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Endoscopic endonasal surgery for nasopharyngeal angiofibroma

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ABSTRACT

Introduction. The treatment of nasopharyngeal angiofibroma (NAF) is surgical. Various approaches have been described, but due to its lower morbidity and the use of magnification and angled views, the endoscopic-assisted endonasal technique is the most commonly used. The likelihood of achieving complete resection is similar to or better than that of external approaches.

Objectives. To describe the clinical, endoscopic, and imaging outcomes of endonasal endoscopic surgery for nasopharyngeal angiofibroma, evaluated in terms of overall local control and tumor stage.

Population and methods. A descriptive, retrospective study that included patients treated for NAF using an endonasal approach with endoscopes between March 2012 and November 2024.

Results. Eighteen patients were included. The Radkowski staging of the NAFs was as follows: stage I-A: 1; I-B: 3; II-A: 3; II-B: 1; II-C: 4; III-A: 3; and III-B: 3. Three of the 18 patients underwent reoperation due to the presence of residual tumor, using the same endonasal approach (21 endonasal approaches with endoscopes).

Conclusion. The overall local control achieved in patients treated for NAF via an endonasal endoscopic approach was 72.22%; local control by stage was as follows: I-A: 1/1, I-B: 3/3, II-A: 3/3, II-B: 1/1, III-A: 1/3, and III-B: 0/3. Complete resolution of nasal obstruction and epistaxis was achieved in all patients.

In none of the cases did we need to switch to an external approach due to difficulties with visualization or exposure.

Keywords: *angiofibroma; nasopharyngeal neoplasms; endoscopic surgery through natural orifices.*

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INTRODUCTION

Nasopharyngeal angiofibroma (NAF) is a rare, vascularized, benign tumor with an incidence of 0.05% to 0.5% among head and neck tumors.[1] It is locally aggressive due to its location and its potential to spread to different regions of the skull base and intracranial space. It originates at the level of the sphenopalatine foramen, and its most common symptom is nasal obstruction, followed by epistaxis.

Treatment is surgical, and various approaches have been described for its resection.[2-4] Endonasal surgery using endoscopes is one of the most used surgical techniques, replacing or complementing open approaches. Its advantages include improved visualization, provided by the magnification of endoscopes, and angled views that allow better exposure and dissection of the NAF's extensions to the various sectors of the skull base and its intracranial extensions. By using the endonasal approach, external incisions and osteotomies are avoided, reducing surgical morbidity.

OBJECTIVES

To describe the clinical, endoscopic, and imaging outcomes of endonasal endoscopic surgery for nasopharyngeal angiofibroma, evaluated based on overall local control and tumor stage.

POPULATION AND METHODS

Descriptive and retrospective study. Patients treated for NAF using an endonasal approach with endoscopes between March 2012 and November 2024 were included.

To enhance the analysis, we included two young adult patients in the series, given the low prevalence of NAF and the similarity in clinical presentation, diagnostic approach, and treatment strategies to those of pediatric patients.

Local control was considered achieved when no postoperative recurrence was diagnosed with follow-up facial MRI or CT scans.

Residual NAF was defined as the identification of a contrast-enhancing tumor on postoperative facial MRI or CT scans at 3 months; recurrent NAF was defined as the diagnosis of a tumor on imaging follow-ups after 3 months, when no lesion was detected at the first follow-up; and stable NAF was defined as residual or recurrent tumors that did not increase in size during subsequent follow-ups.

Postoperative clinical follow-up was considered satisfactory when nasal obstruction and epistaxis were completely resolved.

All patients underwent videoendoscopy in the clinic and computed tomography and contrast-enhanced magnetic resonance imaging of the facial skeleton.

The Radkowski classification was used to stage the tumors (*Figure 1*).

In most patients, preoperative embolization was performed 48 hours before surgery.

The surgery was performed using 0- and 30-degree endoscopes, conventional endoscopic rhinosinus surgery instruments, and a drill with burs.

