BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 2

DOI: 10.58240/1829006X-2025.2-181

REVIEW ARTICLE

COMPLICATIONS IN ENDOSCOPIC SINUS SURGERY:A NARRATIVE REVIEW

Araik Garibyan[1]
[1.]Associate Professor of the Department Head and Neck, Aesthetic and Reconstructive Surgery of the of the National Institute of Health, Deputy Director of the ARTMED Medical and Rehabilitation Center, Armenia
* Corresponding author: Araik Garibyan, Otorhinolaryngologist, Associate Professor of the Department of Aesthetic and Reconstructive Surgery of the Head and Neck of the National Institute of Health, Deputy Director of the ARTMED Medical and Rehabilitation Center, Armenia; e-mail: aradoc@gmail.com

Received: *Jan. 6, 2025;* ***Accepted:*** *Feb. 12, 2025;* ***Published:*** *Mar. 10, 2025*

ABSTRACT

Endoscopic sinus surgery has become a widely used technique in the treatment of chronic sinus disease, but it is sometimes accompanied by various complications, especially when used by less experienced surgeons. The risk of injury is closely related to the anatomical features, the degree and severity of the disease, the results of previous operations, and the experience of the surgeon.

The aim of this literature review is to analyze the complications associated with endoscopic sinus surgery; searches were conducted in various scientific databases, including PubMed, EMBASE, Europe PMC, PubMed, Medline, Scientific Information Database (SID) and Google Scholar. Of the total 126 entries, 32 were reviewed. The complication rate associated with endoscopic sinus surgery is not high, and improvements in surgical technology and experience may reduce its side effects. Knowledge of anatomy, good preparation, and meticulous surgical technique are essential. Early recognition and proper management of complications of endoscopic sinus surgery is extremely important to minimize and prevent disability. To minimize the risk of developing these complications, it is necessary to take into account possible anatomical variations in the structure of the paranasal sinuses and orbit, which should be identified using computed tomography at the preoperative stage. To successfully perform endoscopic sinus surgery, the surgeon must be appropriately qualified in the diagnosis and management of potential complications during surgery.

Keywords: chronic sinus diseas, endoscopic sinus surgery (ESS), complication

INTRODUCTION

Diseases of the mucous membrane of the nasal cavity and paranasal sinuses consistently have a high proportion among all diseases of the ENT organs and are one of the most pressing problems in modern otolaryngology.

Among all sinusitis, inflammatory diseases of the maxillary sinuses make up the largest number, which is due to their prevalence, tendency to chronic recurrent courses and insufficiency of traditional treatment methods. Chronic inflammation of the sinus cavity is estimated to occur in more than 15% of adults, and treatment procedures are diverse.[1]

Normally, the sinuses provide voice resonance, humidify and warm the inhaled air, participate in the sense of smell, serve as a heat insulator and provide mucus secretion.

Long-term bacterial, fungal infection, anatomical changes in the nasal cavity (deformation of the nasal septum, proliferation of the mucous membrane of the nasal concussion), allergies, dental diseases can lead to the development of sinusitis (inflammation of the paranasal sinuses).

In cases where medical therapies are ineffective, sinus surgery will be recommended to improve the symptoms associated with the disease.

The problem of surgical treatment of diseases of the maxillary sinuses is far from being finally solved.

Over the past few years, the choice of surgical intervention method on the maxillary sinus in purulent and polypous sinusitis, as well as in cysts, has variedv from the Caldwell-Luc operation with removal of the entire mucous membrane to various methods of "micro maxillary sinusotomy".[2,3]

The Caldwell-Luc operation provides the most complete access to all parts of the maxillary sinus. At the same time, this operation involves fairly large trauma to the anterior and medial walls of the sinus. It can be noted that, despite the complete removal of pathologically altered tissues from the sinus cavity, recovery of patients after such surgical intervention does not always occur.[4,5]

Endoscopic sinus surgery is an effective and safe surgical technique that has revolutionized the surgical treatment of diseases of the nasal cavity and paranasal sinuses.[6-8]

With the endoscopic endonasal approach, the natural opening of the sinus is expanded, thereby providing drainage, but this technology does not always allow for a complete examination of the sinus and careful removal of a cyst, polyps or foreign body.[9] ESS can be performed either with or without image guided navigation (IGN). The main aim of sinus surgery is to allow the surgeon to get access to different areas of the nose and nasal sinuses. This may be in order to remove diseased tissue or get a biopsy to help make decisions about further management.

