Endoscopic Endonasal Infrasellar Approach to the Sellar and Suprasellar Regions: Technical Note

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ABSTRACT

We report a technical variation of the endoscopic endonasal approach to the sellar and suprasellar regions which relies on the use of a 45-degree angled endoscope. The so-called “infrasellar approach” aims at excising lesions situated within the intermediate and posterior lobes of the pituitary gland without damaging the anterior lobe, thus potentially minimizing endocrinological morbidity. In this regard the endoscopic infrasellar approach might be advantageous in selected cases when compared with the traditional transsphenoidal approach with the microscope. We describe the technique and illustrate it with representative clinical cases.

KEYWORDS: Endoscopic endonasal approach, infrasellar approach, 45-degrees angled endoscope, Rathke’s cleft cysts, Cushing disease, hypothalamic pilocytic astrocytoma

The vast majority of pituitary adenomas sit on the anterior lobe of the pituitary gland. A few adenomas, and typically Rathke’s cleft cysts (RCCs), are primarily located in the intermediate or posterior lobes of the gland. In these cases, a microsurgical transsphenoidal approach to the sella must cross an intact anterior lobe.

There has been some controversy regarding the technical superiority of the endoscope as a visualization tool during the resection of sellar lesions. Nowadays, it has been well established that the endonasal endoscopic approach offers at least similar results than the microscopic transsphenoidal approach when treating pituitary adenomas.¹ Some obvious advantages of the endoscope reside on the fact that the wide angle and dynamic endoscopic view allow for truly expanded approaches. This marks a difference when dealing with large adeno-

mas with several degrees of parasellar and suprasellar extension. The advantage of the endoscope for purely sellar lesions has not been demonstrated and one of the criticisms to the endoscopic technique is that the lack of stereoscopic vision may impair the ability of the surgeon to remove small intrasellar lesions when compared with the microscopic approach.

In the current study, we present a technical variation of the endoscopic endonasal approach for sellar lesions, which we will refer to as the “infrasellar approach.” This modification is perfectly suited for lesions located posterior to the adenohypophysis that can therefore be removed without the need to transgress intact gland. In this note, the technical nuances of the endoscopic infrasellar approach are presented and illustrated with selected clinical cases.

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Skull Base 2011;21:335–342. Copyright © 2011 by Thieme

Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662.

Received: January 27, 2011. Accepted: March 6, 2011. Published online: June 9, 2011.

DOI: <http://dx.doi.org/10.1055/s-0031-1280682>.

ISSN 1531-5010.

TECHNICAL NOTE

The basic techniques of the endoscopic endonasal approach to the sella have been described in detail elsewhere.^{2,3} Once the sphenoid sinus has been widely opened, the next step involves the bony removal of the sellar floor from anterior to posterior to reach the dorsum sellae. The width of the bony exposure should ideally reach the inferomedial margin of the cavernous sinus bilaterally.

This approach is dependant on the continuous use of an angled scope (45 degrees) during the exposure of the sellar floor and the intrasellar portion of the procedure. The smaller convexity of the sellar floor at the level of the posterior gland is typically recognized. In cases of expansive lesions located in the intermediate or posterior lobes, a distinct dural tint might be identified. The dura of the sellar floor, as it is usually done for the dura of the sellar front, is opened in a cruciate fashion. Depending on the location of the lesion, direct access will be obtained without any need for dissection through the anterior lobe of the pituitary gland. In some cases such as RCCs, which completely split anterior and posterior lobes, direct entrance into the cyst contents is obtained inferiorly without even opening the dura covering the anterior gland. For pituitary microadenomas located in the intermediate or posterior lobes, typically adrenocorticotrophic hormone (ACTH) secretor adenomas, some degree of dissection and exploration will be required within these lobes, but without any additional manipulation of the anterior lobe. Not only angled scopes but also curved instruments are employed when performing the infrasellar access. The assistance of an experienced endoscopist during the procedure is critical, since two instruments and the scope will share a very limited space. As opposed to previous descriptions (Fig. 1A),³ the angled scope sits now on the inferior margin of the right nostril (the 6 o'clock position), and the ipsilateral instrument (normally a curved tear-drop suction) is placed at the upper margin (the 12 o'clock position) (Fig. 1B). This positioning implements the inferior to superior view provided by the endoscope allowing for identification of the sellar roof (or dural diaphragm) and pituitary aperture. In cases of lesions located in the posterior gland and extending into the suprasellar space, the pituitary aperture will guide the access.

