

# Surgical Approach to Brain Tumors : Past, Present & Future

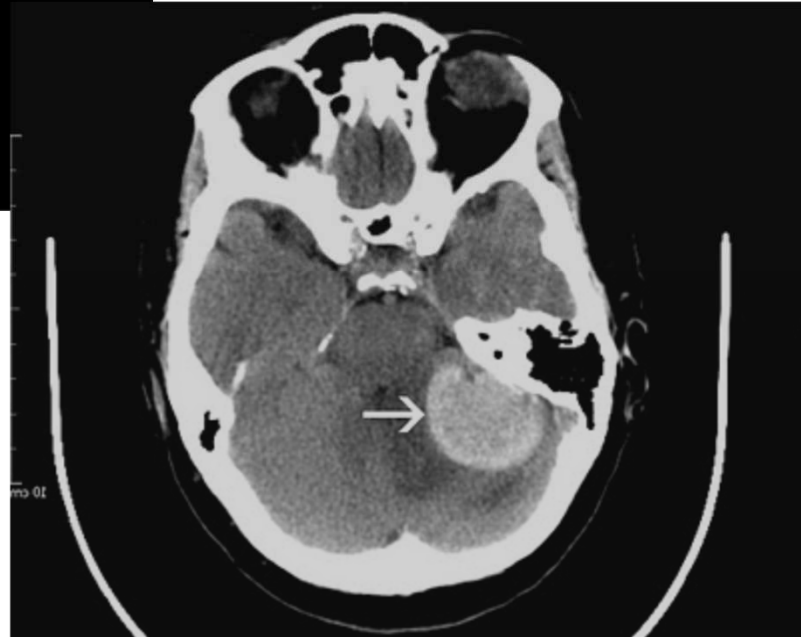
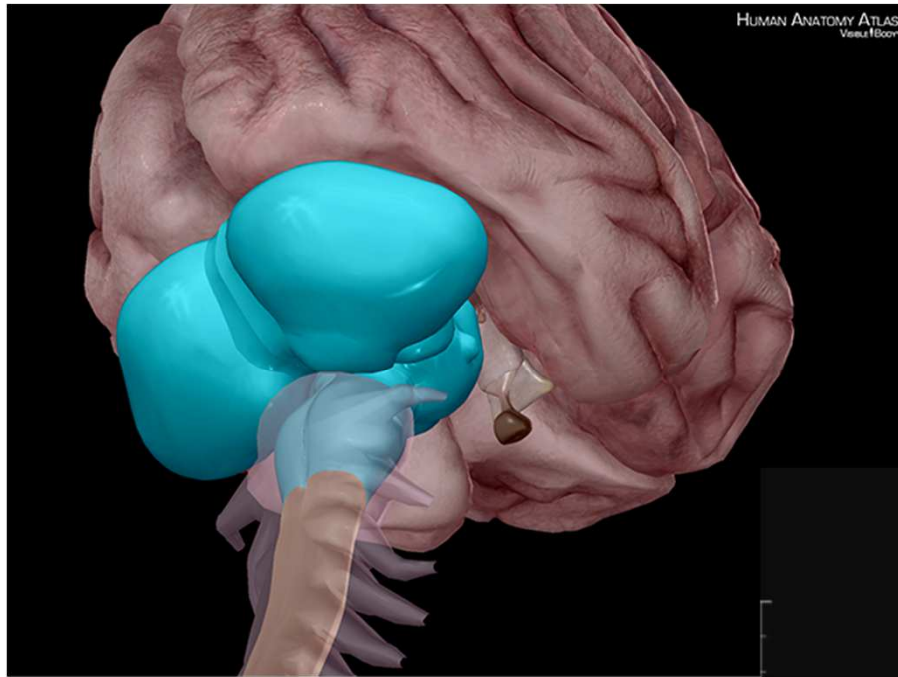
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- Evolution –
- 1879 - William MacEwan removed parasagittal meningioma  
Surgery was based on Cerebral Localization
- X-rays - 1895 by Wilhelm Conrad Roentgen  
Surgery based on - Pneumo-Encephalography and  
Carotid Angiography
- CT Scan - 1972- Godfrey Hounsfield and William Cormack
- MRI - 1977 Raymond Vahan Damadian

## Relevance of Anatomy

- Nerve cannot regenerate – precise approach must.
- Guides the surgical approach and intra op planning.
- One of the predictors of post operative outcome.





- *Features exclusive to brain –*
- Neurons cannot regenerate
- Concept of Malignant is different
- No Lymphatics in brain
- Intra Cranial Pressure

# The approach

- Planning
- Medical Management
- Surgery
- Adjuvant Therapy

# Surgical Planning - Considerations

- Patient Factors –
- Age
- KPS

# Tumor Location

- Scalp to Skull base
- Supra tentorial / Infra tentorial
- Bone / Brain parenchyma / Intra ventricular
- Important for surgical & radiation planning  
as some will be easily resectable and others will be difficult to access

## Surgical Considerations : Tumor Factors

- Tumor - Primary vs Metastatic
- Tumor Grade - Low / High
- Tumor Margins - Well defined / Infiltrating
- Compartment - Single / Multiple
- Morphology - Calcifying / necrotic

