Combined Transoral and Endoscopic Approach for Total Maxillectomy: A Pioneering Report

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Abstract

Keywords

- ▶ total maxillectomy
- ▶ combined transoral and endoscopic approach
- ▶ malignant tumor
- ▶ maxillary sinus
- ▶ endoscopic technique

Total maxillectomy is sometimes necessary especially for malignant tumors originating from the maxillary sinus. Here we describe a combined transoral and endoscopic approach for total maxillectomy for the treatment of malignant maxillary sinus tumors and evaluate its short-term outcome. This approach was evaluated in terms of the physiological function, aesthetic outcome, and complications. Six patients underwent the above-mentioned approach for resection of malignant maxillary sinus tumors from May 2010 to June 2011. This combined transoral and endoscopic approach includes five basic steps: total sphenoidectomy, sublabial incision, incision of the frontal process of the maxilla, incision of the zygomaticomaxillary fissure, and hard palate osteotomy. All patients with malignant maxillary sinus tumors successfully underwent the planned total endoscopic maxillectomy without the need for facial incision or transfixion of the nasal septum; there were no significant complications. Five patients received preoperative radiation therapy. All patients were well and had no recurrence at follow-up from 13 to 27 months. The combined approach is feasible and can be performed in carefully selected patients. The benefit of the absence of facial incisions or transfixion of the nasal septum, potential improvement in hemostasis, and visual magnification may help to decrease the morbidity of traditional open approaches.

Introduction

Total and subtotal maxillectomies are performed to resect malignant tumors of the maxilla. The techniques of maxillectomy have changed considerably since the procedure was first performed by Lizards in 1826.¹ Many surgical approaches have been developed for resection of the maxilla, including lateral rhinotomy and midfacial degloving procedures. These approaches are still widely performed despite the disadvantage of leaving facial scars.

Surgical treatment of sinonasal disorders has undergone significant changes during the era of endoscopic sinus surgery. Recently, endoscopic approaches such as endoscopic medial maxillectomy and extended endoscopic medial

maxillectomy^{2–4} have been used to deal with neoplastic diseases of the maxilla. Ramakrishnan and colleagues⁵ found that the anterior maxilla can be accessed with straight instruments after septal dislocation. Access to these areas may be necessary for treatment of inverted papilloma, schwannoma, and juvenile nasopharyngeal angiofibroma.⁵ However, a complete resection of the maxilla is required for malignant tumors of the maxillary sinus, especially if the tumor extends to the lateral, inferior, or anterior wall of the maxillary sinus.

In this study, we describe the procedure and report the short-term outcomes of a combined transoral and endoscopic approach for total maxillectomy. The advantages, disadvantages, complications, and aesthetic outcome were evaluated.

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Patients and Methods

Patients

All treatments were approved by the ethics committee of the Eye, Ear, Nose, and Throat Hospital of Fudan University. A retrospective study was performed of patients operated on between May 2010 and June 2011. Six patients with malignant maxillary sinus tumors underwent the combined transoral and endoscopic approach in the Eye, Ear, Nose, and Throat Hospital of Fudan University. These maxillary tumors did not involve the skin or the orbit and they did not extend to the skull base. A nasal cavity lesion or involvement of the ethmoid or sphenoid sinuses was compatible with the procedure. Extension to the pterygopalatine fossa and minimal invasion of the infratemporal fossa were not contradictions. The malignant nature of the maxillary tumors was proved by biopsies before surgery.

Computed tomography (CT) and enhanced CT were performed for every case to evaluate the staging of the maxillary tumor and to confirm that there was no involvement of the skull base, orbit, or soft tissue of the cheek (►Fig. 1). A temporary obturator was prepared before surgery. With the exception of one patient with myochondrosarcoma, all patients received adjuvant radiation therapy (50 to 60 gray [Gy]) for 2 to 3 weeks prior to surgery.

Surgical Approach and Techniques

Surgery was performed under general anesthesia. After that, 1% lidocaine with 1:100,000 epinephrine was injected in the mucosa of the pyriform aperture and the labiogingival groove for local hemostasis.

The approach began with a total ethmoidectomy and sphenoidectomy, and then the frontal sinus ostium was widened. The middle turbinate and superior turbinate were resected, and a wide maxillary antrostomy was performed. Then, the maxillary bone was resected.

The first incision made was an endoscopic endonasal incision along the ipsilateral pyriform aperture from the nasal bone to the floor of the nose to dissect the soft tissues. Subsequently, a second incision was made in the gingivobuccal sulcus, starting from the central contralateral incisor to the third ipsilateral molar, connecting to the first incision.

