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Sensory Changes in Nasal Subunits Following Open and Closed Rhinoplasty: A Randomized Controlled Trial

Sinan Kadir Altunal[1] · Murat Celik[1] · Ugur Kocer[1] · Arda Kucukguven[1]

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Abstract

Background Skin sensation changes are common after rhinoplasty and can be troublesome for patients postoperatively. The closed technique may be considered as causing less sensory loss compared to the open technique due to its conservative approach, minimal dissection and low tissue damage potential. A randomized study was planned to compare the sensory changes in the subunits of the nasal skin caused by the two main methods using objective and subjective parameters.

Methods In the analysis of the patients, the nose was divided into seven subunits: nasion, rhinion, nasal tip, left alar wing, right alar wing, infratip lobule and columella base. Evaluations were done preoperatively and at the first, third, sixth and twelfth months postoperatively. Objective sensory evaluations were done using the Semmes–Weinstein monofilament test. The subjective sensory changes of each nasal unit were subjectively evaluated by the patients on a three-point Likert scale.

Results Both objective and subjective evaluations showed a statistically significant decrease in sensation in the nasal tip and infratip lobule in the open group one month after surgery. In the closed group, no significant differences were observed between the preoperative and postoperative sensory values for nasal subunits across all periods.

Conclusion While a decrease in sensation was observed in the tip and infratip lobule in the open technique by the first month postoperatively, this loss of sensation returned to a normal level by the third month. In the closed technique, however, no significant loss of sensation was detected in the postoperative period. In light of our findings, surgeons can have a better insight into postoperative sensory changes in the subunits of nasal skin which makes them more confident and reassuring when there are concerns regarding altered sensation after rhinoplasty.

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Keywords Rhinoplasty · Open rhinoplasty · Closed rhinoplasty · Tip numbness

Introduction

The ongoing debate regarding modern rhinoplasty revolves around the relative superiority of its two main techniques: open and closed. It is commonly believed that the closed technique leads to faster recovery and less postoperative swelling [1]. On the other hand, the open technique is often preferred due to its ability to provide greater visibility of the anatomy and easier access to deeper tissues [2]. However, it is important to note that neither technique is ideal, and evaluation should be made on a patient basis.

Skin sensation changes are common after rhinoplasty and can be troublesome for patients postoperatively [3]. They might have a decrease in the sensation of touch, temperature and even proprioception which may cause discomfort. Therefore, it is crucial to prevent or minimize these sensory changes. Various factors, such as the skin

✉ Sinan Kadir Altunal
dr.sinanaltunal@gmail.com

[1] Department of Plastic, Reconstructive and Aesthetic Surgery, Ankara Training and Research Hospital, 06230 Ankara, Turkey

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incision technique, surgical modifications, demographic factors, comorbidities and drug use, can contribute to these changes. However, the choice of rhinoplasty technique, particularly the skin incision technique (open or closed), is arguably the most critical factor in predicting sensory changes. The closed technique may be considered as causing less sensory loss compared to the open technique due to its conservative approach, minimal dissection and low tissue damage potential. Nevertheless, the effects of the two primary techniques, open and closed rhinoplasty, are still under investigation. It is important to evaluate the short- and long-term sensory changes of these techniques on different subunits of the nose. While a number of studies have investigated these effects, few have used today's modern structural rhinoplasty techniques, and no studies have comprehensively used both objective and subjective assessment [4–7]. Therefore, it was worth investigating whether the closed method, which is thought to be better in post–operative recovery, is better in the recovery of the nasal skin sensation. To address this gap, a randomized study was planned to compare the sensory changes in the subunits of the nasal skin caused by the two main methods using objective and subjective parameters.

Methods

Study Setting and Participants

The study was designed as a prospective randomized clinical trial conducted according to Consolidated Standards of Reporting Trials guidelines [8]. Patients between the ages of 18 and 40 years who had applied to our hospital with a request for primary rhinoplasty between June 2021 and December 2021 were accepted as eligible for the study. Two parallel allocation groups (open and closed technique) were created, and the allocation ratio was 1:1. Ethical approval was obtained from the Local Ethics Committee of the University of Health Sciences Ankara Training and Research Hospital (No: E-93471371-514.99) and conducted under the basic principles of the Declaration of Helsinki. All the participants were given information regarding the study, and they provided written consent for their participation. All data collection and interventions were carried out at the Ankara Training and Research Hospital.

