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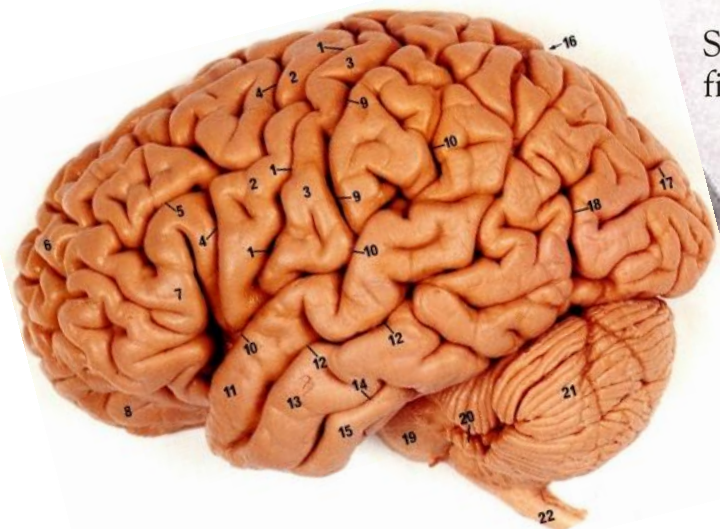
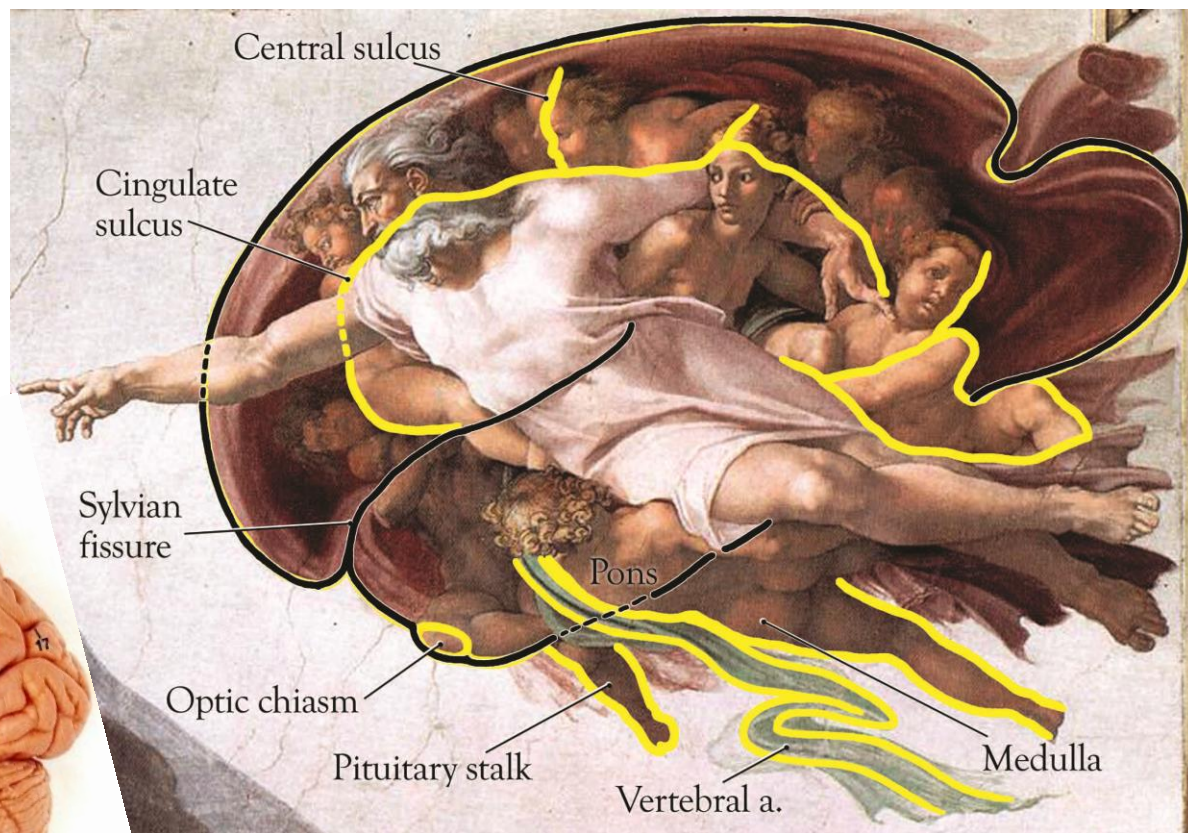
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# Advances in Minimally Invasive Brain and Spine Surgery