The surgical technique involved creating a unilateral or bilateral nasal corridor by resecting a posterior segment of the nasal septum to expose the tumor in the nasopharynx adequately. The sphenopalatine artery or maxillary artery was cauterized, unilaterally or bilaterally, depending on the extent of the tumor, before proceeding with the resection.

In cases of more extensive NAF, the endonasal approach was extended to the pterygopalatine fossa (PPF) and infratemporal fossa (ITF), following prior resection of the posterior wall of the maxilla.

Large NAFs were resected through the mouth, retracting the soft palate using two Foley catheters inserted through the nose and secured with knots to maintain palatal retraction.

Following resection of the NAF, the tumor implantation site in the sphenopalatine foramen and the pterygoid process was always debrided.

Figure 1. Staging of angiofibroma

Stage I-A	Tumor confined to the nasal cavity or nasopharynx
Stage I-B	Extension into one or more paranasal sinuses
Stage II-A	Minimal extension into the pterygopalatine fossa
Stage II-B	Complete involvement of the pterygopalatine fossa, with or without bony erosion of the orbit
Stage II-C	Extension to the infratemporal fossa or the pterygoid process
Stage III-A	Skull base erosion with minimal intracranial extension
Stage III-B	Skull base erosion with extensive intracranial extension, with or without invasion of the cavernous sinus

In tumors that had invaded the intracranial space and encircled the internal carotid artery, a craniotomy was performed in conjunction with the endonasal approach (*Figure 2*).

In cases of significant extension of the NAF into the ITF, endoscope-assisted transoral access was used in some patients to dissect the tumor extension better or cauterize the maxillary artery (*Figure 3)*.

At the end of the surgery, a hemostatic matrix (Surgifló®) was applied.

Patients were admitted to the pediatric intensive care unit or the adult intermediate care unit during the postoperative period.

Postoperative follow-up was conducted at 3 months, then every 6 months, and after 3 years, every 12 months, using endoscopy, magnetic resonance imaging of the facial skeleton, or contrast-enhanced computed tomography.

RESULTS

Eighteen patients were treated using an endonasal endoscopic approach.

All were male; the youngest was 11, and the oldest 27; the average age was 16.05.

The most common symptoms were nasal congestion and nosebleeds. Two patients experienced changes in visual acuity (decreased vision and unilateral blindness).

The staging of the NAFs was as follows: stage I-A: 1, I-B: 3, II-A: 3, II-B: 1, II-C: 4, III-A: 3, and III-B: 3.

We had no intraoperative or postoperative complications.

The length of hospital stay ranged from 2 to 7 days (patients who underwent craniotomy).

The average follow-up period for patients was 5.8 years.

The overall local control rate we achieved was 72.22% (13/18), broken down by stage as follows: stage I-A: 1/1, stage I-B: 3/3, stage II-A: 3/3, stage II-B: 1/1, stage II-C: 4/4, stage III-A: 1/3, and stage III-B: 0/3.

Five patients had persistent NAF, and 2 had small residual tumors (6 and 8 mm).

Three patients underwent reoperation using the same endonasal approach (21 endonasal procedures with endoscopes).

In 3 of the 5 patients with residual NAF that continued to grow after primary endonasal surgery (2) and reoperation, radiation therapy was indicated.

In 4 patients with residual lesions, the tumor remained stable, showing no growth and causing no symptoms, during an average follow-up period of 6.25 years.

In the other patient with residual intracranial NAF who underwent radiation therapy 12 months after surgery, the follow-up period was too short to determine whether the growth of the residual tumor had stabilized.

Clinical control was achieved in all patients.

In one case, blindness persisted, while in another, further deterioration of visual acuity was prevented (*Table 1*).

