

Main Article

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Endoscopic-assisted maxillectomy: our experience in tumours affecting the posterior wall of the maxillary sinus

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Abstract

Objective. To show our experience in performing endoscopic-assisted maxillectomy (EAM), with the aim of facilitating delineation of tumour resection and improve the achievement of free tumour resection margins.

Methods. Patients undergoing EAM between 2021 and 2024 were reviewed. During the endoscopic approach, the medial and lateral plates of the pterygoid were drilled, taking as reference the superior margin of the inferior turbinate.

Results. Six patients underwent an EAM surgery. The maxillectomy was completed with an external transfacial approach in four patients and with a transoral approach in two. No intra-operative complications were observed. Five patients had postoperative flap dehiscence; two cases healed spontaneously and three cases required surgery.

Conclusion. EAM allows delimitation of the posterior limit of tumour resection in total or subtotal maxillectomies. This endoscopic approach facilitates the drilling of the pterygoid process to complete the posterior osteotomy, which is a complex manoeuvre during the exclusive external approach.

Introduction

Maxillectomy is a surgical procedure indicated to treat malignant and/or benign tumours of the maxillary sinus affecting at least one of its walls. There are different classifications depending on the extent of resection^{1,2}, but as a whole they can be grouped into: medial maxillectomy, subtotal maxillectomy with preservation of the floor of the orbit, total maxillectomy and extended total maxillectomy (including orbital exenteration, dissection of the infratemporal fossa, craniofacial resection or bilateral maxillectomy). With the advancement of endoscopic techniques, in most centres, medial maxillectomy is performed by an exclusively endoscopic approach and the indications for external approaches have been significantly reduced.

The main goal of surgical treatment of malignant tumours is complete oncological resection with a margin of healthy tissue around the lesion³. In order to fulfil this principle, tumours affecting the posterior wall of the maxillary sinus require a wide resection including anatomical regions such as the pterygopalatine fossa, the plates of the pterygoid process or the infratemporal fossa. The external approach offers good visualisation and manipulation of the surgical field, except for the region posterior to the maxillary tuberosity. Often, as the region is difficult to access, delimiting the posterior margin of the resection including the osteotomy over the base of the pterygoid is complex. This procedure is usually performed under tactile guidance and is subject to haemorrhagic complications⁴.

In 2018, Hanazawa T et al⁵ described for the first time a contralateral transmaxillary approach for resection of the lateral and medial plates of the pterygoid process during total maxillectomy. They described an osteotomy below the base of the pterygoid process to facilitate en bloc resection of the maxilla. Later, the group of Deganello et al⁶ published their experience with endoscopic-assisted maxillectomy (EAM). This technique consists of determining the posterior and medial limits of the resection through an endoscopic endonasal approach and completing the maxillectomy through an external or transoral incision. This group also uses the endoscopic endonasal approach to resect the pterygoid process, and the pterygopalatine and the infratemporal fossae, with a high overall control rate of the posterior margin.

In this study we show our experience in performing EAM in malignant tumours with involvement of the posterior wall of the maxillary sinus, with the aim of facilitating the subsequent delimitation of tumour resection.

Table 1. Summary of clinical and pathological characteristics of the patients included