The Central Limit Theorem was utilized to determine the sample size. For open and closed rhinoplasty, sample sizes of thirty are deemed sufficient to draw accurate and reasonable insight and to reach meaningful results. Patients were divided into open and closed technique groups using a clinical trial randomization tool [9]. Maximally tolerated imbalance (MTI) was used to define how much difference was allowed between the group sizes. MTI was set as '3' for this study. One of authors (SKA) generated a random allocation sequence and enrolled patients as well as concealing the sequence until the interventions were assigned. Another author (MC) assigned the participants to interventions according to randomization protocol.

Demographic and medical information of the patients was recorded at the time of application. Any history of injury that may affect nasal skin sensation, chronic diseases that may impair nerve healing (such as vitamin B12 deficiency or Diabetes Mellitus) and past surgery to the nose were determined as exclusion criteria. In addition, patients who underwent subcutaneous tissue excision and/or alar base reduction during the operation, which may also affect skin sensation, and patients who were lost in follow-up were excluded from the study.

All the patients were followed up for at least one year. The study was completed in December 2022, when the last follow-up of the last patient was included in the study.

Surgical Method

All surgical operations were carried out by the same surgeon (AK). The same structural rhinoplasty steps were performed in all the patients in both groups, except for the additional transcolumellar incision in patients who underwent the open technique. Nasal dissection of all the patients was performed on the same surgical plane in order not to adversely affect the study results. After the marginal (infracartilaginous) incision, sub-SMAS dissection was performed in the lower lateral cartilages. Subperichondrial and subperiosteal dissection was performed in the upper lateral cartilages and nasal bones. The degree of dissection was similar in both groups. L-strut septoplasty was performed in all cases, and the excised septal cartilage was used as a septal extension graft. Since the instruments used for the osteotomy may affect the study results, the same instruments were used in all the surgeries. Endonasal low-to-low lateral and medial oblique osteotomies were applied. Cephalic excision of the lateral crura was performed. Transdomal and interdomal sutures and septal extension grafts were used for tipplasty. The columellar incision was closed with a 6/0 non-absorbable suture. Silicone septal splints were placed in the nasal cavity in all the patients. Silicone septal splints, columellar sutures and external nasal splints were removed on seventh post–operative day.

Outcome Measurement

In the analysis of the patients, the nose was divided into seven subunits: nasion, rhinion, nasal tip, left alar wing, right alar wing, infratip lobule and columella base (Fig. 1).

