

## Removal of Sinonasal Tumors by the Endonasal Endoscopic Approach

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### Abstract

**Background:** The external approach is the golden standard for sinonasal tumor removal but is associated with several side effects, including facial scars, intracranial and extracranial complications, a long hospitalization period and high costs. Endoscopic sinus surgery enables resection of benign and selected malignant sinonasal tumors and has the advantages of no facial scars, better functional and structural preservation of the sinonasal complex, minimal trauma to surrounding tissue, a shorter hospitalization stay and lower costs.

**Objectives:** To evaluate the advantages and limitations of endoscopic resection of benign and malignant sinonasal tumors, their recurrence and complication rates.

**Methods:** The medical and radiology records of 56 patients who underwent endonasal endoscopic resection of benign and malignant sinonasal tumors between 1996 and 2003 were retrospectively reviewed. Tumors located in the center of the nose and sinuses were endoscopically resected.

**Results:** Six cases of malignant tumor and 50 cases of benign tumor underwent resection by ESS. One of the patients with malignant tumor died, the remainder showing no evidence of disease on follow-up of 3–60 months (mean 26.8 months). Inverted papilloma was the most common benign tumor (40 patients). Seven patients (18%) had recurrence followed by endonasal resection. No major complications were recorded. Hospitalization stay was 2–7 days (mean 3.6 days).

**Conclusions:** Endoscopic resection of benign sinonasal tumors that are centrally located in the nose and sinuses should be considered before the external approach is used. In very carefully selected cases of malignant tumors ESS is oncologically acceptable, but more experience is needed for discerning the indications for endoscopic resection of malignant tumors. The complication rate for endoscopic resection is low, there are no facial scars, hospitalization stay is short, and costs are low.

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Tumors of the nasal cavity and the paranasal sinuses are rare. The external approach is considered the golden standard for the excision of sinonasal tumors, and in most cases enables removal of the tumor with secure margins [1] and reconstruction of the anterior base of the skull with separation from the sinonasal cavity. One of the disadvantages of the external approach is cosmetic deformity, which includes facial scars and facial skeletal deformities. In addition, manipulation of the brain, which is often necessary in the external approach, can cause encephalomalacia, cerebrospinal fluid leak, meningitis, intracranial hematoma, tension pneumocele and other neurologic sequelae [2].

ESS = endoscopic sinus surgery

The exact location of the tumor determines whether the endonasal endoscopic approach can be used for oncologic resection of the lesion. Endoscopic resection of tumors can be considered in lesions that are located in the center of the nasal cavity between the frontal and sphenoidal sinuses and do not extend laterally to the lateral lamella of the pterygoid bone. Based on the anterior and lateral borders, extension of the tumor to the glabella area and to the lateral wall of the maxillary sinus are both considered contraindications for the use of the endoscopic approach because the procedure cannot be controlled safely enough endoscopically [3]. Benign and selected malignant tumors can be considered for endoscopic resection. In certain cases the external and endoscopic endonasal approaches can be combined. The endonasal endoscopic approach is performed with the aid of straight and angled endoscopes (30, 45, and 70 degrees) through the nostrils, resulting in no external marks or incisions. The surgical microscope is used in some centers. The Navigator System, which aids in the localization of the surgical instruments in the surgical field, is used in complicated cases in order to avoid damaging nearby structures such as the meninges of the brain, the orbital contents, the optic nerve and the internal carotid artery. The advantages of the endoscopic endonasal approach over the open approach are superior cosmetic results, lack of damage to the skeletal framework of the nose and paranasal sinuses, preservation of the function of the nose and sinuses, minimal trauma to the surrounding tissue, a shorter postoperative hospitalization period and lower costs [4].

### Patients and Methods

The medical records of patients who underwent endonasal endoscopic resection of benign or malignant tumors at Assaf Harofeh Medical Center between the years 1996 and 2003 were retrospectively reviewed. The location of the tumor dictated the surgical approach. Tumors that were located in the region between the posterior wall of the frontal sinus and the sphenoid sinus and between the lateral lamella of the pterygoid bones were resected endoscopically. When extension of the tumor beyond the medial wall of the maxillary sinus was suspected, endoscopy of the maxillary sinus was conducted through the fossa canina for the complete resection of benign tumors only. Tumors involving the lateral wall of the maxillary sinus were not resected endoscopically. Tumors involving the dura, the orbit, the palate and the skin were not approached endoscopically and were excluded from this study.

