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Original Investigation

Comparison of Sinonasal Complications of Microscopic and Endoscopic Approaches for Transsphenoidal Hypophyseal Surgery: Prospective Study

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ABSTRACT

AIM: The surgical success rates of microscopic and endoscopic transsphenoidal approaches for treatment of pituitary adenomas have often been compared. However, little has been reported regarding sinonasal complications of these approaches. We compared sinonasal complications after microscopic and endoscopic approaches for pituitary adenomas.

MATERIAL and METHODS: At our clinic, sinonasal complications occurred in 31 patients who underwent microscopic transsphenoidal surgery between 2007 and 2014 and in 32 patients who underwent endoscopic transsphenoidal surgery between 2014 and 2016. We statistically compared the complications observed during endoscopic sinonasal examination performed by an otorhinolaryngologist.

RESULTS: Sinonasal pathology occurred in 22 of the 31 patients (70.9%) in the microscopy group (Group 1) and 19 of the 32 (59.3%) in the endoscopy group (Group 2). Of the 31 patients in Group 1, 13 had nasal septal perforation, 13 had nasal synechiae, three had anosmia, two had hyposmia and one had saddle nose deformity. In Group 2, no patient had nasal septal perforation, whereas eight had nasal synechiae, one had anosmia, 11 had hyposmia and four had infection.

CONCLUSION: There were no statistically significant differences in sinonasal complications (e.g. synechiae, anosmia, deformity, and sinusitis) between the two groups. Although the perforation rate (especially for perforations in the middle portion of the septum) was statistically greater in Group 1 than in Group 2, the hyposmia rate was statistically greater in Group 2 than in Group 1.

KEYWORDS: Endoscopic transsphenoidal surgery, Hypophysis, Microscopic transsphenoidal surgery, Pituitary adenoma, Sinonasal complication

INTRODUCTION

The goal of treatment for pituitary adenomas is the removal of the adenomas and the correction of the local mass effects and metabolic derangements due to hormonal hypersecretion. Treatment also is aimed at protecting the major neurovascular structures and tissues in the surgical field so as to prevent minor complications that may affect quality of life (12,16). Transsphenoidal surgery initially became the preferred approach for treating pituitary adenomas because it is minimally invasive with low morbidity and mortality rates and because it results in better patient comfort (5,34). Endoscopic or microscopic transsphenoidal

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surgical approaches often have been compared to determine the superior approach in terms of success rates. However, few studies have been conducted on sinonasal complications, which may negatively affect quality of life, occurring after these surgical approaches (3,20).

We prospectively performed a detailed analysis of sinonasal complications in patients who underwent endoscopic or microscopic surgery for pituitary adenomas. Along with the statistical comparison of data, we performed a literature review.

MATERIAL and METHODS

This study was approved by the local ethics committee of the University of Health Sciences Bakırköy Prof Dr Mazhar Osman Training and Research Hospital (dated 06/09/2016 and number 570). Among patients undergoing surgery for pituitary adenomas, we included 31 patients who underwent microscopic transsphenoidal surgery between 2007 and 2014 (Group 1) and 32 who underwent endoscopic transsphenoidal surgery between 2014 and 2016 (Group 2). This study has been designed as prospective. All patients with pituitary adenoma who were operated previously by the same surgeon with the microsurgery method and who were operated also by the same surgeon with the endoscopic method in our clinic and whose files and films could be accessible and who accepted to attend to the study were included in the present study.

Patients who had missing data, those who underwent a transcranial operation or those who could not be reached were excluded. All 63 patients were provided detailed explanations of the study, and informed written consent was obtained from them. After their general physical and neurological examinations were performed, sinonasal examinations were performed at the University of Health Sciences, Bakırköy Dr Sadi Konuk Education and Research Hospital, Ear–Nose–Throat (ENT) Clinic. Data were recorded in detail using an ENT examination form and included rates of nasal septal perforation, nasal synechiae, anosmia, hyposmia, deformities, perinasal hypoesthesia, oronasal fistula and purulent secretion. According to complaints of the patient assessment of hyposmia and anosmia, patients whose sense of smell was natural and the same as that before the surgery were considered "normal". Patients who could only smell strong odors and whose sense of smell had been reduced in reference to the pre-operation state were considered to have hyposmia. Patients, who did not have any problem before the operation but could not sense any smell were considered to have anosmia.

