

# Endonasal Approach to Tumors of the Pituitary Fossa: A Shift in the Treatment Paradigm

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There have been significant advances in the surgical treatment of pituitary tumors over the last century. Paradigm shifts occurred with the introduction of the transsphenoidal route, the intraoperative use of x-ray, the option of dopamine antagonists, and the use of the surgical microscope.<sup>1</sup>

In the last 15 years, there has been an explosion of articles describing a transsphenoidal approach using the endoscope as a sole means of visualization. Driving this novel approach is the superior view one has of the sphenoid sinus and pituitary fossa. However, a paradigm shift in the management of pituitary tumors requires robust comparative studies showing clear benefits in outcomes. Advantages would include fewer intraoperative or postoperative complications, more complete resections, a higher incidence of biochemical or radiological cure, or even documentation of less postoperative pain and shorter recovery periods. Any advantage would be well received.

Until now, cavernous sinus invasion by pituitary adenomas has been a poor prognosticator and in some minds a contraindication to surgery. This has largely been the result of the added difficulty of operating in the cavernous sinus when using the operating microscope that sees only in a straight line between the surgeon's eyes and the pathology on which it is focused. Opening the anterior wall of the cavernous sinus is possible and frequently described, but it is a psychological impediment to many surgeons because of the venous bleeding, variable location of the carotids, and relative unfamiliarity with its anatomy when approached from the anterior-inferior angle. The endoscope allows the surgeon to follow the tumor from the sella into the cavernous sinus using the natural plane created by the tumor's invasion. Staying in this plane results in less bleeding, increased safety, and more complete resections.

To evaluate the outcomes of purely endoscopic approaches to pituitary tumors in a moderate-volume center, we reviewed our last 160 cases for surgical outcomes. This represents a volume more applicable to most neurosurgical centers. We perform a large volume of other skull base and

intracranial endoscopy and have a dedicated operating room team that assists in these cases.

## METHODS

After local Institutional Review Board approval was obtained, a retrospective chart and radiographic review was performed on the last 160 pituitary adenoma removals performed by the senior author at the Centre for Minimally Invasive Neurosurgery. Patients were selected for surgical management if they displayed chiasmopathy or other neurological deficit directly attributable to the adenoma, evidence of biochemical hormonal derangement not amenable to medical management, concerning growth on serial magnetic resonance imaging scans, or apoplexy. Extrasellar extension was not a contraindication to surgery. All patients had full endocrinological and neuroophthalmological examination both preoperatively and postoperatively.

Surgery was performed with a "2-nostril" approach. Stereotactic guidance was used as confirmation of the locations of the carotid arteries, adenoma, and normal anatomy, especially during repeat operations. When necessary, a transtuberular extension was performed. All surgeries were performed with the endonasal endoscopic approach without the addition of the surgical microscope. Details of the approach have been published elsewhere.<sup>2</sup> It is important to note that during the operations, 0°, 30°, and 70° endoscopes were used to maximize the view of any extrasellar (suprasellar or cavernous sinus) extension.

Surgical outcomes for nonsecreting tumors were quantified as gross total or subtotal on the basis of postoperative magnetic resonance imaging. Magnetic resonance imaging is routinely performed 3 months postoperatively and yearly thereafter. For biochemically active tumors, the resections were quantified as gross total or subtotal, and postoperative endocrine laboratories were performed to assess the resolution of hormonal imbalance.

## RESULTS

Over the time period of 2006 to 2010, 160 surgeries were performed on 160 patients for pituitary adenoma (112

female patients, 70%). The average age was 34 years (range, 3-77 years).

Patients had undergone previous microsurgical or endoscopic resection by other surgeons and presented with recurrences in 22 cases (14%). Overall, 76 tumors (47.5%) were biochemically active (32 prolactin, 22 ACTH, 21 growth hormone, and 1 gonadotropin; Table).

One hundred twenty-six patients (79%) presented with tumors confined to the sella. Thirty-four patients (21%) presented with extension of the adenoma into the cavernous sinus.