## Surgical Considerations : Tumor factors

- Vascularity - Very vascular to avascular
- Functional Area - Eloquent Vs non eloquent area
- Prox. To CSF Path - Obstructive vs Non obstructive
- Potential to disseminate via CSF

# Planning

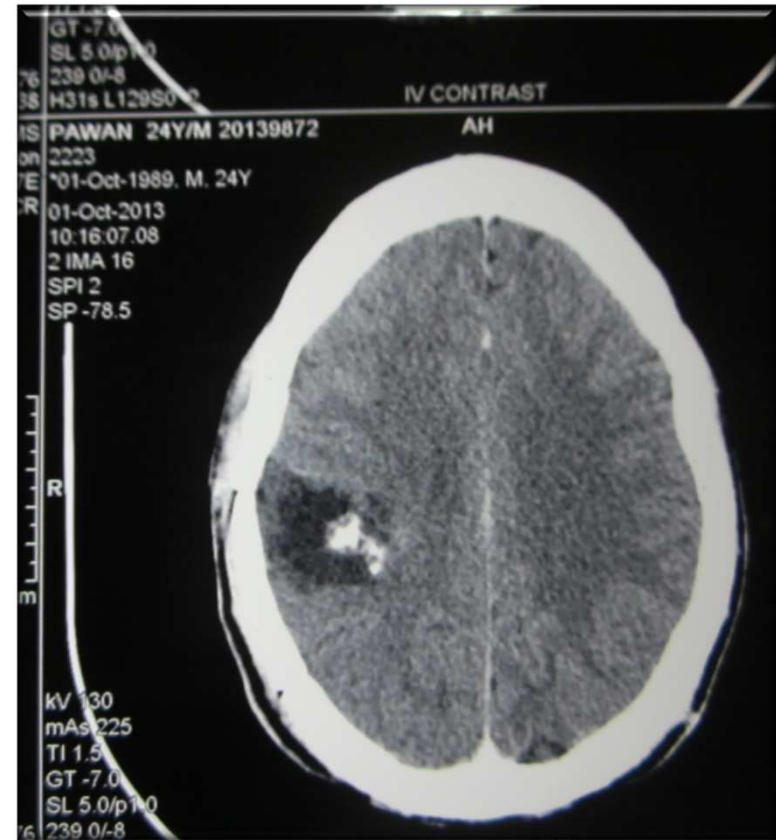
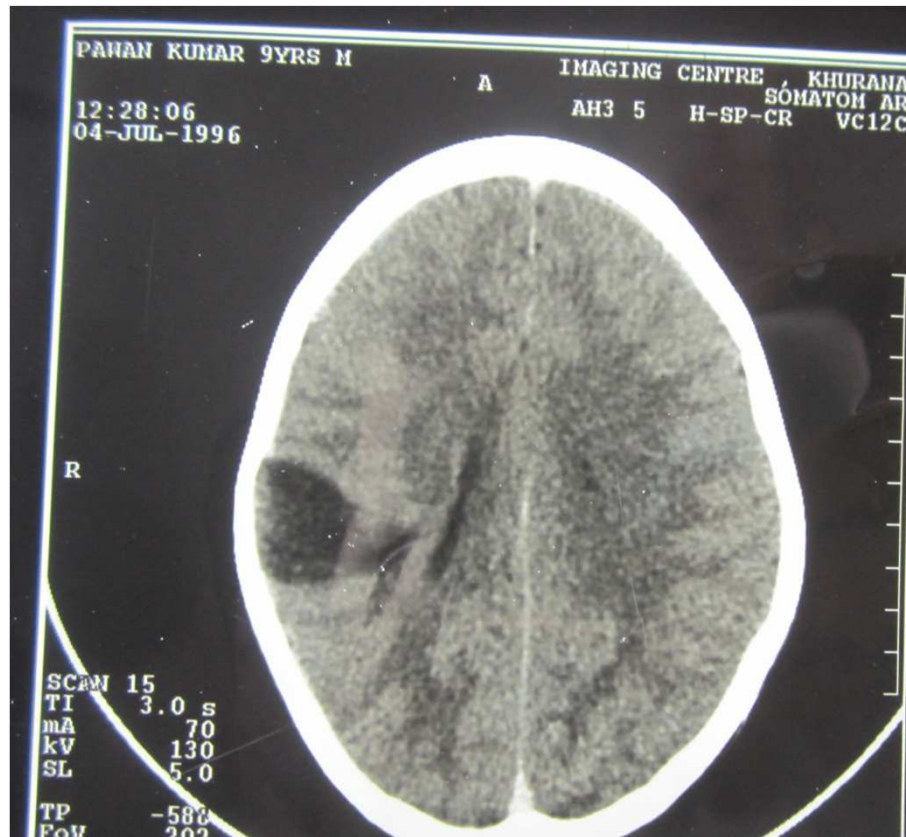
- Counseling the patient/ attendant about Diagnosis
- All Treatment options to be discussed
- Duration of surgery and expected blood loss
- Future plans of adjuvant treatment
- Cost of Treatment
- Life expectancy