Nasal synechiae in the right and left nasal cavities were evaluated separately and were classified according to location in the septum and the inferior, middle or superior conchae. Septal perforation was classified as anterior, middle and posterior according to its location in the cartilaginous septum, osteocartilaginous junction and bony septum, respectively. Septal perforation size was classified as small (<1 cm), medium (1–2 cm) and large (>2 cm). All other sinonasal pathologies were also recorded, and statistical comparisons between individual subgroups were performed.

Microscopic Transnasal Surgical Technique

After advancing a Killian nasal retractor through the right nostril, the cartilaginous septum was incised approximately 2 cm posterior to the posterior part of the cartilaginous septum. This is the standard transsphenoidal approach to access the sphenoid sinus. After traversing the subperichondrial plane and accessing the septal bone, a mucosal tunnel that extended over the rostrum sphenoidale and anterior wall of the sphenoid sinus was created in the subperiosteal plane. The cartilaginous septum was resected, and a retractor was placed in the anterior wall of the sphenoid sinus. After resecting the tumor and closing the sphenoid sinus, the Papavero nasal retractor was removed, and the nasal septal mucosa was re-positioned. Merocel® and a silicone internal nasal splint with an integrated airway were placed in the nasal cavity bilaterally, and the operation was terminated. The nasal tampon was removed 2 days later.

Endoscopic Nasal Surgical Technique

Surgery was performed bilaterally using a 0°, 4-mm diameter, 18-cm long rigid endoscope. The surgical field was opened with the middle concha dissector and dissection proceeded posteriorly between the septum and middle concha to locate the superior concha. The ostium of the sphenoid sinus between the septum and immediately medial to the superior concha was seen. At this point, the mucosa was elevated over the bony nasal septum using endoscopic cautery.

This process was also applied to the contralateral nasal cavity. The anterior wall of the sphenoid sinus was opened. The mucosa covering the sella floor was elevated with the microdissector, revealing the sella floor and adjacent structures. The dura was seen by opening the sella floor using a hook or Micro-Tour device. The dura was cauterised with endoscopic bipolar cautery and opened in a circular manner. Adenomatous tissue was removed by means of an aspirator, ring curette and micro forceps. A nasal speculum and endoscope holder were not used during surgery. A nasal tampon was not used postoperatively.

Statistical Method

The Number Cruncher Statistical System (NCSS) 2007 and Power Analysis and Sample Size (PASS) 2008 Statistical Software (NCSS, LLC, Kaysville, UT, USA) were used for statistical analyses. For study data analysis, apart from descriptive statistical methods (e.g. averaging, standardising, median, frequency, rate), qualitative data were compared with Yates Continuity Correction (Yates corrected χ^2) and Fisher's exact test. Significance was accepted as $p< 0.05$.

RESULTS

Of the 31 patients in Group 1, 14 (45.2%) were male and 17 (54.8%) were female (average age, 48±7 years; range, 24–75 years), compared with 18 (56.2%) and 14 (43.8%), respectively, of the 32 in Group 2 (average age, 48.7±15 years; range, 17–77 years).