Indications Endoscopic sinus surgery

- Isolated sphenoid sinus disease, e.g.,
- Aspergillosis
- Purulent bacterial infection
- Inverted papilloma
- Mucocele
- Biopsy of skull base lesions

Surgical Technique

The sphenoid ostium can be found at the level of the superior turbinate. It is often necessary to lateralize the middle and superior turbinate in order to visualize it If visibility is poor because of polyps or bleeding, the sphenoid sinus can safely be approached by staying close to the septum in the midline and palpating with the straight sucker up the posterior wall of the sphenoid At 1-1.5 cm above the posterior choana, the bone of the anterior wall of the sphenoid sinus is thin and it can be punctured by applying moderate pressure with a straight sucker It is advisable not to open the sphenoid ostium downward to a level lower than half the total height of the sinus, as a branch of the sphenopalatine artery runs along its anterior wall and if cut this can bleed briskly. Occasionally, the intersinus septum of the sphenoid is so oblique that one side can be very small. Because of its highly variable anatomy and closely related vital structures, it has many potential complications of endoscopic sinus surgery.

The aim of this literature review is to analyze the complications associated with endoscopic sinus surgery; searches were conducted in various scientific databases, including PubMed, EMBASE, Europe PMC, PubMed, Medline, Scientific Information Database (SID) and Google Scholar. Of the total 126 entries, 32 were reviewed.

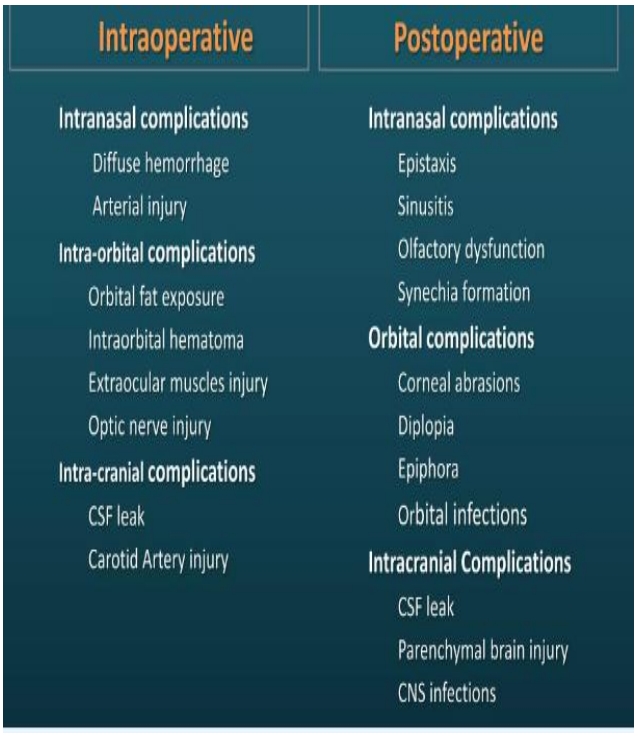
According to research conducted by the European Rhinological Society (ERS), complications are classified according to severity into minor and major complications.[10]

Minor complications and Major complications.[11-14]

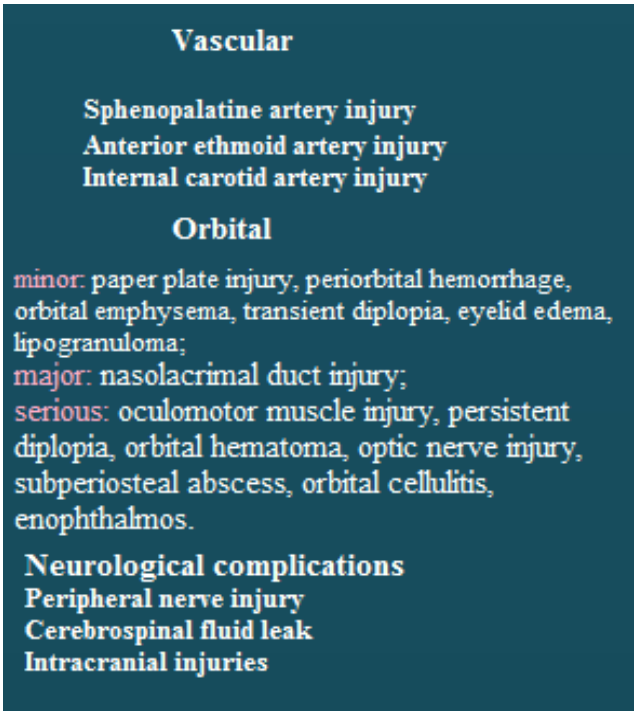
Complications of endoscopic sinus surgery can be intraoperative and postoperative.[15,16]