The data collected included demographic information, length of hospitalization, complications, and recurrence rates. Notes of the endoscopic examination of the nasal cavity were recorded. An axial and coronal high density computed tomography scan was performed. Sagittal reconstructions were added when frontal sinus or base of skull involvement was suspected. When involvement of the dura or orbit was suspected, a magnetic resonance image was performed. Prior to surgery, a biopsy was performed endoscopically, usually under local anesthesia. General anesthesia was used during the resection. Injection of adrenalin at a concentration of 1:100,000 was used to reduce the hemorrhage. En bloc resection was attempted in small tumors when the origin of the growth was identified. When this was unclear and the tumor filled the nasal cavity, parts of the tumor not involving the nasal cavity mucosa were debulked in order to further anatomically delineate the origin of the tumor's growth. Once located, an en bloc excision of the tumor, with as wide a margin as possible, was performed. Secured margins were confirmed by frozen section. Nearby tissue suspected of involvement with the tumor was resected and sent for frozen section. A Draf II frontal sinusotomy was performed when involvement of the frontal sinus with a benign tumor was suspected. Merocele nasal tampons were used for hemostasis for 24 hours after surgery in all but four cases, in which Quixil (a second-generation fibrin glue) was used, without endonasal tampons.

Osteomas up to 3.5 cm in length were cut into two for evacuation through the nostril. Surgery for fibrous dysplasia was usually conducted to decompress the optic nerve or to enable drainage in cases of chronic sinusitis. Chemotherapy and radiotherapy were used as adjuvant therapy in some cases of malignant tumors depending on the histology, the extent of the tumor spread and the patient's medical condition.

Follow-up was conducted in the clinic with the aid of a rigid or flexible endoscope. Follow-up CT or MRI was carried out if the anterior cranial fossa or orbit was invaded, or when the paranasal sinuses could not be viewed completely in endoscopy. Patients suffering from malignant tumors attended follow-up every 3 months in the first year after surgery and every 6 months thereafter, while patients with benign tumors attended follow-up every 6 months and every year thereafter.

## Results

Among the 56 records that were reviewed, 50 patients had benign tumors and 6 had malignant tumors. Table 1 presents the types of tumors resected. The age of the patients with malignant tumors ranged between 18 and 86 years (mean 59.1) and between 16 and 68 years (mean 46.6) in patients with benign tumors. The follow-up in patients with malignant tumors was between 3 and 60 months (mean 26.8 months). In three of these patients, the medial wall of the maxillary sinus was completely resected with wide margins. In the case of a small polymorphous adenocarcinoma, the origin of which was the lateral wall of the nasal cavity, anterior to the nasolacrimal duct, resection of the bone was conducted with preservation of the nasolacrimal duct, which was unaffected by the surgical procedure.

**Table 1.** Types of tumors resected

Benign tumors	No. of patients	Malignant tumors	No. of patients
Inverted papilloma	40	Malignant melanoma	2
Fibrous dysplasia	4	Squamous cell carcinoma	1
Giant osteoma	3	Undifferentiated sinonasal carcinoma	1
Neurofibroma	2	Polymorphous adenocarcinoma	1
Benign solitary tumor	1	Undifferentiated nasopharyngeal carcinoma	1
Total	50		6

The 60 year old patient with a malignant melanoma is disease-free 5 years after resection, the 79 year old patient with a squamous cell carcinoma is free of disease 4 years after surgery, and the 86 year old woman with a malignant melanoma died 8 months after surgery. The other three patients with malignant tumors were free of disease 3–14 months after surgery.