Dr Wong Hoi Tung 黃海東醫生

Associate Clinical Professor (Honorary), CUHK

# Brain: The Home of Soul 靈魂之家



# Where the Evil Live! 魔鬼住處

- The very first cases of craniotomy were probably performed by prehistoric man
  - for reasons related to magic or religious rituals, or as an initiation practice





# Psychosurgery 精神外科

- American psychiatrist Walter Freeman (center) developed the frontal lobotomy 額葉切除術 in 1950's





# Impression on Neurosurgery !!!



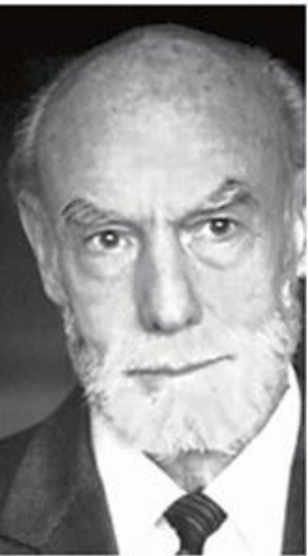
# Why so many complications in the past ?

- *Knowledge Limitation*
- *Technology Limitation*
- *Technique Limitation*



# The Nobel Prize in Physiology or Medicine 1981

for his discoveries concerning the functional specialization of the cerebral hemispheres"  
 or their discoveries concerning reading information processing in the visual system"



**Roger W. Sperry**

1/2 of the prize

USA

California Institute of  
 Technology (Caltech)  
 Pasadena, CA, USA

1913  
 1994



**David H. Hubel**

1/4 of the prize

USA

Harvard Medical School  
 Boston, MA, USA

b. 1926  
 (in Windsor, ON, Canada)