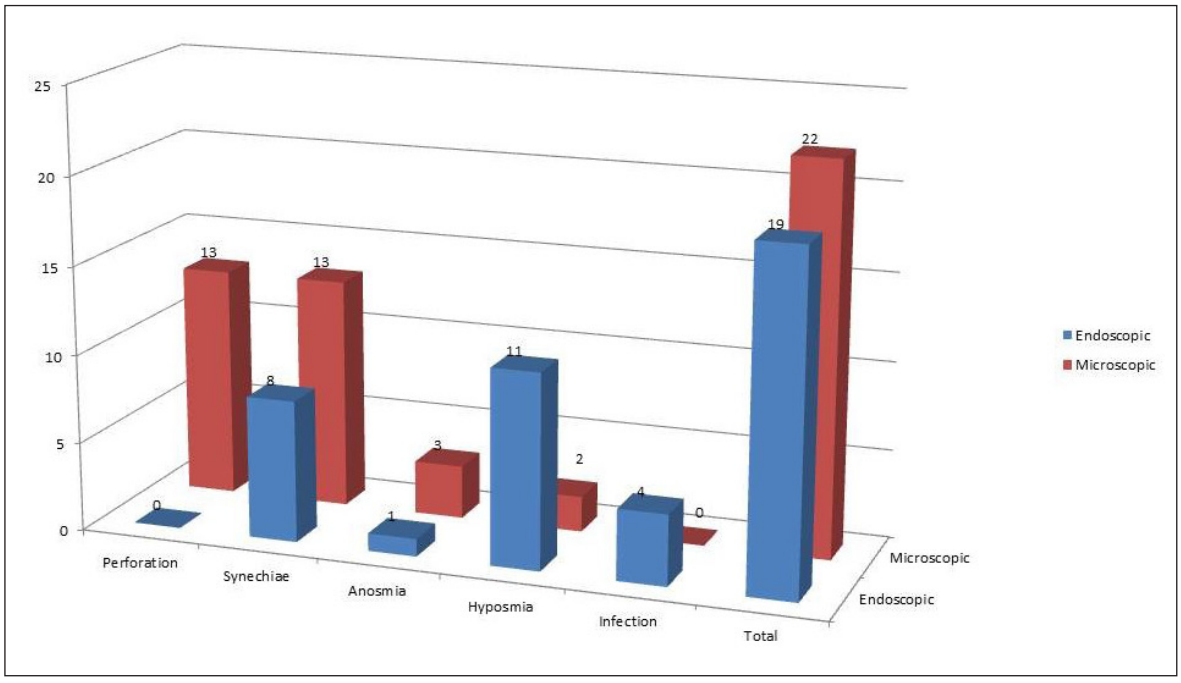

Figure 1: Summary of overall distribution of sinonasal complications.

The average follow-up duration was approximately 34.9±19.35 months (range, 8 months–7 years) in Group 1 and 18.4±6.02 months (range, 6 months–2.8 years) in Group 2. Of the 31 patients in Group 1 and 32 in Group 2, sinonasal pathology occurred in 22 (70.9%) and 19 (59.3%), respectively, whereas no sinonasal pathology occurred in 9 (29.1%) and 13 (41.7%), respectively. There was no statistically significant difference ($p>0.05$; Figure 1, Table I). Nasal septal perforation occurred in 13 (41.9%) in Group 1. In one of these patients, the perforation was pan-septal and a saddle nose deformity developed. In another patient, two septal perforations were found concurrently—a small one in the anterior septum and a medium one in the posterior septum. A small perforation occurred in two patients, a medium perforation in one and a large perforation in seven. Nine perforations were found most frequently in the middle septum, three in the anterior septum and three in the posterior septum (Figures 2, 3A). Two perforations in septum anterior, 8 perforations in the middle, 2 perforations at the rear and 1 perforation which contained all three sections as a whole were observed (Table I). By virtue of attaching the large sized perforation, which contained also the three compartments of the septum, separately to the each of the three groups, it was observed that the total number of perforations was 15, not 13. While assessing and comparing the perforations which are located in front of, in the middle, and at the rear section of septum, large sized perforations have been added also to each of the three compartments.