Blunt subperiosteal dissection of the soft tissues was performed with a freer dissector along the anterior wall of the maxillary sinus in the subperiosteal plane, until the infraorbital rim was located superiorly and the zygomaticomaxillary fissure was located laterally. Superiorly, the infraorbital neurovascular bundle was carefully preserved if it was not involved by the malignancy.

Three points needed to be exposed clearly using a retractor. First, the facial soft tissue had to be fully retracted superiorly up to the level of the medial canthus to expose and cut the frontal process of the maxilla. The second was the zygomaticomaxillary fissure, which had to be cut off vertically. Sometimes it could be difficult to locate the zygomaticomaxillary fissure during the operation. In such cases, osteotomy was performed vertically along a line 2 cm lateral to the infraorbital aperture. A third incision was then made sagittally along the hard palate with a power saw, from posterior to anterior. For optimum results, this osteotomy should be performed as close as possible to the medial maxillary wall to preserve more palatal bone, if it is not involved by the lesion. Finally, maxillectomy was completed in the standard way (►Figs. 2 and 3). Following resection of the maxilla, the facial soft tissue was returned to the normal position. The preoperatively prepared temporary obturator was fixed for immediate temporary prosthetic reconstruction of the hard palatal defect.

Removal of thick and dense bone is necessary during skull base surgery, so a high-speed drill is essential. Endonasal drills should have an extendable bit and differently angled handpieces. We prefer a hybrid and coarse diamond drill bit, as it combines the advantages of rapid and yet precise bone removal. Saline irrigation and endoscopic bipolar electrocautery hemostatic agents are also important to provide excellent visualization.

Preoperative and postoperative broad-spectrum antibiotics (third-generation cephalosporins) were administered for 1 week.

Results

All patients successfully underwent this combined transoral and endoscopic approach for treatment of malignant maxillary

Fig. 1 (A) Coronal computed tomography (CT) showing a destructive maxillary mass with involvement of the hard palate and inferior orbital wall. (B) Postoperative coronal CT showing no sign of recurrence 3 months after surgery.

Fig. 2 Reconstructed three-dimensional image showing sites of osteotomy. (a) Frontal process of maxilla, (b) zygomaticomaxillary fissure, (c) hard palate, (d) junction of maxilla with pterygoid plates.

tumors. The study included four males and two females, with a mean age of 50.6 years (range 31 to 64). ► **Table 1** shows the patient characteristics. The length of follow-up in our present study ranged from 13 to 27 months.

No intraoperative or postoperative mortality occurred in this series. Immediate postoperative facial edema was severe in three of the patients and lasted for 1 week. The immediate

obturator worked well with no significant feeding or speech difficulties. All the patients could speak clearly and swallow soft food provided by the hospital without difficulty after surgery. Other postoperative complications included nasal crusting and infraorbital hypoesthesia. These subsided over several months, if the infraorbital neurovascular bundle was preserved during surgery.

Fig. 3 (A) With extensive traction of facial soft tissue, (b) the frontal process of the maxilla was cut off and (a) the inferior orbital rim and facial soft tissue were exposed. (B) With more lateral traction of facial soft tissue, (c) the zygomaticomaxillary junction was exposed. (C) The zygomaticomaxillary junction (d) was cut off vertically. (D) After the maxilla was removed, (e) the anterior wall of the infratemporal fossa and (f) orbital soft tissue were exposed.

Table 1 Characteristics of Patients Treated with a Combined Endoscopic Approach

Patient	Age	Gender	Pathology	Location	Present symptom	Stage*	Recurrence	Time of follow-up (months)	Preoperative radiation therapy
1	48	M	Squamous cell carcinoma	Rt. maxillary sinus Rt. Nasal cavity Rt. pterygopalatine fossa	Epistaxis, nasal obstruction, facial pain, facial swelling	III	N	27	Y
2	48	M	Adenoid cystic carcinoma	Lt. maxillary sinus Lt. nasal cavity, Lt. sphenoid sinus Lt. ethmoid sinus Lt. infratemporal fossa Lt. inferior orbital fissure	Epistaxis, nasal obstruction, ear fullness, hearing loss	III	N	13	Y
3	64	M	Malignant melanoma	Lt. maxillary sinus Lt. nasal cavity	Nasal obstruction, nasal discharge	IVA	N	13	Y
4	31	F	Adenoid cystic carcinoma	Rt. maxillary sinus Rt. Nasal cavity Rt. pterygopalatine fossa	Epistaxis	IVA	N	13	Y
5	53	F	Myochoondrosarcoma	Lt. maxillary sinus Lt. nasal cavity Lt. ethmoid sinus Lt. inferior orbital fissure	Epiphora, facial numbness, facial pain	IVA	N	13	N
6	63	M	Adenoid cystic carcinoma	Rt. maxillary sinus Rt. Nasal cavity Rt. infratemporal fossa Rt. hard palate	Nasal obstruction, anosmia epiphora, facial pain	IVA	N	14	Y

Abbreviations: F, female; IVA, 4A; Lt., left; M, male; Rt., right.

