A Supraorbital Trans-Eyebrow Approach for Removal of Anterior Cranial Fossa Meningiomas

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Abstract

Background: The eyebrow-trans supraorbital approach is a common procedure used for operating on tumors in the front part of the skull. This gives surgeons good access to the front part of the skull through a small cut and minimal soft tissue dissection along with less brain stretching compared to standard skull operations. The study aims to evaluate supraorbital craniotomy via the eyebrow route in surgery for anterior skull meningiomas. **Methods:** The study included 6 patients (4 females and 2 males) who were subjected to surgery for meningioma using the trans-eyebrow supraorbital approach using a 5 Cm lateral eyebrow incision at the at Al -Azhar University hospitals between January 2020 and January 2021. **Results:** Five patients achieved complete tumor removal and one had subtotal excision due to extension, which was verified by MRI scans after the surgery. They also had good cosmetic outcomes. One patient had Rhinorrhea after the surgery, which improved with non-surgical treatments and did not require re-operation. Another patient had a total loss of vision. None of the 6 patients had any complications from injuring the main blood vessels or the cavernous sinus. **Conclusion:** A supraorbital trans-eyebrow craniotomy is a less invasive surgery for removing most tumors at the front of the skull. The benefits of this small opening surgery compared to standard skull openings are fewer risks related to the surgical approach.

Key Words: Meningioma, supraorbital craniotomy, keyhole surgery, Trans-eyebrow.

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Introduction:

Advancements in microsurgery, surgical tools, and preoperative planning methods have allowed neurosurgeons to treat more complex lesions through small, targeted openings [1]. This type of surgery, known as "keyhole" surgery, gives access to skull base lesions through a small incision and craniotomy while minimizing damage to surrounding structures such as skin, bone, dura, and most importantly, the brain [2]. Through supraorbital craniotomy and sub-frontal approach, many pathologies such as tumors (meningiomas, craniopharyngiomas, etc. and vascular abnormalities (aneurysms, arteriovenous malformations, cavernous hemangiomas) can be removed [1]. Supraorbital craniotomy provides wide access to the anterior cranial fossa and suprasellar region through a small skin incision and minimal soft tissue dissection, reducing brain traction compared to standard craniotomies [3]. The eyebrow-trans supraorbital approach is increasingly used for surgery of the anterior cranial fossa and parasellar tumors. Using this approach, the small lateral supraorbital craniotomy avoids the frontal sinus and superior sagittal sinus medially, provides views of the ventral skull base, reduces frontal lobe retraction, and permits upward visualization when combined with an orbital osteotomy [4].

This study examines the benefits and drawbacks of the supraorbital trans-eyebrow technique for treating individuals with anterior cranial fossa meningiomas.

AIM OF THE WORK

Evaluation of supraorbital craniotomy through eyebrow approach in surgery for anterior cranial fossa meningiomas, and the benefits of lumber drain during the procedure.

Patient and methods

In this study, we report early experience in 6 cases (4 males and 2 females) with anterior cranial fossa meningioma subjected to surgical approach by small supraorbital craniotomy using 5 Cm lateral eyebrow incision in Al -Azhar University hospitals between January 2020 and January 2021and their characteristics are summarized in **Figure1.** The age of the patient ranges between (32 - 70 years) and includes 3 olfactory groove meningioma,1 plenum

sphenoidal meningioma,1 tuberculum Sella meningioma, and 1 lateral sub frontal meningioma. All patients are diagnosed clinically and radiologically by enhanced MRI brain, CT brain, and sometimes angiography. At follow up all patients subjected to a complete neurological examination, local wound examination, and enhanced brain MRI to look for the extent of tumor resection. Summary of included

Surgical approach

General endotracheal anesthesia was used for operations. using a lumbar subarachnoid drain for CSF drainage and closing before Dural opening. All patients received antibacterial prophylaxis one hour before surgery.

The patient was positioned lying flat on their back with their head secured in a Mayfield holder. The head was elevated 15 degrees above chest level and rotated to the opposite side, depending on the location of the lesion: for supra− and retrosellar lesions, around 30 degrees is needed while for more anterior lesions like olfactory groove meningioma, 40 to 60 degrees is used.