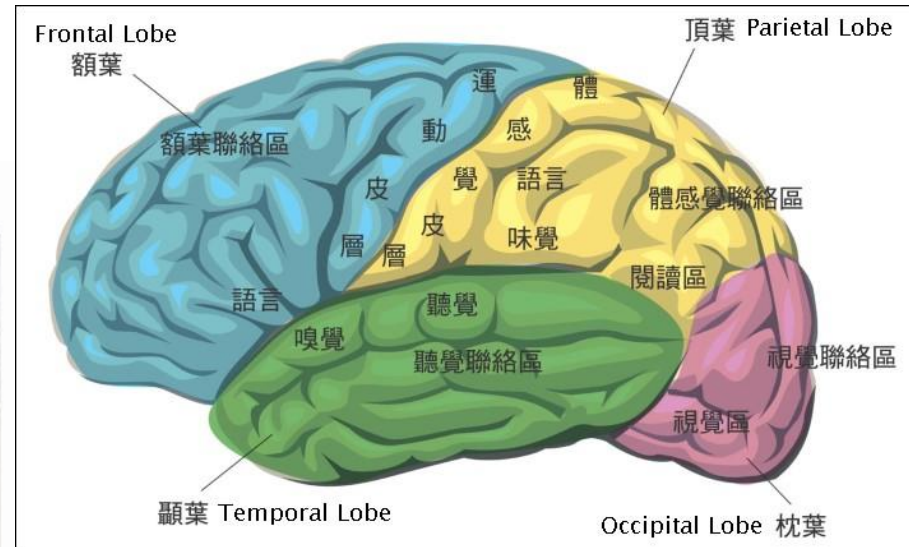
**Torsten N. Wiesel**

1/4 of the prize

Sweden

Harvard Medical School  
 Boston, MA, USA

b. 1924



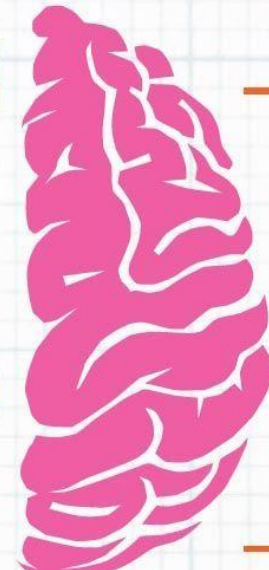
## 左腦

文字  
 邏輯  
 分析  
 順序  
 數字  
 語言  
 操作  
 觀察



## 右腦

人際  
 想像  
 音樂  