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6
Age, sex	60, F	55, M	40, F	56, M	63, M	62, F
Histology	Pleomorphic sarcoma	Squamous cell carcinoma	Spindle cell rhabdomyosarcoma	Squamous cell carcinoma	Squamous cell carcinoma	Adenocarcinoma of minor salivary glands
TNM Stage	pT4N0	pT4aN0	pT4N0	rpT4bN3b	pT2N0	pT3N0
Tumour origin	Left maxillary sinus	Left maxillary sinus	Pterygopalatine fossa and infratemporal fossa	Left maxillary sinus	Hard palate (left)	Hard palate (right)
Previous treatment	Medial maxillectomy + RT	No	CT-RT	Maxilectomy medial + CT-RT	No	No
Surgery extension	Subtotal maxillectomy with preservation of the orbital floor (transfacial)	Extended total maxillectomy with orbital exenteration (transfacial) + neck dissection	Total maxillectomy extended to infratemporal fossa and pterygopalatine fossa (transfacial)	Subtotal maxillectomy with preservation of the orbital floor (transfacial) + neck dissection	Subtotal maxillectomy with preservation of the orbital floor (transoral)	Subtotal maxillectomy with preservation of the orbital floor (transoral)
Reconstruction	Anterolateral thigh flap	Anterolateral thigh flap	Anterolateral thigh flap	Anterolateral thigh flap	Combination of nasal and oral cavity local flaps	Combination of nasal and oral cavity local flaps
Posterior margin	Negative	Negative	Focally positive	Focally positive	Negative	Negative
Adjuvant treatment	CT, posterior RT	CT-RT	CT	CT-RT	CT	CT
Complications	Spontaneously healed dehiscence in posteromedial margin	Dehiscence in the inner canthus of the eye requiring surgical reconstruction.	Dehiscence in posteromedial margin requiring surgical reconstruction.	No	Dehiscence in posteromedial margin requiring surgical reconstruction.	Spontaneously healed dehiscence in anteromedial margin
Follow up	36 months	17 months	13 months	11 months	10 months	6 months
Patient status	No signs of recurrence	No signs of recurrence	No signs of recurrence	No signs of recurrence	No signs of recurrence	No signs of recurrence

F: female, M: male, CT: chemotherapy, RT: radiotherapy

Materials and methods

We retrospectively reviewed all patients undergoing subtotal, total or extended maxillectomy at our centre from 2021 to April 2024. Patients with infiltration of the posterior wall of the maxillary sinus on imaging were included. In all of them a first endoscopic time was performed to determine the medial and posterior limit of the resection. Detailed description of the surgical technique is described in the next section. Patients who underwent surgery using an exclusively external approach or when the tumour did not involve the posterior wall of the maxillary sinus were excluded.

Demographic (age and sex) and oncological data were collected for each patient (Table 1). Lesion location, histology, staging according to the 8th edition of the UICC TNM, previous treatments, margin status and adjuvant treatment were included.

In all cases, CT and MRI were performed to categorise the tumour. Cases were discussed by the multidisciplinary head and neck tumour committee to reach a consensus on treatment. There was a minimum follow-up of 6 months.

The surgical approach was classified as 'transfacial' when a skin incision was made or 'transoral' when the oral cavity approach was completed without skin incisions.

Surgical technique

The maxillectomy was initiated by the endoscopic endonasal approach, using a rigid 0°, 4 mm diameter optic.

In cases where the tumour did not occupy the nasal cavity, two vertical incisions were made in the mucosa covering the medial plate of the pterygoid: the anterior one at the level of the suture between the perpendicular plate of the palatine bone and the medial plate of the pterygoid, and the posterior one just in front of the torus tubarius. Both incisions were joined superiorly and inferiorly with two horizontal incisions, one at the level of the tail of the middle turbinate and the other at the level of the tail of the inferior turbinate (Figure 1).

The mucosa was then dissected subperiosteally to expose the medial plate of the pterygoid and superiorly the base of the pterygoid process. The base of the pterygoid was drilled laterally between the height of the tail of the middle and inferior turbinate until it reached the lateral plate. A Midas Rex™ MR8™ high-speed drill system was used for the purpose. (Figure 1, Video 1)

If the tumour was not invading the sphenopalatine foramen, the mucosa of the medial aspect of the perpendicular plate of the palatine bone was dissected to expose the sphenopalatine artery, it was then cauterised and sectioned to continue with the subperiosteal