CASE 1: RATHKE'S CLEFT CYST

Presentation

A 36-year-old woman presented with a 6-month history of persistent severe generalized headaches with no obvious neurological deficit. Neurological evaluation did not reveal any obvious source for the headaches

Figure 1 (A) Relative positions of endoscopic endonasal instruments during approach with 0-degrees endoscope. (B) Relative positions of instruments during the infrasellar approach with 45-degrees angled endoscope. E, endoscope; I, other instrument; S, suction.

except for an abnormal magnetic resonance imaging (MRI) study that showed an intrasellar hypointense cystic lesion compatible with a RCC (Fig. 2). In the absence of other causes for her headache, the patient was offered and underwent an endoscopic endonasal approach to the intrasellar cyst.

Surgical Procedure

After removal of the right middle turbinate, a wide sphenoidotomy was performed. This was then extended inferiorly to remove the rostrum of the sphenoid sinus and the bone of the sella was drilled out to expose both cavernous sinuses (Fig. 2B). The floor of the sella was completely removed allowing for the inferior part of the pituitary gland to be completely exposed and to be looked at with the use of the 45-degrees angled endoscope. The anterior pituitary gland was gently elevated but not all transected to facilitate access to the cavity from an inferior to superior route. The dural covering of the sella was opened inferiorly as described above at the translucent area corresponding to the cyst. The use of the angled scope from an infrasellar route made it easy to identify the most superficial area of the cystic lesion. The gelatinous highly proteinaceous fluid was completely drained and the opening of the cyst enlarged to "marsupialize" the cystic cavity (Fig. 2C-E). The normal tissue belonging to the neurohypophysis was clearly identified

Figure 2 (A) Contrast enhanced sagittal T1-weighted MR clearly showing the interface between anterior gland, Rathke's cleft cyst (RCC), and posterior gland. (B) Zero-degrees endoscopic intraoperative picture demonstrating the dural opening inferiorly, while most of the anterior gland is still covered by dura. (C) Endoscopic intraoperative picture showing the view of the inferior opening with a 0-degrees endoscope as opposed to (D) with the 45-degrees endoscope. (E) The 45-degrees endoscope has been advanced further showing detailed anatomy of the pituitary stalk and posterior gland.

after drainage of the cyst (Fig. 2E). Finally the sella was covered by a free mucosal graft harvested from the middle turbinate previously removed, paying attention not to cover the inferior part of the gland to leave the drainage pathway open.

Postoperative Course

The headaches were immediately improved after the procedure. There were no neurological or endocrinological abnormalities when the patient was discharged 2 days later.

CASE 2: ACTH SECRETING PITUITARY MICROADENOMA

Presentation

A 46-year-old woman presented with clinical and biochemical diagnosis of Cushing disease. The initial MRI scan was negative and inferior petrosal sinus sampling showed increased central/peripheral ACTH ratio bilaterally failing to lateralize the lesion to one side. More careful evaluation of the original MRI revealed a suspicious 2-mm hypointense lesion in contrast enhanced T1-weighted imaging located in the pars intermedia of the pituitary gland which dictated the choice to approach the gland from an infrasellar route (Fig. 3A).

Surgical Procedure

The sellar face and floor were drilled with a 4-mm diamond burr to expose both cavernous sinuses and the superior and inferior intercavernous sinuses. The dura covering the pituitary gland was then opened in a

cruciate fashion caring to preserve the pituitary capsule. After introducing the 45-degree angled endoscope it became possible to approach the pituitary gland from its inferior wall, thus minimizing the damage of the adenohypophysis. The gland was opened with sharp dissection choosing the shortest route to the area corresponding to abnormality seen on the preoperative images. A subtle interface between normal gland and softer abnormal tissue was identified and carefully taken advantage of with blunt dissection until the microadenoma was completely delivered (Fig. 3B) and the posterior gland was clearly demonstrated (Fig. 3C).

