Supraciliary Keyhole Craniotomy for Pediatric Brain Tumors

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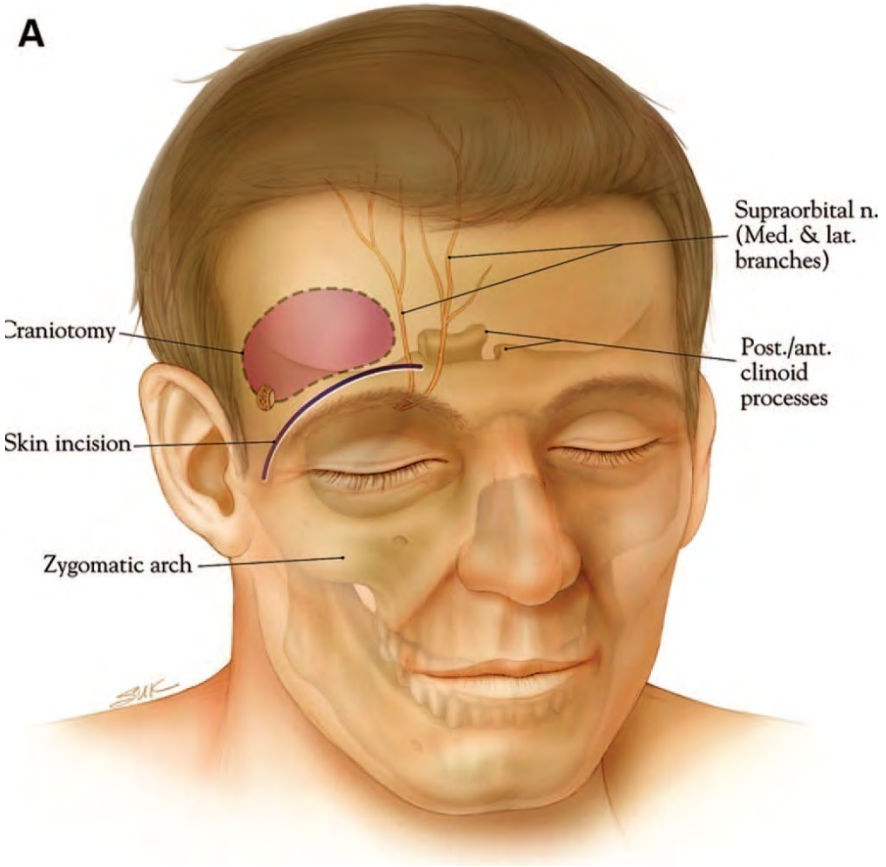
Overview

- The concept of “keyhole” craniotomy
- Technique
- Anatomic Access
- Limitations/Complications
- Indications
- Evolving modifications

Overview

- Hopkins Experience
  - Pediatrics (Jallo)
    - 1998 – 2011
    - 41 patients



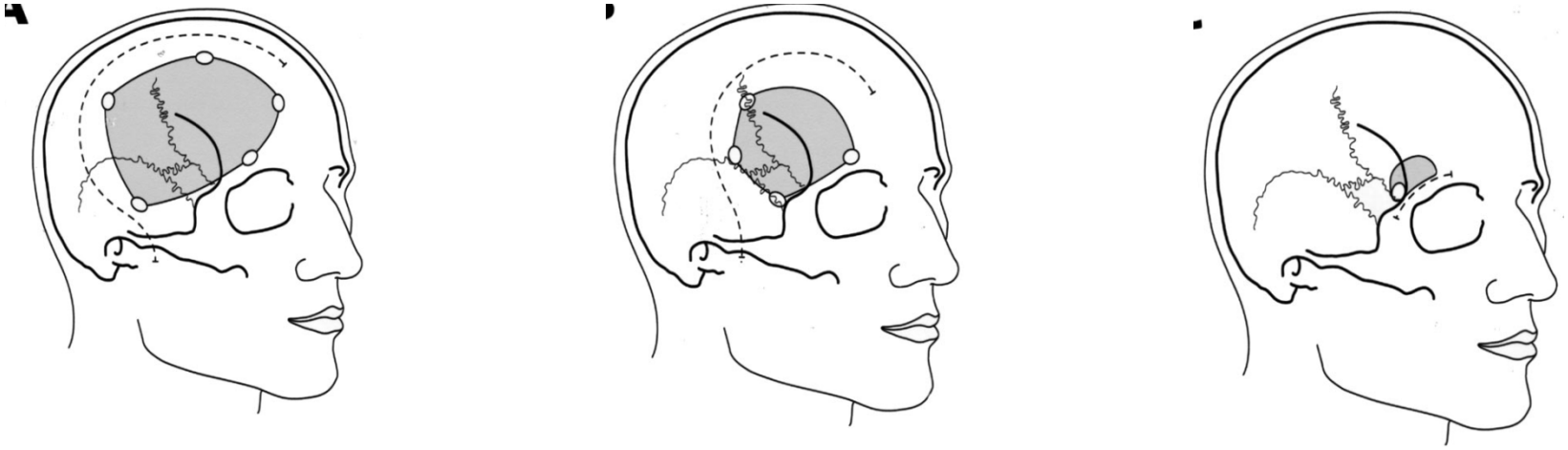
Jallo et al. Eyebrow Surgery: The Supraciliary Craniotomy: Technical Note. Neurosurgery, 2006.

Keyhole Surgery

- Initial importance of large craniotomies
  - Primitive diagnostic techniques
  - Inaccurate localization
  - Poor methods of illumination
  - Inadequate instruments

Keyhole Surgery

- Introduction of keyhole surgery
  - Limited craniotomy with goal of limiting injury
  - Evolution of techniques and technology
  - Improved understanding of anatomic corridors