Stankiewicz (1987) reported an initial 5% major complication rate for his initial 90 endoscopic procedures which reduced to 0.5% for the subsequent.[17]

Intraoperative and postoperative complications of endoscopic sinus surgery



Complications of ESS can be classified according to anatomical location. These include vascular, neurological, ophthalmological, other.[18-20]



The risk of complications during endoscopic sinus surgery (ESS) is always present, and it is necessary to minimize the risks through careful preoperative preparation, careful surgical technique, and diligent postoperative care.

Iatrogenic Factors

- Absence of computed tomography (CT) scan in operating room at time of surgery; considered grounds for malpractice
- Calibration errors with image guidance
- Loss of visualization and poor surgical field
- Failure to identify complications in a timely manner

Patients most at risk for complications include those with revision surgery, extensive disease, skull base anatomic or radiologic variations or dehiscences related to disease or previous surgery, and the use of powered instrumentation.

They are intended to be used with some common sense and to facilitate communication with patients and other physicians.

Complications resulting from damage to blood vessels, including the anterior or posterior ethmoid, sphenopalatine, or internal carotid arteries, are considered major if the hemorrhage affects cerebral circulation or causes a significant drop in hemoglobin levels or requires red blood cell transfusion.

Small amounts of postoperative bleeding that do not require transfusion may be considered minor, as may facial edema, hyposmia, hypoesthesia of the infraorbital nerve or teeth, synechiae, myospherulosis, atrophic rhinitis, and osteitis.[21]

Anterior ethmoid artery injury

Bleeding from the anterior artery can cause significant intraoperative bleeding, resulting in a rapidly expanding orbital hematoma. To prevent artery transection, the important technical point is to pass the microdebride blade from posterior to anterior, with the tip near the base of the skull, and remove the tip at an angle tangent to the base of the skull.

Injury to the branch of the sphenopalatine artery

The sphenopalatine artery is a frequent source of arterial bleeding during ESS. It is usually transected if the anterior sphenoid face is removed superiorly rather than inferiorly, starting from the natural branch, with a downward-pointing instrument. At the end of the operation, it is recommended that the proximal and distal ends of the transected posterior nasal artery be electrocauterized when a large sphenoidotomy is performed.

Due to the proximity of the main stem of the

sphenopalatine artery and the presence of feeder branches, such as the posterior lateral nasal artery and the inferior rhizomatous branch, the posterior fontanelle area of the maxillary sinus is at risk of significant bleeding during antrostomy enlargement.

Internal carotid artery injury

The internal carotid artery can be injured when attempting to remove the sinus septum, and sharp bone fragments can injure the internal carotid artery.

Ophthalmic complications of endoscopic sinus surgery

The ophthalmic complications could be classified as: minor-included injury to the lamina papyracea, major - injury to the lacrimal duct and finally serious - as retroorbital hemorrhage, injury to the optic nerve or any reduction of vision or blindness and injury of orbital muscle.[22-24]

Orbital hematoma could developed as arterial injury (anterior or posterior ethmoid artery) or venous hemorrhage results from entry of the orbit through the lamina papyracea.The hemorrhage can result in visual loss from optic nerve or retinal ischemia. This situation demanded very fast identification and urgent treatment. If the risk is low (low ocular pressure and vision is not compromised) medical treatment is adequate. The optic nerve is commonly dehiscent in the sphenoid sinus or posterior ethmoid. The injury may be indirect (vascular) or direct (mechanical). Direct muscle transection is mostly seen with powered instrumentation surgery. The device extracts tissue very rapidly with very low tactile feedback to the surgeon about the removable material.

The major complications are seen in 0.01-2.25% and some of them can be serious, leading to permanent dysfunction. The incidence of serious complications does not exceed 1%.

Ocular complications can vary in severity from minor, such as localized hematomas, to extremely dangerous, such as damage to the optic nerve leading to complete blindness.[25-27]

Ophthalmic complications of endoscopic sinus surgery are rare but can be potentially dangerous.

Clinical manifestations of orbital injuries can vary from pain and diplopia to complete blindness. The management of these patients with pathology close to the orbit could be associated with serious injuries, leading to permanent dysfunction. It was proved that the extent of the surgery also influenced the rate of complications.