 視覺  
 顏色  
 白日夢  
 空間尺度  
 整體思考



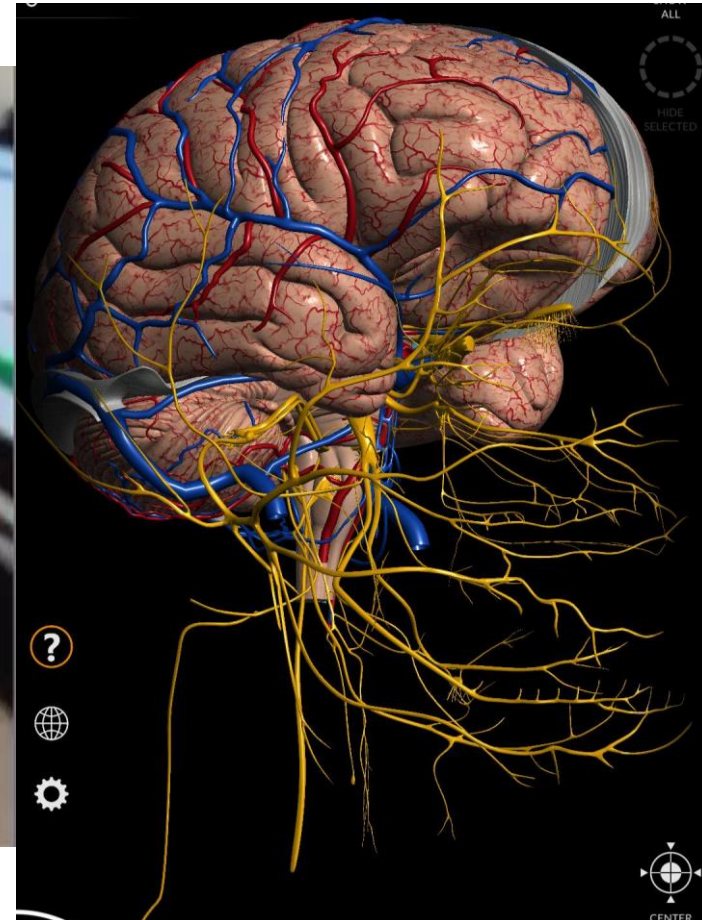
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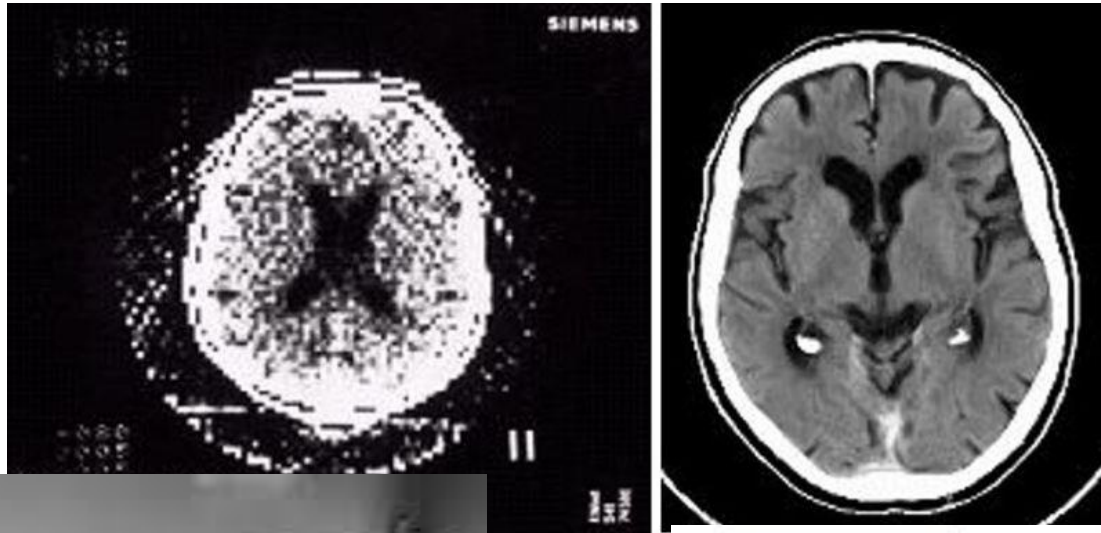
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# Virtual reality in anatomical knowledge



