

## Comparison of Nasal Mucociliary Function before and after Septorhinoplasty Surgery Using Saccharin Test

### Abstract

**Background:** This study was carried out to compare mucociliary function (MCF) of nasal cavity before and after septorhinoplasty surgery by saccharin test. **Materials and Methods:** This study was carried out on 70 patients who needed septorhinoplasty surgery in Kashani and Alzahra Hospital during 2013–2014 to measure MCF. Saccharin test was performed on the patients before surgery and on three more intervals 1 day, 1 week, and on month after ward and the readings were recorded. Saccharin test is performed by placing saccharin granules on the anterior part of inferior turbinate and the time the patient feels the sweet taste is recorded the normal range is below 30 min. **Results:** Mean of test for each time interval was obtained and comparison of measurements was made reading were mean of saccharin test before surgery ( $7.74 \pm 1.65$  min) the day after surgery ( $7.75 \pm 1.7$  min), on week after surgery ( $15.04 \pm 3.4$ ), and 1 month after surgery ( $8.49 \pm 2.08$  min). The readings before surgery did not have statistically significant difference with the readings 1 day after surgery  $P = 0.99$ , but comparison of test results at other time intervals were significant ( $P < 0.001$ ). A relative increase in saccharin test time was seen in a period of 1 month after surgery the rise was more noticeable in the 1<sup>st</sup> week compared to 1 month after surgery. **Conclusion:** This study in the period after septorhinoplasty surgery MCF undergoes slight impairment that gradually progresses to normal values during 1 month after surgery.

**Keywords:** Mucociliary function, saccharin test, septorhinoplasty

### Introduction

One of major defense mechanisms of nose and paranasal sinuses against infection is mucociliary system. Normal mucociliary function (MCF) in all areas of nose except for the most anterior part of septum and inferior concha is directed to nasopharynx.<sup>[1]</sup>

If part of mucosal is resected and reinserted cilia will move in the previous direction.<sup>[2]</sup> Direction of mucociliary transit is independent of body position in relation to gravity. This function can be bypassed in areas without ciliated epithelium. This is because of tension from thick mucus layer.<sup>[3,4]</sup>

Impairment of MCF in prevention of sinusitis is shown with effects of mucociliary dysfunction in conditions such as primary ciliary dyskinesia (PCD) and cystic fibrosis (CF).<sup>[2]</sup>

Environmental contaminants such as fume, dust, smoke, and chemicals can affect MCF directly or they can alter the physical and chemical characteristics of secretions.

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All the factors that decrease MCF cause increased vulnerability to respiratory infection and neoplasms.<sup>[3]</sup>

MCF has been evaluated thoroughly by endoscopic studies and has been shown the direction of MCF in each sinus follows a constant and specific method. In a recent research, MCF in the site of operation and in postoperative period did not follow usual mucus transport pattern.<sup>[4]</sup>

Mucociliary stasis is usually localized to ethmoid sinus and it is more common in patients with persistent or recurrent sinusitis after surgery and this issue is caused by negative local factor such as inflammation, bacterial colonization, and trauma of surgery.<sup>[4]</sup>

Mucociliary system is very sensitive to dryness but considering warming and humidifying mechanisms of the nose rarely dryness reaches the extent that can impair mucociliary transit.<sup>[5]</sup>

At present, septorhinoplasty is the most common esthetic operation performed in

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the world and especially in Iran. Many patients complain of various symptoms and problems in different time intervals after surgery. Some of these symptoms are as follows nasal obstruction, hyposmia, runny nose, headache and facial pain, malodorous smell, chronic watery, thick or purulent nasal discharge, acute and chronic sinusitis, etc.<sup>[6]</sup>

According to different studies and available knowledge of nasal physiopathology, MCF is a major physiologic mechanism of the nasal cavity and dysfunction in this mechanism can directly or indirectly make or exacerbate the above mentioned problems and symptoms.<sup>[1,4]</sup>

This study was done to find whether different manipulations and changes on soft and hard tissue of the nose after septorhinoplasty have any impact on MCF or not, and how much is the extent of probable dysfunction if any is the dysfunction permanent or transient. When can be expected the MCT returns to normal states.