Neurological complications

Complications involving the cranial vault include cerebrospinal fluid (CSF) leakage, tension pneumocephalus, meningitis, abscess, intracranial hemorrhage, direct brain injury, and encephalocele formation.

Cerebrospinal fluid leak

When there is an abundance of inflamed tissue and bleeding around the site of injury, CSF leak may resemble a sudden onset of rapid venous bleeding without any noticeable "washout." If unrecognized or untreated, CSF leak may lead to postoperative pneumocephalus, tension pneumocephalus, meningitis, encephalitis, or epidural or subdural abscess.

Early intraoperative recognition and repair of a CSF leak is important in minimizing the likelihood of serious or long-term sequelae.

Intracranial injuries

Intracranial injuries are extremely rare.The severity of the injury depends on several variables, such as the size and shape of the instrument involved, the type of instrument (electrocautery, electrocautery, cold steel), the depth of penetration, the time between penetration of the skull base and recognition of the complication by the operating surgeon, and the anatomical structures damaged. Depending on the structures affected, the consequences of intracranial injury can include persistent headache, neurological deficits, intracranial hemorrhage, and intracranial infection. Meningoencephalocele can occur in the late postoperative period. Fortunately, these are extremely rare events.

Early postoperative complications may include infection, bleeding, or adhesions; they may occur immediately after surgery up to 2 weeks after surgery. Late complications may include the formation of a mucocele or mucopyocele and may occur many years after the procedure. It should be noted that all of the above classifications are artificial and subject to interpretation. They are intended to be used with some common sense and to facilitate communication with patients and other physicians.

Early signs of orbital hematoma include: a sharp decrease in visual acuity, preseptal edema, bruising, exophthalmos, and increased intraocular pressure. This complication threatens the development of blindness due to compression of the optic nerve in the retrobulbar space and requires immediate treatment.[25-27]

Direct damage to the optic nerve is also quite rare and is mainly associated with mechanical trauma to the nerve with a shaver-microdebrider.[28]

Damage to the extraocular muscles can occur if there is an existing or intraoperative violation of the integrity of the paper plate, and it can lead to the development of diplopia due to muscle entrapment by bone fragments, their direct damage, as well as secondary damage due to nerve trauma.[29]

To prevent intraoperative complications it is recommended to: [30-36]

- identify the contour preoperatively, the presence of infraorbital or supraorbital structures, and their thickness using CT data;
- since the anterior ethmoidal artery is a critical structure, the location of which helps to avoid intraoperative bleeding, a CT image showing a bony protrusion at the junction of the medial rectus and superior oblique muscles is a useful landmark for determining the location of this artery;
- identifying the sphenoethmoid cells (Onodi cells) before performing ECP will help prevent damage to the optic nerve and internal carotid artery;
- the optic nerve and carotid artery form a depression in the lateral wall of the sphenoid sinus. It can be unilateral or bilateral. Some of these depressions have a dehiscence (a gap in the bony canal), which puts the optic nerve and carotid artery at risk. Preoperative axial tomography will help to avoid iatrogenic complications;
- general anesthesia and controlled hypotension will minimize intraoperative blood loss;
- topical decongestants, prothrombotic agents, and bipolar cautery should be available intraoperatively;
- assess the thickness of the periorbital fat pad and the periorbita if the integrity of the paper plate is compromised. If the periosteum of the eye is intact and there is no evidence of orbital trauma, the surgical intervention can be continued. If the periosteum of the eye is damaged and the orbital fat pad is exposed, intraocular pressure should be measured. The presence of periorbital fat or orbital periosteum (periorbita) in the surgical field can be confirmed by gentle balloting of the eye and endoscopic observation;
- avoid blind cautery to prevent injury to the extraocular muscles and optic nerve. Bipolar cautery is effective in situations where bleeding is not associated with the orbit itself;
- keep the patient's eyes open during endoscopic surgery. If there is any evidence of swelling, bruising, or afferent pupillary defect, the operation should be stopped immediately;
- do not use nasal packing over the exposed orbital apex to avoid pressure on the optic nerve.

To minimize the risk of complications, a thorough examination of the patient is necessary at the preoperative stage.

Based on the data of computed tomography of the paranasal sinuses and, in some cases, magnetic resonance imaging, it is necessary to take into account in advance possible anatomical variants of the structure of the paranasal sinuses and orbit.