# Medical Management

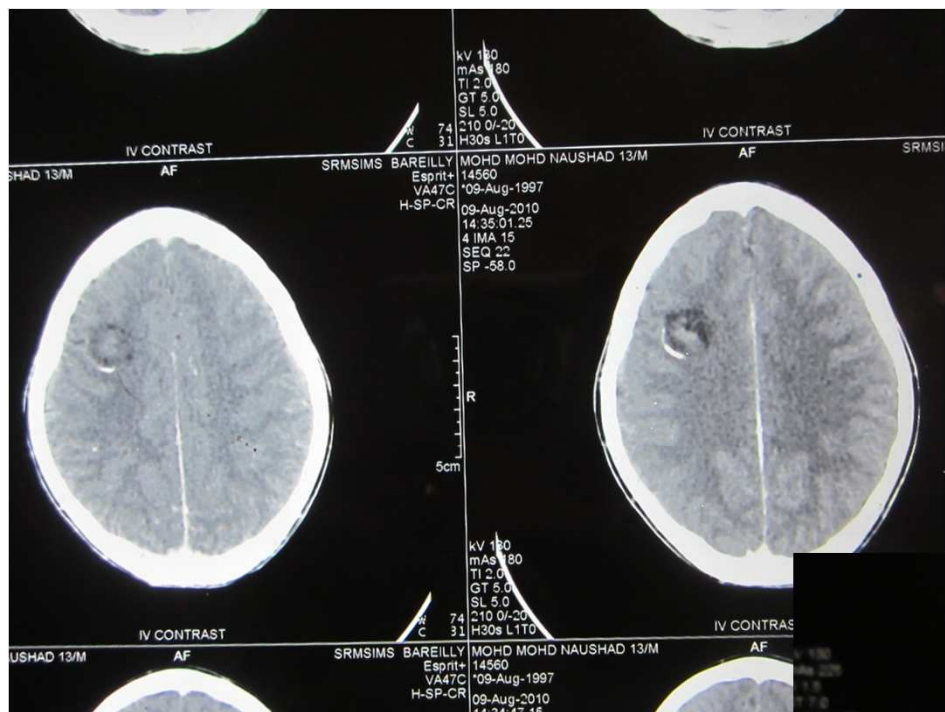
- Treating the symptoms
  - Managing cerebral edema
    - Steroids
    - Mannitol
  - Seizure prophylaxis
  - Supportive treatment

# Observation

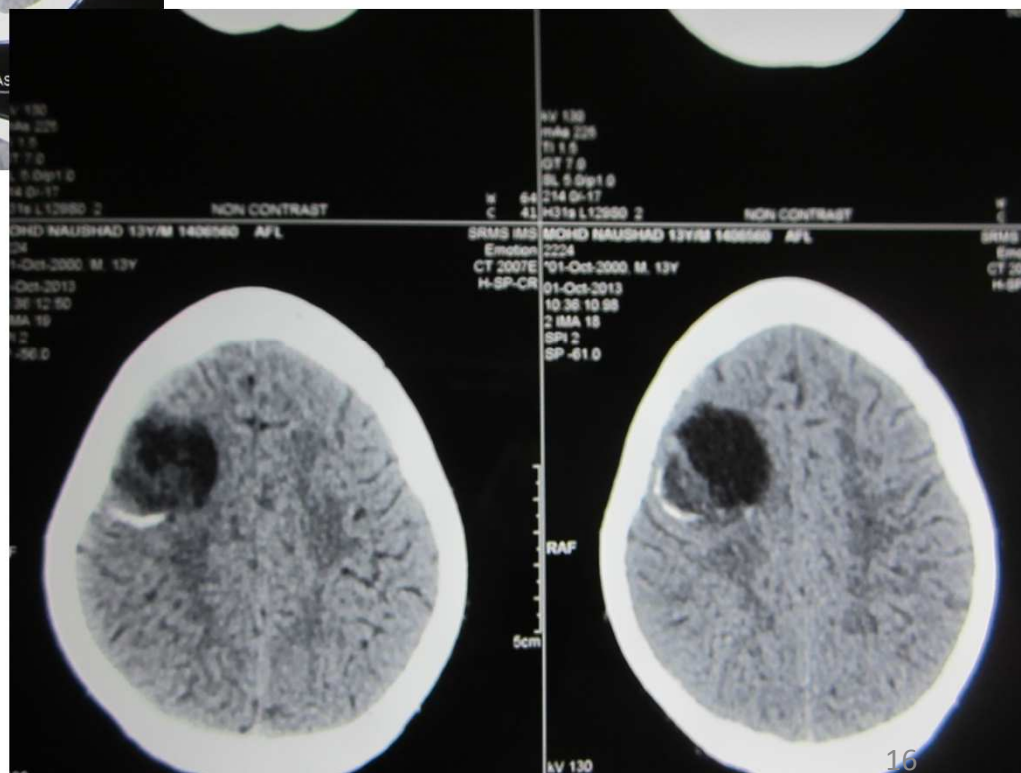
- For Low grade Tumors Pilocytic Astrocytoma
- Tumors with low growth potential, like occasional Meningioma in elderly, non functional pituitary adenoma without optic pathway compression, occasional Acoustic neuromas etc.
- Plan for periodic monitoring essential and patient to be counseled regarding treatment options.



