9 days; $p < 0.001$). Swelling of the face was less with FESS, and surgical time was less in the FESS group (both $p < 0.05$).

In conclusion, FESS was revealed to be related to improved perioperative outcomes and less morbidity in comparison to the conventional Caldwell-Luc procedure in managing maxillary sinus cysts. The findings provide justification to apply FESS preferentially to well-chosen patients since it can minimize complications and improve patient recovery in clinical practice.

Key words: Maxillary sinus cyst; Functional Endoscopic Sinus Surgery (FESS); Caldwell-Luc procedure; endoscopic sinus surgery; postoperative results

Introduction

Maxillary sinus mucous retention cysts (so-called pseudocysts) are encountered commonly as incidental findings on imaging studies, but few of them cause enough

symptoms to result in nasal blockage, facial pain, or chronic sinusitis [1,2]. Should and when they do so, they require decompression, re-establishment of normal sinus drainage, and prevention of infection or cyst growth [3]. Historically, the Caldwell-Luc operation – an incision in the canine fossa and fenestration of the anterior maxillary wall – was the standard operation to access and treat maxillary sinus pathology [4]. The open technique offers great exposure at the expense of hazards of infraorbital nerve injury, significant facial edema, and protracted recovery [4,5].

The development of endoscopic sinus procedures brought about a revolution in sinus surgery. Functional Endoscopic Sinus Surgery (FESS) applies nasal endoscopes to form a minimal access antrostomy by means of which cystic lesions may be observed directly and removed with minimal damage to normal tissue [6,7]. This has proved to be associated with less intraoperative trauma, postoperative pain and facial edema, and recovery periods than in the case of open surgery [6,7]. The Caldwell-Luc procedure continues to be useful in certain cases of extensive sinus disease, anatomic disposition, or where endoscopic entrance is unachievable [8, 23,24].

Where there is extensive literature regarding endoscopic versus open sinus surgeries of chronic sinusitis as well as mucocoeles, head-to-head comparison between outcomes of Caldwell-Luc and FESS is less common in the context of isolated maxillary sinus retention cysts. Prior studies have suggested endoscopic surgery to be useful in heterogeneous indications. In response to this lack, we compared retrospectively between two series of surgeries to compare complication rates and recovery in the context of benign maxillary sinus cysts. Our goal was to establish in this group of patients whether minimally invasive FESS results in demonstrably superior postoperative outcomes when compared to traditional Caldwell-Luc.

Materials and Methods

A retrospective cohort study at Tashkent Medical Academy in the Department of Otorhinolaryngology was conducted following approval by the institution's review panel. We retrospectively assessed patient records of patients aged between 18 and 50 years old who were treated surgically for isolated maxillary sinus mucous retention cysts between 2017 and 2023. The inclusion factors were: (1) computed tomography-verified diagnosis of benign maxillary sinus cyst; and (2) treatment either by Caldwell-Luc procedure or by FESS. Excluded were patients with previous history of sinonasal malignancy or tumor, sinonasal surgery, chronic rhinosinusitis with nasal polyposis, or sinus pathology following trauma as these would presumably alter postoperative outcomes.

The surgical procedure was decided by the treating otolaryngologist according to clinical judgment, nature of cyst, and personal preference. The series consisted of 60 patients operated with FESS and 15 by Caldwell-Luc procedure. The surgeries were performed by seasoned sinus surgeons with general anesthesia. The technique of FESS involved routine uncinctomy and antrostomy of middle meatus and total

removal of the cyst by angled endoscopes. The Caldwell-Luc procedure was done by performing sublabial incision of fossa canina, removal of mucous of the maxillary sinus anterior wall by osteotomy, and enucleation of the cyst. Endoscopic control (FESS) or direct cauterization (Caldwell-Luc) controlled bleeding during surgery. Postoperative treatment was identical in both groups and consisted of systemically given antibiotics and saline irrigation of nostrils.

Patient information was abstracted from electronic health records. Demographic variables (age and sex) and postoperative outcome variables (infraorbital nerve function as patient complaint of numbness or paresthesia of the cheek or upper lip, pain level as rated by a 10-point Visual Analog Scale [VAS] on postoperative day 1, facial edema degree as clinically rated none/mild, moderate, or severe as of postoperative day 1, operative time as in minutes from incision initiation to closure and hospital length of stay as days of in-hospital time post-surgery) were obtained and recorded. Dysfunction of infraorbital nerve and facial edema were assessed at discharge day. All information was entered in an encrypted database for analysis.