In Group 2, because the bilateral-nostril approach was used in all endoscopic surgeries, the window technically opened in the posterior septum; therefore, this was not considered a complication but a part of the surgical technique (Figure 3B). No perforation occurred in the anterior and middle septum. There was a statistically significant difference in the septal perforation rate between the two groups ($p<0.05$). There was a statistically significantly greater rate of middle septal perforation in Group 1 ($p<0.05$). However, there was no significant difference in the anterior septal perforation rate between the groups ($p>0.05$).

Figure 2: A perforation (circle) of the nasal septum (1) is shown (**white star:** Middle concha, **black star:** nasal septum).

Table I: Summary of Overall Distribution of Sinonasal Complications

Group	Operation type	N (Complication count)	p
Complication	Microscopic	22	0.33
	Endoscopic	19	
Perforation (Total)	Microscopic	13	**0.02**
	Endoscopic	0	
Perforation (Anterior)	Microscopic	2	0.07
	Endoscopic	0	
Perforation (Middle)	Microscopic	8	**0.001**
	Endoscopic	0	
Perforation (Posterior)	Microscopic	2	
	Endoscopic	0	
Perforation (Panseptal)	Microscopic	1	
	Endoscopic	0	
Synechiae	Microscopic	13	0.15
	Endoscopic	8	
Deformity	Microscopic	1	0.49
	Endoscopic	0	
Hyposmia	Microscopic	2	**0.006**
	Endoscopic	11	
Anosmia	Microscopic	3	0.35
	Endoscopic	1	
Infection	Microscopic	0	0.11
	Endoscopic	4	
Chi² test			

Significant differences are shown with bold p value.

Synechiae occurred in the nasal cavity in 13 patients (41.9%) in Group 1: between the septum and middle concha in the right nasal cavity in two patients (6.4%), between the septum and inferior concha in the left nasal cavity in seven patients (22.5%), between the septum and inferior concha in the right nasal cavity in five patients (16.1%) and between the septum and inferior concha in one patient (3.2%). Synechiae occurred in the nasal cavity in eight patients (25%) in Group 2: a single synechium was detected in the right nasal cavity between the middle concha and septum in one patient and in the right nasal cavity between the inferior concha and septum in one patient. More than one synechiae occurred in six patients (18.7%). Two patients (6.2%) had two synechiae in the left nasal cavity between the septum and inferior concha, and in the right nasal cavity between the septum and middle concha. A synechium-opening procedure was performed in one of these patients at the ENT clinic. Synechiae occurred bilaterally between the septum and middle concha in two patients (6.2%) and between the septum and inferior concha and between the septum and middle concha in one patient (3.1%). This patient also had anosmia. Lastly, in one patient (3.1%), four synechiae occurred bilaterally between the septum and inferior concha and between the septum and middle concha. No anosmia or hyposmia occurred in this patient (Figures 4; 5A, B). When these data were analysed, although the number of the patients with synechiae was greater in Group 2 than in Group 1, the difference was not statistically significant (p>0.05).

Anosmia occurred in three cases (9.6%) in Group 1, hyposmia in two (6.4%) and saddle nose deformity along with a large septal perforation in one (3.2%). No patient in Group 1 had perinasal sensory loss, oronasal fistula or purulent secretion. One patient with anosmia and synechiae had a large perforation in the middle septum in the right nasal cavity. However, in two patients (6.4%) with anosmia, neither synechiae nor perforations were found. In two patients with hyposmia, synechiae were observed between the inferior concha and the nasal septum of the right nasal cavity in one (3.2%), whereas no synechiae or perforation was observed in the other (3.2%). However, in Group 2, anosmia occurred in one patient (3.1%) and hyposmia in 11 patients (34.3%). When these data were