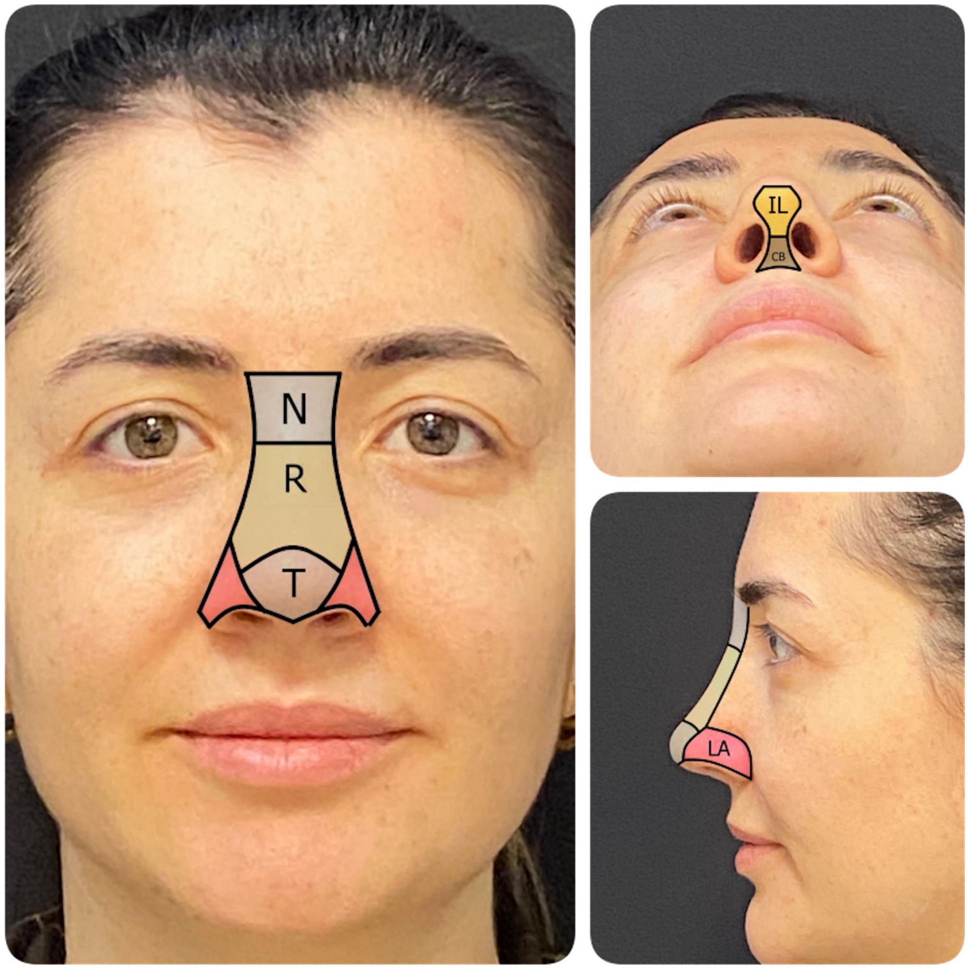

Fig. 1 Nasal subunits: Nasion (N), Rhinion (R), Tip (T), Left Alar Wing (LA), Right Alar Wing (RA), Infratip Lobule (IL), Columellar Base (CB)

Objective sensory evaluations were defined as primary outcomes. It was conducted using the Semmes–Weinstein monofilament test (SMWT) before and one, three, six and twelve months after the operation. This test measures the threshold of slowly adapting nerve fibers. It is a cost-effective, reliable and valid test that has been commonly utilized to detect sensory changes in previous studies [4–7]. Patients were given a brief explanation of the SMWT prior to its administration. They were instructed to lie in a supine position with their trunk flexed at a 45-degree angle and to close their eyes. Monofilaments of increasing thicknesses were randomly applied to one of the seven subunits of the nose while the surgeon determined the order of the subunits to be tested. Each touch was applied for at least 1.5 seconds with equal pressure after the monofilament bowed. Patients were asked whether they felt the touch and were required to correctly identify the subunit location. The monofilament thickness used was recorded as the thickness value if the patient correctly identified the subunit. The lightest value felt by the patient is recorded (Fig. 2).

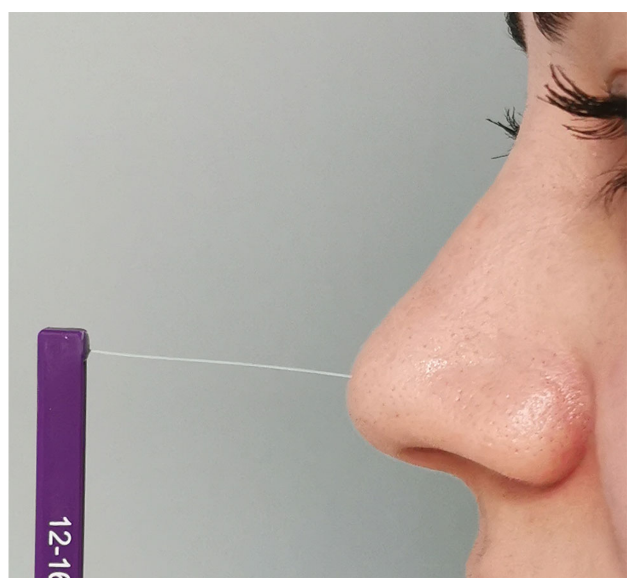

Fig. 2 Application of Semmes–Weinstein monofilament test

The secondary outcomes were subjective evaluations. Sensory changes of each nasal unit compared to the preoperative period in the postoperative first, third, sixth and twelfth month were subjectively evaluated by the patients on a three-point Likert scale (no sensation, decreased or similar with one, two or three points, respectively). The study was non-blinded because of the nature of the surgery (columellar incision or no incision).

