

# Effectiveness of FESS in Smell Improvement of Sinusitis Patients

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**Abstract** The aim of this research was to verify the effect of functional endoscopic sinus surgery (FESS) on olfactory dysfunction in patients who suffer from chronic rhinosinusitis. We enrolled prospective consecutive patients at a tertiary institution who were undergoing FESS; for these patients prolonged medical therapy for chronic rhinosinusitis had failed. Patients were asked to grade their olfactory dysfunction from 1 to 5 with 1 representing lack of any smell function and 5 representing a completely normal sense of smell. Moreover, the pre- and postoperative smell identification test of the University of Pennsylvania was performed for all participating patients. In addition, data including computed tomography scores, nasal endoscopy, and the presence or absence of asthma as well as smoking habits were recorded and analyzed. Patients were followed at least 1 year after surgery. Data were collected on 89 patients who had undergone sinus surgery. Postoperative olfactory function was 77% improved for all subjects as a group. Higher involvement of sinus in computed tomography correlated with poorer results in olfactory UPSIT40 score. Patients' olfaction was significantly related to polyp pathology, duration of disease, age, smoking habits and history of asthma. A variety

of patients' characteristics have impact on olfactory outcome of sinusitis patients after FESS.

**Keywords** Smell disorder · Sinusitis · Polyposis · Endoscopic sinus surgery

## Introduction

Smell dysfunction has a serious influence on a patient's quality of life. Olfaction also plays a key role in the hygiene matters, sensing danger, as well as sexual behavior. Among the various causes of olfactory disorders, nasal and sinus diseases are very important as they are the most treatable causes of olfactory loss [1, 2].

Patients with sinusitis suffer from olfactory problems through different mechanisms. The primary mechanism is airway passage blockage and the second is epithelial changes [3–5], although the exact etiology of this process is unclear [6].

Medical and surgical treatments of chronic sinusitis have different rates of success in improving the sense of smell in various pathologies [1]. Some reports claimed that only medical therapy using corticosteroids has effect on improving olfactory sensation [7], but other reports shows the effect of sinus surgery on it [8]. Moreover, the outcome of postoperative smell depends upon the type of surgery and condition of the patient [8–12].

Few studies on the outcome of endoscopic sinus surgery have dealt with the effect of surgery on the sense of smell and they found contrasting results [7, 8, 13, 14]. Additionally, nature, frequency and associated factors of this disorder are unclear. Therefore, the aim of this study is to further our findings about the effect of functional endoscopic sinus surgery (FESS) in improving of smell

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dysfunction in patients with chronic sinusitis and clarify the associated factors.

## Materials and Methods

### Study Subjects

This study included 97 patients with histories of sinusitis that, after failure of the maximum medical treatment of inhaled nasal steroids, guaifenesin, nasal saline douches, and antibiotics (amoxicillin–clavunate) for at least 1 month before surgery. The study began in January 2007 and finished in June 2008. None of our patients suffered from systemic disease like diabetes which may contraindicate corticosteroid usage and nobody used any drugs which interfere with smell function.

However, eight patients who did not participate in the follow-up smell test were excluded from the study, leaving a total of 89 study subjects. Also we had two miss data in post-operative smell rating. The preoperative characteristics of excluded patients were not different from mean of patients and therefore had no effect on final outcome.

### Ethical Approval

The protocol of this study was approved by the Institutional Review Board of the Tehran University of Medical Science. Detailed information about the study was given to the participants and written informed consent was obtained. All aspects of the study were conducted according to the Declaration of Helsinki.

### Tests and Evaluation

The questionnaire administered to all patients included a subjective assessment of olfactory function, duration of disease, history of asthma and other associated diseases, such as cystic fibrosis. Patients were asked to rate their olfactory condition ranging from 1 to 5, with 1 representing the complete inability to smell, 2-most of time no smell (only poor sense of smell in experience of daily life), 3-sometime no smell (encounter some difficulties in smelling in usual events of life), 4-most of time good sense of smell (normal smelling, but it is not perfect in some situation), and 5 representing the complete ability to smell. Before filling of this item by patients, one of authors explained it to them.

The questionnaire also asked patients to list problems associated with olfactory loss, including a history of medical treatment, sinus surgery, head trauma, toxic exposure, or loss of olfactory function associated with upper respiratory tract infections and habit history.