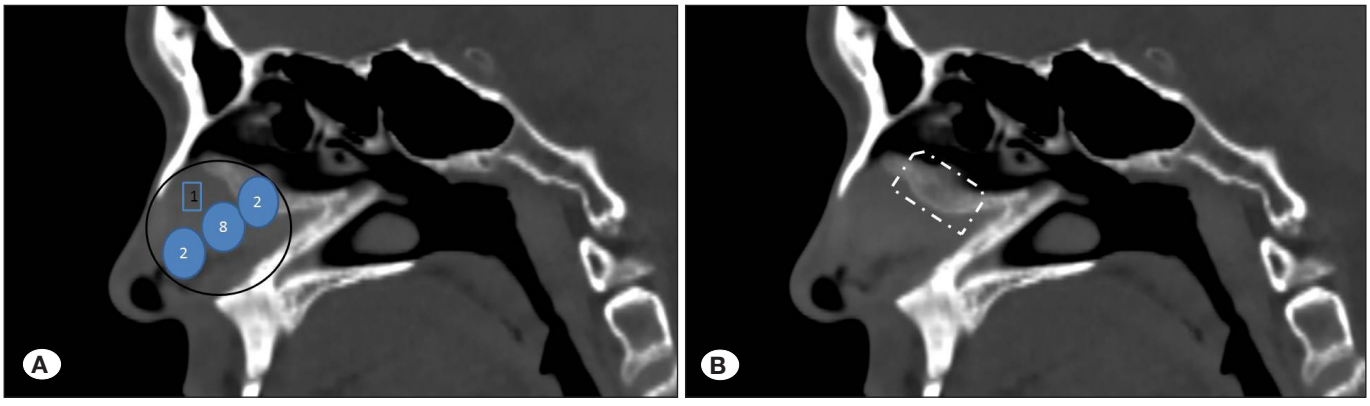

Figure 3: Sagittal images of paranasal sinus computed tomography (CT) showing a nasal septal perforation. **A)** Location and number of nasal septal perforations in Group 1. **B)** In Group 2, the posterior nasal septum was resected, and a window was opened during surgical procedure.

compared statistically, there was no significant difference in anosmia incidence between the two groups ($p>0.05$), whereas the hyposmia incidence was significantly greater in Group 2 ($p<0.05$). No patient in Group 2 had perinasal sensory loss, oronasal fistula or deformity. Purulent secretion occurred in three patients, and a fungal infection was suspected in one patient (Table I).

DISCUSSION

Currently, transsphenoidal surgeries are predominantly performed using microscopic and endoscopic approaches. Many studies have compared these two approaches to determine the superior approach. Most of these studies focused on the success of the surgical approaches, such as a degree of tumor resection, remission criteria or major complications, but few studies have considered sinonasal complications (2,10,14,15,21,27,30). In our study, patients in Group 1 had a longer follow-up (approximately 3 years) than those in Group 2. This is because the endoscopic approach only began to be used at our clinic during the last 3 years. However, the minimum follow-up in patients was 6 months.

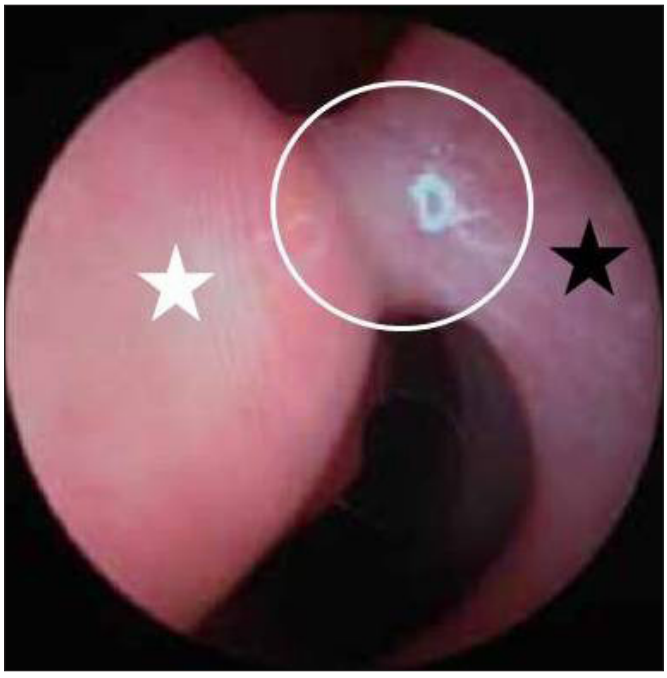

Figure 4: Synechiae (circle) between the nasal septum (1) and middle concha (2) is shown (**White star:** Middle concha, **black star:** Nasal septum).

