Main Building Façade

- OR Room 5
- 3 West Cardiac/Telemetry Unit
- Emergency Department Renovations
Medical Office
Building Façade

- MOB Common Areas
Education:
• Completed his Internship and Residency at George Washington University School of Medicine and Health Sciences

Specializes in:
• Cranial Base Surgery
• Stereotactic Surgery
• Neuro-Oncology

Holds Membership in:
• American Association of Neurological Surgeons
• Congress of Neurological Surgeons
Technological Advances in Neurosurgery:

Timothy G. Burke, MD
Neurosurgery History

• Earliest Neurosurgery attributed to Incas
  • Some believe they were able to achieve high survival rates
    • Avoided dangerous regions
    • Safe surgical techniques
    • Use of herbs and balms for analgesia and antibacterial activity

• Likely the Neurosurgery (trephination) was widely spread
  • China- Hua Tuo (up to 10,000BC)
  • Egypt
  • Oceana( clear evidence on skulls)
  • Arabia- Avicenna and Rhazes

• Moderna era
  • Harvey Cushing-expanded exposure of craniotomy
  • Horsley
  • Krause
What to operate on and how to get there

• Locating tumors/pathology based upon clinical knowledge from previous cases
  • Wilder Penfield
  • Father of electrical stimulation
Homunculus

- Distorted representation of human body
- Based upon volume of brain dedicated to specific sensory and motor functions
The Dark Ages

- No imaging
  - Pneumoencephalogram
  - CT
  - MRI
  - PET
- Light
  - Headlights
  - Microscopes
  - Endoscopes
  - Exoscopes
The Modern World

- Pre-op imaging
  - Detailed anatomy
  - Ability to see fibers(tracts and connections
- Image guided surgery
  - GPS in the OR
- Digitally augmented microscopy
  - Visible light
  - Use of Fluorophores
Preoperative Imaging

- MRI
  - Detailed anatomical assessment of neural structures
    - Gray matter
    - White matter
    - Blood vessels
  - Tract visualization requires 3D rendering of white matter over great distances
Tractography

• Utilizes Brownian movement of water on MRI
• Measures the relative magnitude of diffusion of H2O
• We can now see:
  • Corticospinal tracts
  • Visual pathways
  • Sensory tracts
Stereotactic Navigation

• Originally developed from frame based systems for (Horsley/Clarke)
  • Biopsy
  • Stereotactic radiation
  • Placement of electrodes

• Targeting is taken from:
  • X-Y-Z axis

• Limited to single point/target localization
Frameless Stereotaxy

• Image based
• Utilizes infrared light
• Volumetric calculation from CT/MRI
  • Allows continuous image display
    • X-Y-Z axis
Allows safe tailoring of incisions
Targeted Craniotomy

• Small skin incision
• Small tailored craniotomy
• Safely utilize white matter access to deep and superficial regions
  • Utilize tractography
  • Self protecting operative sheaths/ports

• Digitally enhanced visual information:
  • Visible light
  • Fluorphores
  • Targeted molecules
Retraction Injury

• Challenges of subcortical surgery being with retraction injury
  • Dispersion of Pressure on Tissue
  • Tissue “creep”
  • Visualization at Depth

The quiet revolution: retractorless surgery for complex vascular and skull base lesions

Clinical article
ROBERT F. SPETZLER, M.D., AND NADEH SANAI, M.D.
Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona
Evolution of Access: BrainPath®

- Designed for ACCESS to allow:
  - Smaller craniotomy
    - $\approx 30\text{mm}$ or smaller
  - Smaller dural opening
    - $\approx$ Size of sheath used
    - 13.5mm or 11mm
  - Real-time navigation
  - Gentle dilation of sulcal opening
  - Venting of ICP to be dissipated during cannulation
  - Air-medium & bimanual microsurgical technique
Radial Retraction vs. Access System

The stereotaxic retractor in computer-assisted stereotaxic microsurgery

Technical note

Patrick J. Kelly, M.D., Stephan J. Goebbels, B.S., and Bruce A. Kall, M.S.
Departments of Neurosurgery and Information Processing and Systems, Mayo Foundation and Mayo Medical School, Rochester, Minnesota

BrainPath (2000s)
- Considers WMT analysis
- Designed for serial dilation of tissue
- Designed for transsulcal, parafascicular application
- SHOWING POTENTIAL FOR LESS INJURY

- Dr. Pat Kelly (1980s)
- No inclusion of WMT analysis
- Manual Dissection → Placement of Radial Retractor
- SHOWED POTENTIAL FOR LESS INJURY
Fluorescence Surgery

- Na Fluorescein
  - First used in 1948 for intracranial tumors (Moore et al)
  - Tendency to accumulate where the blood-brain barrier (BBB) is disrupted
  - High dose is visible to naked eye
  - Low dose is visualized by 560nm filter
  - Sensitive
  - Non specific
    - Benign tumors
    - Malignant tumors
    - Radiation necrosis
Fluorescent Surgery

• 5-ALA
  • Converted by certain tumors into protoporphyrin-9
  • FDA approved for grade III and IV gliomas (2017)
  • Excitation at 380-440nm
  • Emission at 620-640nm
  • Sensitive
  • Specific
    • Will not fluoresce radiation changes
  • Expensive
  • Can cause photosensitivity
Figure 2. Kaplan–Meier curves of our results. 5-ALA-GS, 5-aminolevulinic acid-guided surgery.
5-ALA Resection of Glioblastoma
The Future

• Currently 39 Fluorescent agents in clinical trials
  • clinicaltrials.gov
• Targeted molecules
  • Allow for photo therapy intra-op
• AI algorithms for determining neural networks
  • Will allow resection approaches to reduce post-op deficits
THANK YOU