All patients underwent preoperative CT, nasal endoscopy, the 40-item University of Pennsylvania Smell Identification Test (UPSIT). The UPSIT40 contained four booklets and each of them 10 odorants, we asked the patients to rub the bottom of the pencil on it then express detection of smell and the possible odor. Thus each subject received score out of 40 possible correct answers. During the follow up, endoscopy and UPSIT40 were administered at least 1 year after endoscopic sinus surgery. The follow up also included another olfactory questionnaire. The Lund-Mackay score was used to evaluate CT.

### Type of Treatment

In all patients, the Messerklinger method of endoscopic surgery was used as well as the same pre- and postoperative protocol including endoscopic debridement. All patients were treated with broad-spectrum antibiotics for 2 weeks after surgery. All patients continued to be treated with their same medical regimen for rhinosinusitis after surgery (inhaled nasal Beclometasone tree time daily and changing in dosage depends on endoscopic finding, and nasal saline douches three time daily) for at least 3 months.

### Statistical Method

Various possible factors were statistically compared, including extent of disease, age, sex, cigarette smoking, pathology of disease, middle turbinate resection and other risk factors.

The data was analyzed by Chi square and *t* tests using SPSS version 12. *P* values less than 0.05 were considered significant. Data was presented as the mean  $\pm$  standard deviation.

## Results

Among the patients examined, 89 patients were eligible for our survey. Of these, 42 (47.2%) were male and 47 (52.8%) were female, and the mean age was  $35.45 \pm 13.07$  years.

Most patients (79.8%) had undergone different courses of medical treatments before the surgery in this study, 14 (23.7%) of whom had previous surgery. In addition, 11 (12.4%) patients had a history of asthma, although none suffered from Samter's syndrome. Patients' record was positive in smoking habit in 9 (10.1%).

The mean duration of sinusitis prior to surgery was  $6.3 \pm 2.44$  years. Additionally, the mean duration of evaluation until time of surgery was  $13.1 \pm 2.7$  months.

The extent of sinus disease according to the data obtained during surgery is summarized in Tables 1 and 2.

**Table 1** Distribution of pathologic findings among sinusitis patients

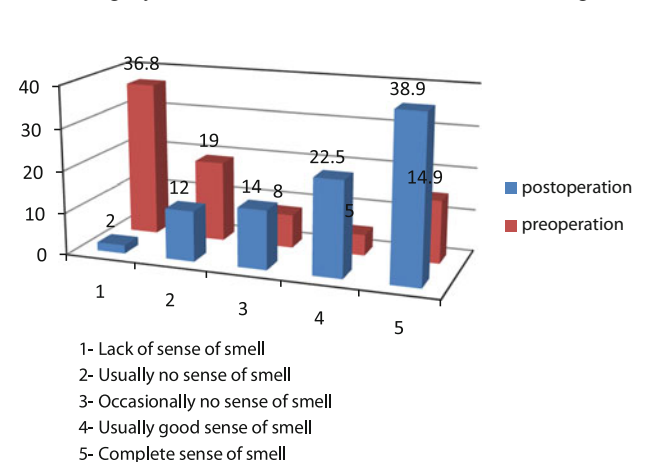
Pathology	Frequency	Percent
Polyp	61	68.5
Chronic sinusitis	22	24.7
Fungal sinusitis	2	2.2
Others	4	4.5
Total	89	100

**Table 2** Extent of sinusitis

Sinuses involved	Frequency	Percentage
Anterior ethmoid only	4	4.5
Maxillary only	10	11.4
Sphenoid only	1	1.1
Anterior and posterior ethmoid	2	2.3
Anterior ethmoid and maxillary	4	4.5
Maxillary and sphenoid	2	2.3
Anterior and posterior ethmoid and maxillary	11	12.4
Anterior and posterior ethmoid and frontal	7	7.9
Anterior and posterior ethmoid, maxillary and sphenoid	10	11.4
All	38	42
Total	89	100

Preoperative imaging evaluation revealed a mean Lund-MacKay score of  $14.02 \pm 6.2$ . The mean UPSIT40 score among the preoperative patients was  $20.31 \pm 7.4$ . As shown in Fig. 1, in the preoperative subjective smell rating, 32 (36.8%) patients declared that they lacked any sense of smell and only 13 (14.9%) reported a complete sense of smell all the time, but the results is completely different after surgery.

