

# Endoscopic Endonasal Approach to Skull Base Lesions. Surgical Outcome

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## Abstract

**Introduction:** The complexity of the pathology treated by this route, frequently of tumor origin, lies in the close anatomical relationship that they have with important neurovascular structures which, most of the time, are deformed, displaced or completely engulfed in them.

**Methods:** A retrospective, descriptive, cross-sectional study was carried out. The universe of study was made up of all the patients operated by an endoscopic endonasal approach at the Institute of Neurology and Neurosurgery, in the period from May 2017 to April 2021.

**Results:** A sample of 65 patients was identified. The average age was 52 years. Among the treated lesions, patients with pituitary macroadenomas (52.3%), followed by craniopharyngioma (20%) predominated. The postoperative complications that were recorded in our series were postoperative CSF fistula, epistaxis and vascular lesion (frontopolar artery) with a total of 3 cases (4.6%) and two deaths (2.9%) The degree of tumor resection in our series was total in 64.7% of the cases operated on by both the standard endoscopic endonasal approach (21.5%) and the extended approach for 43.2%.

**Conclusion:** The endoscopic endonasal approach is a fundamental tool for the management of most lesions of the anterior cranial base and the sellar / parasellar region because it allows for extensive resections with a relatively low number of complications.

**Keywords:** Endoscopic Endonasal Approach • Skull Base • Macroadenoma • Craniopharyngioma.

## Introduction

The endoscopic endonasal approach to the base of the skull represents one of the great challenges facing a neurosurgeon. The complexity of the pathology treated by this route, frequently of tumor origin, lies in the close anatomical relationship that they have with important neurovascular structures which, most of the time, are deformed, displaced or completely engulfed in them. Another situation is added in the special case of craniopharyngiomas and pituitary adenomas (mainly secreting ACTH or GH), which trigger a series of hormonal metabolic events that hinder the pre, trans and postoperative management of these patients [1,2].

Albert E. Halsted is credited with the first successful resection of a tumor in the sellar region in 1909, who published it a year later, as an oronasal approach to the pituitary by a gingivolabial incision [3]. Harvey Cushing and Oskar Hirsch played an important role in the transsphenoidal approach to the sellar region. In 1909 Cushing described his first surgery by a transsphenoidal route and the partial removal of the pituitary gland in a patient with acromegaly. This technique was abandoned years later by Cushing himself, for reasons of safety and poor visualization [4]. However, Hirsch developed and continued to perform the technique, reporting his series of 12 patients with pituitary tumors, at a congress held in Berlin in 1911 [5]. The introduction of the surgical microscope in 1971 by Jules Hardy opened new doors to the transeptosphenoïdal pathway [6].

In 1963, when Guiot et al. [7], first introduced the use of the endoscope

during pituitary surgery as a form of assistance to the use of the microscope, Apuzzo reported the successful excision of tumors of the sellar region by the endonasal route. microsurgical supported by endoscopy in 1970.

The working group of Dr. Ricardo Carrau and Dr. Jho published in 1997 the first 50 cases of "purely" endoscopic approaches to the sellar region [8]. In 2006 Gustavo Hadad and Luis Bassagaiteguy [9], published their contribution on the usefulness of pedicled flaps (the nasoseptal flap) for the closure of the defect created by the creation of the same sinonasal corridor [9,10]. This contribution demonstrated a 50% reduction in CSF fistulas, and complemented the technique described in 2004 by Cappabianca managing to incorporate the reconstructive phase into the nasal, sphenoidal and sellar phases already described. Subsequently, the works by Carrau et al. [11], on the reverse flap with a report of a CSF fistula index lower than 5% and the most recent lateral flaps, also devised by Hadad.

The sinonasal corridor provides a common entrance to access a great variety of anatomical sectors of the skull base and thus address a group of pathologies that are neuroendoscopic treatment. Unifying concepts in our institution, this procedure began in 2017, using the scheme proposed by Amin Kassam in 2011, after intervening its first 800 patients.

The objective of our work is to present the surgical results obtained in patients operated on by means of the different variants of the endoscopic endonasal approach to skull base lesions at the Institute of Neurology and Neurosurgery.

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## Case Presentation

A retrospective, descriptive, cross sectional study was carried out. The universe of study was made up of all the patients operated by an endoscopic endonasal approach at the Institute of Neurology and Neurosurgery, in the period from May 2017 to April 2021.

For the realization of the Endoscopic Endonasal Approach in its different Modular variants described by Kassam, we used a rigid endoscope of 0°, 30° and 45° of 4 mm in diameter and 18 cm in length (Karl Storz GmbH and Co., Tuttlingen, Germany), with the 4 hand technique, 2 surgeons. The reconstruction method used in all cases was the multilayer technique, using autologous fat and fascia lata and a vascularized nasoseptal flap (Figure 1).