DISCUSSION

The treatment for all stages of NAF, including recurrences, is surgery. Various surgical approaches have been described, but for several years now, endoscopic endonasal surgery has been the first-line treatment;[5-7] the main alternative is the transmaxillary sublabial approach using a microscope.[8]

The blood supply to the NAF comes primarily from the external carotid system; however, in advanced stages, the tumor may receive blood supply from the internal carotid artery. To reduce intraoperative bleeding, improve visualization, and facilitate dissection in advanced stages, bilateral embolization of the branches of the external carotid system supplying the tumor is helpful 24 to 48 hours before endonasal surgery.[1,9]

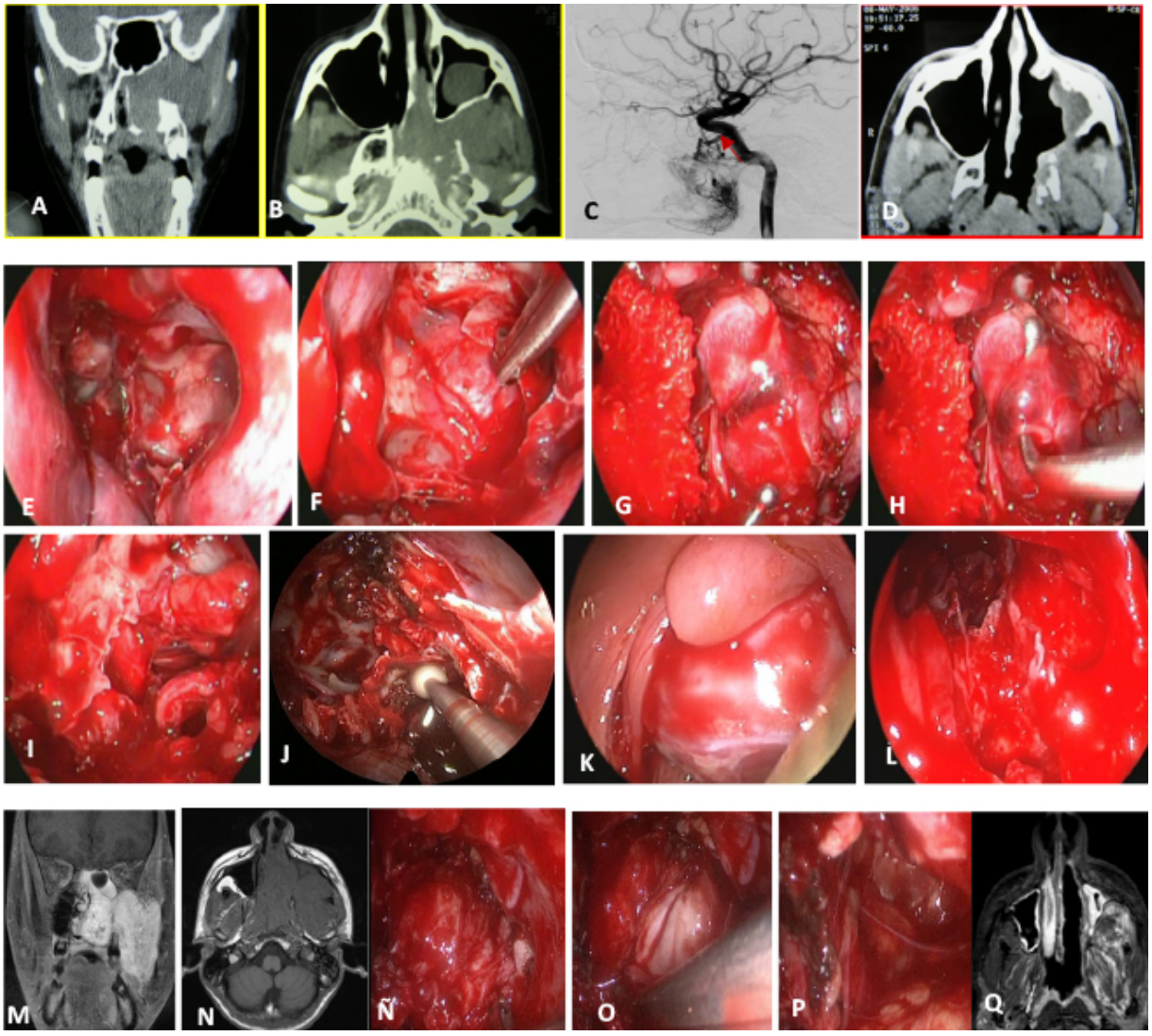
Some studies question whether presurgical embolization reduces recurrence, while others were unable to determine this.[10,11] In our series, we did not perform embolization in two patients with stage I-B and III-B disease; we were able to perform surgery without complications and without the need for blood transfusions in one patient; the other patient received 2 units of blood.

