Causes of Failure in Endoscopic Sinus Surgery - Anatomical Landmarks and the AID of Computed Tomography

A. Koç, B. Veyseller, Ü. Taşkın, M. Bilgili, O. Karaaslan

Endoskopik sinüs cerrahisinde başarısızlık nedenleri - Anatomik belirleyiciler ve bilgisayarlı tomografi yardımı

Kasım 2000 ile Haziran 2002 ayları arasında endoskopik sinüs cerrahisi uygulanan 272 hasta retrospektif olarak değerlendirilmiştir. 20 hastaya (%7.3) tıbbi tedaviye rağmen tekrarlayan sinüzit nedeni ile revizyon operasyon uygulanmıştır. Tüm hastalara revizyon cerrahisi öncesi koronal ve aksiyel planda paranazal sinüs bilgisayarlı tomografi (BT) incelemesi yapılmış, tüm revizyon girişimler genel anestezi altında gerçekleştirilmiştir. BT bulguları, endoskopik muayene bulguları ve intraoperatif bulgular not edilmiştir. En sık başarısızlık (revizyon) nedeni olarak bakiye etmoid hava hücreleri (%80) ve adezyonlar (%45) saptanmış, bunları maksiller sinüs ostium stenozu (%40), frontal sinüs ostium stenozu (%25), konka hipertrofisi (%20) ve septal deviasyon (%15) izlemiştir. Revizyon endoskopik sinüs cerrahisinde; orta konka kalıntısı, lamina papirasea, nazal septum, maksiller sinüs ostiumu ve posterior koana arkı, güvenilir anatomik belirleyicilerdir. BT, revizyon endoskopik sinus cerrahisinde operasyon öncesi değerlendirmenin değişmez parçası olmalıdır.

Anahtar Sözcükler: Endoskopik sinüs cerrahisi, revizyon, bilgisayarlı tomografi.

Abstract

Two hundred seventy two patients who underwent endoscopic sinus surgery defined by Kennedy, between November 2000 and June 2002 were evaluated retrospectively. Of 272 patients twenty (7.3%) required a revision procedure because of recurrent sinusitis in spite of medical management. All patients underwent coronal and axial CT imaging of the paranasal sinuses before revision surgery. All revision procedures were performed under general anesthesia. Data on CT findings, endoscopic examination findings and intraoperative findings were collected. The most common causes of failure were residual ethmoid air cells (80%) and adhesions (45%), followed by maxillary sinus ostium stenoses (40%), frontal sinus ostium stenoses (25%), conchal hypertrophy (20%) and septal deviation (15%). In revision endoscopic sinus surgery, the remnant of the middle turbinate, the lamina papyracea, nasal septum, maxillary sinus ostium and the arch of the posterior choana are the useful landmarks. CT must be a part of the preoperative evaluation for revision endoscopic sinus surgery.

Key Words: Endoscopic sinus surgery, revision, computed tomography.

Ahmet Koç, MD; Bayram Veyseller, MD; Ümit Taşkın, MD; Mert Bilgili, MD; Osman Karaaslan, MD
Haseki Training and Research Hospital
ENT & Head and Neck Surgery Clinic, Istanbul

Introduction

Endoscopic sinus surgery (ESS) is the most common procedure performed for the treatment of chronic sinusitis in which medical management has

failed. The efficacy and safety of this procedure has been discussed by many studies, and its symptomatic improvement has ranged from 76% to 97.5%.[1-6]

However, there is a group of patients in whom ESS does not provide any symptomatic relief. The surgical failure rate ranges from 3% to 20%.[7,8] Failures of ESS can be due to local and systemic causes. Cystic fibrosis, immotile ciliary dysfunction and other systemic causes are reported.[9,10] Failures may be related to paranasal anatomical abnormalities that are evident on computed tomographic (CT) imaging of the paranasal region and/or on nasal endoscopy.

The purpose of this study was to evaluate the causes of failure in a group of patients who underwent revision ESS and to improve our surgical technique and reduce these causes of failure. Also the importance of preoperative evaluation of CT scans was discussed.