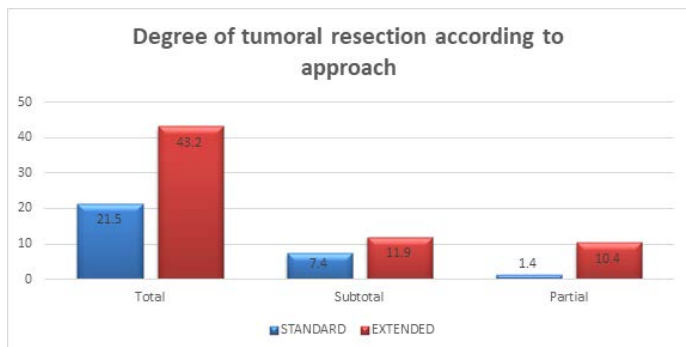


Figure 1. Degree of tumor resection.

The data were obtained from a data collection worksheet. All patients in the study previously gave their informed consent. In the statistical tests performed, a significance level of  $p < 0.05$  was used. Fisher's exact test was used to correlate the qualitative variables and the results were shown using tables for better understanding.

Table 1. Clinical and surgical characteristics of the sample.

Variables	Number (%)
<b>Age groups</b>	
18-30	11 (16.4%)
31-50	27 (40.2%)
51-70	29 (44.6%)
<b>Sex</b>	
M	25 (38.4%)
F	42 (62.6%)
<b>Histology</b>	
Pituitary macroadenoma	34 (50.7%)
Adenoma n-20 Invasive n-14	13 (19.4%)
Olfactory Groove Meningioma	5 (7.4%)
Sellar tubercle meningioma	3 (4.4%)
Chordoma of clivus	4 (5.9%)
Suprasellar cholesteatoma	1 (1.4%)
Juvenile Angiofibroma	1(1.4%)
Basilar impression	1(1.4%)
CSF fistula	2(2.9%)
Suprasellar germinoma	1 (1.4%)
Esthesioneuroblastoma	2 (2.9%)
<b>Approaches</b>	<b>ow</b>
Standard	20 (29.8%)
Transtuberculum	14 (20.8%)
Transplanum/ transtuberculum	26 (38.8%)
Transcribiform	10 (14.9%)
Transclival	4 (5.9%)
Transodontoid	1 (1.4%)

Table 2. Complications according to surgical approach.

Approaches	CSF fistula			Epistaxis			Intraoperative Vascular Rupture			Deceased		
	No	%	p	No	%	p	No	%	p	No	%	p
Transplanum-transtuberculum	1	1.4	0.99	1	1.4	0,99				1	1.4	0.99
Transtubérculo	1	1.4	0.99									
Transclival										1	1.4	0.99
Transcribiforme							1	1.4	0.99			
<b>TOTAL</b>	<b>2</b>	<b>2.9</b>	<b>0.99</b>	<b>1</b>	<b>1.4</b>	<b>0.99</b>	<b>1</b>	<b>1.4</b>	<b>0.99</b>	<b>2</b>	<b>2.9</b>	<b>0.99</b>

## Results

A sample of 65 patients was identified. The average age was 52 years. The male female ratio was 0.7:1. Among the treated lesions, patients with pituitary macroadenomas (52.3%), followed by craniopharyngioma (20%) predominated.

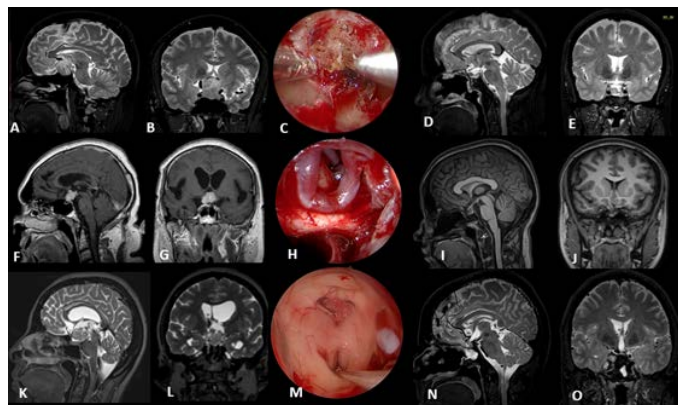
The postoperative complications that were recorded in our series were postoperative CSF fistula, epistaxis and vascular lesion (frontopolar artery) with a total of 3 cases (4.6%). In the case of the CSF fistula (infundibular craniopharyngiomas), it was necessary to put spinal drainage and direct

closure of the fistula through the endonasal route, the case of epistaxis was 15 days after the operation, I presented access of sneezing (allergic rhinitis) and Suddenly, it begins with intense and diffuse bleeding, it is taken to the operating room and tamponade is performed, resolving 5 days after it and the case of the vascular lesion, during the excision of a meningioma of the olfactory groove in the final dissection of the tumor. The frontopolar artery was torn, the situation resolved with its coagulation, without having neurological or clinical implications (Table 1).

The methodology used to repair the CSF fistula was spinal drainage for 5 days and close for 24 hours, if it is reactivated, open drainage for 5 more days and if it reactivates, (Figure 2) we proceed to direct repair of the fistula

with fatty tissue, fascia lata, repositioning the HB flap.