Finding this information by this study and previous and future studies in this regard can aid physicians and patients by offering different approaches for diagnosis, treatment and prevention of these problems and appropriate timing of interventions if needed at all. Furthermore, patients can be informed and reassured about the severity and period of the symptoms and time of resolution.

## Materials and Methods

This study was a descriptive – analytic before – after type study that was done on 70 septorhinoplasty patients. To measure MCF before and after operation saccharin test was used. Statistical population of the study was a number of admitted patients for septorhinoplasty surgery at Kashani and Alzahra Hospital during 2013–2014.

Subjects were selected randomly according to their admission to the hospital for the operation and the only factor for their selection was passing inclusion criteria.

Inclusion criteria for the study are as follows:

1. Septorhinoplasty was proposed operation of the patients
2. Operation was done on both the septum and nasal bones by at least bilateral mucoperichondrial flap elevation of septum and medial and lateral osteotomies of nasal bones
3. No current disease such as: Sinonasal and respiratory conditions, asthma ciliary dysfunction, allergy, upper and lower respiratory infection, sinusitis, polyposis, recent facial trauma, Kartagener disease, CF, furosemide usage
4. Execution of other facial or sinonasal surgeries was not planned at the same time
5. Reading, understanding and signing the consent paper by the patients.

All patients who did not complete the four-stage of the study or refused to remain in the study were excluded from the study.

Saccharin test was done in four stages. First stage was before surgery, second the day after surgery when the nasal packing was removed before discharging the patient, the third stage was done on 1 week after surgery when the patient came to remove the external nasal splint and the fourth stage 1 month after surgery in each stage, time of saccharin test was calculated from placement of saccharin granule on the anterior part of inferior concha until the patient sensed the sweet taste in their pharynx. In the unilateral turbinate hypertrophy or turbinoplasty, the test was done on the other intact side.

Mucociliary dysfunction can be diagnosed by saccharin test. This test is performed by placing saccharin tablets on the inferior turbinate behind the anterior margin and the moment the patients feels the sweet taste in the pharynx is recorded. Maximum time in normal people is 30 min.<sup>[1,4]</sup>

The patients is requested to blow his or her nose then under direct vision by use of a small forceps like an alligator a quarter of a saccharin tablet is placed on the medial aspect of inferior turbinate 1 cm behind the anterior rim then the patient is asked while sitting calmly and avoiding actions such as sneezing, eating and drinking, sniffing, and snorting; to swallow every minute and report the sweetness immediately.

A modification of the test can be done by adding color substance Evans blue to saccharin and looking for the blue color in the nasopharynx.<sup>[4]</sup>

In normal people saccharin clearance time is <20 min.<sup>[4]</sup> Longer times are associated with conditions such as PCD and CF.<sup>[8]</sup> Increase in test time can also be seen in infectious states such as chronic rhinosinusitis and acute viral infections. The longer than normal results should be repeated at another time and if still increased the patients should further be evaluated for mucociliary dysfunction.<sup>[1,3,4,7]</sup>

The obtained data were entered in computer and analyzed using *t*-test, one-way variance analysis test and analysis of variance (ANOVA) (one-way repeated measures) with the help of software SPSS version 22 IBM Corporation.

## Results

In this study, 70 patients with septorhinoplasty operation with average age of  $25.7 \pm 4.9$  (rang 18–39) were studied 18 patients (24%) were male, 57 (76%) female 8 persons (17%) were smoker. Distribution of demographic variable is shown in Table 1.

Mean of saccharin test time was  $7.74 \pm 1.65$  min before surgery  $7.75 \pm 1.7$  the day after,  $15.04 \pm 3.4$  1 week after and  $8.49 \pm 2.08$  1 month after surgery according to ANOVA one-way with repeated measures mean of variation of saccharin test time during study period was statistically significant. Mean of the test measurement is shown in Figure 1 and Table 2.