Materials and Methods

272 patients who underwent ESS from November 1, 2000 to June 1, 2002 were evaluated. Patients with a history suggestive of allergies underwent allergy screening by skin testing with the skin end-point titration techniques. Those patients with allergic disorders were treated appropriately and excluded from the study. Patients with immune deficiency disorders, cystic fibrosis, ciliary abnormality, immunosuppression and patients with a previous intranasal or external surgical sinus procedure were also excluded. After the procedure, patients with continued or worsening of symptoms of nasal stuffiness, facial pain and postnasal drainage and who required continued medical treatment were re-evaluated. Twenty (7.3%) patients from this group had revision ESS for recurrent sinusitis. All patients in this group were tried to be treated conservatively before revision surgery with several courses of antibiotics, decongestants and topical nasal steroids. All patients underwent coronal and axial CT imaging of the paranasal sinuses after the failed antibiotic treatment. Nasal

endoscopy was performed to evaluate the middle and inferior meatus, the middle and inferior turbinate, nasal septum, sinus ostia and to evaluate the presence of synechia, polyps or other abnormality. Clinical diagnosis of recurrent sinusitis was based on the presence of persistent mucopurulent nasal discharge, evidence of hyperplastic mucosa or polyps during routine rhinoscopy, endoscopic examination and CT imaging of the paranasal sinuses. Disease recurred at 4 to 13 months following initial surgery. This group of patients included 11 men and 9 women. The mean age was 38 (ranging from 28 to 66).

All revision procedures were performed under general anesthesia and, the endoscopic procedure performed was defined by Kennedy.[4] The release of adhesions, the opening of residual air cells, the widening of the maxillary and frontal sinus ostia, connecting the natural ostia with the surgically made one, septoplasty and turbinoplasty if necessary, were the goals of the revision operations. A submucous resection was performed prior to endoscopic surgery in some patients because of the blockage of the airway patency or difficulty for adequate technical visualization of the intranasal cavity. If the preoperative CT scans showed sphenoid sinus disease, and it's confirmed by intraoperative examination, then sphenoidotomy was performed. The maxillary sinus ostium and frontal recess were identified and opened if they were obstructed by synechia or diseased mucosa. In cases of a concha bullosa, a paradoxical middle turbinate, or a polypoid middle turbinate narrowing the middle meatus, partial middle turbinate resection was then performed leaving a stub of turbinate attached to the lateral nasal wall if it had not been previously performed.

The nasal cavity was not packed with any material. Starting with the first postoperative day, we used an aggressive regimen of saline irrigations as well as topical nasal decongestant sprays for 4 weeks postoperatively. Antibiotics were not routinely used postoperatively. Data on age, sex, CT findings, endoscopic examination findings and intraoperative findings were collected.

Results

The characteristics of the patient population are summarized in Table 1. 272 patients had ESS between November 1, 2000 and June 1, 2002 and 20 (7.3%) patients required a revision procedure. Preoperative coronal CT scan findings of these patients were evaluated, and the distribution of the pathology of paranasal sinuses and any other anatomical abnormality were recorded (Table 2). Operative procedures were discussed in Table 3.

Tablo 1. Characteristics of the patients.

Veriable	Revision Patient	Non-revision patient	Total
Male/female	11/9	141/131	152/140
Mean age	38 (28-66)	35 (19-68)	37 (19-68)

Tablo 2. Preoperative coronal computerized tomographic findings.

	Non-revision patients (n=252)	Revision patients (n=20)
Maxillary sinus disease	248 (98.4%)	16 (80%)
Ethmoid sinus disease	237 (94.0%)	19 (95%)
Sphenoid sinus disease	56 (22.2%)	3 (15%)
Frontal sinus disease	47 (18.6%)	4 (20%)
Septal deviation	84 (33.3%)	5 (25%)
Concha bullosa	35 (13.8%)	4 (20%)
Paradoxal concha	5 (1.9%)	1 (5%)

Tablo 3. Operative procedures in non-revision and revision patients.

	Non-revision patients (n=252)	Revision patients (n=20)
Anterior ethmoidectomy	190 (75.3%)	16 (80%)
Posterior ethmoidectomy	142 (56.3%)	10 (50%)
Maxillary antrostomy	252 (100.0%)	14 (70%)
Frontal sinusotomy	52 (20.6%)	8 (40%)
Sphenoidotomy	60 (23.8%)	2 (10%)
Septoplasty	75 (29.7%)	12 (60%)
Middle turbinoplasty	64 (25.3%)	6 (30%)
Inferior turbinoplasty	11 (4.3%)	1 (5%)

The two patient groups were similar except that a septoplasty was performed in 60% of revision cases compared to 29.7% of the primary cases. Intraoperative findings in the 20 patients who

Tablo 4. Operative findings of revision patients (n=20).

