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Supraorbital Craniotomy: Pro and Cons of Endoscopic Assistance

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Up until several decades ago, large craniotomies were the only method of surgical treatment for intracranial tumors. Various approaches to lesions in the anterior cranial fossa and sellar region have been described in the literature under various names related to the extent and shape of the craniotomy, but none of these satisfied the criteria of a minimal-access surgical procedure. Because of the continual evolution of the neurosurgery practice, reduced invasive procedures with significantly minimally invasiveness gradually have been introduced and have gained more widespread acceptance. Wide-ranging approval for these reduced approaches has been gained from neurosurgeons as alternative methods to previous larger craniotomies. These techniques, soon adopted throughout the surgical community and accepted by the general population, have contributed partly to changes in the field of neurosurgery.

Although most would associate the birth of reduced craniotomies for the approach of tumors of the anterior cranial fossa tumors with Perneczky (19), the credit should give to D. H. Wilson, the first neurosurgeon who embraced this philosophy and coined the term "keyhole surgery." He stated that "The ideal exposure is one which is large enough to do the job well, while preserving the integrity of as much normal tissue as possible. We make no fetish of keyhole surgery" (26). The aforementioned authors have been credited with contributing significantly to the development of modern minicraniotomies.

A limited-sized craniotomy is one that allows an unhindered approach to the tumor and is associated with the least amount of manipulation of the brain. The benefits of this approach for patients include shorter duration of hospital stay, decreased postoperative pain, better outcome, minimal complications, early convalescence, and improved quality of life. During the past two decades, minimal-access surgical approaches have been used increasingly to access anterior cranial base lesions (1, 10, 11, 20, 21, 23).

The evolution of neurosurgical and anesthesiologic techniques has reduced surgery-related traumatization of patients, who now have more comfortable postoperative outcomes. Furthermore, the evolution of microsurgical techniques and the development of preoperative and intraoperative diagnostic tools have enabled neurosurgeons to treat different lesions through limited and specific keyhole approaches. A supraorbital keyhole approach via an eyebrow incision and supraorbital minicraniotomy is one of the most commonly used keyhole approaches to treat lesions located in this area. The term "keyhole" has the characteristic that "may imply a concept of geometric construction of the surgical approach with a choice of the correct limited craniotomy, as a key characteristic for entering a particular intracranial space," aimed to target a lesion through a short, direct, precise route (20).

In supraorbital "eyebrow" craniotomy, the skin incision is made within the eyebrow; it extends just medial to the supraorbital notch (care must be taken to avoid injury to the supraorbital nerve) and courses laterally and inferiorly to the termination of the eyebrow (1). The craniotomy should be performed away from the frontal sinus if possible, even though a prominent frontal sinus is habitually not a contraindication. If the frontal sinus is

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violated, cranialization can be performed with bone wax, muscle, and a pericranial flap (16). A simplified cranial base closure yields a rapid patient recovery compared with traditional larger craniotomies.

Indications for the supraorbital approach include most tumors of the anterior skull base, as well as tuberculum sellae, planum and anterior clinoid meningiomas, some olfactory groove meningiomas and craniopharyngiomas, and anterior circulation aneurisms (21). It should be stressed that there is no standard technique used in all instances, and the choice of surgical approach must be based on the patient's preoperative status, size of the tumor, location and extent of the lesion, and its relationships with neurovascular structures. It is fundamental, as explained by Chen and Huang, "to use the most suitable approach for a particular patient rather than using a one-size-fits all approach for all patients" (4). As a result, multiple variations of the supraorbital craniotomy via "eyebrow" incision, tailored to the individual patient, have been developed in recent years.

Placement of the craniotomy can be extended up to 1 cm beyond the eyebrow; in this manner, additional pterional (minipterional craniotomy), orbital, and zygomatic (miniorbitozygomatic craniotomy) osteotomies have been developed to address particular types of lesions to assure their best management and optimize surgical efficacy (3, 12, 24).