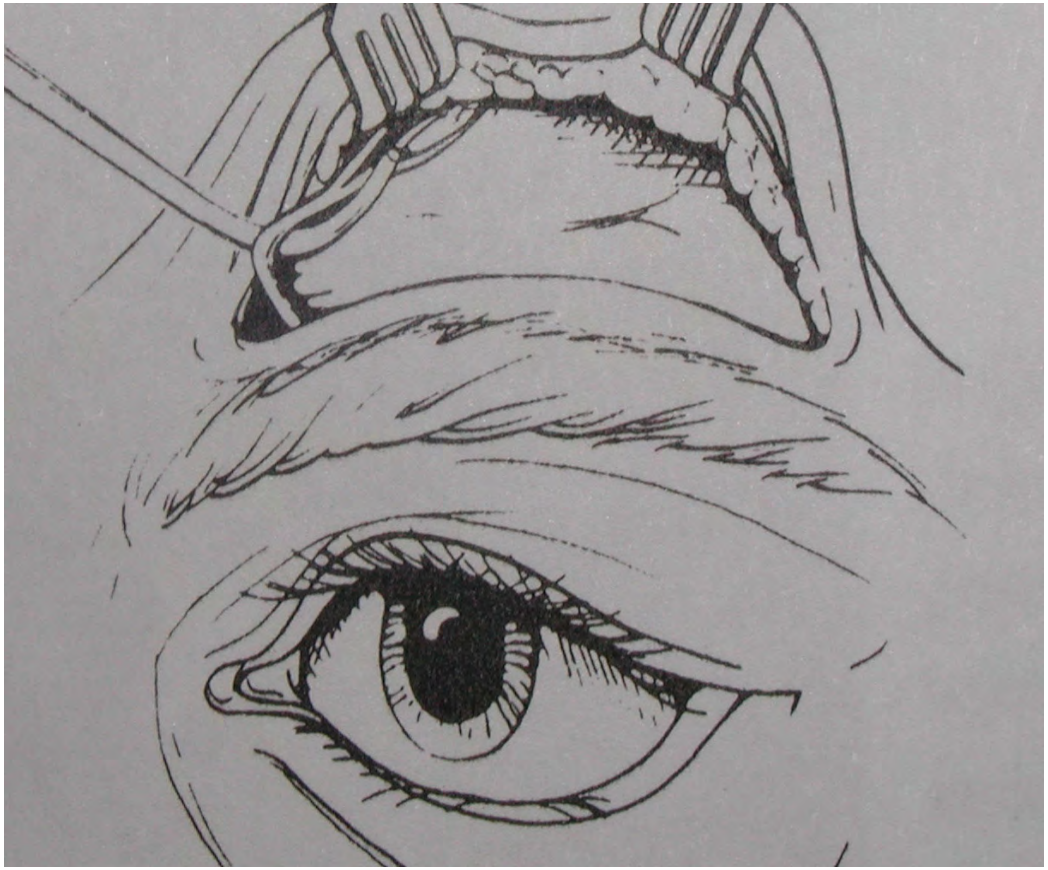
Reisch et al. Ten-year experience with the supraorbital-subfrontal approach through an eyebrow skin incision. Neurosurgery. 2005

Keyhole Surgery

- Access to the suprasellar region
  - Anterolateral approaches
    - Splitting of the sylvian fissure
    - Temporal lobe retraction
  - Anterior subfrontal approaches
    - Direct access to anatomic structures

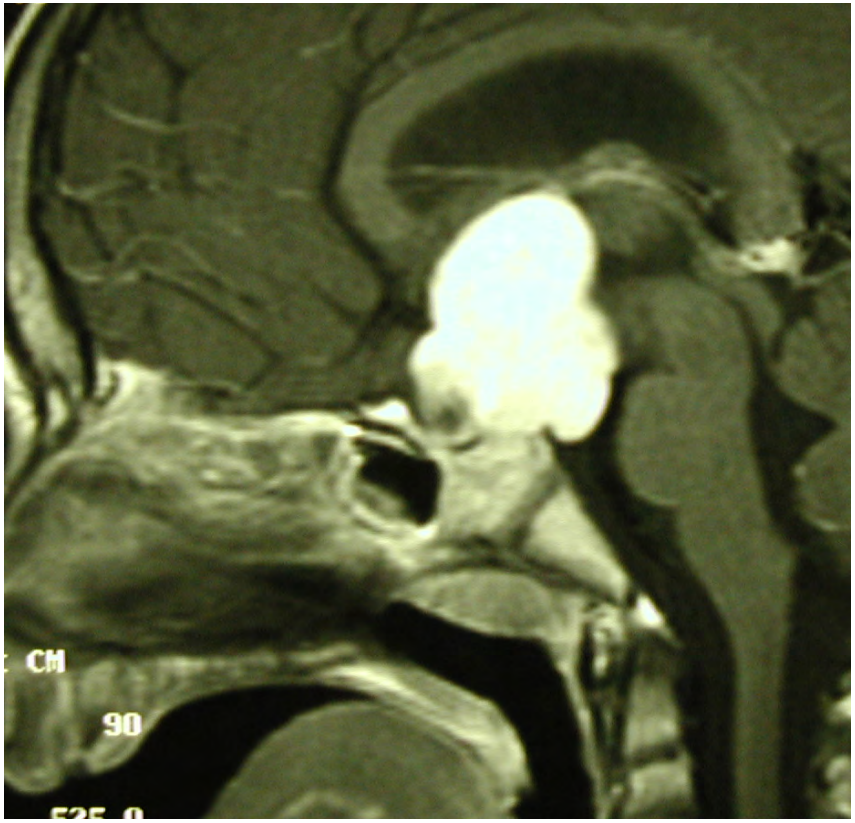
Frontolateral Keyhole Craniotomy

- The frontolateral keyhole craniotomy is a modification of the generally used pterional approach



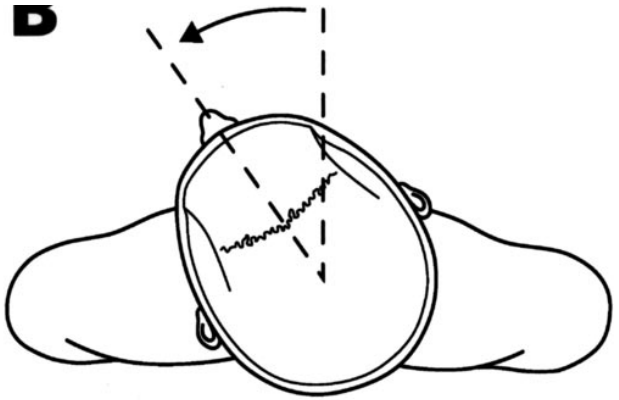
Indications in Children

- Suprasellar-parasellar lesions
- Frontobasal tumors
- Frontal or temporomedial arachnoid cyst



Surgical Technique

- Patient Positioning:
  - Head elevation
  - Head extension
  - Contralateral rotation
    - Ipsilateral temporal: 15°
    - Lateral suprasellar: 20°
    - Anterior suprasellar: 30°
    - Olfactory groove: 60°

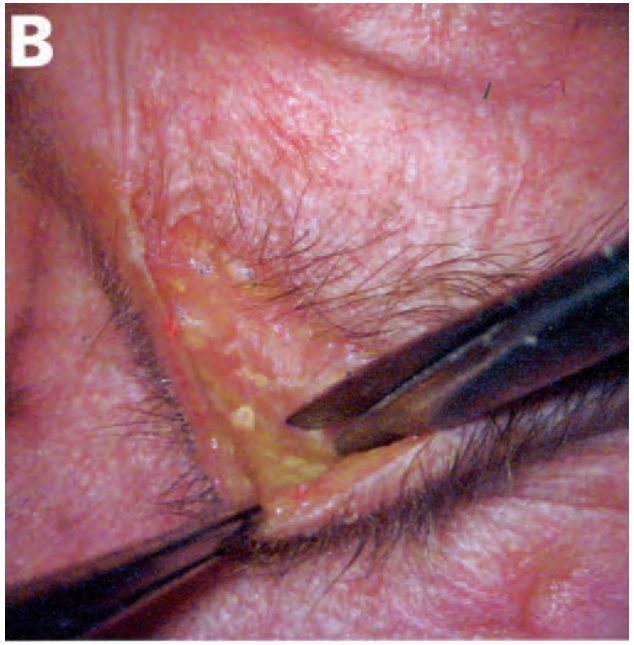


Surgical Technique

- Skin Incision:
  - Through eyebrow
  - Supraorbital foramen
  - Lateral extent of eyebrow
    - Extension into facial crease
  - Oblique incision parallel to hair follicles