There are various staging systems based on the extent of NAF, but none of them is considered the best for predicting treatment outcomes. Extension into the infratemporal fossa and the intracranial space was associated with a higher risk of transfusions and persistence of NAF.[12]

In our study, we used the Radkowski staging system, which we found to be the best method for staging NAF with intracranial extension. If the extension is minimal, it is classified as stage III-A; if extensive, as stage III-B. It does not take into account whether the invasion is intradural (Andrews classification), which is difficult to determine and very rare.

In our study, 55.55% (10/18) of the treated NAF patients presented with advanced-stage disease (II-C: 4, III-A: 3, and III-B: 3).

Figure 2. Nasopharyngeal angiofibroma: endonasal surgical technique using endoscopes

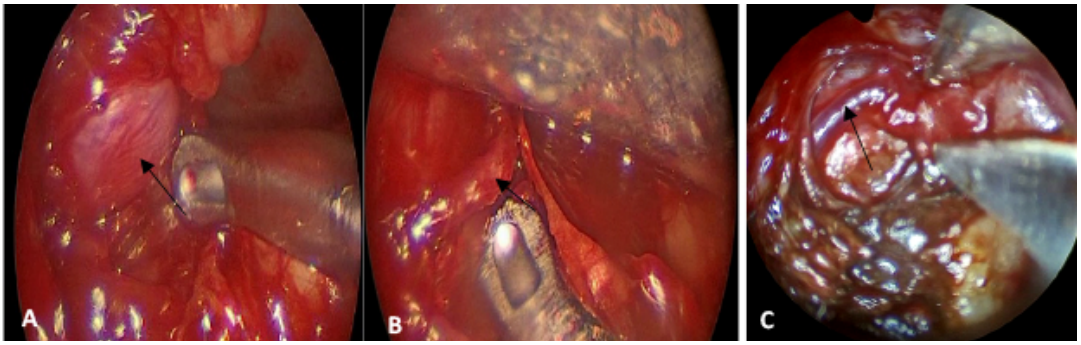


A, B. *Computed tomography showing the AFN extending into the pterygopalatine and infratemporal fossae (stage II-C).*
C. *Digital angiography with preoperative embolization: blood supply from the internal carotid artery is visible (arrow).*
D. *Postoperative CT scan showing no residual tumor.*

Endonasal endoscopic surgical technique
E*. Unilateral nasal corridor (middle maxillary antrostomy, anterior and posterior ethmoidectomy, sphenoidotomy, and middle turbinectomy).*
F. *Resection of the bone of the posterior wall of the maxillary sinus to expose the pterygopalatine fossa (PPF).*
G, H*. Exposure of the maxillary artery in the PPF displaced by the tumor for cauterization.*
I*. View of the PPF after resection of the NAF.*
J. *Milling of the pterygoid process.*
K*. Transoral resection of the NAF.*
L. *Postoperative view following endoscopic resection of the sphenoid sinus and basisphenoid bone via the oral cavity.*

Nasopharyngeal angiofibroma with complete extension into the infratemporal fossa
M, N*. Coronal and axial CT scans.*
Ñ, O*. After dissecting the nasal and sphenoid extensions (fragmentation of the NAF), the infratemporal extension is retracted and dissected toward the nasal cavity.*
P*. View of the infratemporal fossa (ITF) after tumor resection.*
Q. *Postoperative MRI showing no residual tumor.*