Findings	Number	%
Maxillary sinus ostium stenoses	8	40
Frontal sinus ostium stenoses	5	25
Residual ethmoid air cells	16	80
Adhesions	9	45
Septal deviation	3	15
Conchal hypertrophy	4	20

underwent revision surgery are summarized in Table 4. Maxillary and frontal sinus ostium stenoses were noted in 8 (40%) and 5 (25%) patients respectively. Adhesions were noted in 9 of the cases (45%), and the most common site was between the middle concha and lateral nasal wall. Residual air cells were noted in 16 cases.

Discussion

In revision ESS, the risk of complications is higher than in initial ESS. The causes of the high potential for complications are the distorted landmarks by the previous surgery and postoperative scarring, adhesions and mucosal disease. Normal anatomic landmarks such as the middle turbinate, the uncinate process, the maxillary ostium, the basal lamella, or the anterior wall of the sphenoid sinus were often distorted because of the prior surgery. Most of the intraoperative complications occur due to disorientation. To ensure optimal success and minimal morbidity, the causes which lend to recurrence of sinonasal disease must be exactly known by the endoscopic surgeon. By this way, the need for the revision operations can be reduced.

ESS has a 3% to 20% failure rate. In literature, factors discussed that may contribute to surgical failure were smoking, asthma, allergy, polyposis, ostium stenoses, steroid use, previous classic surgery, intranasal synechia and residual disease. It is very important to identify the exact site of recurrence and the application of a revision surgical approach directly to that site.

Because of persistent symptoms even after medical therapy, 20 (7.3%) of our 272 patients required

a revision ESS. Those patients had presented with complaints of pain, nasal obstruction and mucopurulent rhinorrhea. All of our patients underwent nasal endoscopic examination and abnormalities were noted and remaining landmarks identified. Preoperative coronal CT scans were performed on all patients. On endoscopic examination, some had nasal polyposis and adhesions. In most of these cases, CT scans demonstrated disease in the maxillary and ethmoid sinuses (Fig. 1).

The causes of failure of resolution of symptoms in these individuals were middle meatus adhesions, maxillary ostium stenosis and residual air cells in ethmoid and frontal recess area. In literature, middle meatus scarring which obstructs the ostiomeatal complex was reported in 3.8% to 42.9% of revision patients.[1,3,11] King et al. reported that 56% of their revision cases had adhesions.[12] Partial resection or medialization of middle turbinate and meticulous postoperative care could prevent lateralization of middle turbinate and blockage of ostiomeatal complex. In our study, stenoses of maxillary sinus ostia were noted in 40% of patients and adhesions in 45% of patients. Katsantonis et al. observed that all of their revision cases had ethmoid disease and

50% of them had obliteration of ostiomeatal complex.[4,11,13]

King et al. reported that maxillary sinus ostium stenoses were present in 27% of their revision cases.[12] Ramadan also noticed that he had performed surgery on the maxillary sinus or ostium in all revision patients.[14]

Deviated nasal septum may be a cause for surgical failure. In our study, 60% of revision cases had a deviated nasal septum (Fig. 2). King et al. reported that patients who had significantly deviated nasal septum was 53.5% in their series.[12] Matthews et al. stated that patients who had deviated nasal septums corrected during ESS had better outcomes.[15]

Incomplete ethmoidectomy or remnants of intact ethmoidal cells is one of the major reasons for surgical failure. The reason for incomplete removal of the ethmoidal labyrinthine may be large anterior ethmoid and agger nasi cells. Because these cells make confusion in the identification of medial orbital wall, Chambers et al. reported that the most common cause of surgical failure was residual ethmoid air cells and scarring in the middle meatus.[16] We observed residual ethmoid air
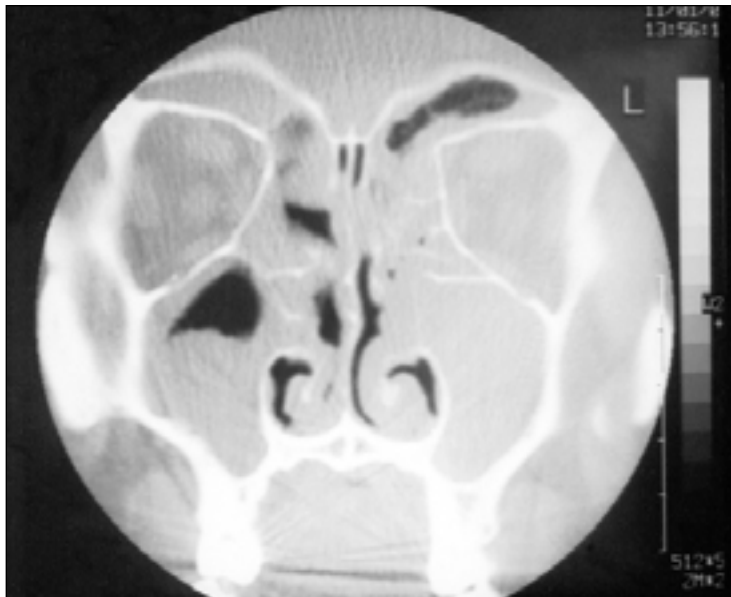

