

# Endoscopic Endonasal and Keyhole Surgery for the Management of Skull Base Meningiomas



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## KEYWORDS

• Endoscopic surgery • Keyhole • Skull base meningiomas

## KEY POINTS

- The supraorbital keyhole approach and the endoscopic endonasal approach to the anterior skull base allow for minimally invasive resection of anterior cranial fossa meningiomas.
- The supraorbital keyhole approach has been shown to provide higher rates of gross-total resection of anterior cranial fossa meningiomas when compared with endoscopic techniques.
- Rates of postoperative visual deterioration are higher with the supraorbital keyhole approach when compared with endoscopic techniques.
- The endoscopic endonasal approach has higher rates of postoperative cerebrospinal fluid leakage.
- The individual radiographic and anatomic characteristics of each tumor must be the main determinant in choice of surgical approach.

## INTRODUCTION

Anterior skull base meningiomas comprise a diverse group of tumors that can involve a wide range of locations, including the olfactory groove, planum sphenoidale, tuberculum sellae, parasellar region, anterior clinoid process, and petrous ridge.<sup>1</sup> Collectively, these neoplasms account for approximately 10% of all intracranial meningiomas.<sup>2–4</sup> Patients typically present with vision loss and headache, although more uncommon symptoms, such as endocrine disturbances, hydrocephalus, anosmia, or extraocular movement palsies, may occasionally be seen.<sup>5</sup>

Historically, the traditional approaches for the resection of anterior skull base meningiomas have focused on several different transcranial routes, including the more common pterional craniotomy, the unilateral subfrontal craniotomy, and the bilateral subfrontal craniotomy.<sup>6</sup> More recently, introduction of the surgical

endoscope into the neurosurgical armamentarium has allowed for minimally invasive approaches to the anterior skull base. The supraorbital keyhole approach and the endoscopic endonasal approach, both techniques in which the endoscope aids immensely in intraoperative visualization, have been developed to provide alternative, less-invasive approaches to aid the resection of these tumors. The determination of which approach is most appropriate depends greatly on the anatomic and imaging features of the meningioma in question and its relationship to critical neurovascular structures<sup>3,7,8</sup> (Figs. 1 and 2). In this article, we review the supraorbital keyhole and extended endoscopic endonasal approaches for the resection of anterior skull base meningiomas.

## THE SUPRAORBITAL KEYHOLE APPROACH

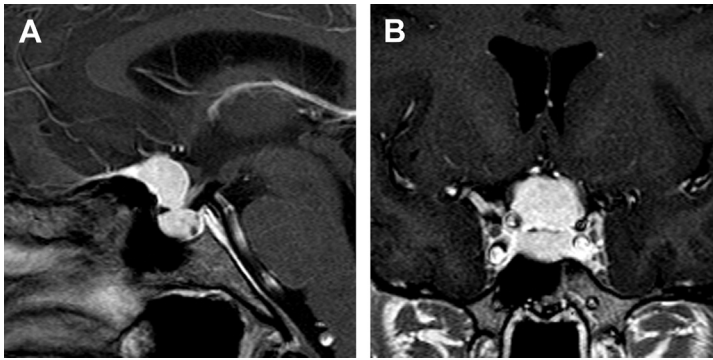
The supraorbital keyhole approach is a minimally invasive technique that provides access to a

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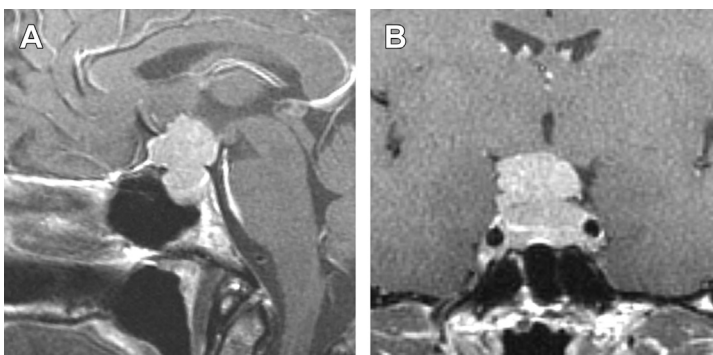
**Fig. 1.** Sagittal (A) and coronal (B) MRIs of a typical tuberculum sellae meningioma.

wide range of pathology along the anterior cranial fossa floor and the parasellar region. The addition of endoscopy allows for improved illumination and enhanced visualization of previously hidden areas while still maintaining the benefits of a traditional craniotomy and the familiarity of standard microsurgical dissection techniques. Initial tumor exposure and resection are typically performed with the operative microscope. The endoscope may then be used to magnify the field of view and visualize areas not within the line of sight of the microscope (eg, looking around anatomic corners using angled lenses). Many surgeons advocate for early introduction of the endoscope into the operation to improve visualization of tumor not well visualized using the operative microscope.<sup>9</sup>

The supraorbital keyhole approach is advantageous in its allowance for direct visualization and dissection of tumor from critical neurovascular structures of the anterior skull base. It is truly a minimally invasive approach in that the bone flap typically required is only  $3 \times 2$  cm, and the incision can be made via an eyebrow. It allows the surgeon familiarity of working with standard microneurosurgical instruments during tumor resection, from a standpoint of working between both optic nerves and with an option of working both inferior and superior to the optic chiasm. Additionally, the

supraorbital route does not confine the surgeon to working between confined anatomic triangles to reach the suprasellar region, such as the optico-carotid triangle. Meningiomas that extend superior and lateral to the optic nerve, difficult to reach from a transnasal approach, can be easily removed from the supraorbital route.<sup>10</sup> Compared with pterional and subfrontal craniotomies, this approach requires far less brain retraction to visualize the tumor, and does not necessitate splitting of the Sylvian fissure. Also, unlike transnasal approaches, the supraorbital route has a minimal risk of postoperative cerebrospinal fluid (CSF) leakage.<sup>11</sup> Patients who undergo this procedure have the potential for shorter operative times and hospital stays, improved postoperative pain, and better cosmetic outcomes compared with traditional transcranial approaches.<sup>9</sup> With the addition of endoscopy, better operative field illumination and the ability to achieve an angled view of hidden areas are possible.

Drawbacks of the supraorbital approach include the potential for decreased maneuverability through the small craniotomy, the possibility for damage to the frontotemporal branch of the facial nerve, and the risk of entering the frontal sinus during the bony opening.<sup>6,12</sup> Tumors that extend into the midline depression of the anterior cranial base



**Fig. 2.** Sagittal (A) and coronal (B) MRIs of a typical diaphragm sellae meningioma.

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