**Figure 2.** Sagittal and coronal preoperative MRI images, as well as intraoperative captures of different lesions of the sellar-suprasellar region operated by endoscopic endonasal approach. A-E: Pituitary macroadenoma. The sellar phase is observed, during the opening of the dura of the floor of the sella turcica (C). F-J: Meningioma of the sellar diaphragm. The final intraoperative image is observed after total excision of the lesion, visualizing the right anterior cerebral artery, the chiasm and the pituitary stalk (H). K-O: Adamantinomatous craniopharyngiomas. The final image of the third ventricle is observed after gross total resection of the lesion (M).



The degree of tumor resection in our series was total in 64.7% of the cases operated on by both the standard endoscopic endonasal approach (21.5%) and the extended approach for 43.2%. Coinciding with what has been suggested by other series where the degree of total resection is what is observed [12,13].

## Discussion

Endoscopic endonasal surgery has undoubtedly revolutionized the management of cranial base injuries, especially injuries to the sellar, suprasellar and anterior cranial base regions. Initially one of the disadvantages attributed to these approaches was the higher frequency of cerebrospinal fluid fistula, but with the adoption of the nasoseptal flap described by Hadad-Bassagasteguy said this complication was reduced from 50% to less than 5%, especially when combined with a multilayer closure recommended by Kassam.

Pituitary adenomas were the first tumors to be approached by endonasal endoscopic route by neurosurgeons, 1-8 and the development of this technique has led them to constitute today the procedures of choice in most patients, because they have shown superiority in regarding the results of the microsurgical transeptosphenoïdal approach.

Craniopharyngiomas are benign tumors that originate from the craniopharyngeal duct and present a high surgical challenge due to their relationship with the hypothalamus, the polygon of Willis, the visual pathway and the pituitary. When analyzing the evolution of treatment in these patients, it can be observed that "open" surgical approaches have traditionally been limited by the need for brain retraction and work through a narrow surgical window around large vessels. On the other hand, while total resection provides the best results in terms of local control and progression free interval, in certain cases an intentional subtotal resection is performed to preserve hypothalamic and pituitary function. In the present series, resection was total in all patients, which is related to the classification of these lesions as they were all pre-infundibular craniopharyngiomas with little hypothalamic adherence, which is associated with better surgical possibilities. Other minimally invasive approaches to these lesions have been described, such as the supraorbital keyhole; however, this approach is limited by its poor visualization of the ipsilateral optic nerve and the sellar region, as well as the superior third ventricle. The traditional pterional

approach continues to be the one of choice in neurosurgeons who do not master the endoscopic endonasal technique [14].

Meningiomas of the anterior cranial base can be divided according to their origin into meningiomas of the olfactory groove, the sphenoid plane, and those of the sellar tubercle. The optimal surgical approach is still a controversial topic and is still under debate. Importantly, recent literature has suggested that the Simpson scale, traditionally used to assess the degree of tumor resection in these types of lesions, is less relevant for meningiomas of the anterior cranial base than it is for meningiomas of the convexity, because adjuvant radiotherapy to residual or recurrent lesions is particularly effective in the latter lesions [15].

Standard (transcranial) surgical approaches to these injuries require the neurosurgeon to work in the narrow space between the carotid, the middle cerebral artery, the anterior cerebral arteries, and the optic chiasm. In fact, there is often a residual lesion at the level of the optic canal. In recent years, a group of modifications have been described that include the supraorbital keyhole approach and several modifications of the pterional craniotomy and anterior interhemispheric approaches.

The endoscopically assisted supraorbital approach in particular has been extensively described reducing the need for significant manipulation of the frontal lobe and optic nerves. One study noted a high total resection rate (93%) and visual improvement (90.9%) compared to previous results [16]. In these lesions, the absence of a cortical mantle over the tumor has been considered an element that increases the risk of vascular damage; however, this does not constitute an absolute contraindication for the endoscopic endonasal approach, assuming that the surgeon is adept at bimanual dissection. The endoscopic endonasal approach extended to the anterior cranial base, the tubercle and the sphenoid planum also has the advantage of an early devascularization of the lesion by ligation of the anterior ethmoid arteries, and the possibility of also resecting the implantation base. Another aspect to be discussed is the anosmia observed in the majority of patients operated on by means of a transcribiform approach, which should be taken into account and approached selected cases [17,18].

Cranial base chordomas are unusual lesions derived from remnants of the notochord [19-21]. Surgery remains the ideal treatment, but is limited by relationships with neurovascular structures. Due to their site of origin they are idea lesions (Table 2).

## Conclusion and Recommendation

The endoscopic endonasal approach is a fundamental tool for the management of most lesions of the anterior cranial base and the sellar / parasellar region because it allows for extensive resections with a relatively low number of complications.

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## Conflicts of Interest

Authors declare that there are no source of funding and no conflicts of interest in this work.

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