Postoperative Course

The serum cortisol level dropped dramatically to less than 1 $\mu\text{g/dL}$ within 36 hours from the operation requiring cortisol replacement for adrenal insufficiency symptoms. From the endocrinological as well as the neurological point of view the postoperative course was uncomplicated and the patient was discharged after

Figure 3 (A) Contrast enhanced sagittal T1-weighted MR showing the small hypointense nodule in the pars intermedia. (B) Intraoperative picture with 45-degrees endoscope. The microadenoma has been excised with minimal dissection of the anterior gland. (C) Intraoperative picture with 45-degrees endoscope to demonstrate the integrity of the posterior gland.

5 days. Two weeks after the operation cortisol levels were repeated after discontinuing hormonal replacement. Cortisol levels were again undetectable. At 2 months follow-up the patient continues in clinical remission with decreased weight, normal blood pressure, and discontinuation of oral metformin treatment.

CASE 3: HYPOTHALAMIC PILOCYTIC ASTROCYTOMA

Presentation

A 44-year-old woman was referred to with a history of headache and irregular menstrual cycles and an MRI scan allegedly showing a pituitary lesion. After more careful examination of the imaging it was noted that the tumor was intimately attached to the pituitary stalk as well as to the posterior part of the gland (Figs. 4A and 4B). There was significant compression of the optic chiasm; however, there were no visual field defects on Humphrey's perimetry test. The most likely diagnosis was thought to be craniopharyngioma, with pituicytoma and granular cell tumor as less likely possibilities.

Surgical Procedure

The initial steps were similar to the previous cases. A combined infrasellar-suprasellar approach with pituitary transposition was planned. A nasoseptal mucosal flap was harvested as previously described.⁴ Once wide sphenoidotomies and posterior ethmoidectomies were performed, the bone of the sella and tuberculum sellae was removed with a 4-mm diamond burr, while the thicker bone at the medial opticocarotid recess was thinned down using a 3-mm burr. The exposure extended down to include the sellar floor and laterally to uncover both cavernous sinuses and parasellar carotids. The distal dural rings and the optic nerves at the entrance into the optic canal were also clearly exposed bilaterally. The dura of the sella as well as the suprasellar area was widely opened to expose the entirety of the gland, pituitary stalk, and optic nerves. Although it was not possible to clearly discriminate between tumor and pituitary stalk, it became evident that the bulk of the tumor was posterior to the pituitary gland (Fig. 4C). After dissection of the gland from the pituitary aperture and medial walls of the cavernous sinus, and infrasellar trajectory was undertaken with the aid of the 45-degrees angled endoscope. This allowed developing a plane of dissection between the anteriorly located pituitary gland and the tumor posterior to it, and successful tumor resection all the way up to the hypothalamic region (Fig. 4D). The posterior communicating branches as well as the superior hypophyseal arteries were identified and preserved bilaterally. Intraoperative histological examination showed the tumor to

be a pilocytic astrocytoma so this was completely excised with the exception of a layer of capsule that was left behind at the level of the inferior hypothalamus (Figs. 4E and 4F). An intraoperative specimen of the capsule showed no tumor cells. The dural defect was covered with the nasoseptal flap which was kept in place by an intranasal Foley balloon.

Postoperative Course

The patient awoke without any neurological deficits suggestive of hypothalamic damage. Not unexpectedly, the patient developed adrenal insufficiency and diabetes insipidus, which required her to be discharged on hormonal replacement and oral DDAVP. Further follow-up will reveal whether the structural preservation of the pituitary gland and stalk is accompanied by functional restoration.

DISCUSSION

Variants of the endoscopic approach to the sellar region include the transellar (through the anterior gland), suprasellar (superior to the gland), parasellar (lateral to the gland—cavernous sinus), and retrosellar (posterior to the dorsum sella) approaches.^{5–10} In this article we described the endoscopic infrasellar approach to the intermediate and posterior lobes of the pituitary gland.