Statistical analysis was done using SPSS software, version 26.0. The results of the continuous variables (age, VAS pain scores, operative time, and hospital stay) are given as mean $\pm$ standard deviation. The categorical variables (sex, occurrence of nerve dysfunction, edema category) are given as numbers and percentages. Comparison of group differences of continuous variables was carried out by the independent Student's t-test following establishment of normal distribution; categorical variables by Chi-square or Fisher's exact test where appropriate. Two-tailed p-value of less than 0.05 was considered to be statistically significant.

Results

1. Patient Characteristics

The population included 75 patients (mean age, 34.5 ± 8.2 years; males and females, 42 and 33, respectively). Demographic admission parameters were comparable in between patients treated by Caldwell-Luc and those treated by FESS. The mean was 34.1 ± 7.9 years in group FESS and 35.8 ± 8.9 years in group Caldwell-Luc ($p > 0.05$). The population of males was comparable (70% males in group FESS and 67% in group Caldwell-Luc, $p > 0.05$). The involved side of maxillary sinus (right or left) and size of the cyst (on computed tomography) were comparable in between groups and ensured that both populations were well matched.

2. Post-surgical outcomes

The comparative outcomes have been presented in Table 1. Postoperative results in all of those parameters that were investigated improved significantly following FESS.

Parameter	FESS(n=60)	Caldwell-Luc (n=15)	P value
Infraorbital Nerve Dysfunction (%)	5.0	26.7	0.01
Mean VAS Pain score(0-10)	3.2±1.1	5.8±1.3	<0.001
Moderate / Severe facial Edema (%)	10.0	46.7	<0.001
Mean operation time (minutes)	45.3±9.8	71.4±12.1	<0.001
Mean Hospital Stay	1.8±0.5	3.1±0.9	<0.001

Infraorbital nerve dysfunction: Postoperative infraorbital numbness or paresthesia was present in only 3 of 60 (5.0%) patients operated with FESS versus 4 of 15 (26.7%) patients operated with Caldwell-Luc. This difference was significant ($p=0.010$, Chi-square) and reflected much less risk of nerve damage by endoscopic technique.

Postoperative pain: The VAS score of pain at postoperative day 1 was lower in FESS cases (3.2 ± 1.1) than in those operated by Caldwell-Luc (5.8 ± 1.3) as determined by an independent t-test ($p<0.001$). More patients in the group operated by FESS reported mild pain ($VAS \leq 4$) than in the Caldwell-Luc group (83% versus 27%).

Facial Edema: Facial edema was clinically much less evident in the FESS group. Mild (or no) edema was the prevailing finding in the majority of the FESS patients, whereas facial edema of moderate to marked extent was the norm following Caldwell-Luc operation. This prevalence of facial edema distribution was statistically significant ($p<0.01$).

Operative time: The surgical time of the FESS group (mean of 42 ± 10 minutes) was less than that of the Caldwell-Luc group (mean of 58 ± 12 minutes) and was significantly different ($p<0.05$). This shows that, despite there apparently being a technical disadvantage to endoscopic surgery, it is now possible to do FESS with existing technique in less time.

Hospital Stay: The hospital stay was less in the case of the FESS patients, with their mean hospitalization time of 1.8 ± 0.5 days compared to 3.1 ± 0.9 days in Caldwell-Luc patients (mean difference of 1.3 days; $p<0.001$). This reflects the expeditious recovery and lesser immediate morbidity of endoscopic surgery.

Overall, patients operated upon by means of FESS had lower infraorbital nerve injury rates, less facial edema, lower pain scores, shorter surgical time, and hospital stays compared to patients operated by means of the Caldwell-Luc procedure.

Discussion

This retrospective analysis demonstrates Functional Endoscopic Sinus Surgery to have definite advantages over the classic Caldwell-Luc operation for treatment of benign maxillary sinus cysts. Specifically, it was found that FESS was linked to much less morbidity and superior initial postop outcomes. This confirms the paradigm shift in endoscopic treatment of maxillary sinus disease [6,7].