*According to 1997 American Joint Committee on Cancer (AJCC) staging system.

Fig. 4 Three months following total maxillectomy and radiotherapy, this patient was satisfied with his facial appearance.

The cosmetic results were good and all patients were satisfied with the outcomes. The mean length of hospital stay was 8.5 days, and mean blood loss was ~666 mL.

Patient follow-ups showed that the well-vascularized soft tissues of the face showed good tolerance of the high doses of preoperative radiation therapy. No skin contracture or concavity of the face was observed following the procedure (→Fig. 4).

Discussion

Lateral rhinotomy and midfacial degloving approaches are traditionally performed for total and subtotal maxillectomy. Lateral rhinotomy can provide good exposure of the tumor to the pyriform aperture, but this approach leaves an obvious facial scar. Furthermore, if the patient received radiation therapy preoperatively, it is possible to cause a facial fistula as a result of insufficiently vascularized soft tissues. One of the advantages of the midfacial degloving approach is the avoidance of facial incision, so cosmetic outcomes are better. However, sometimes it is difficult to expose the frontal process of the maxilla. It also requires transfixion of the nasal septum, and therefore carries the risk of vestibular stenosis.⁵

Maxillectomy via open approaches involves some intraoperative difficulties, especially in detaching the posterior aspect of the maxilla. In addition, because of the limited vision during surgery, this detachment often causes bleeding from the maxillary vascular plexus. Combining transoral and endoscopic techniques provides advantages in overcoming this problem. The magnified surgical field given by the endoscope can offer better visualization of anatomical structures and more surgical precision and control in the oncologic setting. The posterior osteotomy can be performed more accurately under endoscopic assistance, and surgical margins can be more precisely secured.⁶

Additional advantages of endoscopic techniques are angled visualization and magnification of the operative field, which allow a better view of the depths of the nasal cavities and sinuses,^{3,7} and this was approved by recent cadaveric study.⁶ Therefore, it may result in better tumor excision. Transnasal endoscopic approaches for the resection of malignant tumors of the maxilla have been suggested for reducing perioperative morbidity and tumor recurrence.^{3,7} Avoiding external scarring and long recovery time is another advantage of this technique.

Patients did not experience the serious complications that can be associated with craniofacial resection nor, are they likely to be subject to a reduction in quality of life.

Some reservations still remain regarding the use of endoscopy for the treatment of skull base malignancies.⁸ A primary doubt is the ability to achieve the classical en bloc excision. Other concerns include visualization of the tumor margins, the ability to deal with bleeding or major vascular injury, and the ability to reconstruct the resulting skull base defect. However, even in open surgery, it is impossible to perform an en bloc resection,⁹ especially for tumors close to critical neurovascular structures, which often requires a resection piece by piece with minimal margins. In an international collaborative study, Patel et al¹⁰ showed that in areas adjacent to critical structures, such as the orbital apex and the lateral wall of the sphenoid sinus, piecemeal resection is often required to produce clear margins. Theoretically, this may increase the risk of local recurrence or tumor seeding, but this has not been proven clinically.^{8,11} Multivariate analysis showed that the surgical margin is a critical predictor, which is closely associated with recurrence-free survival.¹⁰ A retrospective review by Cohen et al¹² showed that there did not seem to be increased risk of positive margins in patients with malignant tumors undergoing endoscopic-assisted resection. Furthermore, endoscopic techniques can reduce the incidence of morbidity and the duration of hospital stay.

Earlier reports suggest that in the short term, the outcomes following surgery using an endoscopic approach are at least equal to those obtained with traditional approaches.^{13,14} Despite technical advances, traditional craniofacial resection is associated with significant complications.^{11,15,16} In our series, no significant complications were observed in the perioperative period.

The combined approach has some potential disadvantages. It is more difficult to deal with structures surrounding the zygomatic arch. In addition, the combined approach can also increase the difficulty of intraoperative reconstruction because of the more restricted space.

It is necessary to bear in mind that not all maxillary malignancies can be treated using this approach. Several factors have to be thoroughly assessed before choosing this surgical approach. Large tumor size and infratemporal fossa involvement are relative, but not absolute contraindications. In fact, under endoscopic guidance, it is not difficult to resect

the soft tissue of the orbit and the anterior wall of the infratemporal fossa, which was deemed a technical difficulty with the midfacial degloving approach.⁷ Contraindications for this combined transoral and endoscopic approach includes tumors with involvement of the dura and extension into facial soft tissues.