Statistical Analysis

Primary and secondary outcomes were statistically analyzed within and between the groups using the SPSS 24 (IBM Corp., Armonk, NY). The results with a P value less than 0.05 were considered statistically significant. Normal distribution was checked using skewness and kurtosis. Differences within the groups were evaluated using a one-way repeated measures ANOVA test for normally distributed data, as well as the Friedman test if the normal distribution was not present. In the post hoc analysis, the Tukey HSD and the Wilcoxon signed-rank tests were used. Age and preoperative SWMT values were compared between the open and closed rhinoplasty groups using the Mann–Whitney U test. Gender distribution was compared between the open and closed groups using the Chi-square test.

Results

After the application of exclusion criteria, a total of 62 Caucasian patients were included in this randomized prospective study (Fig. 3). The open group had 32 patients (25 females, and 7 males, with a mean age of 27.2 years, ranging from 20 to 46 years), while the closed group had 30 patients (24 females and 6 males, with a mean age 26.6 years, ranging from 19 to 42 years). There was no statistically significant difference in the mean age, gender distribution and SWMT values of the nasal subunits ($p > 0.05$) between the open and closed groups in the preoperative period. The SWMT values showed a decrease in sensation in the nasal tip and infratip lobule of the open group one month after surgery ($p < 0.05$), but this decrease did not differ significantly from the preoperative state at the third postoperative month ($p > 0.05$). No significant changes in sensation were observed in other subunits of the nose in the open group. In the closed group, no significant differences were observed between the preoperative and postoperative sensory values for nasal subunits according to the SWMT results across all periods (Table 1).

When the patients were asked to evaluate the sensory change on a three-point Likert scale, it was observed that there was a statistically significant decrease in sensation in the nasal tip and infratip lobule units in the first month postoperatively compared to the preoperative period in the open group ($p < 0.05$). There was no significant change in the postoperative sensory values of the other units in the open group and in all subunits of the patients who underwent the closed technique (Table 2).

According to both the SWMT and the three-point Likert scale, it was statistically significant that the decrease in sensation in the nasal tip and infratip lobule was higher in the open group compared to the closed group in the first month postoperatively (Fig. 4). No ancillary analyses have been carried out.

No serious complications were observed in either group.

Discussion

Today, open and closed techniques continue to be compared with each other. This comparison is made on both the intraoperative differences and the postoperative recovery period. Changes in nasal skin sensation are among the most common adverse conditions postoperatively [3].

While the infratrochlear nerve supplies the sensation of radix, the sensation of the nasal tip is supplied by the external nasal branch of the anterior ethmoidal nerve. The sensory supply of the alar wings comes from the nasal branches of the infraorbital nerve [10]. The sensation of columella is provided by the external nasal nerve near the tip and by the labial branches of the infraorbital nerve at the base [11]. Damage to these nerve branches that provide the sense of the nasal skin causes a decrease in sensation [7]. However, there are limited studies comparing the change of nasal skin sensation with open and closed techniques [4, 5, 7]. Although all the differences between open and closed rhinoplasty are beyond this study, we aimed to reveal the sensory difference and sensory recovery times in the postoperative period.

Both objective and subjective parameters were used to comprehensively evaluate sensory changes in nasal subunits. There are two common methods for the numerical evaluation of tactile sensation: the two-point discrimination test and the monofilament test. Studies have shown that although monofilaments can be affected by heat and erode over time, it is more reliable than the two-point discrimination test [12]. Therefore, the SWMT was used for objective sensory evaluation. Patients were asked questions on a three-point Likert scale to evaluate the change in nasal skin sensation. By making subjective evaluations, it was aimed to reveal how much the results obtained with the SWMT overlap with the answers of the patients about the nasal skin sensation.