Possibly Glioma - on Observation alone: Minimal enlargement over 17 years



Tumor Enlargement - Over 3 years



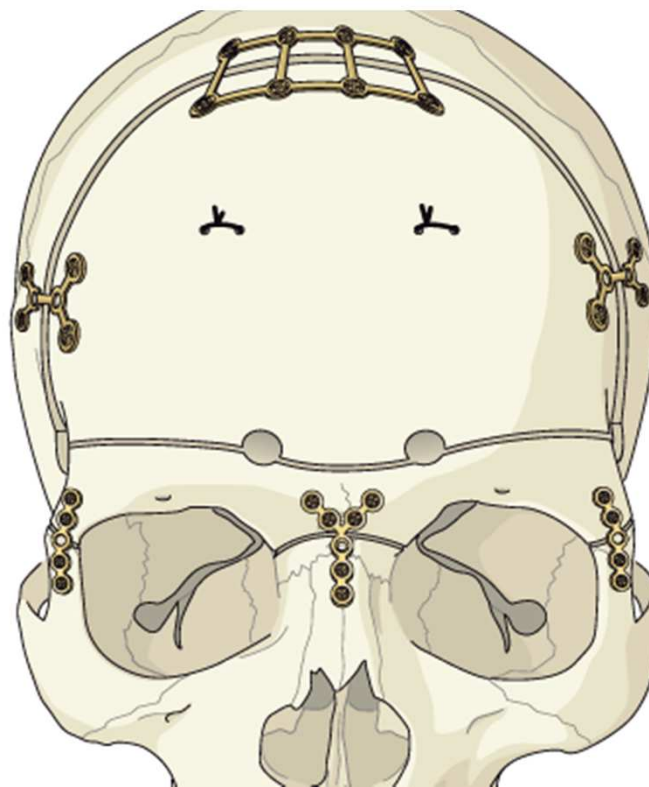
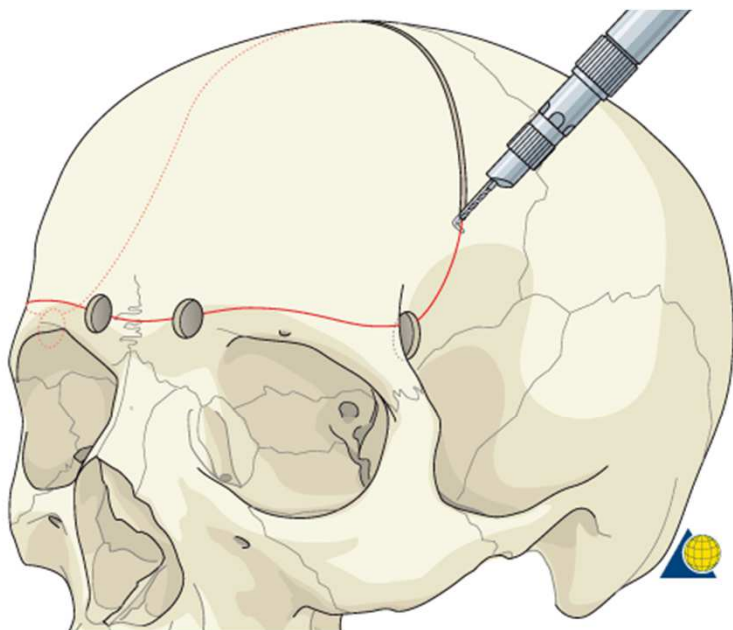
# Surgery

- *The Goals* -
  - To obtain tissue for diagnosis
  - To tackle the disease burden by tumor decompression or if possible, by complete excision.

# Surgery

- Open method - Craniotomy
- Closed or min. invasive- Endoscopy -  
Trans cranial  
Trans nasal