Inverted papilloma was the most common benign tumor, affecting 40 patients. Endoscopic resection was repeated in all 7 patients (18%) in whom recurrence occurred. Follow-up was conducted with repeated endoscopic inspection of the nasal cavity, biopsy of suspicious tissue, and repeated CT. All other benign tumors were resected with no evidence of recurrence.

No major complications such as CSF leak, intraorbital damage or major hemorrhage were recorded. Synechiae were evaporated by CO<sub>2</sub> laser. Nasal crusts were observed in the immediate post-operative period, and the hospitalization length was between 2 and 7 days (mean 3.6 days). Nowadays, we tend to discharge patients from hospital 1 day after surgery.

## Discussion

The current popularity of the endonasal endoscopic approach can be attributed to recent technologic advancements in endoscopic surgery and the widespread use of angled endoscopes connected to a video camera [3–8]. Modern equipment widens and magnifies the surgical view available to the surgeon. The shaver, which cuts and sucks the tissue and blood, enables fast, clean and safe resection of the tumor. A navigator was not used in our series. Localization was usually achieved with the aid of a CT scan. Endonasal endoscopic resection of tumors mandates a skilled nasal endoscopist.

Tumors of the nasal cavity and paranasal sinuses are rare and comprise 3% of all head and neck tumors, the incidence of these tumors being 0.5–1 per 100,000 [9]. The presenting symptoms of sinonasal tumors are not specific and include discharge, which may be bloody, and nasal obstruction. The tumors usually enlarge indolently and, typically, 4–6 months elapse before a diagnosis is made [10]. Malignant tumors may present in a similar fashion, but cranial nerve involvement, facial swelling, epiphora and proptosis are additional signs that tend to appear in malignant tumors and obviously result in a worse outcome [10].

In our study, four cases presented with exophthalmus – two with giant osteomas and two with fibrous dysplasia. Two other cases

CSF = cerebrospinal fluid

presented with bloody discharge: one had a malignant melanoma and the other had a benign solitary tumor. Forty-three of the 56 (80.3%) cases reviewed complained of unilateral or bilateral fixed nasal obstruction.

The external surgical approach is adequate for tumors extending to the brain, orbit and maxillary sinus. Improved survival rates since the 1960s in all base-of-skull malignant tumors except for nasal carcinoma can be attributed to advances in surgical techniques [9].

The osteomas in our series were all symptomatic, rendering resection necessary. In two cases the presenting symptom was exophthalmus. Evacuation through the nostril necessitated dividing the tumors into two sections because of their dimensions. Asymptomatic osteomas were managed by annual follow-up in our clinic. If symptoms appeared a CT scan was conducted. The three cases of osteomas in our review had nasal polyposis as well. One had a benign neurofibroma filling the nasal cavity and an osteoma extending from the anterior base of the skull, adherent to the lamina papyracea. The tumor was resected with the aid of a diamond bur. There was no penetration to the anterior skull base or orbit.

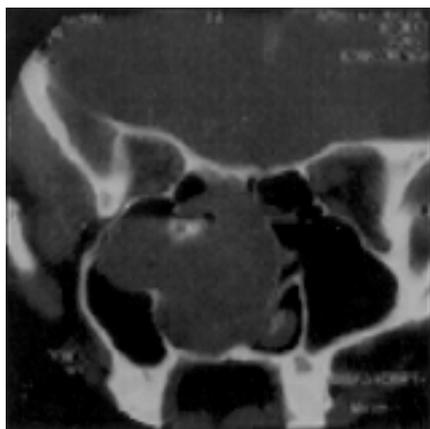
All four patients with fibrous dysplasia who were operated on were symptomatic. Two suffered from exophthalmus with compression of the optic nerve that necessitated decompression, and the other two suffered from chronic sinusitis resulting from blockage of the sinus drainage channels. We encountered one case of a benign solitary tumor, which is a highly vascular tumor. Embolization via angiography preceded surgery [Figures 1–3].

Quixil is a biologic glue with adhesive and hemostatic properties. Its use after the resection of nasal tumors, some of which were large, proved to be as efficient in preventing bleeding as nasal packing [11].