The second evaluation was performed at least 6 months after surgery. The mean UPSIT40 score among the



**Fig. 1** Frequency of level of ability to smell before and after surgery

postoperative patients was  $31.21 \pm 10.4$ , while after surgery and medical treatment; only one patient was totally anosmic, with 39 (43.8%) patients having intact sense of smell.

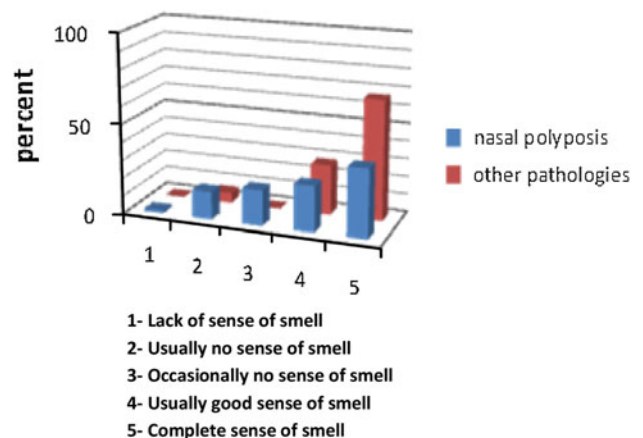
Subjective smell ratings showed that 77% of the patients improved after surgery, which means the answer of them to subjective smell rating was one or more groups higher.

Two patients claimed that they had no change after the surgery and treatment; however, according to the UPSIT results, their sense of smell improved. Two other patients claimed that their sense of smell diminished after surgery and treatment, however, their UPSIT scores revealed no change.

The mean age of subjects correlated with subjective smell status ( $P = 0.047$ , *t* test), with a lower score for older subjects. There was no significant relationship between pre- or postoperative neither smell and sex in this survey, nor was there any significant relationship between age and preoperative smell status, in both subjective rating and UPIST40.

Moreover, the improvement in the subjective smell rating after surgery also had a significant relationship with age ( $P = 0.028$ , *t* test). We found no significant relationship between preoperative UPSIT and history of asthma; however, history of asthma was significantly related to the postoperative UPSIT score (Chi square,  $P = 0.007$ ), with asthmatic patients having poorer scores.

There was a significant relationship between preoperative UPSIT40 score and nasal polyposis (Chi square,  $P = 0.049$ ) and they had poorer smell, but the same is not true in postoperative UPSIT40 score. After surgery, the change in ability to smell significantly correlated with nasal polyposis (Chi square,  $P = 0.001$ ), which shows that patients without polyposis had better changing in



**Fig. 2** Postoperative subjective smell improvement in polyposis and other pathologies

**Table 3** Endoscopic findings at time of final UPSIT40

Finding	Number	Percent
Normal	17	19
Crust	24	26.9
Syneshia	18	20.2
Lateralization of middle turbinate	9	10.1
Polyp	33	37

subjective smell rating. (Fig. 2) A similar pattern can be seen for smokers ( $P = 0.030$ ).

When we compare the results of the preoperative UPSIT40 with the subjects' histories, we find a significant relationship with history of asthma ( $t$  test,  $P = 0.008$ ). There was no significant relationship between pre- and postoperative subjective smell tests and the duration of the condition. However, the correlation between postoperative UPSIT40 and the duration of the condition was significant ( $P = 0.013$ ,  $r = -0.265$ ), with a moderate and reverse pattern.

The type of preoperative treatment was not related to the results of smell in our series.

The extent of disease found during endoscopic surgery was significantly related to preoperative subjective smell ( $P = 0.002$ ), postoperative subjective smell ( $P = 0.001$ ), and change in the ability to smell after treatment ( $P = 0.001$ ), with greater extent associated with poorer subjective smell rating results. These data were confirmed by the results of the UPSIT40 ( $P = 0.001$ ).

Lund-Mackay scores of the preoperative imaging were also related to the ability to smell, both preoperatively ( $P = 0.001$ ) and postoperatively ( $P = 0.027$ ). Also, the correlation between the postoperative UPSIT40 and the Lund-MacKay score was inverse and moderate ( $P = 0.049$ ,  $r = -0.0247$ ). However, there was no significant relationship between the postoperative endoscopic findings and the UPSIT40 score. The endoscopic finding at time UPSIT40 was summarized in Table 3.