# Craniotomy



# Surgical aids

- Diathermy
- Suction Machine
- Microscope
- Endoscope
- CUSA

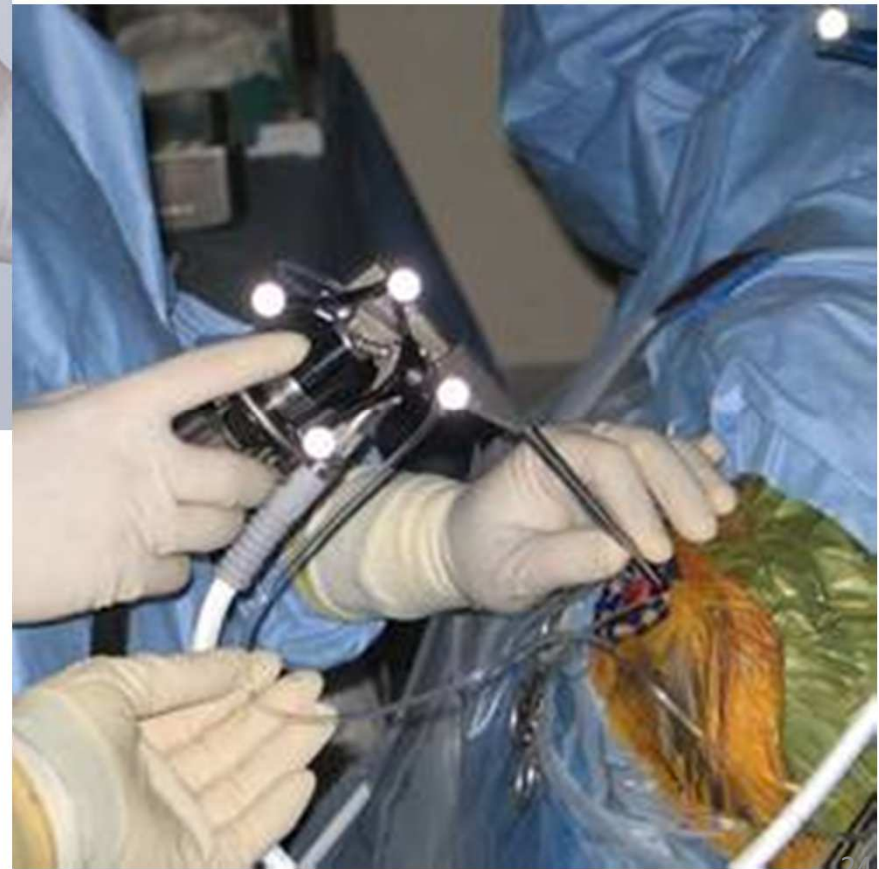
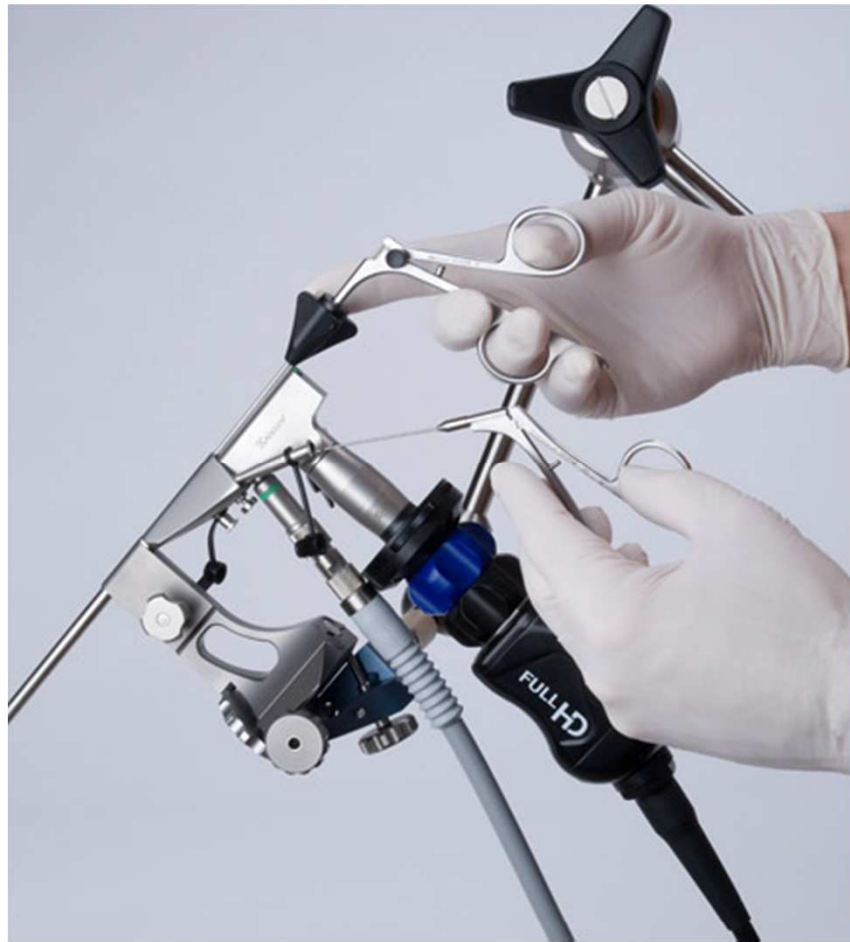
# The Microscope

- Magnification – better delineation of anatomy
- Illumination at depth – helps prevent inadvertent injury to important structures
- Better resectability - complete excision