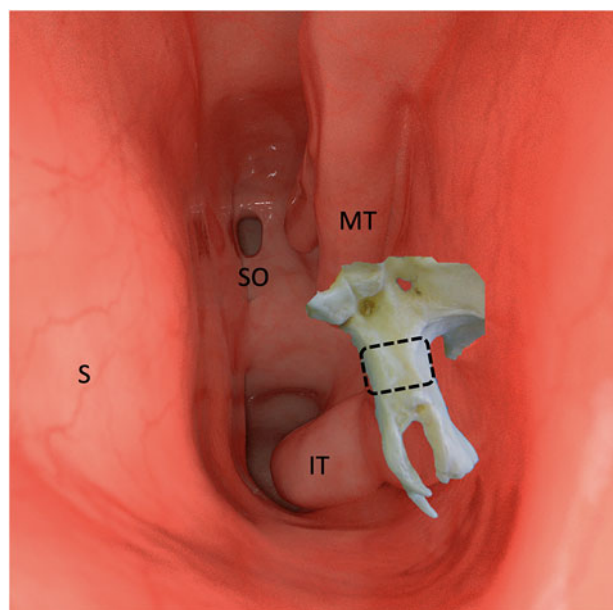


Figure 1. Illustration showing the location of the pterygoid process in the left nostril. The dashed line indicates the optimal location of the drill. S: septum, MT: middle turbinate, IT: inferior turbinate, SO: sphenoid ostium.

dissection of the medial plate of the pterygoid. The contents of the pterygopalatine fossa were kept covered by the periosteum and dissected laterally⁶.

In cases where the tumour mass occupied the nasal cavity on the affected side, the procedure began with a posterior septectomy to work from the contralateral fossa.

In both transfacial and transoral cases, soft tissue incisions and osteotomies were completed until the tumour (maxillectomy and pterygoid plates) was excised en bloc. The osteotomy on the base of the pterygoid was completed, if needed, with a curved osteotome.

Results and analysis

From 2021 to June 2024, 11 patients diagnosed with a malignant maxillary sinus tumour underwent total or subtotal maxillectomy by an external approach (transfacial or transoral). In 6 cases a combined external and endoscopic approach was used to complete the maxillectomy (Figure 2A). In all of them an initial endoscopic approach was performed in order to delimit the posterior limit of

the resection and to facilitate the osteotomy at the level of the base of the pterygoid process. Of these cases, total maxillectomy was completed in 4 patients using a classic external approach with an extended paralateronasal incision, and in the remaining 2 patients, subtotal maxillectomy was completed using a transoral approach.

The demographic and oncological characteristics of the patients are summarised in Table 1. The median age was 56 years (range 40-63). Eighty-three percent (5/6) of the cases were stage III or IV tumours. The remaining case was a stage II. Histologically, 50% of the tumours were squamous cell carcinomas, while the remaining three cases were a high-grade pleomorphic sarcoma, a spindle cell rhabdomyosarcoma and a minor salivary gland adenocarcinoma.

Four subtotal maxillectomies (67%) and 2 extended total maxillectomies (33%) were performed.

The reconstructive and plastic surgery team completed the reconstruction with an anterolateral microanastomosed thigh flap in 4 cases (Figure 2B). In the remaining 2 cases the defect was reconstructed by combining local contralateral endonasal (nasoseptal or anterior ethmoidal septal flap) and oral cavity (facial artery muscle-mucosal flap) flaps. Maxillectomy was completed with lymph node dissection in 50% of patients, depending on tumour histology, location and extent.

A non-absorbable nasal packing was placed for 48 hours in the nostril affected by the tumour. Patients were fed through a nasogastric tube for a minimum of two weeks.

Posterior margins of the tumour specimen were focally positive in 2 patients (33%). Adjuvant treatment with radiotherapy was performed in all cases, combined in 50% of cases with chemotherapy.

No intraoperative complications associated with EAM were observed. Postoperatively, 5 patients had a flap dehiscence (83%). Of these, 2 cases were punctiform dehiscences that healed spontaneously. The remaining 3 cases required revision surgery to repair the fistula using local flaps.