To begin the procedure, a 5-6 cm skin incision was made along the unshaved eyebrow line, taking care to avoid the supraorbital nerve and frontal branch of the facial nerve **(figure 1).** A burr hole was then placed behind the temporal line, just behind the fronto-zygomatic junction. A supraorbital craniotomy of around 3 x2 cm is done using a craniotome. The dura mater is opened in a C shape fashion with a base on the upper orbital rim. Placing a lumbar drain pre-procedure for CSF drainage facilitates the approach with optimal brain relaxation, early tumor exposure with gentle brain retraction, and good manipulation without damaging the brain and surrounding structures. Once the tumor was completely removed, proper hemostasis was achieved, and the dura was closed watertight using continuous suture **(figure 2).** Gelfoam was placed above the sutured dura for filling the space and hemostasis. The bone flap was then placed and fixed with two titanium plates, and the borehole was covered by temporal muscle and fascia **(figure 3).** The closure was done in a layer without a drain, and the skin was closed with absorbable continuous subcutaneous suture for good cosmetic results. Finally, a small local bandage was applied to the wound for wound dressing **(Figure 4).**

Results

Six cases of anterior cranial fossa extra-axial lesions were diagnosed radiologically as meningioma including 3 olfactory groove meningioma,1 plenum sphenoidal meningioma,1 tuberculum Sella meningioma and 1 lateral sub frontal meningioma. the study includes 4 males and 2 females with an age range between (32 - 70 years).

All patients underwent microscopic mini supraorbital craniotomies through a small lateral brow incision, and the entire procedure took somewhere between 3 and 6 hours.

Using intraoperative lumbar CSF drainage in 5 patients has an important role in facilitating the approach with good brain relaxation, minimal brain retraction, and early tumor dissection without brain damage. drain not used in one patient with plenum sphenoidal meningioma and associated with brain swelling and contusion, late tumor dissection, long operation time, and minimal temporary frontal manifestation.

No reported operative mortality or major neurological complications. Postoperative one patient with plenum sphenoidal meningioma developed CSF rhinorrhea through opened frontal sinus and He improved by conservative measures without the need for reoperation. another female patient with tuberculum Sella meningioma presented with headache, diabetes insipidus, and incomplete bilateral visual loss which complicated pot operative by complete visual loss although preservation of visual pathway.

Using a mini plate for fixation of bone flap and wound closure by continuous subcutaneous proven stitches in all patients with post-operative ipsilateral periorbital ecchymosis and swelling which subside gradually in 2 weeks.

All patients were followed clinically and radiologically for one year by enhanced brain MRI and achieved total excision of tumor in 5 cases and subtotal excision in one patient with lage extended olfactory groove lesion with ethmoidal, nasal, and orbital extension **(figure 5).**

Although there are 2 cases of wound swelling due to CSF collection which resolve by tight banding. No reported wound infection with good wound healing and the better cosmetic result is associated with excellent patient satisfaction in all cases **(figure 6),** and no one re-operated.

Table 1: characteristics of included patients

	Age (Year)	sex	Type of lesion	Clinical Presentation	Intra op Lumber drain	Operation time(hour)	Excision	complication	Post op Hospital stay (day)
1	32	male	Planum sphenoidal meningioma	Headache	No	4	Total	Temporary CSF leak	3
2	60	Male	Olfactory groove	Bilateral anosmia and headache	yes	6	Subtotal	None	6
3	70	female	Lateral sub frontal meningioma	Headache	yes	3	Total	None	3
4	41	male	Olfactory groove meningioma	Headache	yes	3	Total	None	4
5	40	female	Tuberculum sella meningioma	Visual loss, Headache ,diabetes insipidus	yes	6	total	Visual deterioration	10
6	51	male	Olfactory groove	Headache, anosmia	yes	4	total	None	4