Both the objective and subjective data showed a decrease in sensation in the nasal tip and infratip lobule at the first month postoperatively in the open rhinoplasty technique compared to the preoperative period, indicating that the nerve fibers involved in the sensation of these regions were more damaged in the open technique. The

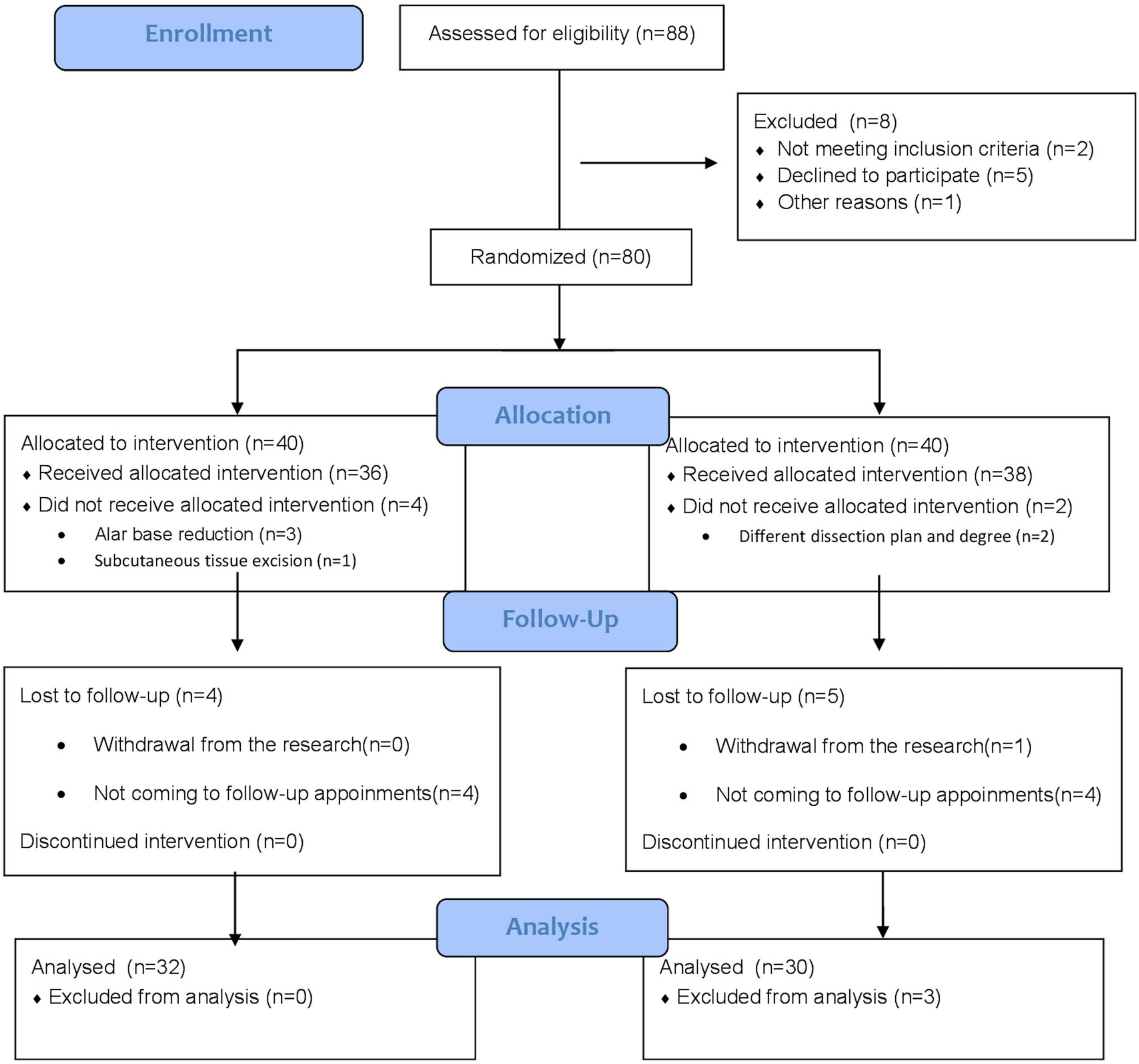

Fig. 3 Flow of participants through trial

findings obtained in the subjective sensory evaluation support the results of the monofilament test.