Discussion

EAM takes advantage of the benefits of endoscopic endonasal surgery to delineate the posterior and medial limits of tumour resection. The endoscopic view provides a magnified and panoramic view of the surgical area. It is complemented by the external or transoral approach for en bloc removal of the tumour. The indications for this approach are tumours originating in the posterior wall of the maxillary sinus or hard palate, upper alveolar ridge or upper retromolar trigone that extend behind the maxillary tuberosity.

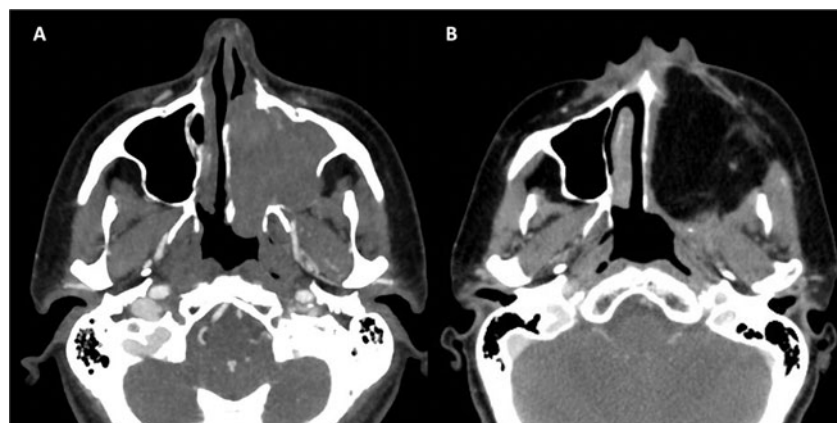


Figure 2. Axial CT slices of the same patient. A: Pre-operative CT scan - left maxillary sinus tumour infiltrating the posterior wall of the maxillary sinus. B: Postoperative CT scan - total maxillectomy and reconstruction with anterolateral thigh flap.

Because of their posterior extension, these tumours are not candidates for excision by an exclusive endonasal endoscopic approach. When the posterior wall of the maxillary sinus is infiltrated by the tumour, it is necessary to extend the resection by displacing the contents of the pterygopalatine fossa to the base of the pterygoid and including the medial and lateral plates of the pterygoid process in the resection. Osteotomy at the base of the pterygoid is a difficult procedure to perform externally due to the depth of the area and poor visibility. Defining this posterior limit through the fossa facilitates the procedure considerably.

In order to perform the osteotomy of the pterygoid base, the anatomy of the region must be kept in mind. The pterygoid process emerges from the inferior aspect of the body of the sphenoid and consists of two plates, one medial and one lateral. Between the two lies the pterygoid notch, occupied anteriorly by the pyramidal process of the palatine bone and posteriorly by the insertion of the medial pterygoid muscle. The medial side of the medial plate forms the posteriormost part of the lateral wall of the fossa, forming the choana, and articulates anteriorly with the perpendicular plate of the palatine bone (sphenoid process) (Figure 1)⁷.

García-Lliberós et al⁸ recently published an anatomical and radiological study to determine the safest location for endoscopic endonasal osteotomy at the base of the pterygoid. They demonstrated that by performing the osteotomy at the level of the upper limit of the inferior turbinate tail, resection of both pterygoid plates was achieved with less risk of injury to structures passing through the pterygoid canal. As described in the paper, the endoscopic approach to the medial plate of the pterygoid should be performed after completion of the median meatotomy and excision of the posterior wall of the maxilla, in order to cauterise the sphenopalatine artery and expose and laterally displace the contents of the pterygopalatine fossa. However, in many cases the tumour invades this region and it is not possible to perform this regular dissection. This is why in this work we have described the technique directly aimed at subperiosteal dissection of the medial aspect of the medial plate of the pterygoid and its base.