The pituitary gland is anatomically divided in pars distalis, intermedia, and nervosa. The anterior lobe of the pituitary gland is formed by the pars distalis and the pars intermedia. The pars distalis comprises the majority of the anterior pituitary and it is here that the bulk of pituitary hormone production occurs. Occasionally, the pars distalis is incorrectly used as a synonym for the anterior pituitary. The pars intermedia is normally either very small or entirely absent in adulthood. In human fetal life, this area produces melanocyte stimulating hormone (MSH), which causes the release of melanin pigment in skin melanocytes.¹¹ The pars intermedia is a recognized location for ACTH-secreting microadenomas and is the typical location for RCC for embryological reasons.^{12,13} The pars nervosa or posterior lobe of the gland is rarely affected by cysts or tumors. Oldfield's group has reported 12 patients with Cushing disease in whom an ACTH-staining adenoma was contained entirely within the posterior lobe of the pituitary.¹⁴

In comparison to conventional microscopic transphenoidal approaches, the infrasellar endoscopic approach allows for effective drainage and resection of intermediate and posterior lobes lesions with complete preservation of the anterior lobe of the gland. Whether this anterior lobe sparing technique carries better endocrinological results remains to be demonstrated, but it

Figure 4 (A and B) Preoperative contrast enhanced sagittal and coronal T1-weighted images: the anterior gland is compressed and displaced inferiorly by the bulk of the intrasellar and suprasellar lesion. (C) Intraoperative picture with 0-degrees endoscope: the dura of the sella and suprasellar area has been opened to expose the anterior gland; the pituitary stalk and the tumor cannot be clearly discriminated. (D) Intraoperative picture with 45-degrees endoscope: the pituitary gland has been transposed to facilitate the debulking of the tumor from an inferior to superior direction. (E and F) Postoperative contrast enhanced sagittal and coronal T1-weighted images: the small tumor capsule remnant over the inferior hypothalamus and the nasoseptal flap enhance after contrast administration.

makes sense from an anatomical and surgical point of view to avoid transgression of normal tissue whenever possible. The drainage of an RCC through a transellar approach might later be compromised by the anterior gland collapsing on it. If an infrasellar drainage route between the anterior and the posterior gland is established, in theory, both gravity and a more consistent anatomical pathway should prevent recollection. The results of the endoscopic approach using a 45-degrees angled endoscope purely for RCC were reported in a previous publication, with excellent endocrinological outcomes and minimal morbidity rates, supporting its effectiveness.¹⁵

In the cases of functional microadenomas located in the intermediate or posterior lobes, the infrasellar approach provides a more direct access to the lesion with less intraglandular dissection and exploration needed. The location of ACTH-secreting adenomas in the pars intermedia has been well described,¹⁶ although their distinct biogenetical behavior in relation to pars distalis adenomas is not proven. Some authors concluded that there is little direct evidence for involvement of the residual zona intermedia of the adult human pituitary in the development of Cushing disease.¹⁷ In any case, the pars intermedia is defined as the most posterior portion of the adenohypophysis, and its limit is the well-defined posterior gland. In two of the previously illustrated cases, removal of the pars intermedia lesions (Rathke's cyst and microadenoma) was achieved when the distinct pars nervosa was entirely exposed.

Intrasellar craniopharyngiomas tend to displace the anterior gland forward and downward, but craniopharyngiomas primarily situated in the stalk and infundibulum are much more frequent.^{18,19} A suprasellar and/or retrosellar approach is the preferred approach for these lesions. Granular cell tumors and pituicytomas are also more commonly located in the suprasellar area but intrasellar or combined locations are possible,²⁰ and therefore a combined infrasellar-suprasellar approach will be needed. In the present note, we report a hypothalamic pilocytic astrocytoma resected through a combined infrasellar-suprasellar approach that not only facilitated structural preservation of the gland but also radical subtotal removal of the tumor with continuous visualization of the neurovascular structures at risk.

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