Infraorbital Nerve Dysfunction: The most striking difference was less infraorbital nerve dysfunction in the group treated with FESS. Caldwell-Luc procedure sometimes requires manipulation close to maxillary frontal wall and often necessitates blunt dissection and bone removal injuring infraorbital canal [4]. In this series, over a quarter of Caldwell-Luc patients have cheeks and upper lip sensory disturbances, whereas such disturbances occurred in only 5% of those operated on by FESS. This observation concurs with studies done previously [9,10] that documented neuroprotective advantage of endoscopic technique. Weber et al. [9], as an example, reported significantly lower incidence of cheek paresthesia following endoscopic compared to Caldwell-Luc surgery in comparable population. Improved visualization with endoscopes most likely allows surgeon to save infraorbital foramen and to manipulate tissue carefully, and therefore to prevent nerve injury.

Postoperative Pain and Edema: We observed comparatively low postoperative pain scores following FESS. The VAS score of patients treated with FESS averaged nearly half that of patients treated by Caldwell-Luc, and this difference was highly significant. This is because there is less mucous and muscular trauma and resultant nociception with FESS; as Lanza and Kennedy [11] noted, endoscopic sinus surgery is associated with less facial tissue disturbance and therefore less nociception. The resulting decreased tissue handling was also observed as significantly less facial edema. Caldwell-Luc procedure necessarily involves periosteal elevation and formation of a bony window, with attendant inflammatory edema [4]. FESS, by contrast, is performed entirely via the nasal airway, with no facial tissue disturbance. Other studies have reported that patients treated by endoscopic sinus surgery experience less facial edema and bruising than those treated by external procedures [12,13,14]. Such advantages in pain and cosmetic result have clinical significance, in that they result in earlier ambulation, increased patient satisfaction, and less need for analgesia.

Operative time: Although FESS requires special tools and training, in this study it correlated with lower mean operative times. This may be reflective of both newer endoscopic equipment capability and operating team experience. This is consistent with findings by Dessi et al. [20] and Lund [21], both of whom recorded decreased operating time with experience endoscopic surgeons. Decreased procedure time reduces exposure to anesthesia and cost of operation, again to the endoscopic technique's advantage.

Hospital Stay Duration: The combination of less pain, decreased swelling, and less aggressive surgeries resulted in greatly diminished hospitalization in patients of FESS (mean of 1.8 days) compared to Caldwell-Luc (mean of 3.1 days). This takes significant consideration when looking at resource utilization and patient well-being. Decreased stays lower cost of care and allow patients to resume activity faster. Our findings align with prior experience [15,16,17,18,19] of quicker recovery following endoscopic sinus surgery. **Implications to Clinical Practice:** As such, these results confirm that endoscopic access, and hence FESS, is the treatment of choice in solitary maxillary sinus cysts. The significantly lower morbidity with FESS justifies contemporary clinical practice recommendations favoring endoscopic treatment of maxillary sinus disease [22–24]. The Caldwell-Luc would be reserved for rare indications, like in extremely large lesions that cannot be reached by the endoscope or when extensive antral pathology needs to be cleared beyond middle meatus reach [8,22]. Even in these cases, improved results with FESS will encourage endoscopic approaches to be used wherever feasible. **Limitations:** Our study has following limitations due to its retrospective nature. The potential selection bias exists since patients were not randomized and there was potentially selective application of technique by surgeon based on individual patient anatomy or nature of cyst. The small population of patients in the Caldwell-Luc group (n=15) decreases statistical power and comparability as well. We had access to only immediate postop results; long-term follow-up information (such as recurrence rate or late complications such as development of mucocele) was not available in this database. As an institutional study, results can be representative of individual surgeon technique and institutional practice and would be non-transferable elsewhere. Pain and edema were assessed using standardized scales; subjective variables as these outcomes measure and can be confounded by individual patient variables or reporting bias. **Conclusion** In this retrospective analysis, endoscopic sinus surgery (FESS) produced far superior immediate results compared to Caldwell-Luc surgery in patients with benign maxillary sinus cysts. The endoscopic procedure had less risk of infraorbital nerve damage, less postop facial edema and pain, less hospital and operation time, and less hospitalization. The advantages reflect clinical benefits of endoscopic minimal invasion. Thus, where anatomy and cyst morphology allow, FESS would be the preferred procedure to treat maxillary sinus cysts. By providing improved recovery and less risk of morbidity, the study contributes to evidence to inform practice in otolaryngology.

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