Surgical Technique

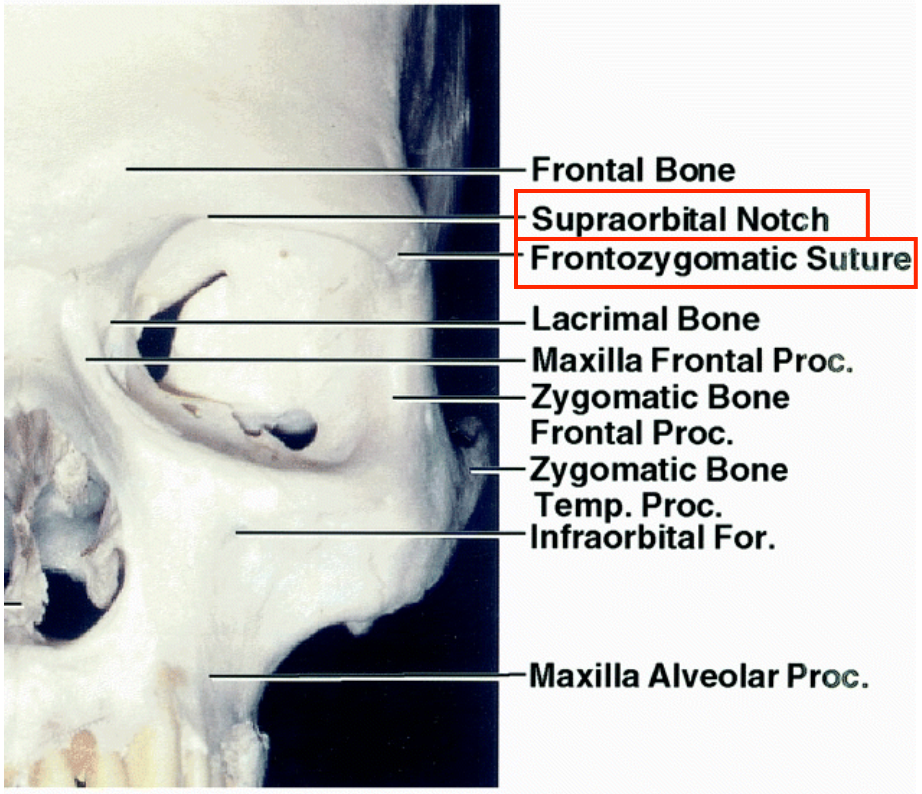
- Soft Tissue Dissection:
  - Subcutaneous dissection
    - Frontalis
    - Orbicularis oculi
    - Temporalis
  - Incision of frontalis muscle
    - Blunt dissection of temporalis muscle and orbicularis oculi



Reisch et al. Ten-year experience with the supraorbital-subfrontal approach through an eyebrow skin incision. Neurosurgery. 2005

Surgical Technique

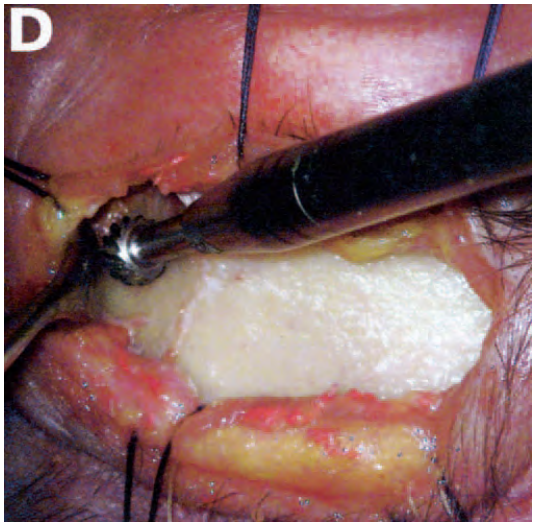
- Landmarks:
  - Supraorbital foramen
  - Fronto-zygomatic suture
  - Orbital ridge

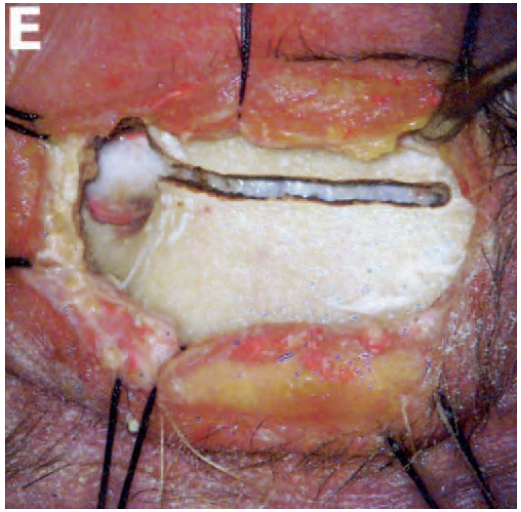


Rhoton, AL. Anterior Cranial Fossa. Neurosurgery, 2005.

Surgical Technique

- Craniotomy:
  - Frontobasal burr hole
    - Variable placement depending on target lesion
  - Cut along orbital ridge
  - Final C-shaped cut