Figure 3. Endoscope-assisted transoral access to the infratemporal fossa



A. *The infratemporal extension of the angiofibroma is visible (arrow).*
B. *Dissection of the maxillary artery in the infratemporal fossa (arrow) when the size of the angiofibroma prevents endonasal cauterization in the pterygopalatine fossa.*
C. *Bipolar cauterization of the maxillary artery.*

Snyderman et al. introduced a new classification based on residual vascularization following embolization (perfusion of the internal carotid system), classifying these patients as having advanced-stage disease.[13] In our study, we had 6 patients with NAF who received perfusion of the internal carotid system.

In advanced stages, the endonasal approach can be combined with other access routes to dissect extensions of the NAF into the infratemporal fossa or the orbit.[14,15]

We performed five endoscope-assisted transoral approaches to improve exposure and dissection of the infratemporal extension of the NAF and to cauterize the maxillary artery in the ITF when the tumor was large, making it difficult to access the pterygopalatine fossa for cauterization. In one of these patients, we also performed an endoscope-assisted internal transorbital approach to cauterize the ethmoidal arteries supplying the tumor.

Intracranial extension of NAF is present in 10% to 20% of advanced-stage tumors, but it is not usually transdural.[16] In most cases, extradural intracranial extension can be resected endonasally using endoscopes by traction and dissection of the tumor from the dura mater.[7,16,17] The exception is in cases of reoperation, where the NAF may be more firmly adherent to the dura mater.

In two patients in our study, we combined the endonasal approach with a craniotomy due to an intracranial extension of the tumor that encircled the intracranial internal carotid artery.

A systematic review of the English-language literature on patients with NAF treated surgically between 2012 and 2022 (1586 patients) reported lower recurrence rates in patients treated with endoscopic surgery than in those treated with open surgical approaches.[18]

Another review reported a 10% recurrence rate, but the patients were not stratified by stage.[6] These results are better than those reported for open approaches (14.5% recurrence rate).[6]

In a study of 68 patients with NAF treated with surgery, 26 (38.6%) experienced recurrence. It was concluded that a higher recurrence rate was associated with tumors larger than 4 cm, advanced stages (III-A or III-B), preoperative embolization, transfusion, or an open surgical approach.[18]

In a multicenter study of patients with stage III-A and III-B NAF treated with endoscopic surgery, a residual tumor incidence of 33.33% (26/54) was reported. The most common sites where residual tumor was detected were the pterygoid process and the sphenoid base. In one case with a residual tumor in the cavernous sinus, radiosurgery was indicated. Two other patients were treated with surgery and radiation therapy. The last two patients, along with 16 others with residual tumors, remained asymptomatic, and follow-up MRI scans over an average of 35.6 months showed no tumor growth.[5] In another retrospective study, 45 patients with advanced stage III-A and III-B NAF who were treated using different surgical approaches were evaluated, with an average follow-up of 20.3 months. It was reported that 25 (71.4%) had no residual tumor in the imaging studies.[19]

The pterygoid process is a common site for recurrences and residual lesions; therefore, it is recommended that this bone be extensively debrided at the end of the surgery.[20-22]

Table 1. Patients with nasopharyngeal angiofibromas treated by endonasal endoscopic surgery

