Endoscopic Endonasal Transsphenoidal "Above and Below" Approach to the Retroinfundibular Area and Interpeduncular Cistern—Cadaveric Study and Case Illustrations

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Key words
- Clivus
- Endoscopic endonasal
- Interpeduncular cistern
- Pituitary gland
- Retroinfundibular area
- Suprasellar cistern
- Transsphenoidal approach

Abbreviations and Acronyms
CSF: Cerebrospinal fluid
IC: Interpeduncular cistern
ICA: Internal carotid artery
MRI: Magnetic resonance imaging
SD: Standard deviation

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■ OBJECTIVE: **To evaluate the feasibility of reaching the interpeduncular cistern (IC) through an endoscopic endonasal approach that leaves the pituitary gland in place.**

■ METHODS: **In a series of 10 injected cadaver heads, the transtuberculum ("above") and transclival ("below") approaches were combined, without pituitary transposition. Using 0-degree, 30-degree, and 45-degree endoscopes, the extent of overlap and if a blind spot occurred were determined. Also, the visualization of the IC was compared with the transposition of the pituitary gland approach. Nonparametric statistics were used to evaluate the results. The approach was implemented in 2 patients.**

■ RESULTS: **For both the "above" and "below" views, there was a statistically significant increase in field of view when comparing the 0-degree endoscope with either the 30-degree endoscope ($P < 0.05$) or the 45-degree endoscope ($P < 0.05$). There was no difference between the 30-degree endoscope and the 45-degree endoscope ($P > 0.05$) in the "below" approach, but there was a difference ($P < 0.05$) in the "above" approach. There was no blind spot with any combination of endoscopes. There was no practical statistically significant difference between the transposition approach and the "above and below" approach. The "above and below" approach was used successfully in 2 surgeries.**

■ CONCLUSIONS: **It is possible to work both "above" and "below" the pituitary gland to reach the IC through an endoscopic endonasal approach. The advantages are the maintenance of normal pituitary and parasellar anatomy and the minimization of the size of the skull base defect. There is no blind spot using this approach that would be revealed with a pituitary transposition. The feasibility of this approach has been confirmed in 2 patients.**

INTRODUCTION

The retroinfundibular region and interpeduncular cistern (IC) together form an anatomic area that lies behind the dorsum sella, defined posterolaterally by the cerebral peduncles of the mesencephalon. Superiorly, its limits consist of the optic apparatus and anterior recess of the third ventricle. Posteriorly, the IC is limited by the mammillary bodies and the basilar artery along with the posterior cerebral arteries. The lateral boundaries are the oculomotor nerves and posterior communicating arteries along with its perforators. Anteriorly, the IC margins are the sella, pituitary gland, and pituitary stalk (11). Various pathologic conditions can extend into or arise within this area, including craniopharyngiomas, pituitary adenomas, meningiomas, chordomas, epidermoid tumors, and basilar tip aneurysms. The retroinfundibular and interpeduncular space lies at the base of the brain and is a challenging area to approach transcranially because it is surrounded by many critical neurovascular structures. Several well-described transcranial skull base approaches have been developed to reach this area (17, 24, 26, 34, 35, 38, 44, 45).

The transsphenoidal approach to the retroinfundibular region and IC provides a more direct access route that avoids brain retraction and the requirement to work through small triangles defined by the cranial nerves and the internal carotid artery (ICA) and its branches. However, the pituitary gland and superior and inferior hypophyseal arteries create an obstruction in the line of sight, which limits access and leads to a risk of panhypopituitarism. Modifications of the transsphenoidal approach have been described to overcome the obstruction provided by the pituitary gland including partial resection of the gland and pituitary transposition to reach this challenging area (10, 23, 32, 33, 43).

In our experience, using pituitary transposition or pituitary resection to reach large tumors not only distorts normal hypophyseal anatomy and increases the risk of hypopituitarism but also results in a large defect in the skull base, which can be challenging to close in

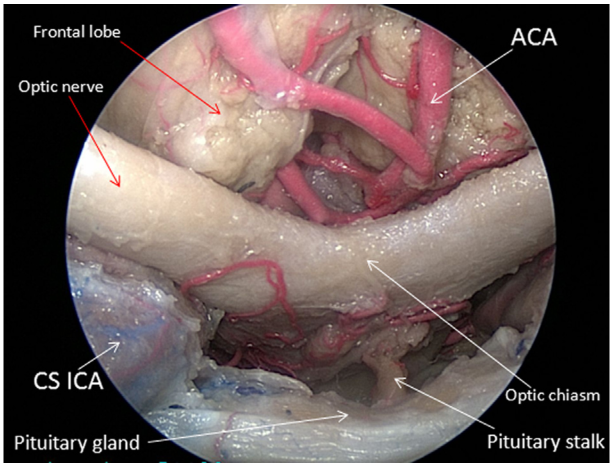

Figure 1. Endoscopic image with a 0-degree endoscope in a cadaveric specimen demonstrating the field of view provided from the transplanum, transtuberculum approach "above" the pituitary gland. ACA, anterior cerebral artery; CS, cavernous sinus; ICA, internal carotid artery.