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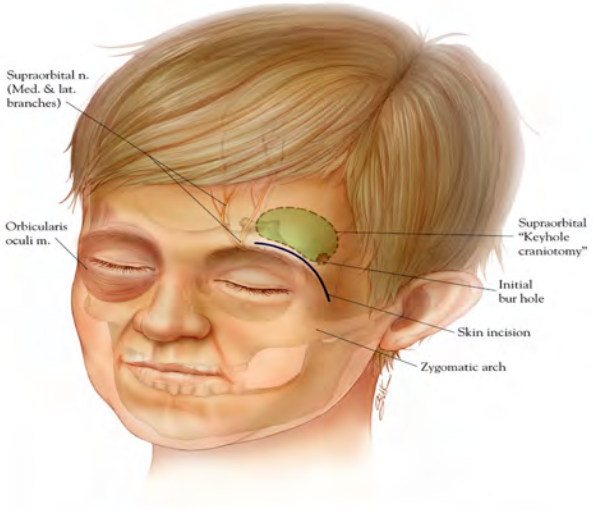
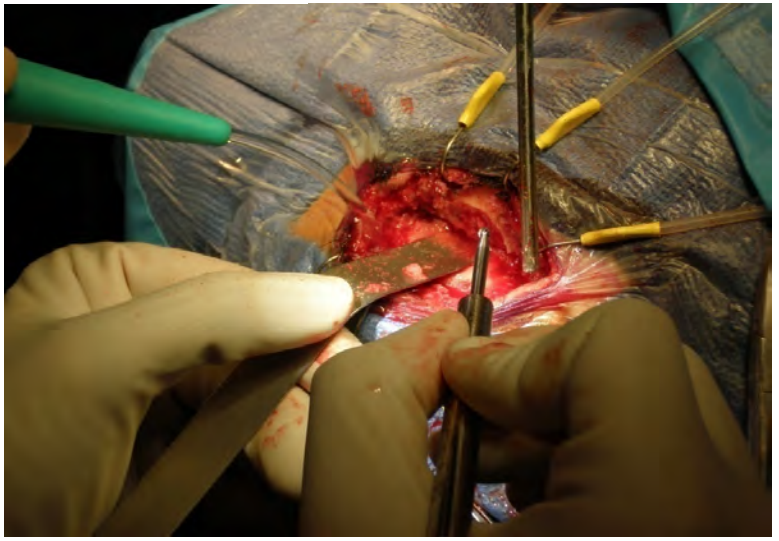
Surgical Technique

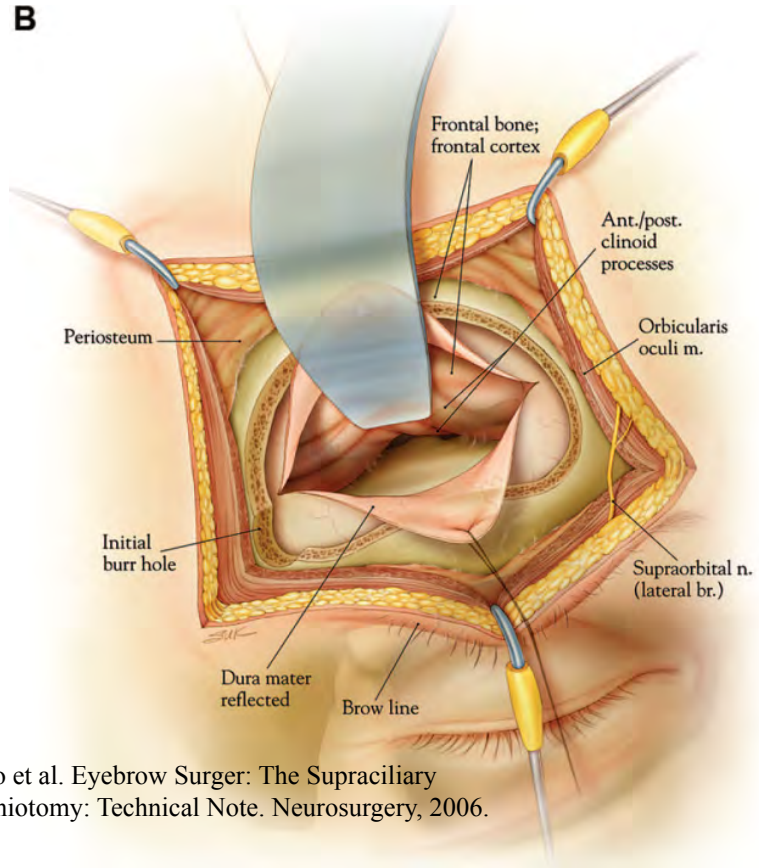
- Craniotomy:
  - Drilling
    - Inner edge of craniotomy
    - Osseous extension of orbital roof





Surgical Technique

- Intradural Dissection
  - Opening of cisterns



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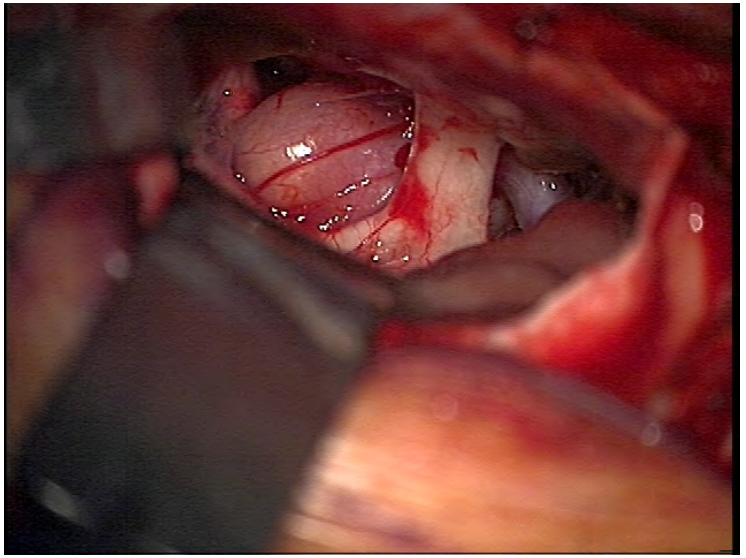
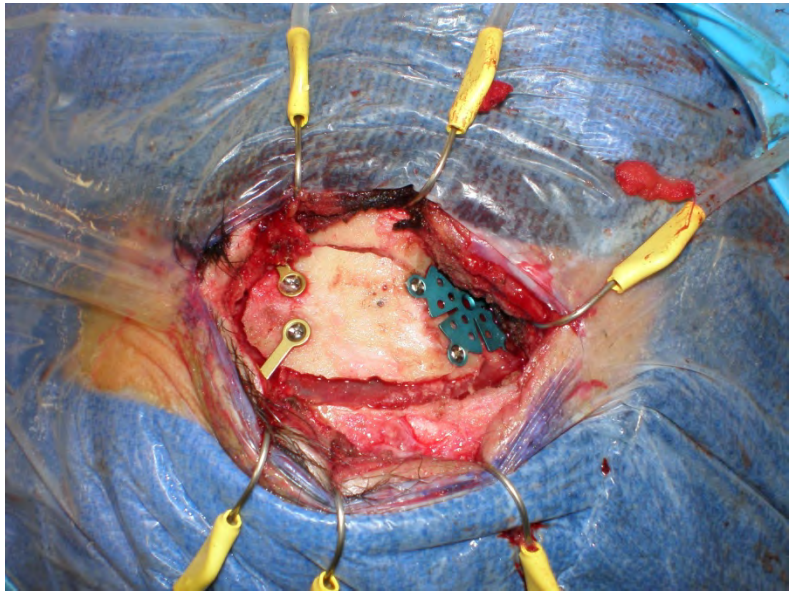
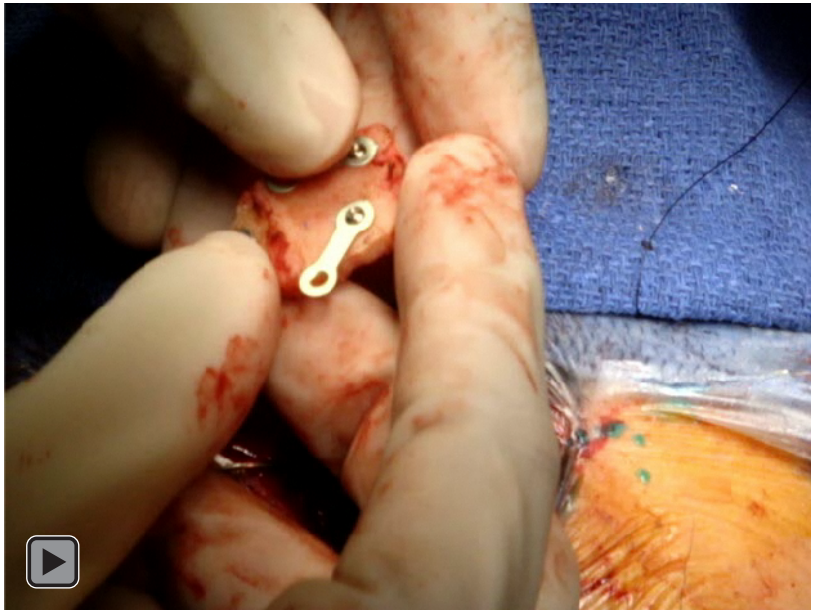