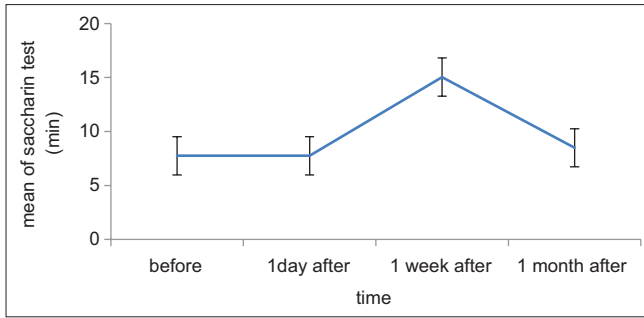


Figure 1: Mean of saccharin test in four stages

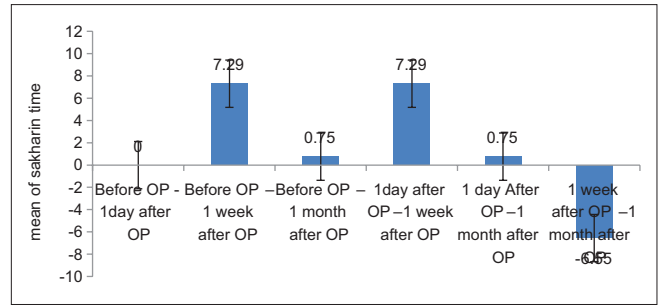


Figure 2: Comparison of saccharin test time of different study stages

**Table 1: Distribution of demographic variables**

Variable	n (%)
Age distribution	
Under 20 years	7 (9.3)
20-29 years	47 (69.3)
30 years and more	16 (21.3)
Sex	
Male	18 (24)
Female	52 (76)
Smoking	
Yes	8 (10.7)
No	62 (89.3)

Mean and standard deviation (SD) of saccharin test has been shown in four stage of the study in Figure 2 mean of saccharin test in 4 stages of the study has been compared [Figure 2].

According to paired *t*-test, the difference between the test results of 1 day after surgery compared to before surgery was not significant ( $P = 0.99$ ), but the difference among other stage times were statistically significant.

Mean and SDs of saccharin test time from before surgery until 1 month after that in four stage is shown in Table 3 considering demographic variables. According to ANOVA one-way, test time difference of saccharin test in all four stages was not statistically significant in according with age and sex of patients but regarding smoking the results was significant in all four stages between smoker and nonsmoker groups. No patient showed longer than normal test results (longer than 30 min) in study stages.

## Discussion

The main goal to perform this study was to find out effects of septorhinoplasty surgery on nasal MCF. In this study, 70 patients undergone the surgery were included and saccharin test was done before and 1 day, 1 week, and 1 month after surgery. According to the obtained test results saccharin test time of 1 day after surgery in comparison to before surgery was not significantly different but 1 week after surgery in comparison to before surgery the test showed a significant increase. Test results of 1 month after surgery compared to 1 week after surgery showed a

significant decrease, but they did not reach the readings before surgery but approached close to them.

The fact that saccharin test time did not show any rise on the day after surgery can be attributed to the following hypotheses.

1. During the 24 h after surgery, mucosal inflammation and edema have not reached the extent that can impair MCF
2. Anti-inflammatory effects of dexamethasone that is routinely administered for the septorhinoplasty patients during operation prevented the increase in test time
3. Copious fluid and secretions in the nasal cavity immediately after removal of packing provide a medium for saccharine granules to dissolve in and bypass the mucociliary transfer and lead to false results.

Considering these hypotheses and other possible ones it sounds prudent to change and modify this part of the study in the form of another research.

Philip *et al.* in 1984 researched efficacy of saccharin test for screening MCF and performed the test based on the method of Anderson who presented the test for the first time in 1974 and later modified by Rutland and Cole in 1984.<sup>[5,8]</sup>

In this test, they put 1 mm saccharin granules 1 cm behind the anterior ridge of inferior turbinate and recorded the time of sweetness announced by the patients in minutes. If the sweet taste was not sensed by the patient in 60 min they stopped the test and put the granule directly on the patients tongue to examine patient's taste and<sup>[6,4,14]</sup> saccharine test was repeated 2 weeks later. They concluded that to evaluate MCF, saccharin test is an inexpensive easily available and simple test.<sup>[5]</sup>

In another study by Stanley *et al.* in 1985, patients with allergic and nonallergic rhinitis without asthma and chronic sinusitis were studied.<sup>[6]</sup>