Since type (blunt–sharp), plane and degree of the dissection and osteotomies can affect the degree of these nerve injuries, to eliminate these discrepancies, in our study, the same degree and plane of the dissection were carried out in both groups. Furthermore, the same surgical equipment was used for the dissection and osteotomy in both groups. The only difference between the groups was the columellar skin incision.

In a study conducted by Bafaqeeh et al. a decrease in sensation was noted in the area innervated by the external nasal nerve (nasal tip and infratip lobule) in the early postoperative period after open rhinoplasty, which correlates with our findings. The researchers stated that the nerve could be injured during subcutaneous dissection as it passes between the nasal bone and the upper lateral cartilage [5]. Oneal et al. state that this nerve can be injured during intercartilaginous and cartilaginous split incisions in closed rhinoplasty [10].

Considering the similar wide dissections done in both groups in our study, we can conclude that the columellar branch coming from the infraorbital nerve also plays a major role in the tip and infratip lobule innervation as there was no decrease in sensation in these subunits in the closed group, whereas there was a significant loss of sensation in

Table 1 Evaluation of the sensation values of groups according to SWMT (g/mm^2)

		Pre–operative	Post–operative 1. month	Post–operative 3. months	Post–operative 6. months	Post–operative 12. months
Nasion	Open	0.02	0.016	0.015	0.018	0.016
	Closed	0.02	0.018	0.018	0.02	0.016
Rhinion	Open	0.019	0.017	0.014	0.017	0.016
	Closed	0.015	0.013	0.016	0.016	0.015
Tip	Open	0.022	0.051*	0.028	0.02	0.018
	Closed	0.02	0.018	0.018	0.02	0.016
Left alar wing	Open	0.01	0.009	0.01	0.009	0.012
	Closed	0.009	0.009	0.008	0.01	0.01
Right alar wing	Open	0.01	0.008	0.008	0.008	0.009
	Closed	0.008	0.009	0.009	0.008	0.01
Infratip lobule	Open	0.01	0.029*	0.019	0.016	0.018
	Closed	0.009	0.013	0.016	0.012	0.013
Columellar base	Open	0.009	0.011	0.009	0.009	0.01
	Closed	0.009	0.011	0.008	0.01	0.009

*$p<.05$

Table 2 Evaluation of the sensation of groups according to three-point Likert scale

		Post–operative 1. month	Post–operative 3. months	Post–operative 6. months	Post–operative 12. months
Nasion	Open	2.97	3	3	3
	Closed	3	3	3	3
Rhinion	Open	2.91	2.91	2.97	3
	Closed	2.92	2.97	3	3
Tip	Open	2.3*	2.81	2.92	2.97
	Closed	2.77	2.81	2.97	2.97
Left alar wing	Open	2.94	2.97	3	3
	Closed	2.92	3	3	3
Right alar wing	Open	2.92	2.97	3	3
	Closed	2.97	3	3	3
Infratip lobule	Open	2.27*	2.78	2.89	2.92
	Closed	2.81	2.86	2.92	2.97
Columellar base	Open	2.92	3	3	3
	Closed	3	3	3	3

*$p<.05$

the same subunits in the open group in the early postoperative period.

Regardless of the technique, it is obvious that the greater the degree of dissection, the longer the sensory recovery will take. When the degree of dissection remains the same, we attribute the greater decrease in sensation to the incision in the columella, the degree of intraoperative trauma to the tissues and the postoperative edema.

In a study by Okur et al. in which they compared open and closed rhinoplasty, it was found that the sensation of the nasal tip and infratip lobule decreased with the damage caused by an incision made in the open technique, similar to our results. They found that these sensations were regained by the first month after the surgery [7]. It should be highlighted that there was no dissection of the lower lateral cartilages in their closed rhinoplasty group. They made intercartilaginous incisions to dissect only the upper laterals and nasal bones. Therefore, their sensory findings around the nasal tip may not be considered accurate as tip surgery is a key step in modern structural rhinoplasty.