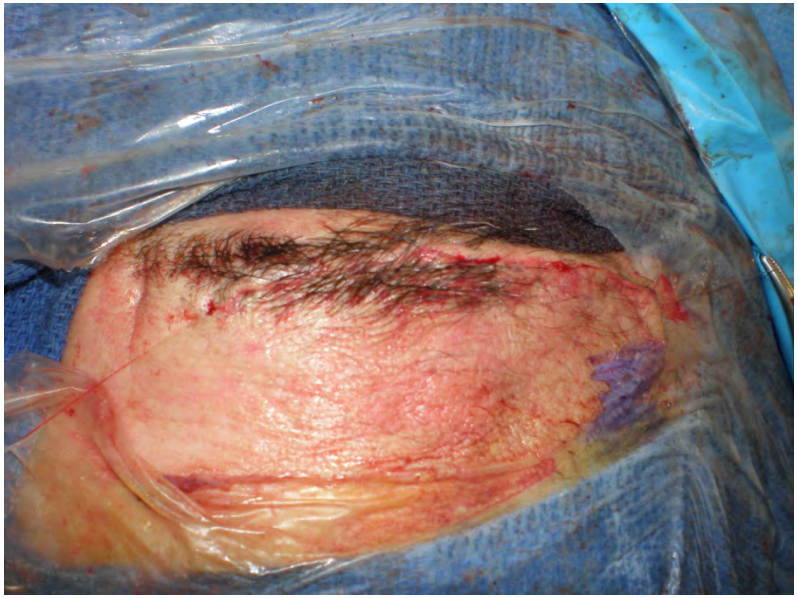
Surgical Technique

- Closure
  - Standard fixation
  - Bone cement
  - Subcuticular closure





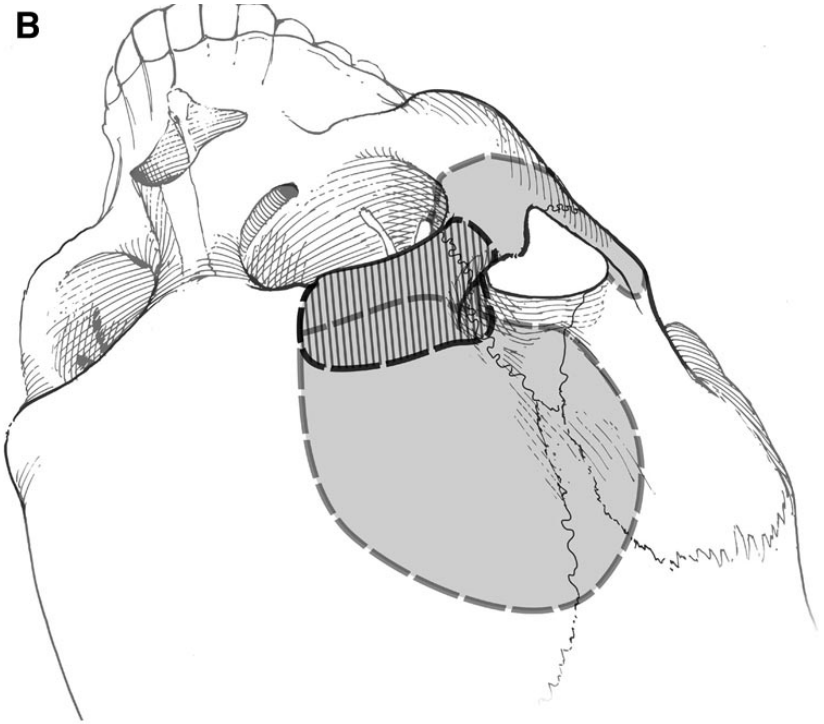
Closure



Anatomic Access: Comparison With Other Approaches

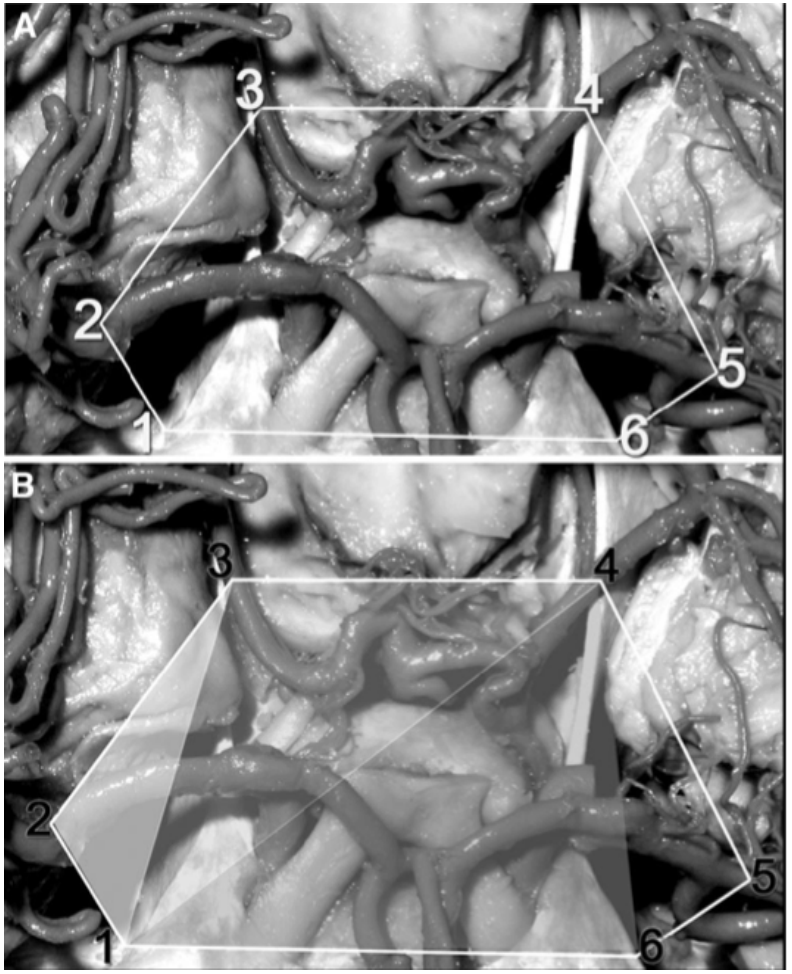
Anatomic Access

- Comparison with other approaches:
  - Supraorbital
  - Pterional
  - Orbitozygomatic



Figueiredo et al. An Anatomical Evaluation of the Mini-Supraorbital Approach And Comparison With Standard Craniotomies. Neurosurgery. 2006