In a study comparing sinonasal quality of life and olfactory functions of patients undergoing endoscopic and microscopic transsphenoidal pituitary surgery, the microscopy group showed better results at 1–3 months postoperatively in terms of sinonasal quality of life. In this study, olfactory function results were similar in both groups, which emphasized the importance of the surgeon protecting the sinonasal mucosa (15). Very different rates of sinonasal complications occurring after transsphenoidal surgeries have been reported in the literature (1.3%–87.7%) (3,13,23,26). This difference and the reason for the wide range of results are likely because of the different parameters used to determine the incidence rate. In some studies, because complications, such as synechiae, perinasal sense loss, columellar retraction or saddle nose deformity, were not considered complications, only early postoperative complications were included in the study; hence, the reported rate of nasal complications was very low (3). However, the reason for a high complication rate in some studies is that the findings such as nasal irritation and crusting were considered complications (26). In our study, we included and analysed major and many minor complications, such as nasal septal perforation, nasal synechiae, hyposmia, deformities, perinasal sense loss, oronasal fistula and sinus complications, which were all considered as sinonasal complications. According to our data, sinonasal pathology occurred in 22 (70.9%) of the 31 patients in Group 1 and 19 (59.3%) of the 32 patients in Group 2. There was no significant difference in rate of sinonasal complications between the groups ($p>0.05$). These rates corresponded to those reported in the literature in studies of similar complications.

Nasal septal perforation generally occurs as a bilateral mucosal laceration in the septum. Symptoms, such as nasal

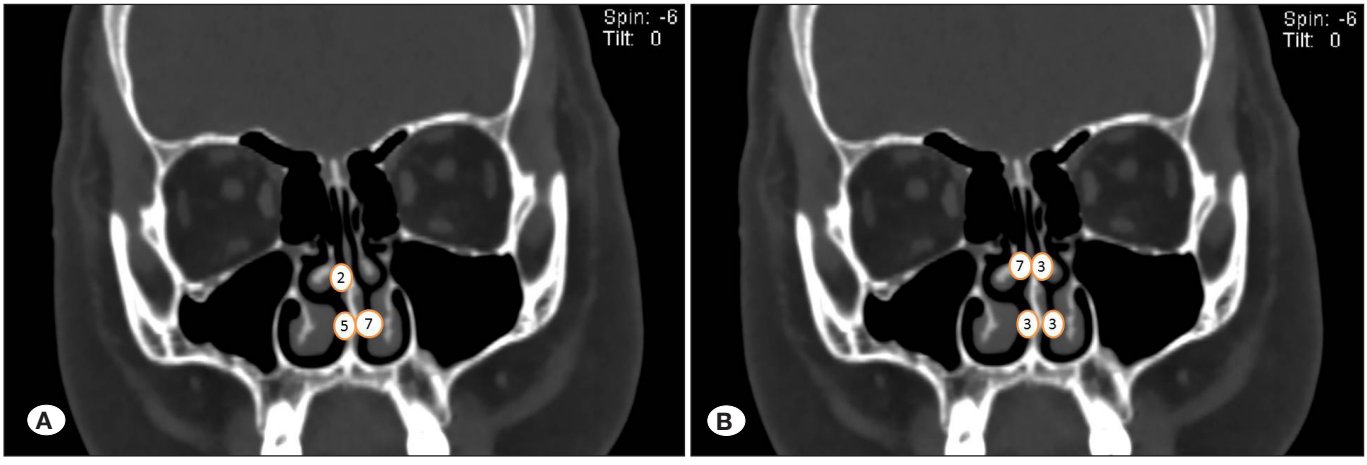

Figure 5: Coronal images of paranasal sinus CT. **A)** Location of synechiae in Group 1. **B)** Location of synechiae in Group 2.