# Technology advancement

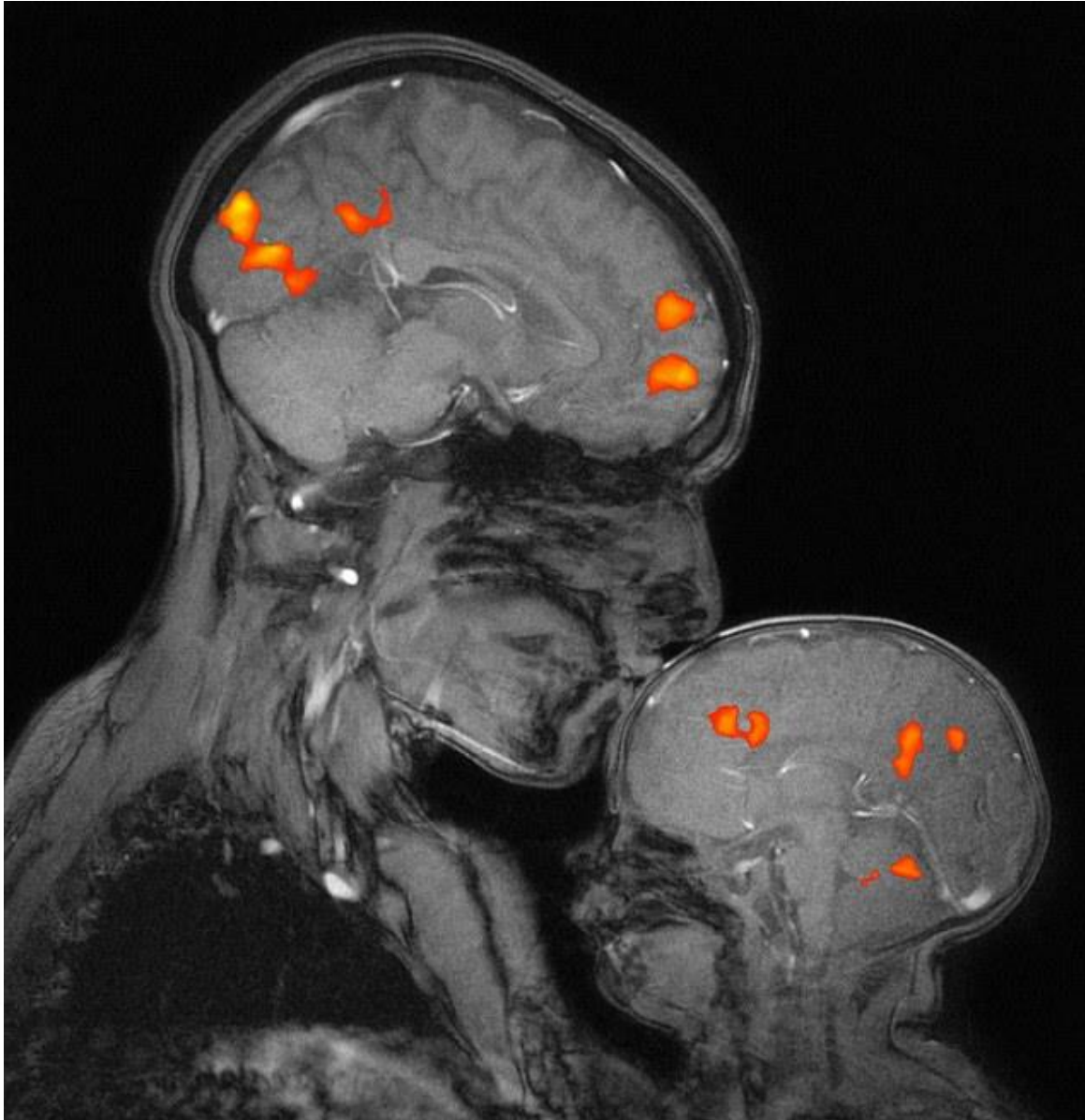


CT scanner



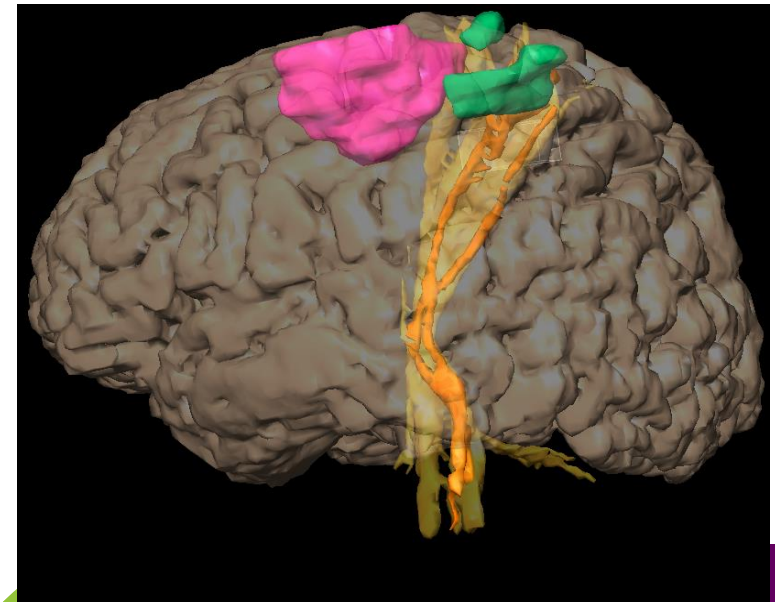
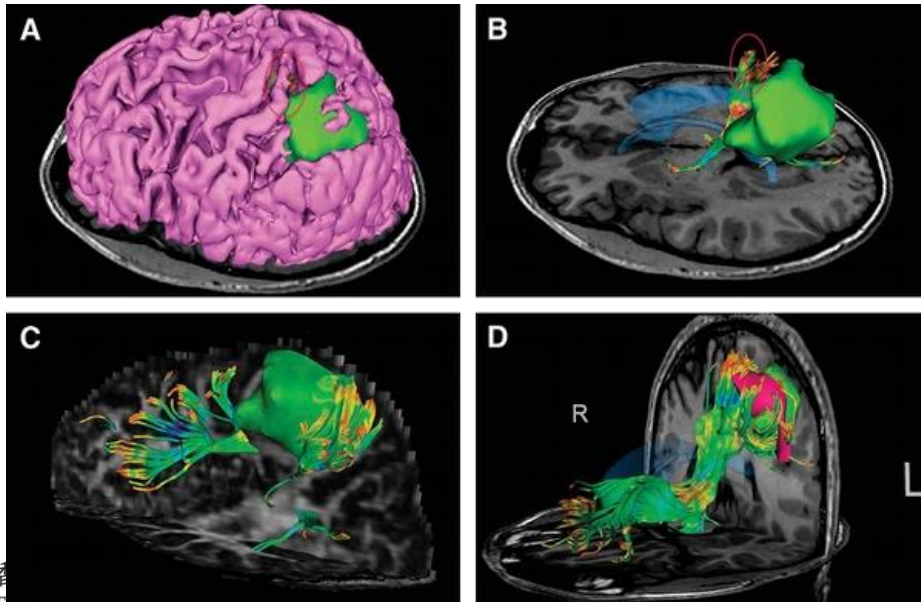
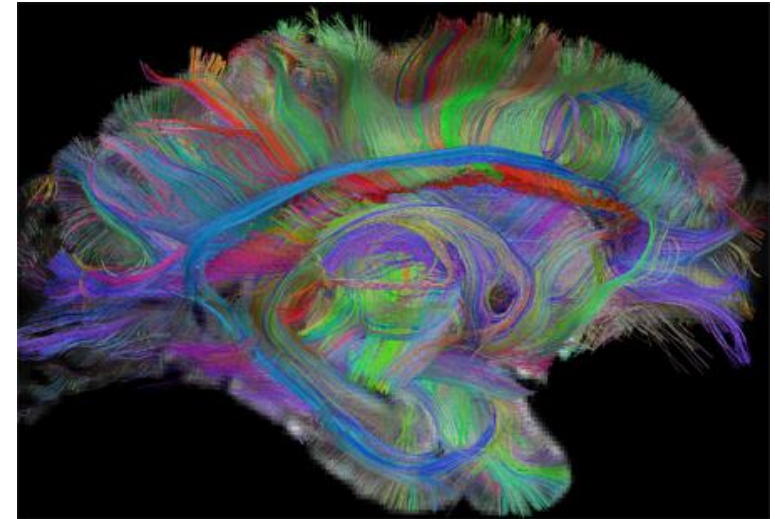
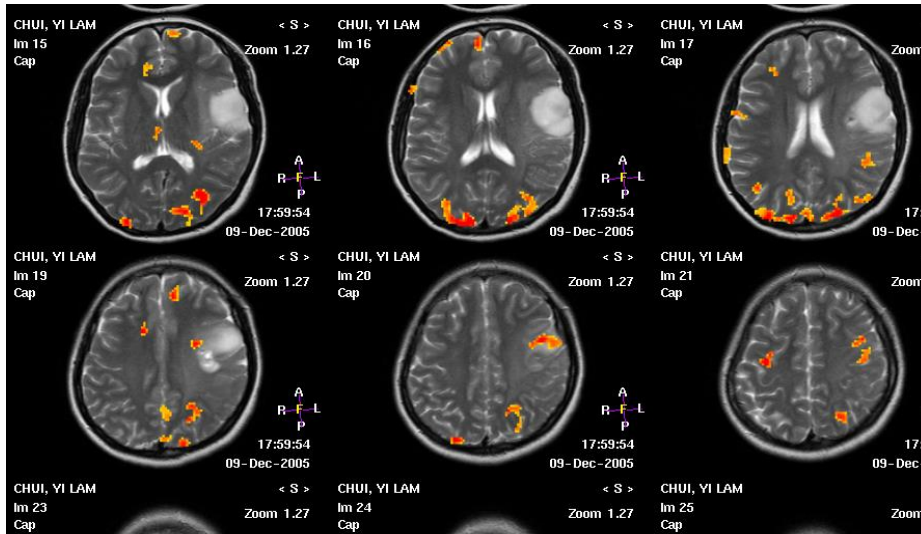
Interesting fact of the day:

On July 3, 1977, the first MRI body exam was performed on a human being. It took almost 5 hours to produce one image. The images were rudimentary by modern standards. Now we can perform an MRI scan on a patient in about 30 minutes, resulting in hundreds of images!