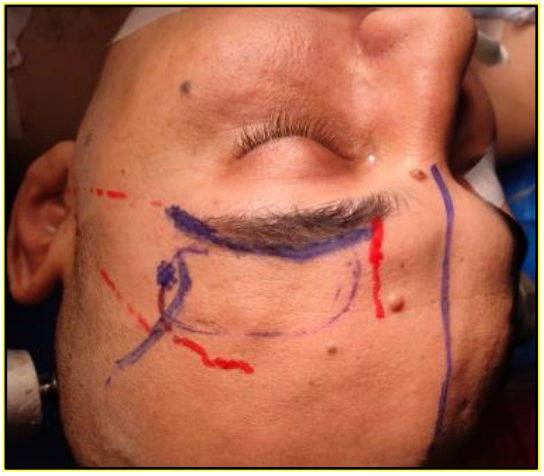

Figure 1: Skin incision along the eyebrow line

Figure 2: after the closure of Dura

Figure 3: placing the bone flap and fixation with two titanium plates

Figure 4: closing the incision using continuous subcutaneous sutures

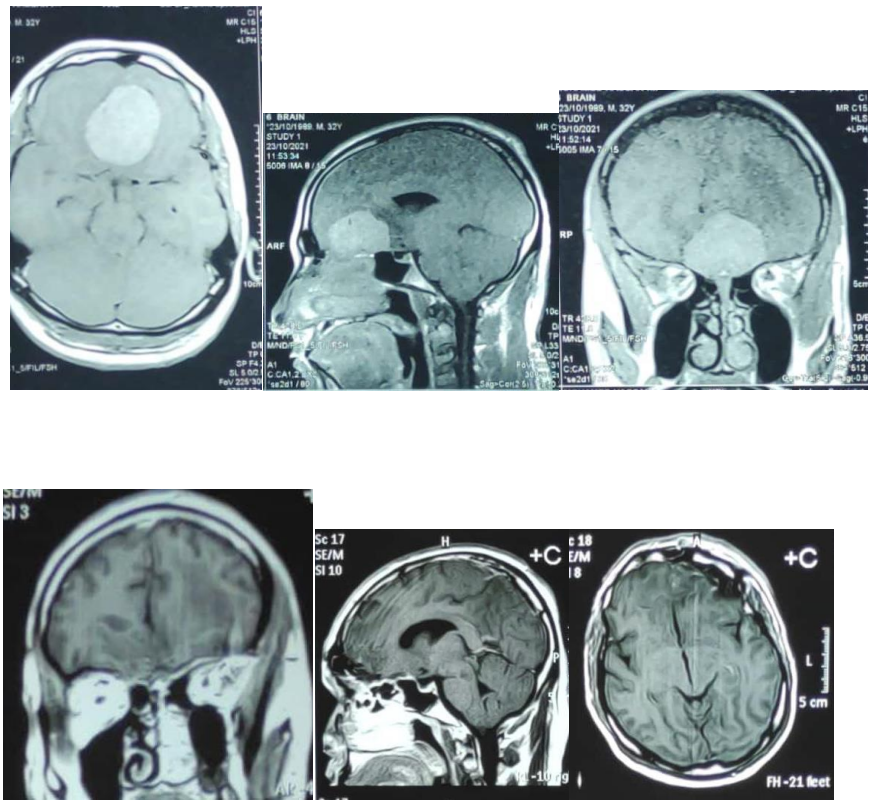

Figure 5: pre and post-operative MRI brain with the contrast of patient with olfactory groove meningioma demonstrate total excision of the lesion

Figure 6: Appearance of the incision after closing.

Discussion

In the domain of neurological surgery, customary strategies of medical procedures permit a really extensive exposure to the patient's pathology, like the encompassing typical structures, and this exposure is related to substantial neurological and outward complications. Utilizing restricted and more explicit craniotomies is most significant in diminishing medical traumatization, and restricting mind exposure, and retraction. [5].

The supraorbital trans-eyebrow approach is minimally invasive, less traumatic, and gives a good view of the anatomical structures in the chiasm-sellar region and anterior cranial fossa and allows adequate surgical manipulation in these areas [6].

The supraorbital trans-eyebrow approach has an anterolateral location that provides adequate and short trajectory to ACF lesions with less development of neurologic complications and epileptic seizures [7].

When it comes to operating on meningiomas located in the front part of the skull base, there are certain goals that need to be achieved for the best possible outcome. These include finding the shortest route to the tumor, relaxing the brain by releasing cerebrospinal fluid, ensuring adequate exposure for working inside the skull while keeping the frontal lobes intact, and preventing damage to the smell nerves and frontal sinus. It's also important to recognize the visual pathways, carotid arteries, and their branches early on, as well as easily cutting the Dural attachment and possibly opening the bony optic canals if necessary. Lastly, good esthetic results should be a priority.

In our study, we use a supraorbital approach for access the anterior cranial fossa meningioma that provide a minimally invasive approach associated with a small skin incision, small bon flap, minimal brain retraction, and delicate manipulating the tumor without harm to surrounding neurovascular structure.

The study includes 6 cases (4 male and 2 female) of anterior cranial fossa meningioma with an age range between(32 - 70 years).

The supraorbital approach involves a small incision within the eyebrow that minimizes soft tissue retraction while preserving key structures like the supraorbital nerve and artery, the frontal branch of the facial nerve, and the superficial temporal artery. It also involves limited manipulation of the temporal muscle, which results in substantially reduced morbidity unrelated to the brain lesion [9].

Only a burr hole is needed through the minimally disrupted temporalis muscle for the small craniotomy, limiting poor cosmetic results and unnecessary exposure of the cerebral cortex that could cause brain damage [1].

Multiple series recommend conventional transcranial approaches for very large meningiomas while the supraorbital approach is recommended for tumors smaller than 5 cm to adequately expose the surgical field and manipulate anatomical structures without difficulty [8].