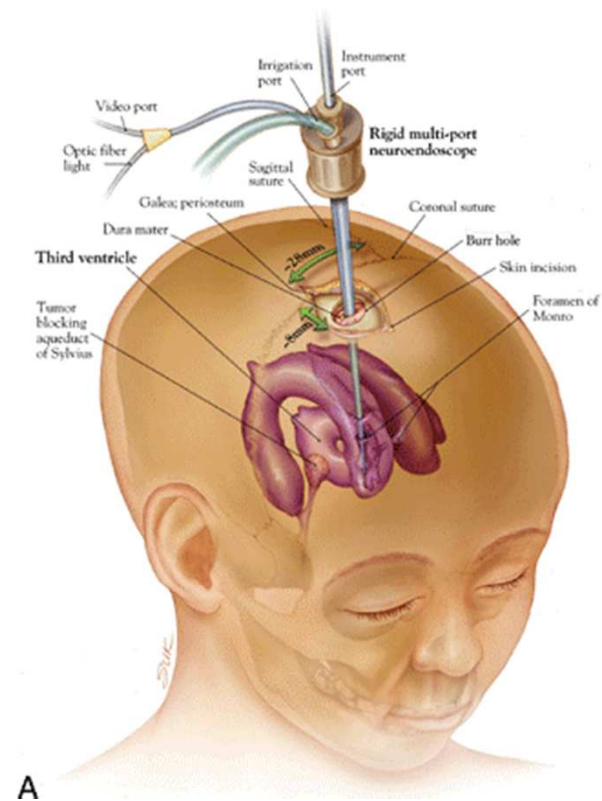
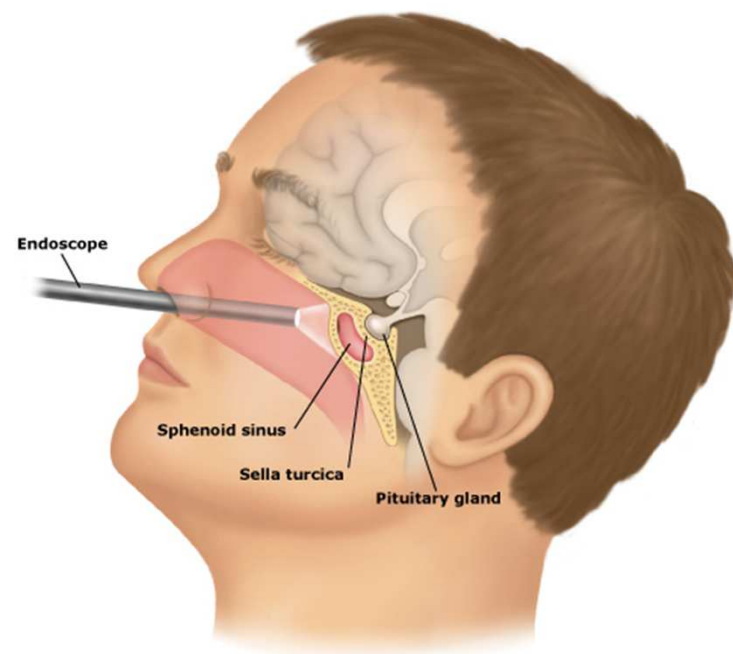
# Neuro-Endoscopic surgery

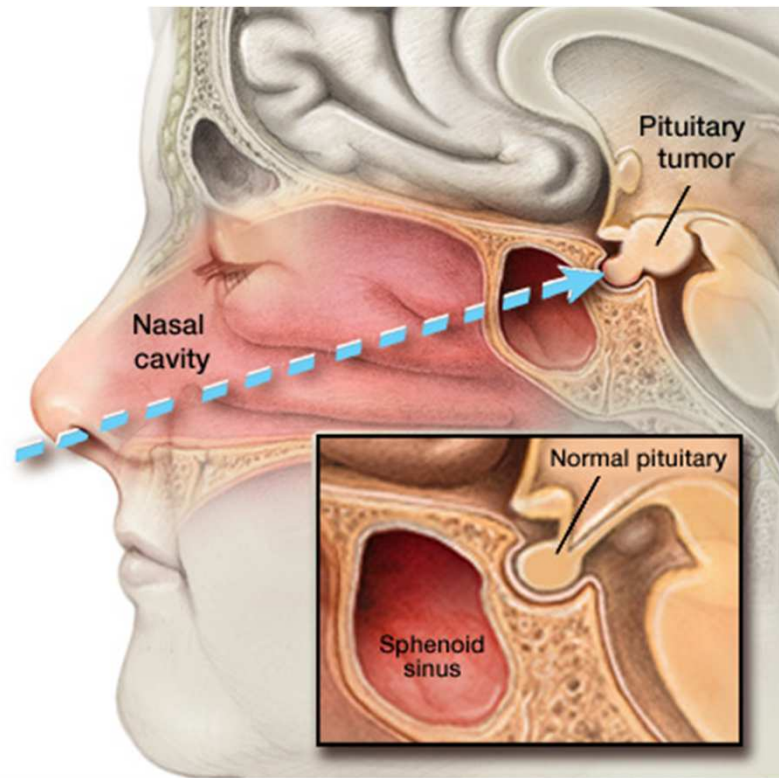
- 1910, Victor de l'Espinasse, - First endoscopic operation
- February 6, 1923, William J. Mixter, a neurosurgeon, performed the first endoscopic ventriculostomy in a child with congenital obstructive hydrocephalus.