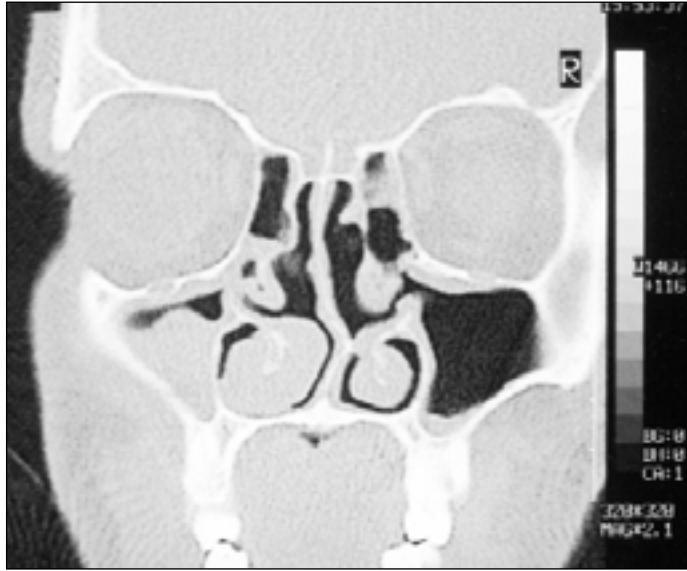**Figure 1.** Disease in maxillary and ethmoid sinuses.

Figure 2. Deviated nasal septum.

cells in 80% (Fig. 3) and maxillary sinus disease in 70% of revision cases. Sphenoid disease was present in 10% of patients. King et al. reported that in the majority of their revision ESS patients, maxillary, ethmoid and sphenoid diseases were evident. They reported that it was indicating an incomplete outcome.[12] Kennedy determined that sinus disease present on preoperative CT scans was highly predictive for surgical outcome.[4] In contrast Matthews et al. determined that maxillary, ethmoid or frontal sinus opacification had no predictive value for surgical outcome.[16]
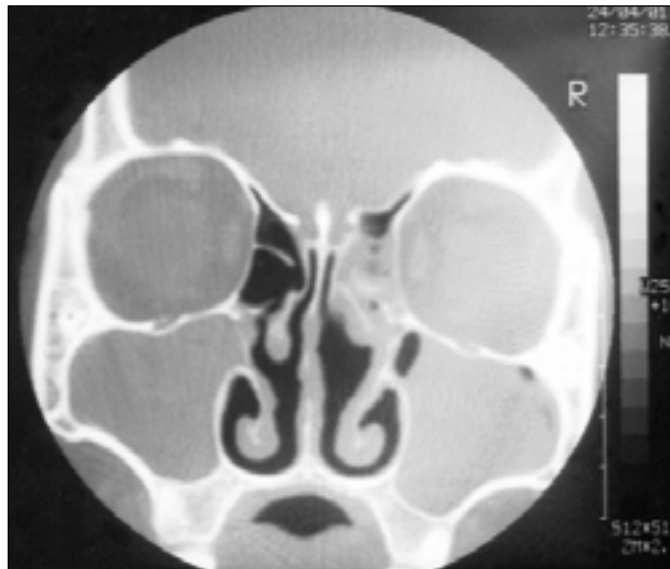