blockage, nasal crusting, mucosal dryness, intermittent epistaxis, nasal discharge, whistling noise as a result of abnormal air stream during inspiration, headache and local pain have been observed. Perforations in the small, anterior portion of the septum generally cause a decrease in humidity in the inspired air. They may cause other nasal problems, such as large perforation atrophic rhinitis (8,24,25,29). Nasal septal perforation occurring after endoscopic or microscopic surgery is an important problem. In a study in which the microscopic approach was used, the lowest septal perforation rate was 2.1% (1). In previous endoscopic surgery series, the septal perforation rates have varied. Although some previously conducted endoscopic case series have reported no septal perforations, the septal perforation rate was 5% in a study including 19 patients, 10% in a study including 20 patients, and 1.85% in a series including 54 patients (14,19,20,32,34). Dew et al. indicated a septal perforation rate of 18% in a series of 135 cases (9). The highest septal perforation rate in our literature review was 61% in a study including 49 patients (26). In our study, septal perforation occurred in 12 (38.7%) of the 31 patients in Group 1 and no patient in Group 2. In Group 2, all operations were performed in bilateral nostrils; thus, the window, which was opened where the septum joined the sphenoid crest at the posterior septum, was not technically considered a perforation. The rate of septal perforation was statistically significantly greater in Group 1 than in Group 2 ($p<0.05$). When the data were assessed according to perforation site, no significant difference occurred between perforation rates in the anterior or posterior septum ($p>0.05$). The perforation rate in the middle septum was significantly higher in Group 1 ($p<0.05$). We believe use of cautery to control the nasal septum mucosal dissection and the accompanying bleeding in Group 1 may have initiated the ulceration and perforation processes depending on the mucosal blood building up during the deterioration. However, use of a speculum in Group 1 may also have started ischaemic processes that may have resulted in perforation because of the pressure being applied on the septum. Furthermore, during subperichondrial and subperiosteal dissection, the possibility of bilateral mucosal perforation also increases this risk. Different rates in different studies may be because of the surgeons' experience or the technique used. In one study, the septal perforation rate was 7.6% among surgeons who had performed <200 transnasal transsphenoidal procedures and 3.3% among those who had performed >500 procedures (7). These data demonstrate the importance of surgical experience and following the appropriate surgical steps.

Synechiae, also termed adhesions, are defined as inflammatory bands adherent to the mucosa. They occur as a result of septoplasty or other sinonasal operations and may cause nasal blockage. Synechiae generally form between injured or worn surfaces. One study reported synechiae in 24 of the 49 patients (48%) after microscopic surgery (26). However, another study in 50 patients who underwent endoscopic surgery reported no synechiae (34). However, this complication was seen in 7% patients after septoplasty (8,24,25,28,29,33). In our study, synechiae generally occurred in 13 (42%) of the 31 patients in Group 1 but in only eight (25%) of the 32 patients in Group 2. When these data were analysed, even though there were fewer cases of synechiae in Group 2, the difference was not statistically significant ($p>0.05$). However, the incidence rate of synechiae was high when comparing our two groups to corresponding groups in the literature. The most important factors in preventing synechiae have been reported to be the control of infections postoperatively and the minimisation of tissue trauma intraoperatively (28,29).