All patients had at least 1 year of follow-up (mean, 20 months; range, 46-13 months). For the group as a whole, 134 patients (84%) had gross total resections. Analysis of the groups based on adenoma hormonal activity shows that the active group had gross total resections/biochemical cure in 67 of 86 cases (78%). Notably, the group with Cushing disease had gross total resections/biochemical cure in 22 of 22 cases (100%). The group with nonsecreting adenomas had gross total resections in 74 of 84 cases (88%) Patients with nonsecretors were no more likely to have gross total resections/biochemical cure than patients with secreting adenomas ( $P = .65$ , Fisher exact test).

Cavernous sinus invasion was not a predictor of incomplete resection ( $P = 1.00$ ; Table). This was true for the group as a whole and for individual comparisons based on hormonal activity.

There were no significant complications in this series. One patient operated on during this time period died 2 weeks after surgery of myocardial infarction and was excluded because of the 1-year follow-up cutoff.

## DISCUSSION

Throughout the history of medicine, and surgery in particular, technology and methods have evolved. There is often reluctance by established practitioners to accept or embrace newer methods and technology because of skepticism regarding its effectiveness or because of a significant learning curve required to use the newer technology.<sup>3</sup> More often than not, the skeptics turn out to be correct. Generally, high-quality

studies must confirm the benefit of the newer technology/method over the gold standard before general acceptance. We are in the middle of this process with regard to the use of endoscopy for skull base surgery, including pituitary adenomas, and the verdict has yet to be returned.

Over the course of the last century, pituitary surgeons have incorporated a series of advances that have increased the available operative field in the sellar/parasellar region while decreasing the destructiveness/invasiveness of the approach (Figures 1 and 2). Recently, proponents of endoscopy have lauded the increased visualization, better lighting, minimally invasive nature, reduced nasal trauma, and ability to operate outside of a straight line between microscope and pathology as reasons to adopt this method.<sup>4,5</sup>

Many articles have been published over the last 15 years describing the outcomes of endoscopic pituitary surgeries amounting to a collection of Class III evidence in support of this practice. These articles have generally been produced by large-volume centers that are recognized as leaders in the endoscopic movement. Several meta-analyses have been published on the safety and efficacy of endoscopic surgery.<sup>5-10</sup> There have been no Class II or better studies in the English-language literature that can be considered strong evidence of the superiority of one method of visualization over another. We agree with Dr Edward Oldfield's remark, "It is premature for claims of superiority to be made for one approach over another until the facts are in."<sup>11</sup> He also argues that the answer may not lie in either extreme but somewhere in the middle: "Larger suprasellar tumors and tumors extending laterally beyond the direct view of the operating microscope are often best addressed with the endoscope, whether endoscopic surgery alone or endoscope assisted, whereas the very small tumors, those occurring with some frequency in Cushing's disease, may be best addressed with the operating microscope." There is likely a population of tumors that may be removed equally well by either method, depending on the surgeon's particular skill with each.

As we developed facility with the endoscope, we adopted a purely endoscopic approach. There was a learning curve in the lead-up to this adoption. The last 160 cases of

**TABLE.** Preoperative and Postoperative Hormonal and Cavernous Sinus States of 160 Pituitary Adenomas

Hormonal Status	Total, n	Gross Total, n (%)	Cavernous Sinus Invasion, n	Gross Total, n (%)	No Cavernous Sinus Invasion, n	Gross Total, n (%)	<i>P</i>
Nonsecretor	84	74 (88)	18	16 (89)	66	58 (88)	1.00
Prolactinoma	32	23 (71)	8	6 (75)	24	17 (71)	1.00
Cushing disease	22	22 (100)	2	2 (100)	20	20 (100)	1.00
Acromegaly	21	14 (67)	5	3 (60)	16	11 (69)	1.00
Gonadotropin	1	1 (100)	1	1 (100)	0	0	N/A
Total	160	134 (84)	34	28 (82)	126	106 (84)	1.00