In this study, patients with chronic sinusitis with or without asthma showed a significant difference compared to control group. In patients with chronic sinusitis, ciliated mucosa is disrupted, and MCF in regions with normal cilia is normal. Different studies have shown that topical drugs such as corticosteroid and anti-cholinergics have no effect on MCF.<sup>[6-11]</sup>

**Table 2: Comparison of saccharin test time of different study stage**

Paired	Paired differences				t	P
	Mean	SD	95% CI of the difference			
			Lower	Upper		
Before operation - 1 day after OP	0.0001	0.8	-0.18	0.18	0.001	0.99
Before OP - 1 week after OP	-7.29	2.14	-7.79	-6.8	-29.5	<0.001
Before OP - 1 month after OP	-0.75	0.83	-0.94	-0.56	-7.77	<0.001
1 day after OP - 1 week after OP	-7.29	2.08	-7.77	-6.82	-30.4	<0.001
1 day after OP - 1 month after OP	-0.75	0.85	-0.94	-0.55	-7.63	<0.001
1 week after OP - 1 month after OP	6.55	1.78	6.14	6.96	31.78	<0.001

SD: Standard deviation, CI: Confidence interval

**Table 3: Mean and SD of saccharin test time considering demographic variables**

Variable	Before surgery	After surgery			P
		1 day	1 week	1 month	
Age group					
Under 20	8.36±1.35	8.07±2.23	16.57±3.55	9.14±1.65	0.13
20-29	7.45±1.66	7.53±1.7	14.53±3.46	8.19±2.13	
30 and more	8.44±1.55	8.31±1.4	16.03±2.89	99.19±1.96	
P	0.07	0.24	0.14	0.17	
Sex					
Male	8.08±1.78	8.22±1.53	15.97±3.43	9.19±2.1	0.16
Female	7.64±1.61	7.6±1.74	14.75±3.38	8.27±2.04	
P	0.3±3	0.18	0.19	0.1	
Smoking					
Yes	9.25±1.36	9.63±0.79	18.94±1.27	10.81±0.8	<0.001
No	7.57±1.6	7.52±1.64	14.57±3.29	8.22±2.01	
P	0.006	0.001	<0.001	0.001	

SD: Standard deviation

A study by Niedzielska *et al.* in 2006, concluded that Le Fort I fracture of facial skeleton causes mucociliary dysfunction and the severity of this dysfunction in Le Fort III fractures is higher than Le Fort I and surgical management.<sup>[12]</sup>

In another study by Janic and Niedzielska in 2013, in patients with unilateral zygomaticomaxillary and orbital fractures, saccharine test in fractured side was compared with nonfractured side and significant dysfunction in fractured side was seen also mucociliary dysfunction was noticed in patients whose fracture was reduced by Foley catheter balloon.<sup>[13]</sup>

In a study by Danielle in 2010, use of furosemide raised saccharin test time significantly.<sup>[14]</sup>

According to above mentioned studies facial bone trauma including maxilla, ethmoid, and nasal bones and their treatment including closed and open reduction can result in impairment of mucociliary function but trauma inflicted during septorhinoplasty could only slightly increase saccharin test time and not to the extent that MCF would be impaired according to our study.

Some of the limitations of this study are:

- Administering corticosteroids during surgery can be a confounding factor to the results

- Nasal secretion in the second stage of the test can make some false negative results
- Poor cooperation of some patients during the test can result in inaccurate test results.

### Conclusion

According to the obtained data from our study and comparing it with other related studies.

It can be concluded that septorhinoplasty operative can affect MCF and impair it slightly but this impairment is not to the extent that can be called mucociliary dysfunction by definition (saccharin test more than 30 min). On the other hand, this impairment after septorhinoplasty seems to be transient and during the 1 month period after surgery progresses to normal values so various long-lasting symptoms and complication after surgery probably are not related to mucociliary dysfunction and other diagnostic and management strategies should be sought. In this regard, saccharin test is a simple, reliable, and inexpensive test to examine MCF after septorhinoplasty.

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### Conflicts of interest

There are no conflicts of interest.

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