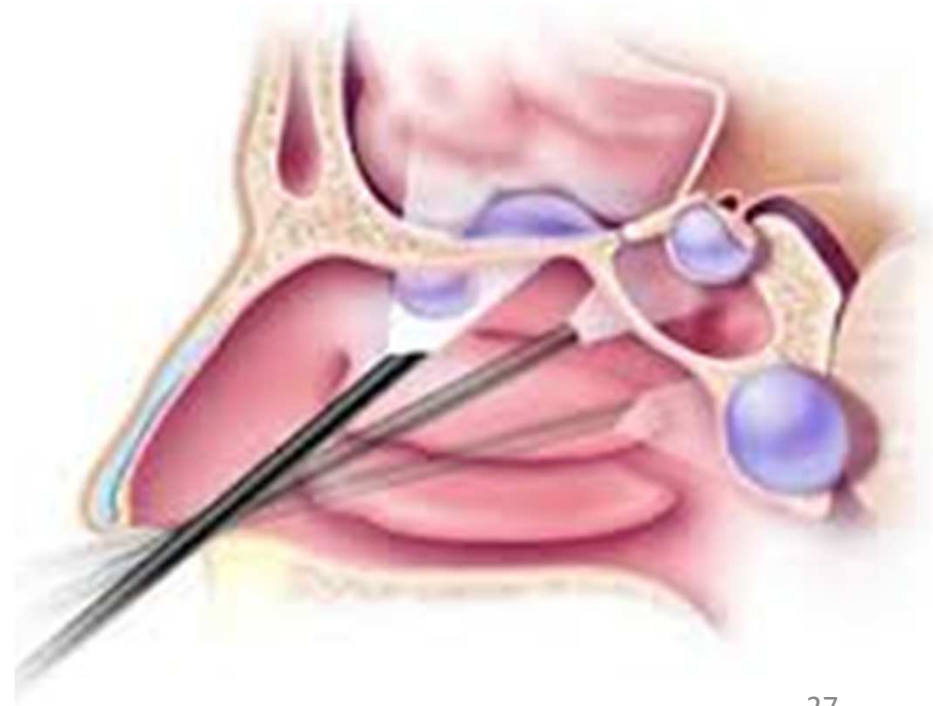


- Trans nasal Approach -
  - Pituitary Tumors
  - Craniopharyngioma
  - Planum Meningioma
  - Clival Tumors
- Trans-cranial Endoscopy
  - Endoscopic Third Ventriculostomy
  - Colloid Cyst
  - Biopsy for Intra Ventricular lesions





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# The Change to Minimally Invasive Surgery

*From Maximum exposure - minimum resection*

*to Minimum exposure - maximum resection*

## Advantages

Minimal Blood Loss

Less post operative pain

Faster Recovery

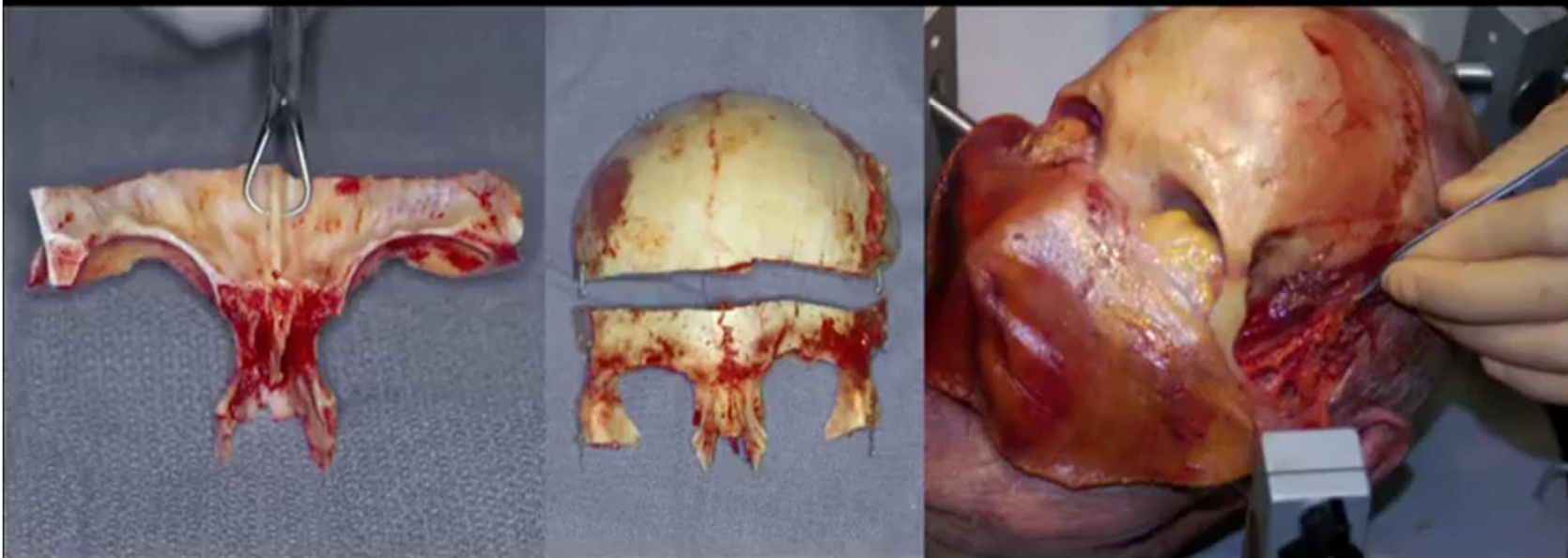
Shorter Hospital Stay

Caution: Learning curve like laproscopic surgery

# Skullbase approaches

- Required mainly for Meningioma  
Schwannomas, Chordomas, Glomus tumour
- Multi-compartmental skull base tumors