Specific sites of involvement according to preoperative CT had significant relation with pre and post-operative subjective smell test. Among different sites, OMC (osteo-meatal complex) involvement had the greatest effect on smell and the sphenoid sinus had the slightest effect.

We also found no significant relationship between middle turbinate resection and postoperative ability to smell in both subjective rating and UPSIT40.

## Discussion

Olfaction is a multifaceted process that is affected by chronic sinusitis. The most probable explanation is a combination of factors including a mechanical blockade to

airflow, neuroepithelial edema, and the direct neurotoxic effects of viruses and bacterial toxins [6].

In spite of these obstacles to proper smell function, there are various reports claiming improvement varying between 50 and 100% after surgery [3, 8, 13–15].

These reports and other similar ones have shown various factors effecting response to treatment. In our series we achieved 77% improvement, comparable to other reports [11, 12, 14]. Considering the 68.5% prevalence of nasal polyposis with worse prognosis, this is an acceptable level of improvement. Different mechanisms have been proposed to explain the cause of the lack of response to treatment in some patients. The probable explanation is a direct toxic effect of inflammation from rhino sinusitis on the olfactory epithelium, which contributes to this type of smell problem, this supported by the identification of areas of respiratory metaplasia and intraepithelial neuromas [16].

The result of this study confirmed the efficacy of endoscopic sinus surgery for smell improvement in patients, in contrast to the idea of some authors that surgical treatment of patients with sinusitis and anosmia often has only limited effects on olfactory sensation [7].

All patients in our series received maximal medical treatment prior to surgery and almost 80% had medical therapy prior to this study protocol, but they nevertheless benefitted from surgery with short-term improvement in smell function after surgery for sinusitis.

Our study, as in some previous series, found that age, sex and previous surgery had no relation with postoperative smell improvement as determined by objective evaluation of the ability to smell [14]. However, in our series we found a significant relationship between subjective post-operative smell test results and age.

Patients with greater extent of disease had lower results on the smell test, which is compatible with other reports [6, 9–11, 17]. Asthma was not related to preoperative smell test results, but did relate with postoperative smell test results, with asthmatic patients having poorer prognosis.

The duration of disease, gender and involvement of one specific sinus was not significantly related with smell test results, in contrast to reports of Vento et al. and others. Perhaps this difference can be explained by dissimilarity of patients' characteristics or follow up periods. [9, 12].

There was no significant relationship between middle turbinate resection and smell tests, in contrast to the results of Delank, who found this resection to have an adverse effect on olfaction, due to destruction of the olfactory filia or alteration of the normal aerodynamics through the olfactory cleft [11]. The possible explanation about this difference can be the method of Turbinoplasty in this research, which was conservative resection of exclusively anterior part of middle turbinate by using of cutting punch

forceps. This method can reduce damage to olfactory function during the endoscopic surgery.

History of smoking and polyp pathology had a more negative effect on final outcome than other causes, similar to other studies [9, 14, 17, 18].

As in other reports, the postoperative endoscopic findings, including the presence of polyp, crust or synchia, were not related to the ability to smell [3]. This can be illustrated by the probable difference between the pathologic finding in the olfactory cleft and in other parts of sinus and nose.

Specific sites of involvement, such as the osteomeatal complex or other sites had significant relation with smell outcome. These findings are compatible with some series have shown a prognostic role for anterior ethmoid involvement in treatment outcome in patients [7]. However, osteomeatal complex doesn't have direct role in smell function, The method of evaluation in this variable is imaging and the opacity of the osteomeatal complex in imaging can be accompanied by middle meatus polyposis which possibly have adverse effect on smell function.

Finally, the results of this study are compatible with the concept positive effect of sinus surgery in improvement of the smell status sinusitis patients.

The limitation of this study is the results only show the short term effect of FESS in smell improvement of chronic sinusitis patients. In long term follow up period, this effect may be unstable, especially in nasal polyposis patients; reoccurrence of polyp may impair the olfactory function. So in future study, we propose the long term effect of surgery in smell status of sinusitis patients.

## Conclusion

Endoscopic sinus surgery for patients with chronic rhino sinusitis significantly improves subjective and objective olfactory function. Despite the effect of the patients' characteristics on final outcome, in overall points of view we can consider FESS an efficient tool in most of patients with sinusitis related smell problems.

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