DECLARATIONS

Conflict of interest and Financial Disclosures

The authors declare no conflicts of interest related to this study and no source of external funding.

Ethical approval

The authors declare to have conducted their research in accordance with the World Medical Association Declaration of Helsinki.

Source of Funding

Study was by author themselves.

REFERENCES

1.Wullianallur R, Viju R An empirical study of chronic diseases in the United States:A visual analytics approach to public health Int J Environ Res Pub.Health.2018;15:431doi:10.3390/ijerph15030431

2.Nashef A, Joachim MV, Liubin N, Abdel Raziq M, Abu El-Naaj I, Laviv A. The Modified Caldwell-Luc Approach for Treating Odontogenic Maxillary Sinusitis Without Need for Functional Endoscopic Sinus Surgery: A Retrospective Study. J Oral MaxillofacSurg.2025;83(2):199-207.doi: 10.1016/j.joms.2024.09.006.

3.Becker SS, Roberts DM, Beddow PA, Russell PT, Duncavage JA. Comparison of maxillary sinus specimens removed during Caldwell-Luc procedures and traditional maxillary sinus antrostomies. Ear Nose Throat J.2011;90(6):262-6.doi: 10.1177/014556131109000607.

4.Han JK, Smith TL, Loehrl TA, Fong KJ, Hwang PH. Surgical revision of the post-Caldwell-Luc maxillary sinus. Am J Rhinol. 2005;19(5):478-82.

5.Cutler JL, Duncavage JA, Matheny K, Cross JL, Miman MC, Oh CK. Results of Caldwell-Luc after failed endoscopic middle meatus antrostomy in patients with chronic sinusitis. Laryngoscope. 2003 Dec;113(12):2148-50.doi:10.1097/00005537-200312000-00018.

6.Cho DY,Hwang PH. Results of endoscopic maxillary mega-antrostomy in recalcitrant maxillary sinusitis. Am J Rhinol. 2008;22(6):658-62. doi: 10.2500/ajr.2008.22.3248.

7.Ju Song C, Kwang HC, Nam IJ Functional endoscopic sinus surgery with microdebrider for chronic rhinosinusitis with nasal polyps Muller J Med Sci Res. 2019; 10;17:20

8.Masterson L, Tanweer F, Bueser T, Leong P Extensive endoscopic sinus surgery:Does this reduce the revision rate for nasal polyposis? Eur Arch Otorhinolaryngol 2010; 267; 1557: 61

9. Weber RK, Hosemann W. Comprehensive review on endonasal endoscopic sinus surgery. GMS Curr Top Otorhinolaryngol Head Neck Surg. 2015 Dec 22;14:Doc08. doi: 10.3205/cto000123.

10.Fokkens W, Lund V, Mullol J European position paper on rhinosinusitis and nasal polyps group European position paper on rhinosinusitis and nasal polyps 2007 Rhinol Suppl 2007 20 1 136

11Sun H, Tan G, Li S, Xiao J, Chen J. Complications of endoscopic sinus surgery: incidence and prevention-analysis of 307 cases. Hunan Yi Ke Da Xue Xue Bao.1998;23(6):583-6.

12..Li Y, Xu G. Complications of nasal endoscopic surgery]. Zhonghua Er Bi Yan Hou Ke Za Zhi. 1998 ;33(3):142-5. Chinese.

13.Sun S. Intraoperative complications of endoscopic sinus surgery. Zhonghua Er Bi Yan Hou Ke Za Zhi. 2001;36(5):335-7. Chinese.

14.Patel AB, Hoxworth JM, Lal D. Orbital Complications Associated with the Treatment of Chronic Rhinosinusitis. Otolaryngol Clin North Am. 2015;48(5):749-68. doi: 10.1016/j.otc.2015.05.004

15.Karligkiotis, A., Dalfino, G., Castelnuovo, P., Gravante, G.Complications of Endoscopic Sinus Surgery. In: Elwany, S. (eds) Current Rhinology. Springer, Cham. 2024;https://doi.org/10.1007/978-3-031-70077-4_25

16.Khademi, Sara; Kazemi, Aida Divanbeigi, Reza Afzalzadeh, Mohamadreza·A review of the revisions and complications management procedure in sinus surgery*Journal of Family Medicine and Primary Care.2022;* 11(3):887895. *DOI:* 10.4103/jfmpc.jfmpc_897_21

17,Stankiewicz JA. Complications of endoscopic intranasal ethmoidectomy. Lary ngoscope 1987 ;97: 1270-1 273

18. Krings JG, Kallogjeri D, Wineland A, Nepple KG, Piccirillo JF, Getz AE. Complications of Primary and Revision Functional Endoscopic Sinus Surgery for Chronic Rhinosinusitis. The Laryngoscope2014;124:838–45.

