Supraciliary Keyhole Craniotomy for Pediatric Brain Tumors

George Jallo MD
Johns Hopkins University,
Baltimore, Maryland
Overview

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

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

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

Surgical Technique

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

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

- **Craniotomy:**

  - Drilling
    - Inner edge of craniotomy
    - Osseous extension of orbital roof
Surgical Technique

- Intradural Dissection
  - Opening of cisterns

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

Comparison with other approaches:

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

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)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arachnoid Cyst</td>
<td>5 (12%)</td>
</tr>
<tr>
<td>Craniopharyngioma</td>
<td>9 (22%)</td>
</tr>
<tr>
<td>Hypothalamic-Optic Glioma</td>
<td>10 (24%)</td>
</tr>
<tr>
<td>Hypothalamic Hamartoma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Neuronal Tumor</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>Epidermoid/Dermoid Tumor</td>
<td>4 (10%)</td>
</tr>
<tr>
<td>Other</td>
<td>9 (22%)</td>
</tr>
<tr>
<td>CSF Fistulae</td>
<td>1 (2%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>41</strong></td>
</tr>
</tbody>
</table>

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.