These minicraniotomies, which strive to treat lesions not considered amenable with the standard supraorbital approach, allow for a steep angulation of surgical viewing and may be potentially helpful in the presence of larger lesions that extend superiorly, aneurysms of middle cerebral artery and its branches, intraventricular craniopharyngiomas, and lesions located on the inferior and lateral sphenoid ridge. A mini fronto-orbito-zygomatic approach via an eyebrow incision is considered safe, effective, suitable, and convenient for treating pediatric lesions, especially at the sellar region (7).

In some cases the location and extent of the tumor dictate the potential need for an alternative craniotomy. Lateral supraorbital (10, 21) and traditional bifrontal craniotomy (18) is preferred by some surgeons for some large olfactory groove meningiomas, thanks to previous control of the internal carotid artery at the beginning and during tumor removal. The microscopic extended transsphenoidal technique has been proposed by Weiss (25) as an alternative to traditional open limited approaches. The endoscopic endonasal expanded approaches have had a further role by establishing a widely patent surgical corridor that provides a rapid and effective access to the skull base lesions.

The potential benefits of this technology, its feasibility, safety, and potential clinical efficacy have allowed for its use in various selected cases, such as lesions located on the pituitary fossa, the midline anterior skull base tumors with significant extension into the nasal sinuses, retrochiasmal craniopharyngiomas, and tuberculum sellae meningiomas less than 30 mm with modest lateral extension (6, 9, 14).

The rather narrow viewing angles and dim light in the depth of the operating field (with a corresponding reduced visual field during surgery) that stem from these types of minicraniotomies have been viewed as a sort of the Achilles' heel of the procedure. The growing need for even greater accuracy and visualization and the attempt to overcome these restrictions has led to the intraoperative use of endoscopes, in addition to the surgical microscope, to assist the surgeon during the procedure. i.e., the so-called endoscope-assisted microsurgery (19, 22).

Because of its intriguing ability to visualize otherwise-blind corners within the operative field and to provide a variety of panoramic and close-up views, endoscopy, as adjunct to traditional microscopic procedure, already had been proposed previously in specific surgical instances. Endoscopic assistance has been suggested by Yasargil to address suprasellar tumors, particularly tuberculum sellae meningiomas, where the surgical approach could be limited by obstruction of anatomical structures. The improved use of a mobile tip mirror or a flexible endoscope has been recommended during microscopic pterional approaches to the parachiasmatic area because it was noted tha "dissection of neurovascular structures to expose the tumor is blind" (27).

The extent of suprasellar exposure of meningiomas during a transnasal microscopic approach could be, according to Couldwell et al., "enhanced with the application of endoscopic visualization" (5); in addition, in other cases of meningiomas operated on with the same technique, Kitano et al. noted that the "intermittent use of an endoscope was helpful in visualizing residual tumor, and its relationship to key structures" (13). This integrated technology, which has become very popular in recent decades, provides a safer and more effective excision of the lesion, even in hidden parts of the surgical field, thanks to increased light intensity, extended viewing angle, and a clear depiction of details of the most important neurovascular structures.

In the endoscopic-assisted microsurgery technique, most of the procedure is performed in microscopic open fashion, whereas during the procedure, but more frequently at the end of tumor resection, the endoscope is introduced to check the operative field and to inspect blind corners that cannot be visualized with the microscope.

A significant role, then, is played by side-viewing endoscopes (30°, 45°). These tools allow visualization of tumor fragments in areas difficult to adequately visualize and reach, particularly extensions in the interpeduncular fossa, and provide further inspection under the ipsilateral optic nerve and internal carotid artery, which habitually are poorly visualized under microscopic view. In aneurism surgery, endoscopy allows the surgeon to inspect anatomical vascular features during preclipping, clipping, and postclipping procedures to assure effective occlusion of the aneurysm and the preservation of parent vessel and perforators. In contrast, according to some authors (17), endoscopic assistance is not necessary because all aneurysms are well visualized and clipped with the use of the microscope alone.

Thus, these advantages make this instrumentation a very useful adjunct during the surgical approach, and its assistance can certainly enhance surgical applications. A further alternative to both the endoscopic endonasal and "eyebrow" microsurgical routes to the anterior cranial base is the fully endoscopic "eyebrow" supraorbital approaches, in which the endoscope is used for visualization without the microscope (2).