19. Chou T-W, Chen P-S, Lin H-C, Lee K-S, Tsai H-T, Lee J-C, m.fl. Multiple analyses of factors related to complications in endoscopic sinus surgery. J Chin MedAssoc2016;79:88–92.

20. Sun H, Tan G, Li S, Xiao J, Chen J. Complications of endoscopic sinus surgery: incidence and prevention-analysis of 307 cases]. Hunan Yi Ke Xue Xue Bao Hunan Yike Daxue Xuebao Bull Hunan Med Univ 1998;23:583–6.

21.Maniglia AJ . Fatal and major complications secondary to nasal and sinus surgery. Lary ngoscope 1989;99:276-283

22.C. Rene, G.E. Rose, R. Lenthall, I. Moseley.Major orbital complications of endoscopic sinus surgery. Br J Ophthalmol,2001;85;598-603

23.Maharshak, J.K. Hoang, M.T. Bhatti.Complications of vision loss and ophthalmoplegia during endoscopic sinus surgery.Clin Ophthalmol,2013; 7 573-580 http://dx.doi.org/10.2147/OPTH.S40061

24.L.M. Vasquez, M. Gonzalez-Candial.Permanent blindness after endo-scopic sinus surgery.Orbit.2011; 30;108-110 http://dx.doi.org/10.3109/01676830.2010.546554

25.J.A. Stankiewicz, J.M. Chow. Two faces of orbital

hematoma in intranasal (endoscopic) sinus surgery.Otolaryngol Head Neck Surg,1999;120;841-847
26.J.C. Lee, P.I. Chuo, M.W. Hsiung.Ischemic opyic neuropathy after endoscopic siunus surgery: a case report. Eur Arch Otorhinolaryngol,2003; 260;429-431 http://dx.doi.org/10.1007/s00405-003-0612-0 | Medline
28.Krings JG, Kallogjeri D, Wineland A, Nepple KG, Piccirillo JF, Getz AE. Complications of primary and revision functional endoscopic sinus surgery for chronic rhinosinusitis. Laryngoscope. 2014 Apr;124(4):838-45. doi: 10.1002/lary.24401.
29.Lund VJ, Kennedy DW. Quantification for staging sinusitis. The Staging and Therapy Group. Ann Otol Rhinol Laryngol. 1995;167(Suppl):17-21
30.Michel O, Bresgen K, Russmann W, et al. Endoscopically con-trolled endonasal orbital decompression in malignant exoph-thalmos. Laryngorhinootologie. 1991;70:656-662. doi: 10.1055/s-2007-998119.
31,Siedek V, Pilzweger E, Betz C, et al. Complications in endona-sal sinus surgery: a 5-year retrospective study of 2,596 patients. Eur Arch Otorhinolaryngol. 2013;270:141-148. doi: 10.1007/s00405-012-1973-z
32.Stankiewicz JA, Lal D, Connor M, Welch K. Complications in endo-scopic sinus surgery for chronic rhinosinusitis: a 25-year experience. Laryngoscope. 2011;121: 2684-2701. doi: 10.1002/lary.21446
33.Rombout J, de Vries N. Complications in sinus surgery and new clas-sification proposal. Am J Rhinol.2001;15(6):363-37
34.Stankiewicz JA, Chow JM. Two faces of orbital hematoma in in-tranasal (endoscopic) sinus surgery. Otolaryngol Head Neck Surg. 1999;120:841-847.doi:10.1016/S0194-5998(99)70324-4
35.Asaka D, Nakayama T, Hama T, et al. Risk factors for complications of endoscopic sinus surgery for chronic rhinosinusitis. Am J Rhi-nol Allergy. 2012;26:61-64. doi: 10.2500/ajra.2012.26.3711
36.Al-Mujaini A, Wali U, Alkhabori M. Functional Endoscopic Sinus Surgery: Indications and Complications in the Ophthalmic Field. OMJ2009; 24(2):70-80. 3. Wu W, Sia DI, Cannon PS, et al. Visual Acuity Recovery in Traumatic Optic Neuropathy Following Endoscopic Optic Nerve Decompression: A Case Report.Ophthal Plast Reconstr Surg 2011; 27(1):e13-5.