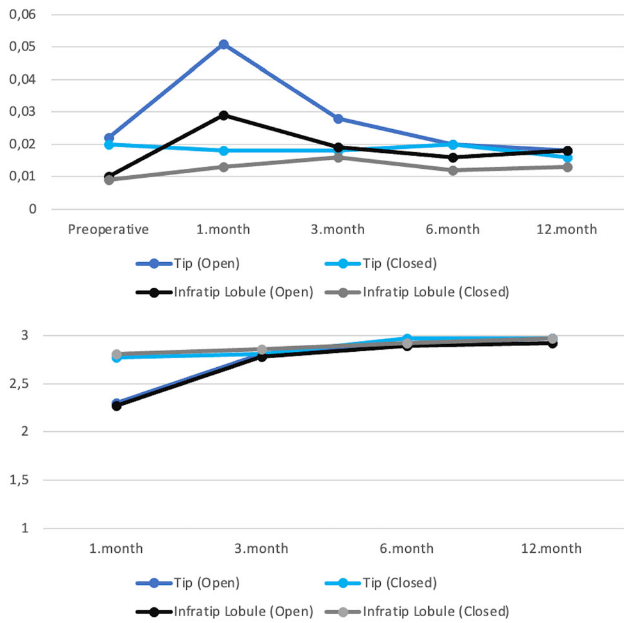

Fig. 4 According to both SWMT (above) and three-point Likert scale (below), it was statistically significant that the decrease in sensation in the nasal tip and infratip lobule was higher in the open group compared to the closed group at the first month postoperatively.

Patients who underwent subcutaneous tissue excision and alar base reduction were excluded, as we thought this might affect the patients' sensory outcomes in our study. However, Bakhshaeekia et al. show that there is no difference in sensation between the groups after open rhinoplasty with and without subdermal soft tissue excision in the tip and infratip lobule in their study [6].

In a study by Akyigit et al. it was found that there was a statistically significant decrease in sensation in all nasal subunits in revision rhinoplasty compared to primary rhinoplasty. Similar to our results, a greater reduction in sensation of the tip and infratip was noted in patients with primary rhinoplasty. Although it was not specified when, a return to normal sensation was observed in primary rhinoplasty patients at the end of the first year [4].

We found that there was no significant difference in the sensation of nasal subunits between the preoperative and the 3-month postoperative periods regardless of the surgical technique. This recovery of sensation is believed to occur through the formation of collaterals from adjacent nerve fibers. Nerve healing can also be seen with axonal regeneration of end-to-end nerve fibers after columella suturing [13].

The generalizability of the study results was evaluated. The study population of patients aged between 18 and 40 years fairly represents the target population of rhinoplasty. Although it constitutes a small population, the exclusion of patients with nerve healing impairment limits external validity. Despite the existence of cutaneous variations and skin sensation differences between different races according to the study of Fotoh et al. [14], we believe that our findings can be applied to those from different ethnic origins as the nasal nerve anatomy is similar in the general population. Other than the surgeon's experience, there is no hindrance to the applicability of the study results.

Our study has certain limitations that should be addressed. Because of the easy detectability of the columellar skin incision, no blind evaluation was possible for the SWMT. Even though the SWMT is used as an objective test for the evaluation of skin sensation, the results are dependent on patient statement. As we did a wide dissection in all cases, we did not preserve the external nasal branch of the anterior ethmoidal nerve. This branch's clinical implications could be the subject of another study. Finally, we did not measure the sensory changes of the vestibular skin which might be relevant to patients who cannot feel their noses dripping postoperatively.

Conclusion

To our knowledge, this is the first randomized prospective clinical study to analyze sensory changes of the nasal skin after open and closed rhinoplasty using modern structural rhinoplasty techniques based both on objective and subjective data. While a decrease in sensation was observed in the tip and infratip lobule in the open technique by the first month postoperatively, this loss of sensation returned to a normal level by the third month. In the closed technique, however, no significant loss of sensation was detected in the postoperative period. In light of our findings, surgeons now have a better insight into postoperative sensory changes in the subunits of the nasal skin, making them safer and more reassuring when there are concerns regarding altered sensation after rhinoplasty.

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Declarations

Conflict of interest The authors declare no potential conflict of interest with respect to the research, authorship and publication of this article.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards

Informed Consent Written informed consent was obtained from all the patients for the procedures performed and for the use of their images.

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