N.°	Age	Sex	Staging (Radkowski)	Preoperative embolization	Surgical approach	Transfusion	Local control	Follow-up (years)
1	17	M	I-A	Yes	Endoscopic	No	100%	9
2	18	M	I-B	Yes	Endoscopic	No	100%	5
3	14	M	I-B	No	Endoscopic	No	100%	4
4	15	M	I-B	Yes	Endoscopic	No	100%	1.5
5	14	M	II-A	Yes	Endoscopic	No	100%	8
6	16	M	II-A	Yes	Endoscopic	3 units	100%	9
7	12	M	II-A	Yes	Endoscopic	1 unit	100%	1
8	24	M	II-B	Yes	Endoscopic	No	100%	7
9	11	M	II-C	Yes (internal carotid artery supply)	Endoscopic	ND	100%	
10	18	M	II-C	Yes (internal carotid artery supply)	Endoscopic	5 units	100%	7
12	19	M	II-C	Yes (internal carotid artery supply)	Endoscopic	6 units	100%	3
13	12	M	III-A	Yes	Endoscopic	2 units	Small residual tumor one year later, adherent to the internal carotid artery (8 mm)/reoperation/RT	
14	17	M	III-A	Yes	Endoscopic	3 units	100%	8
15	16	M	III-A	Yes (internal carotid artery supply)	Endoscopic	No	Residual tumor/two reoperations	3
16	27	M	III-B	No	Endoscopic	2 units	Residual tumor in the orbital cone with decreased visual acuity (6 mm)/RT Stable tumor	12
17	12	M	III-B	Yes (internal carotid artery supply	Endoscopic + craniotomy	2 units	Residual tumor in the orbit and intracranial/ Reoperation Stable tumor	3
18	12	M	III-B	Yes (internal carotid artery supply)	Endoscopic + craniotomy	9 units	Residual tumor surrounding the internal carotid artery, with infiltration of the cavernous sinus and enlargement of the pituitary gland/RT Stable tumor?	1

ND: no data; RT: radiotherapy.

Radiation therapy is reserved for patients with recurrent or residual NAF lesions that continue to grow on imaging follow-up and involve critical areas of the skull base (cavernous sinus, internal carotid artery, sellar region, or orbit), which cannot be resected or which, in the surgical team's judgment, may carry a high risk of serious complications.[8,21]

For large tumors, one option may be to resect the extracranial component to reduce the tumor size and thereby decrease the radiation field and the side effects of radiation therapy.

In our study, we recommended radiation therapy for three patients with residual tumors: in one patient, the tumor grew and the patient underwent reoperation, leaving a small remnant attached to the internal carotid artery; another had a residual NAF in the orbital cone with decreased visual acuity; and the third, with stage III-B NAF, had a residual tumor that continued to grow, encircling the internal carotid artery, invading the cavernous sinus and the pituitary gland, and causing unilateral blindness.

In all 3 patients, the tumor remained stable

after radiation therapy, and the patients remained asymptomatic (with no nasal obstruction or epistaxis) (*Figure 4*).

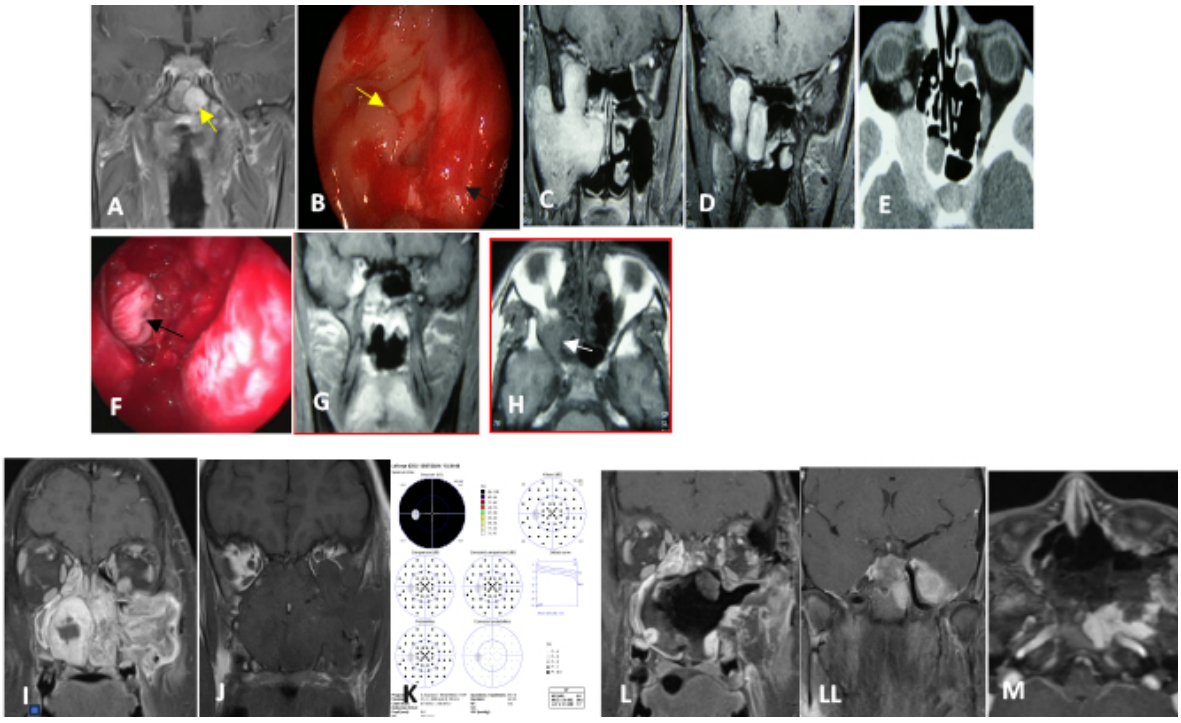
Our findings regarding local control and the presence of residual NAF are consistent with those reported in the literature. However, the small number of patients per stage may limit our conclusions.