- Comparison with other approaches:
  - Surgical exposure:
    - Ipsilateral and Contralateral extent
      - sphenoid ridge
      - MCA bifurcation
      - PCA (most distal point)



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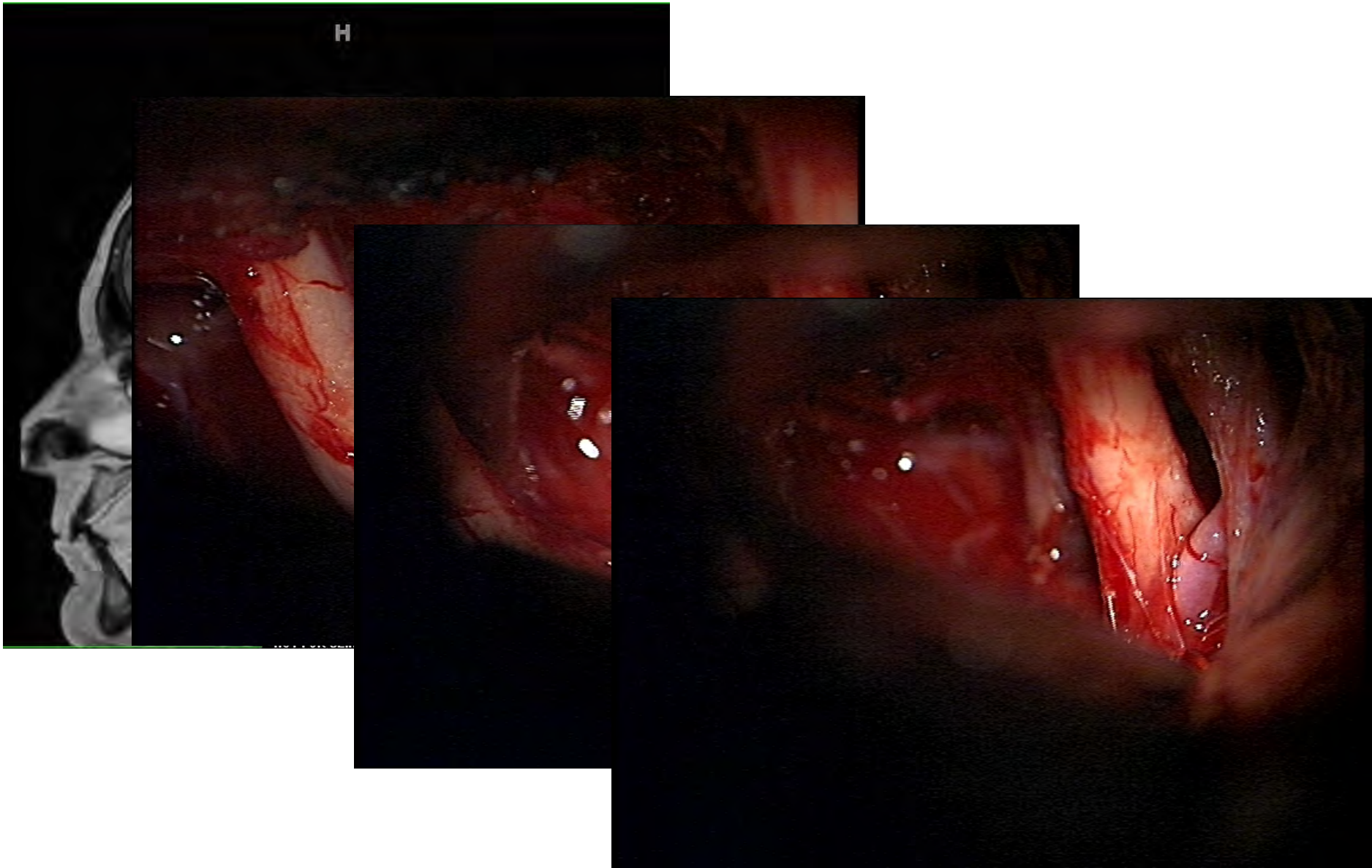
Anatomic Access

- Comparison with other approaches:
  - Area of surgical exposure:
    - No statistical difference
  - Working area:
    - Orbitozygomatic >> pterional >> supraorbital