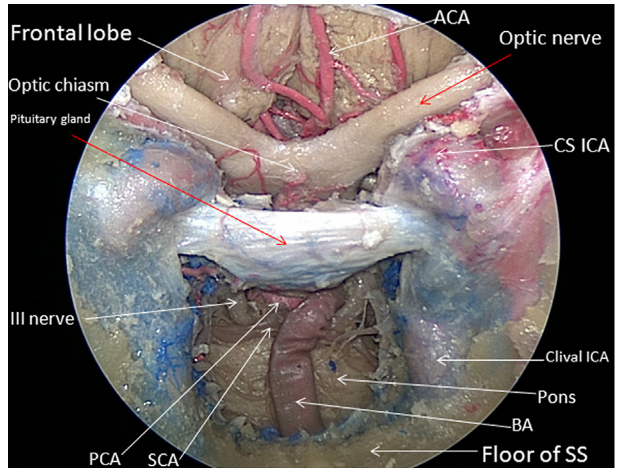

Figure 2. Endoscopic image with a 0-degree endoscope in a cadaveric specimen demonstrating the field of view provided by combining the transplanum, transtuberculum "above" approach with the transclival "below" approach. ACA, anterior cerebral artery; CS, cavernous sinus; ICA, internal carotid artery; BA, basilar artery; SS, sphenoid sinus; SCA, superior cerebellar artery; PCA, posterior cerebral artery.

a watertight fashion. We have developed an alternative technique that takes advantage of the endoscope and its increased field of view and ability to look around corners using angled scopes. We describe an approach to the retroinfundibular space and IC that we call the "above and below" approach because it combines routes above and below the pituitary gland but leaves the gland and its overlying dura intact. This approach creates 2 smaller openings in the skull base, which are easier to close, and increases the preservation of normal pituitary and parasellar anatomy. In this article, we describe the approach in cadaveric studies, quantify the field of view, and describe 2 clinical cases in which the approach was used.

METHODS

Cadaveric Specimen Preparation

The study was performed on 10 alcohol-preserved, colored silicon–injected cadaveric heads. The ICAs and the jugular veins were cannulated and injected with silicone pigment compound (Dow Corning, Midland, Michigan, USA). The cadaveric heads were soaked in 70% ethyl alcohol for at least 24 hours.

Surgical Approach

The cadaveric head was placed in a three-pin Mayfield head-holder in a neutral position and slightly extended. Under endoscopic visualization by a 0-degree, 18-cm-long, 4-mm-diameter rigid endoscope (Karl Storz, Tuttlingen, Germany), the middle and superior turbinates were retracted laterally, and the sphenoid ostia were identified bilaterally. The posterior 1 cm of the nasal septum adjacent to the vomeric bone and maxillary crest was resected. The sphenoid ostia were opened with a Kerrison rongeur (Codman/Johnson & Johnson, Raynham, Massachusetts, USA), and a complete sphenoidotomy was achieved. The mucosa of the sphenoid sinus was removed, and the rostrum was drilled flush with the floor of the sphenoid sinus using a XMax pneumatic drill (Anspach, Palm Beach Gardens, Florida, USA). The intersinus sphenoid septum was removed using a rongeur forceps, and the posterior wall of the sphenoid sinus was brought into full view.

"Above" Approach (Above the Pituitary Gland: Transtuberculum Transplanum Approach)

The details of the transtuberculum transplanum approach have been previously described and published (2, 4, 21, 28). Briefly, the anterior wall of the sella was opened using a high-speed drill, curette, and Kerrison rongeur. The opening was extended above the level of the diaphragma sella, and the planum sphenoidale was partly removed. The dura above and below the intercavernous sinus was opened using a sickle knife, and the sinus was transected. The optic chiasm, optic nerves, pituitary stalk, pituitary gland, anterior communicating artery complex, and bilateral A1 and A2 segments of the anterior cerebral artery were brought into view. The arachnoid of the suprasellar cistern was incised, and a corridor was opened between the pituitary gland and the optic chiasm (Figure 1). In our specimens, the average distance between the optic nerves as they enter the optic canals was 11.4 mm (range, 10.1–12.8 mm; standard deviation [SD], 0.92) (Table 1).

Working on either side of the stalk and introducing the 0-degree, 30-degree, and 45-degree endoscopes in turn, we examined and quantified the degree of visualization of the retrosellar/interpeduncular area and its contents, including the superiormost aspects of the basilar tip, posterior cerebral and superior cerebellar arteries, and third cranial nerve. Although the corridor above the pituitary gland and lateral to the pituitary stalk looks narrow, it is possible to work through this corridor because in real cases the tumor itself usually displaces the stalk laterally, providing enough room to work through this corridor.