Higgins et al. reported anosmia and hyposmia rates of 3%–12% after microscopic surgery. Tan et al. reported these complications in one (4%) of the 25 patients (14,31). However, Actor et al. reported a rate of 35% for deterioration in olfactory function in their patients (1). However, Koren et al. reported hyposmia in two (10%) of the 20 patients who underwent endoscopic surgery (19). Kahiloğulları et al. compared endoscopic and microscopic surgery series in terms of olfactory function deterioration and found that hyposmia developed in 25 patients (2.8%); no patient had anosmia. In addition, the deterioration in olfactory function was significantly high among patients who underwent the microscopic technique (17).

In our study, anosmia occurred in three patients (9.7%) and hyposmia in two patients (6.5%) in Group 1, compared with one (3.1%) and 11 (34.3%), respectively, in Group 1. When these data were compared statistically, no significant difference in anosmia rate was determined between these two groups. However, the rate of hyposmia was significantly high in Group 2. Even though there was no difference in anosmia rates, we can explain the significantly high hyposmia rates in Group 2 because this group had a shorter follow-up. Moreover, when the data in both groups were compared with those in the literature, the olfactory function deterioration rate was lower in the microscopic series but higher in the endoscopic series. Although 14 of our total 63 patients developed synechiae, no patient had deterioration in olfactory function (hyposmia or anosmia). However, although no synechiae occurred in 10 patients, olfactory function deterioration was noted. These data showed us that olfactory function can deteriorate independently of synechiae. We believe that avoiding excess cautery use and unnecessary mucosal damage in areas in which olfactory nerve fibres are densely present, such as the upper part of the superior and middle conchae, is important in both groups to decrease the rate of olfactory function deterioration.

Nasal deformities may occur as a result of changes in the bone and cartilage structure of the nose after transsphenoidal surgery. Petry et al. reported external nasal deformity after transsphenoidal pituitary surgery together with right nasal valve stenosis (26). In our study, although no deformity was encountered in Group 2, one patient in Group 1 had a saddle nose deformity. Saddle nose deformity can develop as a result of cartilage excision.

After septal surgery, depending on the development of the anterior dentition or damage to the central incisor teeth, some postoperative sense deterioration occurred at a rate of 2.8% (6). These deteriorations generally occur because of damage to the nasopalatine region, where the nasopalatine nerve pierces

the crest (6). Petry et al. reported perinasal anaesthesia in two of the 49 patients after microscopic pituitary surgery, whereas White et al. reported no perinasal hypoesthesia in any of their patients after endoscopic surgery (26,34). In our study, we did not encounter perinasal sensory loss in any our patients regardless of the approach. Petry et al. reported an oronasal fistula in one of the 42 patients after microscopic surgery (26). An oronasal fistula did not occur in any patient in either group in the present study. Sinusitis in the postoperative period is another possible complication of this surgery. The rate of sinusitis after microscopic surgery has been reported to be 1%–15% in various studies (11,18,22,26). The sinusitis rate after endoscopic surgery was reported to be 1.65% by Kumar et al., 2.05% by Cappabianca et al. and 0.4% by Berker et al. (3,4,20). In our study, during the nasal endoscopic examination at the ENT clinic, no purulent secretion or sinusitis occurred in Group 1, whereas purulent secretion occurred in three patients (9.3%) and a fungal infection of the sphenoid sinus was suspected in one patient (3.1%) in Group 2. When these data were compared statistically, no significant difference was observed between the two groups.

In our study, the difference in length of follow-up between Groups 1 and 2 may have altered the results. In addition, different techniques can also be used during endoscopic procedures. Thus, this study can only be representative of the bilateral-nostril endoscopic approach used by us, and its result cannot be extrapolated to endoscopic procedures performed on unilateral-nostril and of less-invasive approaches. Consequently, a decision regarding the best surgical approach should be made only after considering the present and future modifications of the endoscopic approach**.**

CONCLUSION

According to the results of our study, as regards the sinonasal complications of the endoscopic and microscopic techniques, the endoscopic technique was superior in terms of perforations and the microscopic technique was superior in terms of the smell function but a distinctive difference was not observed in general.

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