Anatomic Access



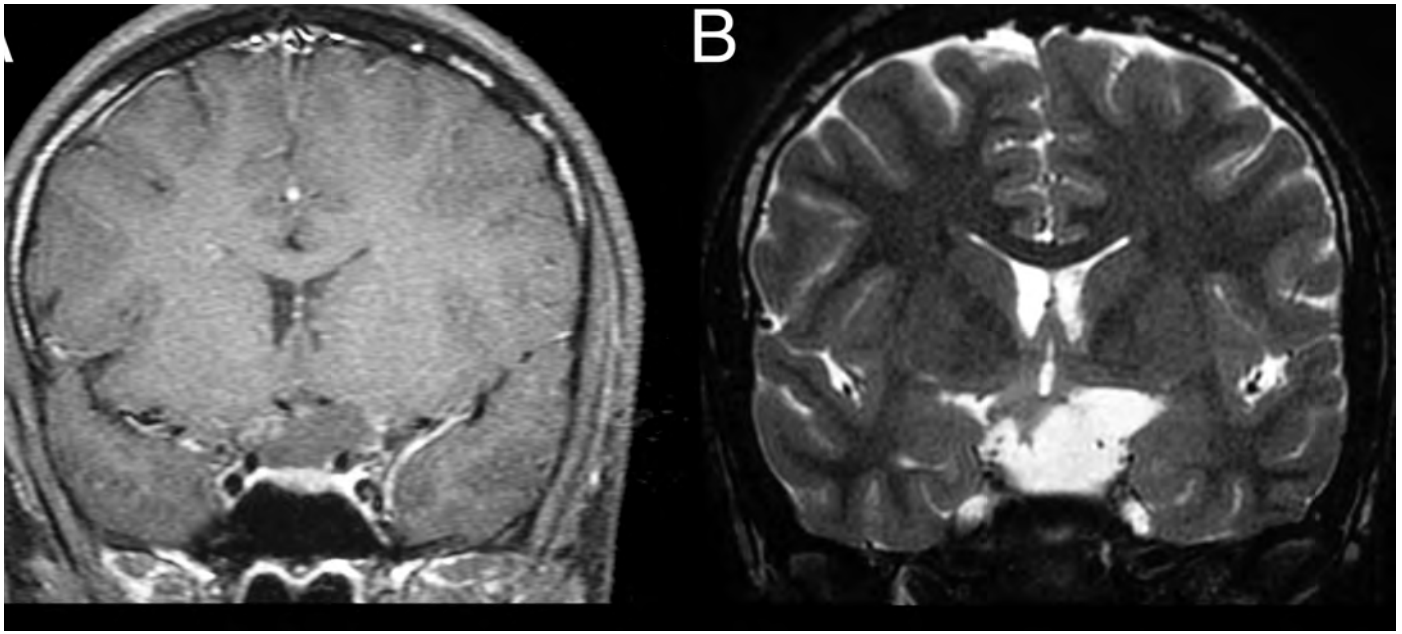
Clinical Summary of 41 patients (1998 to 2011)

Diagnosis	No. of Patients (%)
Arachnoid Cyst	5 (12%)
Craniopharyngioma	9 (22%)
Hypothalamic-Optic Glioma	10 (24%)
Hypothalamic Hamartoma	1 (2%)
Neuronal Tumor	2 (5%)
Epidermoid/Dermoid Tumor	4 (10%)
Other	9 (22%)
CSF Fistulae	1 (2%)
Total	41

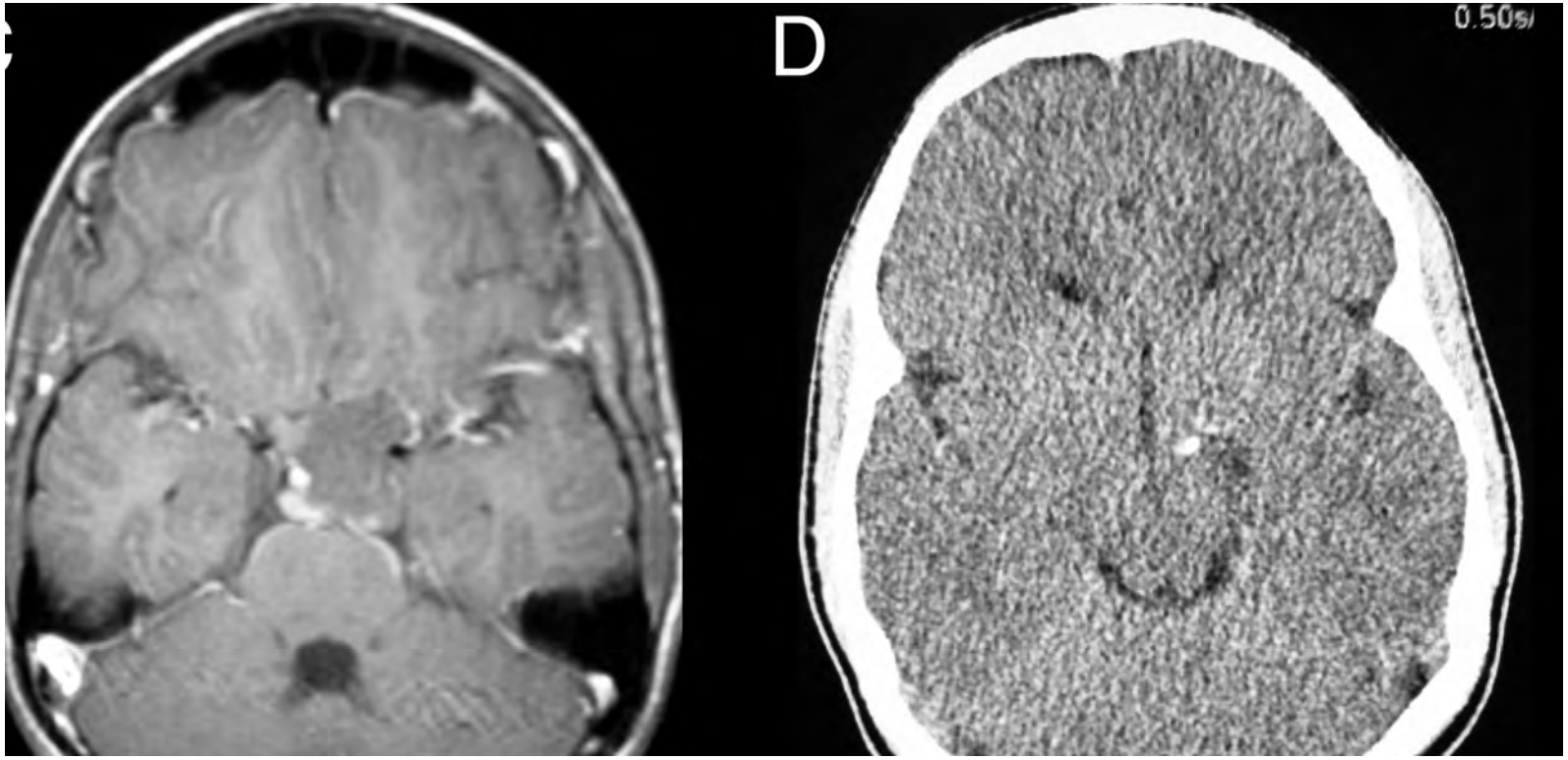
Mean age, 11.2 years (range, 1-18 years)
16 females, 25 males
Mean followup 31 months (range 2-112 months)

Illustrative Case

15 y.o boy with family history of glaucoma, presents to eye clinic with decreasing Acuity in left eye. VA 20/25 OD, 4/200 OS and optic pallor. He had a left APD. Formal visual fields demonstrated a right hemianopsia.