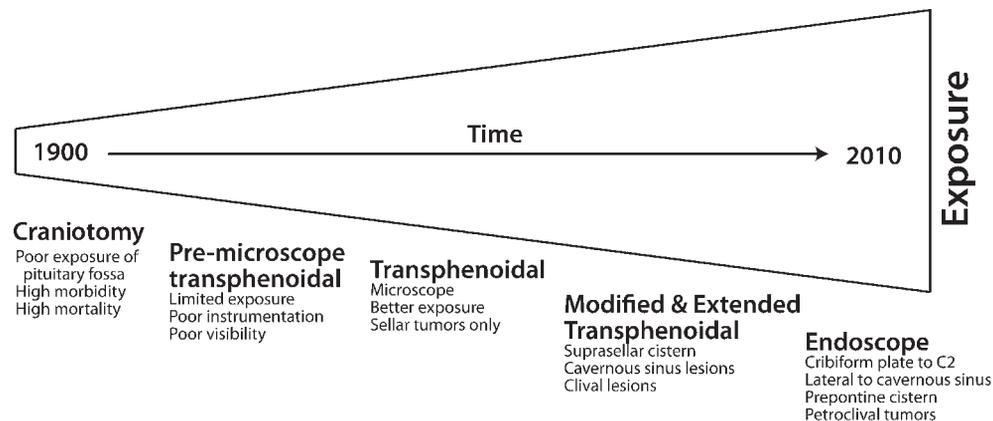


FIGURE 1. Exposure to the sella, suprasellar, and parasellar regions has increased over the past century.

adenoma included here are past the steeper part of this learning curve. The endoscope is particularly useful when operating in the cavernous sinus or the suprasellar region. In our hands, the view is unarguably superior and allows bimanual visualized dissection from sensitive neurovascular structures (Figure 3). With this moderate-sized series, we are able to demonstrate that cavernous sinus invasion does not significantly affect the ability to achieve gross total resection/cure. Second, we were able to demonstrate equivalence in outcome between secreting and nonsecreting tumors (Figure 4).

The value of being able to see laterally through the medial wall of the cavernous sinus and superiorly through the inferior wall cannot be stressed enough. Direct vision, dissection, manipulation, removal, and assessment of residual disease are possible and more easily achievable with the endoscope. This theoretically should increase the safety of cavernous adenoma removal compared with the blind “feel” approaches required with the operating microscope. This remains to be proven or disproven in the literature.

Surgical outcomes for cavernous sinus extension are promising with the endoscopic approach. The literature reports 0% to 75% remission rates with secreting adenomas invading the cavernous sinus; however, most results are clustered in the 50% to 75% range.<sup>12-17</sup> However, nearly all reports indicate that the results are worse for cavernous sinus extension lesions than for sellar/suprasellar lesions. Our results of 60% to 100% are similar to the previously published numbers; in this series, however, there is no difference between lesions confined to the sella/suprasellar area and those with cavernous sinus extension. As is the natural history with secreting adenomas, there are sure to be later recurrences than what is captured by our current follow-up. On the basis of this finding, we are counseling patients with secreting adenomas and cavernous sinus extension that they have a reasonable chance of being tumor free with surgery alone and are recommending surgery as first-line treatment in nearly all cases of secreting adenomas with the exception of some smaller or easily medically managed prolactinomas.