# Functional MRI 功能性磁共振造影 and fibers tracking



# Image Guided Neurosurgery

- Neuronavigation 電腦導航

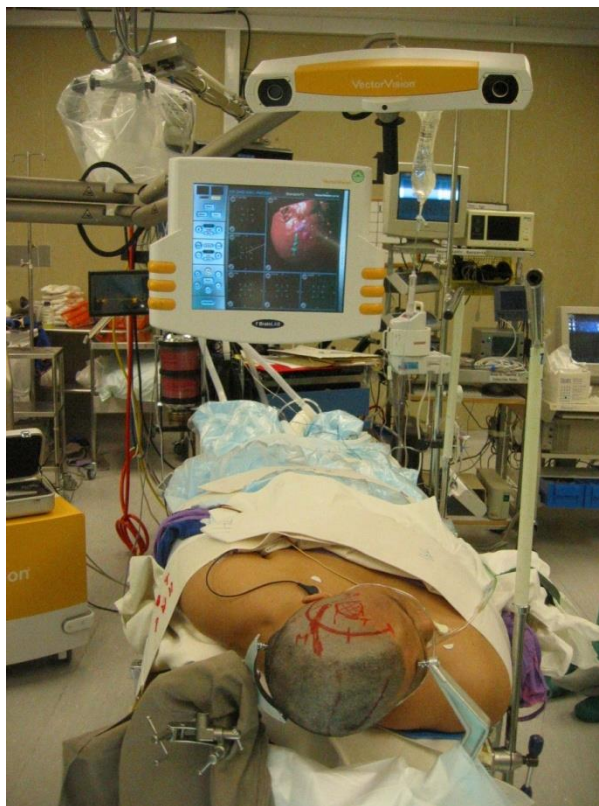
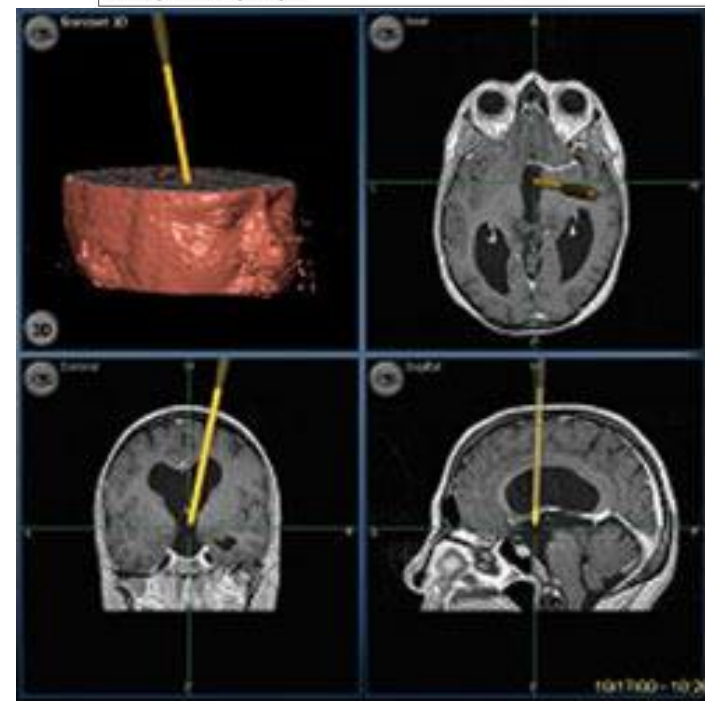
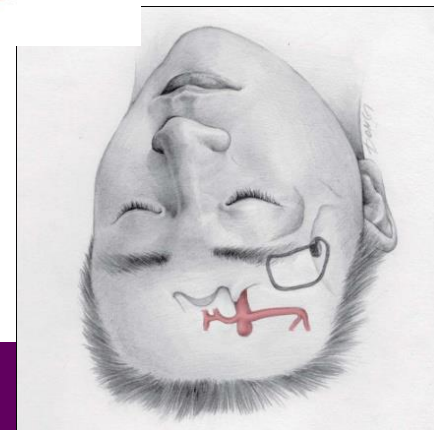
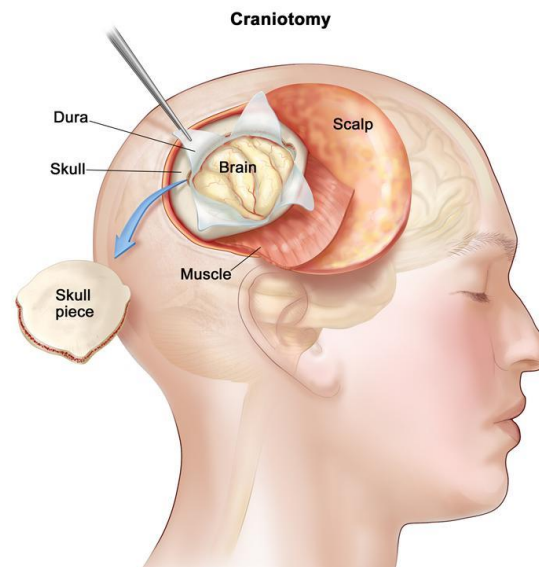
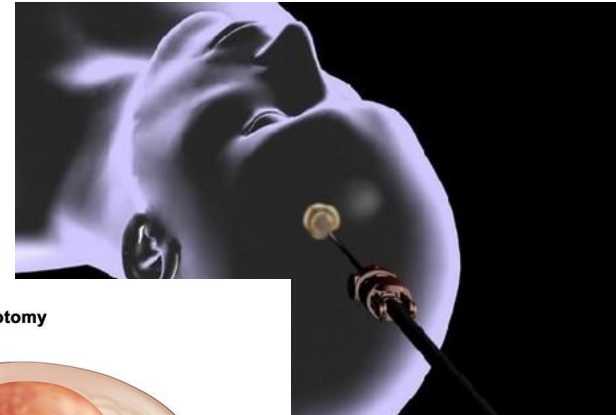