There were limitations to our study. As far as we know, this is the first report of total maxillectomy through a combined transoral and endoscopic approach. This is therefore a preliminary report and involved few patients because of the rarity of these tumors. Another important limitation is that the length of follow-up in our present study ranged from 13 to 27 months because endoscopic maxillary resection is a relatively new procedure.

Conclusion

All cases were treated endoscopically and the postoperative outcome was satisfactory. We found that the combined transoral and endoscopic approach was safe and effective in resecting malignant tumors of the maxillary sinus, thanks to improved accessibility and visualization. One of the innovations of the technique is the use of an endoscope to perform the nasal vestibule incision that can avoid septal dislocation. Another innovation is the use of the endoscope to visualize the medial and lateral maxillary incisions and thus allow visualization of "blind" zones that are obscured from direct view. The approach enables complete removal of maxillary malignant tumors in selected patients, with the advantages of no external incision. It may decrease blood loss and shorten the hospital stay because open approach is avoided and fixing the obturator is easier. However, more data are needed from studies involving a larger number of patients. The combined transoral and endoscopic approach may thus become the treatment of choice for malignant maxillary tumors.

References

- 1 Sisson GA Sr, Toriumi DM, Atiyah RA. Paranasal sinus malignancy: a comprehensive update. *Laryngoscope* 1989;99(2):143–150
- 2 Kamel RH. Transnasal endoscopic medial maxillectomy in inverted papilloma. *Laryngoscope* 1995;105(8 Pt 1):847–853
- 3 Wormald PJ, Ooi E, van Hasselt CA, Nair S. Endoscopic removal of sinonasal inverted papilloma including endoscopic medial maxillectomy. *Laryngoscope* 2003;113(5):867–873
- 4 Sadeghi N, Al-Dhahri S, Manoukian JJ. Transnasal endoscopic medial maxillectomy for inverting papilloma. *Laryngoscope* 2003;113(4):749–753
- 5 Ramakrishnan VR, Suh JD, Chiu AG, Palmer JN. Septal dislocation for endoscopic access of the anterolateral maxillary sinus and infratemporal fossa. *Am J Rhinol Allergy* 2011;25(2):128–130
- 6 Rivera-Serrano CM, Terre-Falcon R, Duvvuri U. Combined approach for extensive maxillectomy: technique and cadaveric dissection. *Am J Otolaryngol* 2011;32(5):417–421
- 7 Banhiran W, Casiano RR. Endoscopic sinus surgery for benign and malignant nasal and sinus neoplasm. *Curr Opin Otolaryngol Head Neck Surg* 2005;13(1):50–54
- 8 Snyderman CH, Carrau RL, Kassam AB, et al. Endoscopic skull base surgery: principles of endonasal oncological surgery. *J Surg Oncol* 2008;97(8):658–664
- 9 Ong YK, Solares CA, Carrau RL, Snyderman CH. New developments in transnasal endoscopic surgery for malignancies of the sinonasal tract and adjacent skull base. *Curr Opin Otolaryngol Head Neck Surg* 2010;18(2):107–113
- 10 Patel SG, Singh B, Polluri A, et al. Craniofacial surgery for malignant skull base tumors: report of an international collaborative study. *Cancer* 2003;98(6):1179–1187
- 11 Eloy JA, Vivero RJ, Hoang K, et al. Comparison of transnasal endoscopic and open craniofacial resection for malignant tumors of the anterior skull base. *Laryngoscope* 2009;119(5):834–840
- 12 Cohen MA, Liang J, Cohen JJ, Grady MS, O'Malley BW Jr, Newman JG. Endoscopic resection of advanced anterior skull base lesions: oncologically safe? *ORL J Otorhinolaryngol Relat Spec* 2009;71(3):123–128
- 13 Roh HJ, Batra PS, Citardi MJ, Lee J, Bolger WE, Lanza DC. Endoscopic resection of sinonasal malignancies: a preliminary report. *Am J Rhinol* 2004;18(4):239–246
- 14 Batra PS, Citardi MJ, Worley S, Lee J, Lanza DC. Resection of anterior skull base tumors: comparison of combined traditional and endoscopic techniques. *Am J Rhinol* 2005;19(5):521–528
- 15 Nicolai P, Battaglia P, Bignami M, et al. Endoscopic surgery for malignant tumors of the sinonasal tract and adjacent skull base: a 10-year experience. *Am J Rhinol* 2008;22(3):308–316
- 16 Lund V, Howard DJ, Wei WI. Endoscopic resection of malignant tumors of the nose and sinuses. *Am J Rhinol* 2007;21(1):89–94