In our study, preoperative use of lumber drain for CSF drainage allows good brain relaxation thus widening the operative field without significant brain retraction which facilitates the approach for very large anterior cranial fossa meningiomas with the significant-good result.

Czirjàk performed 173 supraorbital craniotomies and found that only 3 patients (1.7%) had their frontal sinus entered, while 2 patients had an injury to the supraorbital nerve and 1 patient experienced frontal palsy [3].

In a recent study comparing supraorbital and extended transsphenoidal approaches, the frontal air sinus was transgressed in less than 10% of cases [10]. Reisch and Perneczky reported a cerebrospinal fluid leak rate of 2.6% in a group of 450 patients [11].

In our 6 cases, the frontal sinus was opened in one patient with plenum sphenoidal meningioma and complicated with temporary CSF rhinorrhea and improved by conservative measures without the need for re-operation. another patient with the destruction of the posterior wall of the frontal sinus but intact sinus mucosa not associated with the post-operative leak.

Three factors were found to be linked with poor visual outcomes after surgery. These factors are having a thin and atrophic optic nerve, having an optic nerve that is surrounded by a tumor, and having a dense adhesion between the tumor and the optic nerve [3].

During our study, a patient with tuberculum Sella meningioma experienced severe visual impairment before surgery. Unfortunately, despite both optic nerves appearing to be well preserved during surgery, the patient experienced complete visual loss after the procedure. This outcome was likely due to unexpected vascular damage. This aligns with Puchner MJ's findings that supports the importance of early diagnosis, as the severity of pre-operative visual impairment was shown to significantly affect post-operative eye exam results [12].

In our cases, tight dural closures, the use of a mini plat for fixation of bone flap, and skin closure by subcuticular suture are associated with good cosmetic results and better patient satisfaction. multiple complications were reported as CSF Rhinorrhea, subcutaneous CSF collection, visual loss, and frontal manifestation but all were temporary and did not affect the final result.

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REFERENCES

1. **Reisch, R., Perneczky, A., & Filippi, R. (2003).** Surgical technique of the supraorbital key-hole craniotomy. Surgical neurology, 59(3), 223-227.
2. **Perneczky, A. (1999).** Keyhole concept in neurosurgery: with endoscope-assisted microsurgery and case studies. Thieme.
3. **Czirják, S., & Szeifert, G. T. (2001).** Surgical experience with frontolateral keyhole craniotomy through a superciliary skin incision. Neurosurgery, 48(1), 145-150.
4. **Reisch, R., Marcus, H. J., Hugelshofer, M., Koechlin, N. O., Stadie, A., & Kockro, R. A. (2014).** Patients' cosmetic satisfaction, pain, and functional outcomes after supraorbital craniotomy through an eyebrow incision. Journal of Neurosurgery, 121(3), 730-734.6.
5. **Perneczky, A. (1999).** M ü ller-Forell W, van Lindert E, et al Keyhole Concept in Neurosurgery.
6. **Wilson, D. H. (1971).** Limited exposure to cerebral surgery. Journal of neurosurgery, 34(1), 102-106.
7. **Nakamura, M., Struck, M., Roser, F., Vorkapic, P., & Samii, M. (2007).** Olfactory groove meningiomas: clinical outcome and recurrence rates after tumor removal through the frontolateral and bifrontal approach. Neurosurgery, 60(5), 844-852.9.
8. **Telera, S., Carapella, C. M., Caroli, F., Crispo, F., Cristalli, G., Raus, L., ... & Pompili, A. (2012).** Supraorbital keyhole approach for removal of midline anterior cranial fossa meningiomas: a series of 20 consecutive cases. Neurosurgical review, 35, 67-83.
9. **Noguchi, A., Balasingam, V., McMenomey, S. O., & Delashaw, J. B. (2005).** Supraorbital craniotomy for parasellar lesions. Journal of neurosurgery, 102(5), 951-955.
10. **Czirják, S., & Szeifert, G. T. (2006).** The role of the superciliary approach in the surgical management of intracranial neoplasms. Neurological research, 28(2), 131-137.13.
11. **Reisch, R., & Perneczky, A. (2005).** Ten-year experience with the supraorbital subfrontal approach through an eyebrow skin incision. Operative Neurosurgery, 57(4), 242-255.14.
12. **Puchner, M. J. A., Fischer-Lampsatis, R. C. M., Herrmann, H. D., & Freckmann, N. (1998).** Suprasellar meningiomas–neurological and visual outcome at long term follow-up in a homogeneous series of patients treated microsurgically. Acta neurochirurgica, 140, 1231-1238.