During the endoscopic time of the maxillectomy, the medial plate and the base of the pterygoid process are exposed so that the pterygoid process can be drilled laterally, weakening it. The upper limit corresponds to the tail of the middle turbinate, as it is a reference for the location of the sphenopalatine artery at the level of the sphenopalatine foramen, and in a more posterior plane, of the pterygoid canal and the foramen lacerum. An attempt should always be made to preserve the neurovascular structures in order to minimise complications and sequelae, provided that the tumour extension allows it. To avoid injury to the pterygoid nerve and artery, the pterygoid process should be drilled below the inferior margin of the tail of the middle turbinate.

During the endoscopic approach, it is possible to work through the fossa affected by the tumour as long as it does not hinder access to the posterior part of the nasal cavity. In cases where the tumour does not allow endoscopic work through the affected fossa, it may be necessary to perform a posterior septectomy to gain access to the pterygoid region from the contralateral fossa.

The contents of the pterygopalatine fossa are displaced laterally to complete the maxillectomy⁶, which reduces the risk of severe bleeding. The authors of this paper believe that the endoscopic manoeuvre over the pterygoid base decreases bleeding from the pterygoid plexus when performing this procedure. This is because the pterygoid base is sectioned in a controlled manner, just above the beginning of the pterygoid plates, leaving the venous plexus of the pterygoid musculature below. However, in the series published

by Nagaoka⁹ they found no statistically significant difference in the volume of blood lost during surgery when comparing external maxillectomy cases and endoscopically assisted cases. Therefore, further studies are needed to validate this hypothesis.

It has been shown that tumours growing in the posterior or lateral wall of the maxillary sinus are associated with a higher risk of local recurrence and worse survival compared to tumours with anterior or medial extension¹⁰.

EAM allows en bloc resection of the pterygoid plates in conjunction with maxillectomy in cases with involvement of the posterior wall of the maxillary sinus. This facilitates complete resection of the tumour with healthy adjacent tissue margins. In Nagaoka's work⁹ they considered the length of the residual pterygoid process after maxillectomy as a sign of precision in delimiting the posterior part of the resection. They observed that endoscopically assisted cases had significantly smaller pterygoid process remnants than in traditional maxillectomy cases.

Deganello et al⁶ describe a high rate of medial and posterior negative margins with EAM (95% and 96% respectively). In our series we observed 67% tumour-free posterior margins.

EAM also allows the indication of combined endonasal-transoral approaches in selected cases. However, the endonasal-transoral approach is contraindicated if the tumour presents: anterior extension of the tumour into the soft tissues of the face; superior extension requiring excision of the periorbital, extracanal fat or orbital contents; or the need for wide exposure during reconstruction. This technique favours a large proportion of patients (60%) avoiding facial incision⁶. In our experience, the last two patients could be performed by endonasal-transoral approach because of the benefits of performing a first endoscopic stage to delimit the medial and posterior margin of the resection.

- Endoscopic-assisted maxillectomy (EAM) facilitates delineation of posterior limit of tumour resection in total or subtotal maxillectomies.
- Medial and lateral plates of the pterygoid process are drilled endoscopically.
- The landmarks for a safe osteotomy on the pterygoid process are the tail of the middle and inferior turbinates.
- This technique allows an endoscopic-transoral approach to be considered, avoiding facial incisions, in selected patients.

Limitations

This work collects retrospective results from a limited series of patients in which tumours of different extension, location and histology are included. Larger studies, with a control group using an exclusively open approach and a longer follow-up time, should be performed to evaluate the oncological benefit of the technique.

Conclusions

EAM allows delineation of the posterior limit of tumour resection in total or subtotal maxillectomies. This technique facilitates the drilling of the pterygoid process to complete the posterior osteotomy, which is a complex procedure during the exclusive external approach. This technique allows an endoscopic-transoral approach to be considered, avoiding facial incisions, in selected patients.

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Competing interests. The author(s) declare none

Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guidelines on human experimentation (please name) and with the Helsinki Declaration of 1975, as revised in 2008.

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