# Skull Base

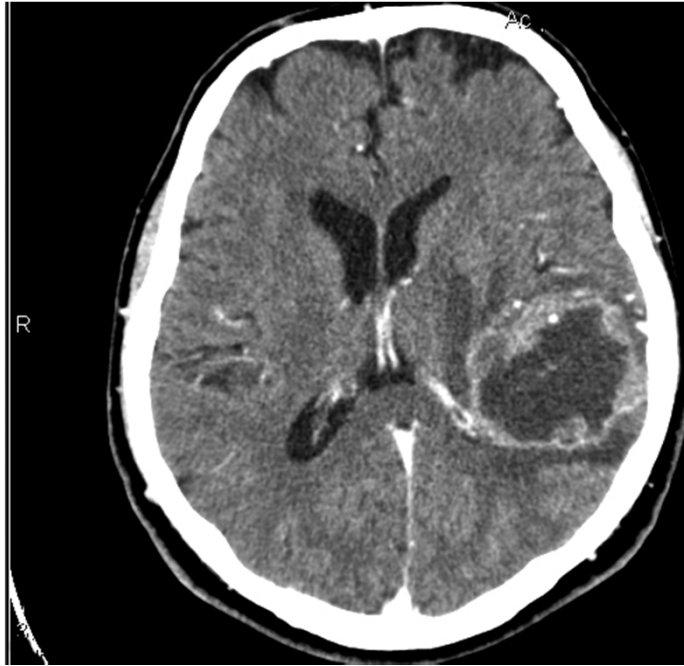


# Awake Surgery for Tumors

- - For Tumors close to eloquent area
- - Concerned Motor function is continuously checked during surgery
- - Patient needs to be motivated and co-operative to follow commands

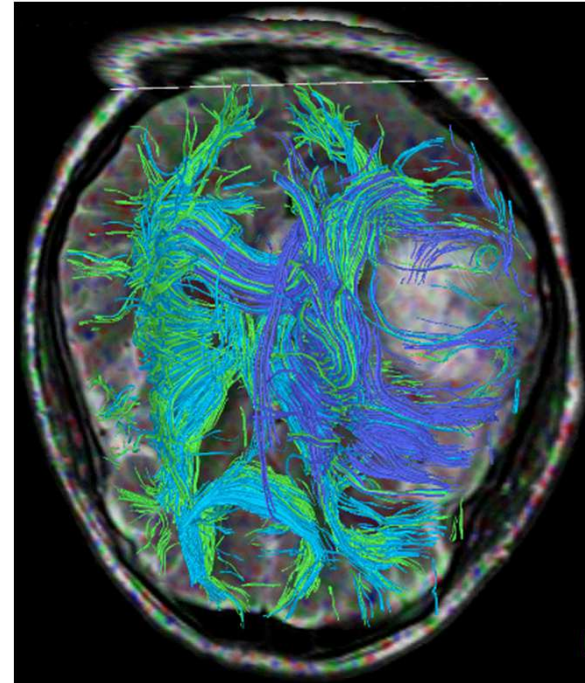
- *After thought*
- Tumor left behind – surgical limitation or surgeon's limitation
- If all clinical variables are same , will 2 pt respond similarly and show same out come
- Post op response of brain

- *Advancements in Diagnostics*
- 3T MRI
  - Better and fast image acquisition
- fMRI
  - maps the function of different area of brain surface
  - Better understanding of cerebral localization
- Tractography
  - Visualization of fiber tracts
- CT Scans
  - High speed multi slice



## CE MRI

showing LtParietal tumor



## MR Tractography

shows displaced nerve fibre around tumor

# Advancements in Surgical Aids

- Stereotaxy
  - for deeper lesions
  - Lesion localization with 3D precision
  - Best for tumor biopsy



# Intra operative MRI



## Advancements in Anaesthesia and Critical Care

- Concept of Neuro-protection
- Long surgery possible
- Post op ventilation
- Supportive treatment

## Past

- Limited Information
- Large craniotomy
- Wide cortical Injury
- Low Resectability
- Pure neurosurgeon's realm
- Outcome unpredictable

## Present

Better Informed

Optimally Invasive

Precise & shortest path

Maximum resection

Multi-disciplinary

Mostly predictable

# Has this all changed the outcome !!!

- Significantly improved outcome with very low morbidity mortality and predictable outcomes
- Better equipped and informed to tackle more challenging cases
- Better tumor resection has lead to either Cure or prolonged PFS in benign tumors

- Failures
- Glioma - Survival in 1970's - 12 months
- 2015' - 14 months
- Role of Surgery / Chemotherapy / RTh
- Local Failure
- Need to review the tumor biology and approach to tackle the menace

*What's the Patient's view !!!*

# The Approach

- Our approach to patient's complaints and it's analysis
- Radiologist's Approach
- Surgical Approach
- Pathologist's approach
- Medical/Radiation Oncologist's approach
- Nursing approach
- Physical and Psychological rehabilitation
- Approach to manage the complications / failure

- What lies ahead ?
- Simulators for Training –
- LASER Surgery

# LASER



## Laser Interstitial Thermal Therapy

Unlike radiation, the tumor kill is immediate due to thermal effect.

Phase I trials – encouraging results

Treated tumor vol. 3-19cm<sup>2</sup>

Survival - 67-717days

- Gene therapy -

Molecular biology has important role

Highly specific tumor cell killing by non replicating oncolytic viruses

- Tumor Vaccine –

- Mostly against high grade glioma

Targeted against tumor antigens

*Rindopepimut (CDX-110)*, *DCVax-L* - Phase III trial

*ICT-107* - completed phase II trial with encouraging results

# Conclusions

- Better understanding of neuro-anatomy and tumor biology along with advancements in diagnostic and therapeutic adjuncts have significantly changed the patient outcome.
- More work is needed in management of malignant tumors.