The primary objective of this study was to determine local control in patients treated with endoscopic endonasal surgery, defined as complete resection of the NAF (assessed by nasal endoscopy and imaging). It is possible that this objective is not the most appropriate approach, since, as this is a benign tumor, the primary goal is for the patient to remain asymptomatic and for the treatment not to be more aggressive than the natural course of the nasopharyngeal angiofibroma itself. In accordance with this approach, postoperative local control, control of residual angiofibroma growth, and symptom control were achieved in all patients.

CONCLUSION

The overall local control rate we achieved in patients treated for nasopharyngeal angiofibromas using an endonasal approach with endoscopes was 72.22%; local control by stage was as follows: I-A: 1/1, I-B: 3/3, II-A: 3/3, II-B: 1/1, II-C: 4/4, III-A: 1/3, and III-B: 0/3 (0%).

Figure 4. Patients with residual NAF following endonasal surgical treatment, which continued to grow during postoperative follow-up, and were treated with radiation therapy



***Case 1**. Patient with small tumor adherent to the internal carotid artery.*
***A.** MRI showing a small residual NAF attached to the internal carotid artery (arrow).*
***B**. Endoscopic view of the optic nerve (yellow arrow) and internal carotid artery (black arrow) in the sphenoid sinus, showing residual angiofibroma adherent to the internal carotid artery at the conclusion of endonasal rescue surgery.*
***Case 2.** Patient with progressive preoperative visual acuity loss*
***C, D, E.** MRI showing NAF with intracranial, orbital, and infratemporal fossa extension.*
***F.** Endoscopic view of the dissected intracranial extension prior to resection.*
***G, H.** Postoperative MRI showing a small residual NAF in the orbital cone (arrow).*
***Case 3**. Patient with preoperative blindness in the left eye*
***I, J**. MRI showing extensive NAF involving the infratemporal fossa, with intracranial extension invading the cavernous sinus and pituitary gland, and left orbital extension.*
***K**. Visual field: blindness in the left eye.*
***L, LL, M.** Postoperative MRI scans showing residual NAF surrounding the internal carotid artery.*

Nasal obstruction and epistaxis were resolved in all cases.

Endoscopic-assisted endonasal surgery is an excellent option for treating stage I and II nasopharyngeal angiofibromas.

In advanced stages, this technique is also the method of choice for attempting complete resections. To improve visualization of potential extensions of nasopharyngeal angiofibroma, the endonasal approach can be supplemented with other access routes, such as transoral or transorbital approaches, using endoscopes.

In none of the patients who underwent surgery via the endonasal approach did we need to switch to an external approach due to difficulties with visualization or exposure. ■

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