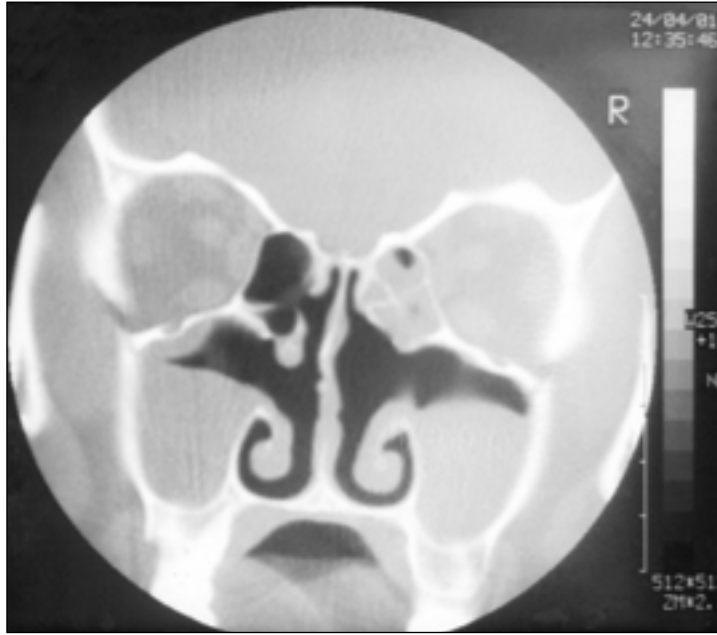**Figure 3.** Diseased ethmoid cells due to incomplet ethmoidectomy.

Figure 4. Distorted anatomical landmarks after previous endoscopic sinus surgery.

In revision ESS, because of the previous surgery, important endoscopic anatomical landmarks such as middle turbinate, uncinate process, maxillary ostium, basal lamella and anterior wall of sphenoid sinus were often distorted (Fig. 4). In revision procedures, there are some useful guidelines like middle turbinate remnant, lamina papyracea and fovea ethmoidalis. CT is very helpful in delineating the remaining landmarks and site of the recurrent disease. When evaluating preoperative CT scans, the extent of sinus cavity disease, the status of middle turbinate remnant, agger nasi, Onodi or Haller cell pathology, lamina papyracea, fovea ethmoidalis, and anterior wall of sphenoid sinus must be discussed. However the inability of CT to differentiate between fibrous tissue and inflammatory mucosal disease must be kept in mind. Katsantonis et al. reported the specificity of the CT was 88.2%, while its sensitivity was 100% in revision cases. It is recommended oral steroid medication 1 week prior to surgery on patients with polyps for reducing excessive bleeding, poor visualisation or disorientation.[12] CT must be a part of the preoperative evaluation for revision sinus surgery. Because the surgeon needs some anatomical landmarks present in spite of previous surgery while working in altered nasal cavity. These landmarks are; the remnant of the middle turbinate (antero-superior attachment), the lamina papyracea, the nasal septum, the maxillary sinus ostium even it has obstructed, the arch of the posterior choana. We can identify these landmarks with the aid of the coronal CT scans. The antero-superior attachment of middle turbinate is present even when the middle turbinate has been resected. This attachment is helpful in maintaining the boundary between the ethmoid complex and the space between the middle turbinate and the septum. Penetration of the cribriform plate can be avoided by remaining within the ethmoid complex using these landmarks medially and the lamina papyracea laterally. Widened maxillary sinus ostium lies inferior to the lamina papyracea. If it has not been widened by previous surgery, it must be opened and this can be performed by penetrating the posterior fontanel.

The sphenoid sinus is the easiest sinus to enter during revision surgery and this makes easy to penetrate the optic nerve and carotid artery. Coronal

and axial CT scans will help to determine the size and shape of the sinus and its relationship to the carotid artery and optic nerve. Posterior aspect of the septum, the arch of the posterior nasal choana and superior border of the maxillary ostium extended posterior help to identify the sphenoid sinus. With the identification of these landmarks, revision ESS and removal of recurrent or persistent disease in the maxillary, ethmoid, frontal or sphenoid sinuses can be completed safely.

Conclusion

ESS is a relatively new surgical procedure in otorhinolaryngological practice. There're not enough reports which discussed the number of individuals requiring revision surgery. The factors which lead to need revision surgery for symptomatic failures must be evaluated for ensuring optimal success and minimal morbidity. In this study, the adhesions and residual air cells were the most common causes of failures of ESS. Removing all the diseased air cells, proper opening of maxillary and frontal sinus ostia, and meticulous postoperative care may improve the operative success. CT must be a part of the preoperative evaluation for revision sinus surgery.

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Correspondence: Ahmet Koç, MD
Haseki Eğitim ve Araştırma Hastanesi
Kulak Burun Boğaz Kliniği
Aksaray-İSTANBUL
Phone: +90 (216) 651 00 00
Fax: +90 (216) 651 00 45
e-mail: ahmetkoctr@yahoo.com