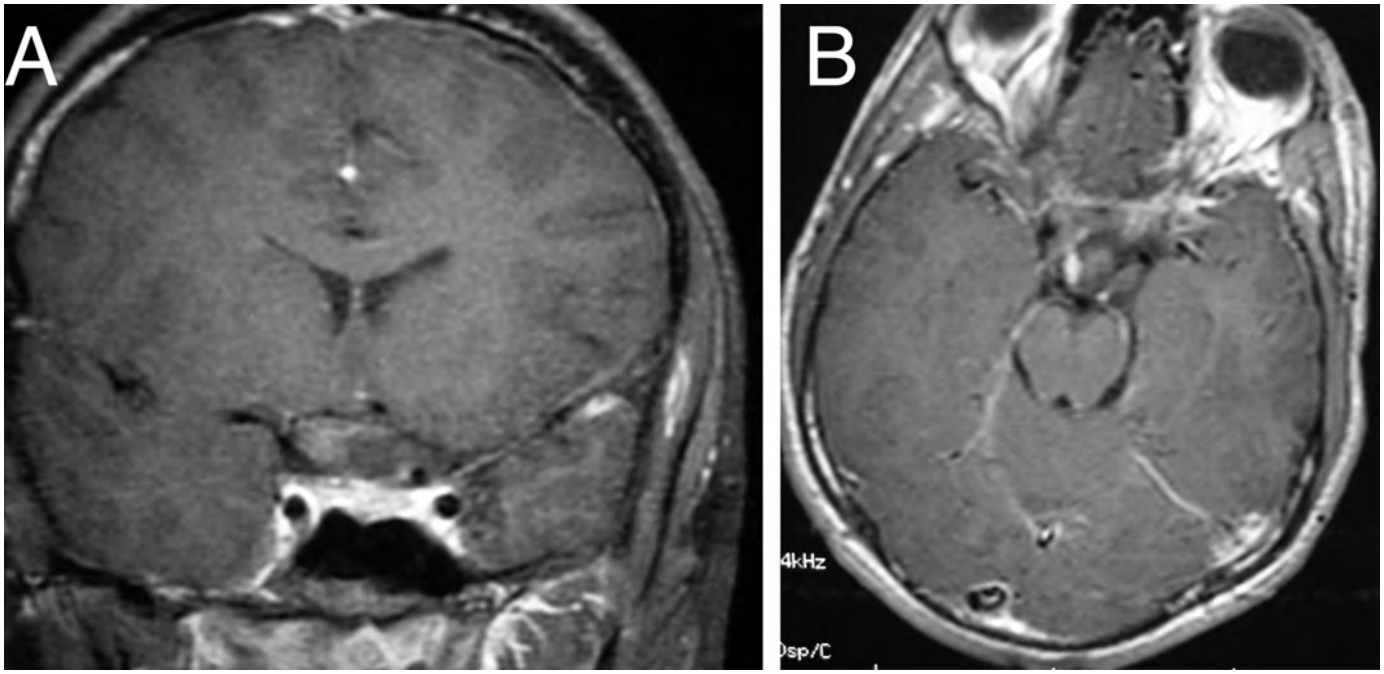


Illustrative Case



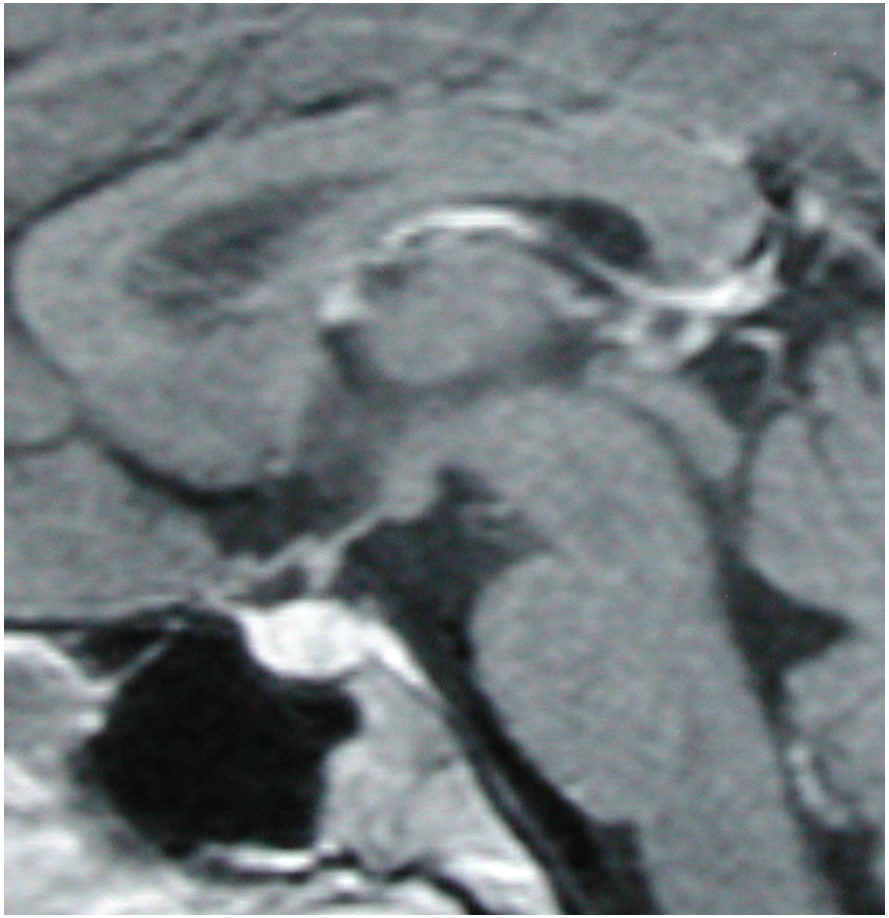
Postoperative Images

Deterioration in OS to counting fingers, OD unchanged. Discharged home In 3 days.



Illustrative Case: Optic Glioma

Preoperative and Postoperative Images



Cosmetic Result

Results

- Despite the small size of the craniotomy, the exploration allows enough room for intracranial manipulation with maximal protection of the brain and other intracranial structures. The presented series of patients did not have any craniotomy related complications.

Results

- In all but one case the frontolateral keyhole craniotomy gave enough room for appropriate surgical manipulation.
  - In this frontobasal CSF fistulae the convexity of the orbital roof over the olfactory groove
- One patient had a wound infection that was cured with good result.

Advantages

- Minimal disruption of the soft tissues
- Short incision that avoids the supraorbital nerve and artery
- Small craniotomy that avoids the frontal air sinus and minimize the bone defect
- Less exposure of the brain
- Diminished operative time

Disadvantages

- Limited size of surgical corridor
  - which can be corrected by:
    - adjustment of patients head tilt
    - medial to lateral location of the craniotomy
    - extent of the resection of the orbital roof and sphenoid wing
    - Use of low profile instruments which minimize obstruction

Conclusions

- In our experience, the frontolateral keyhole craniotomy in children, together with the advent of modern neuroanesthesia, cerebrospinal fluid drainage, and microsurgical techniques, is a safe approach for an experienced neurosurgeon
  - to use in the treatment of tumors or arachnoid cysts of the anterior fossa and sellar regions.
- This approach is not appropriate for olfactory groove dural repair.