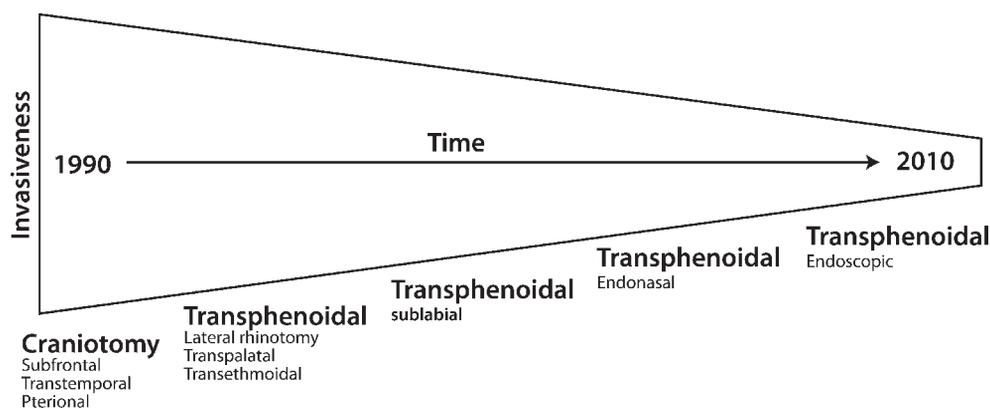
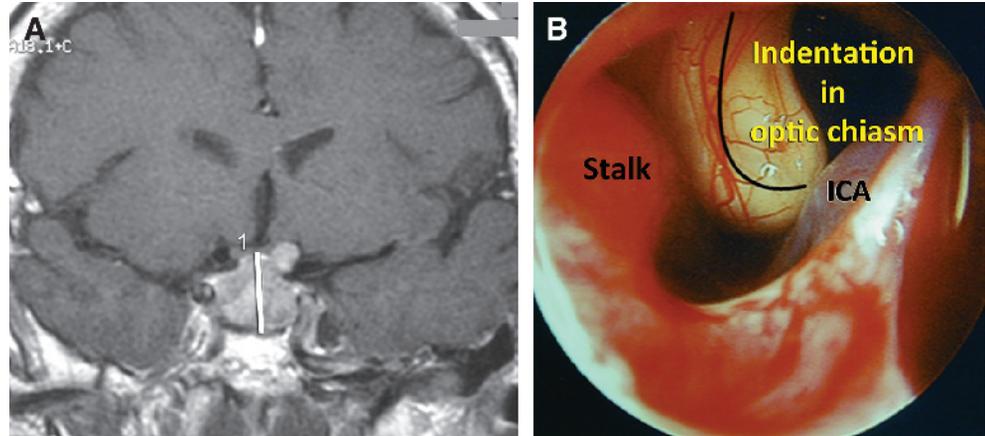


FIGURE 2. Invasiveness of the exposure of the sella, suprasellar, and parasellar regions has decreased over the past century.

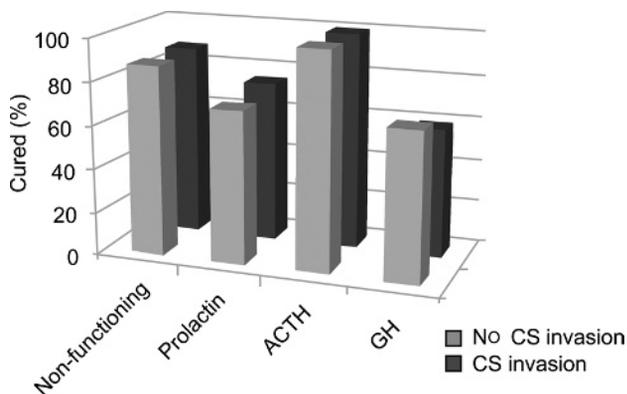
**FIGURE 3.** This 38-year-old man presented with chiasmopathy from this large nonsecreting adenoma with suprasellar extension and chiasmal compression (A). Endoscopic view with the 30° endoscope illustrates the excellent view of the decompressed chiasm and adjacent carotid artery (B). ICA, internal carotid artery.



As is the case with any newer technology, a proper comparison of techniques needs to be performed, and more data will help us define the situations in which endoscopy alone or endoscopy-assisted approaches are better equipped to achieve surgical cure.

## CONCLUSIONS

Endonasal endoscopic resection of pituitary tumors invading the cavernous sinus allows improved visualization compared with the microscopic view. This improved visualization allows complete resection of the adenoma in a much higher percentage of cases compared with the use of the microscope. Cavernous sinus invasion need not be a negative prognosticator when recommending the surgical management of adenomas with extrasellar extension.



**FIGURE 4.** Graphic depiction of the surgical outcomes of 160 patients undergoing endoscopic resection of their pituitary adenomas. There is no statistical difference in outcome when comparing intrasellar only and cavernous sinus extension, nor is there any difference when comparing nonsecretors and secretors. ACTH, adrenocorticotropic hormone; CS, cavernous sinus; GH, growth hormone.

## Disclosure

Dr Teo is a paid consultant for Aesculap.

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