Keyhole Surgery for Primary and Metastatic Brain Tumors: Less is More

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Disclosures

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## Common Brain & Skull Base Tumors

### Standardized Incidence Rates
(new cases/100,000 persons/year)

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>SIR</th>
<th>In USA/yr</th>
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</thead>
<tbody>
<tr>
<td>Meningioma</td>
<td>7.7</td>
<td>26,000</td>
</tr>
<tr>
<td>Glioma</td>
<td>7.1</td>
<td>20,000</td>
</tr>
<tr>
<td>Pituitary adenoma</td>
<td>3.2</td>
<td>11,000</td>
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<tr>
<td>Schwannoma</td>
<td>1.9</td>
<td>6000</td>
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<tr>
<td>Total Primary Brain Tumors</td>
<td></td>
<td>71,000</td>
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<tr>
<td>Brain Metastases</td>
<td></td>
<td>250,000</td>
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</tbody>
</table>
Brain Metastases: Treatment Progress?

- Hope & Prayer
- Surgery & WBRT of solitary metastasis (Patchell 1990)
- Minimally Invasive Surgery
- Radiosurgery
- Targeted Therapies & Immunotherapy

Tumor Treating Fields – An entirely novel modality for anti-tumoral therapy
Brain Metastases Surgery

- Prompt elimination of mass effect and neurologic deficits
- Confirm diagnosis & tumor profiling
- Rapid ability to taper steroids
- Optimize patient for radiosurgery, targeted therapies
Brain Metastases: Surgical Indications

- Expected survival > 3 months & good perform. status (KPS>70)
- One or 2 large accessible sxic or inflammatory metastasis (>2 cm) including in or near eloquent cortex
- Large symptomatic lesion in setting of multiple small metastases
- Failed SRS or radio-necrosis with persistent mass effect, edema, steroid-dependence
Glioma Surgery: Balance of aggressive resection & neurological deterioration

Technical adjuncts help us remove more tumor...
EOR impacts survival but so do new/worsened neurological deficits
Principals of Malignant Brain Tumor Surgery

• This is only the beginning of treatment...
• Aim for maximal safe resection to restore function & QOL
• Obtain sufficient tissue for biomarkers & targeted therapies
• Avoid new neurological deficits
• Surgical approach that promotes early mobilization & short hospital stay
• Optimize patient for adjuvant therapies

• How do we accomplish this?
Keyhole Surgery

Removing tumors via smaller, more precise openings to minimize brain, scalp and muscle manipulation

- Less bone removal
- Less soft tissue disruption
- Less brain retraction
- Less collateral damage

Less is more
“Sneak in & sneak out”
Approach Evolution

Traditional

Endoscopic Keyhole
Endoscopic visualization & Keyhole Surgery

Supraorbital

Gravity-assisted

Brain Port
Use of Endoscope for Tumor Removal

- Endoscopic look & learn
- Endoscope-assisted removal
- Fully endoscopic removal

Most craniotomy cases are endoscope-assisted.
Room set-up for Endoscopic Craniotomy

- Patient positioning, scopes, monitors…
Supraorbital Eyebrow Craniotomy

- "Sweet-spot" of fronto-temporal craniotomy
- Entry point on floor of frontal fossa
- Exposure of frontal fossae, parasellar & peri-sylvian regions
- View and access expanded with endoscopy
Anterior Cranial Fossa Meningiomas Accessible via Eyebrow
Intra-axial Brain Tumors Accessible via SO Route

- Metastases
- Gliomas
- Chiasmal/hypothalamic
- Brain stem tumors
Eyebrow Removal of Brain Metastasis
62 yr old woman with NSC lung carcinoma & cognitive decline after SRS

3 months after left supraorbital craniotomy

Pathology: radiation necrosis with minimal viable carcinoma
Recurrent Glioblastoma – left eyebrow craniotomy
Recurrent Glioblastoma – left eyebrow craniotomy

Post-op day 1
Midbrain Tumor: 82 yr old woman with gait instability, memory decline, diplopia
Left midbrain lesion approached via right eyebrow craniotomy
Supra-orbital Craniotomy:
Excellent exposure & brain-friendly

Cosmesis more than acceptable

Endoscopy Assisted
Gravity-Assisted Endoscopic Trans-Dural Approaches
To Access Lesions Within or Surrounded by Eloquent Cortex

ENDOSCOPIC GRAVITY-ASSISTED TRANSFALCINE APPROACH
Barkhoudarian et al 2016

ENDOSCOPIC GRAVITY-ASSISTED TRANSSTENTORIAL APPROACH
Villanueva et al 2015
Transfalcine Approach for Contralateral Tumors


Transfalcine Approach: Positioning
Metastatic Melanoma in 58 yr old Woman

Right-sided approach for left parafalcine tumor
Pre-op

Post-op day 1

Post-op day 15 – rapid edema resolution
Gravity-Assisted Trans-Tentorial Endoscopic Approach

Intra-axial temporo-parietal & occipital lobe tumors
Metastatic Melanoma
3 Months Post-op & Post SRS

4 years after surgery, SRS & Ipilimumab: married and with first child
Brain Port Approach
64 yr old woman with deep GBM
Brain Port Approach

64 yr old woman with deep GBM

Rapid tumor progression despite adjuvant therapies
Conclusions

• Keyhole surgery is a concept not a size; surgical approaches need to be adaptable to the full spectrum of brain tumor pathology

• Advanced technologies are helping promote greater tumor removal while minimizing collateral damage

• When combined with targeted radiosurgery, medical therapies and immunotherapy, we are entering a new era in brain tumor management

• Collaborative team approach essential to optimize patient outcomes