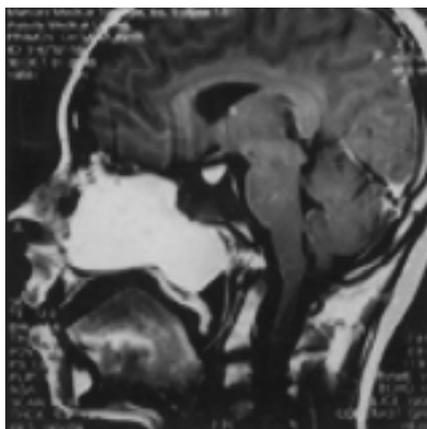
The literature mentions using the endonasal endoscopic surgical approach in malignant tumors of the following types: adenocarcinoma, squamous cell carcinoma, osteosarcoma, chordoma, adenoid cystic carcinoma [6], malignant melanoma [12], and olfactory neuroblastoma [5]. The endoscopic approach is also recommended

for special biopsies of tumors penetrating to the sphenoid sinus from the sella, the petrous apex and adjacent areas [3]. Opponents of the endoscopic approach claim that endoscopic resection is carried out by piecemeal resection rather than by en bloc resection, the latter being a fundamental rule of oncologic surgery. In some cases, debulking of the tumor is needed to identify the origin of the lesion. Once this has been achieved the origin of the tumor can then be resected en bloc. We believe that the latter approach is oncologically acceptable. Furthermore, meticulous use of frozen sections is of utmost importance for achieving an acceptable oncologic result. Chemotherapy and radiotherapy are added, depending on the type of tumor and its extent.

We believe that the endonasal endoscopic approach is the method of choice for the resection of benign tumors. Only in cases where the tumor is located such that it cannot be approached endoscopically should the external approach or the combined approach be considered. Types of tumors that can be resected endonasally include juvenile nasopharyngeal angiofibroma, fibrous dysplasia, meningioma, pleomorphic adenoma, neurilemmoma, inverted papilloma and osteomas [6]. Inverted papilloma usually appears as a unilateral polyp that may be red in color. The differential diagnosis includes antrochoanal polyp, fungal infection and other sinonasal tumors. In 10–15% of cases of inverted papilloma there is a malignant transformation to squamous cell carcinoma, but such malignant transformations were not observed in our study [13]. Our recurrence rate of inverted papilloma (18%) is similar to that reported by Keles and Deger (19%) [7] and Schlosser et al. (23%) [14]. These results are similar to the recurrence rates when using the aggressive external surgical approach [15]. The recurrence rate of inverted papilloma after resection using the open approach is 0–70%. Krouse [16] concluded from his review of endoscopic resection of inverted papilloma that the endoscopic approach has lower morbidity and lower recurrence than the open approach. In our series there were no recurrences in other benign tumors. Draf [3] reported an 11% rate of recurrence or residual tumor in his study, mostly due to inverted papilloma.



**Figure 1.** A coronal CT scan of a patient with a benign solitary tumor filling the nasal cavity, penetrating the maxillary sinus, pushing the nasal septum and occluding the opposite side of the nasal cavity.



**Figure 2.** A sagittal T1 MRI of the same patient with a benign solitary tumor, which demonstrates the tumor filling the nasal cavity and penetrating to the nasopharynx. Note that there is no dural involvement.



**Figure 3.** A coronal CT scan of the same patient a year after surgical resection of the tumor.

In the study by London et al. [17], 16.7% of benign tumors resected endoscopically (not including inverted papilloma) required revision surgery. Though major complications were not encountered in our review, CSF leak, major hemorrhage and blindness could occur, especially in large tumors extending to the orbit and anterior cranial fossa.

## Conclusion

This study is the first Israeli series of endoscopic endonasal resection of tumors. The endoscopic approach is preferred over the external approach for benign tumors due to superior cosmetic and functional results and a low complication rate. For malignant tumors, there are presently no guidelines and more experience is needed. Therefore, careful selection is necessary when considering the endoscopic approach in malignant tumors. The endoscopic approach can be used for biopsy of tumors extending into the nasal cavity and paranasal sinuses from the anterior cranial fossa and the orbit.

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