Abbildung 1: Neuronavigationsgerät



# Types of Brain Surgery 腦手術種類

- Burr holes 鑽孔/ Biopsy
- Craniotomy 開顱
- Neuro-endoscopy Surgery 腦內鏡
- Minimally Invasive Surgery 微創手術/  
Keyhole Surgery





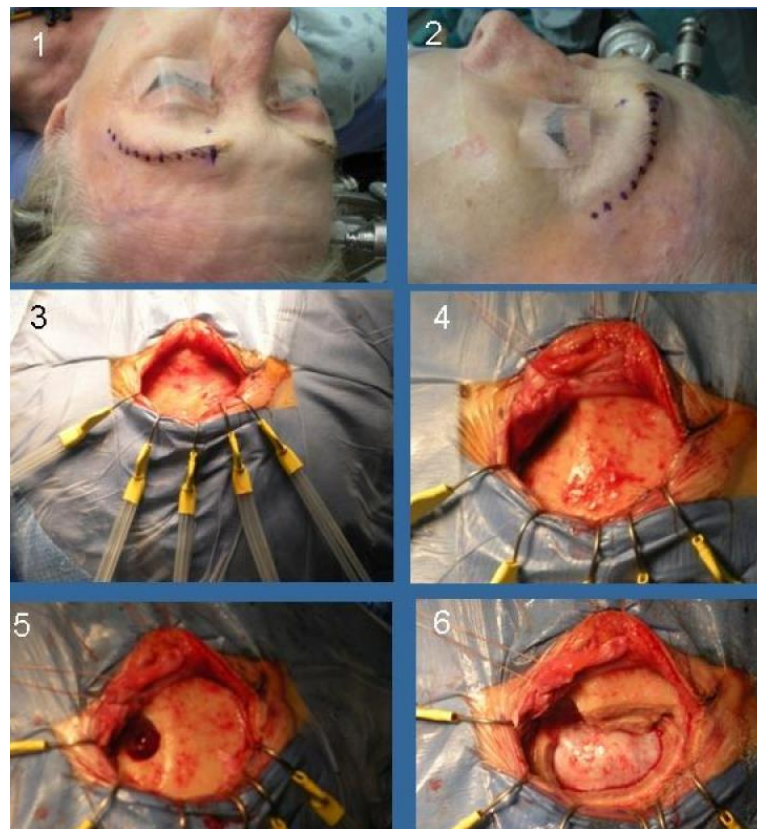
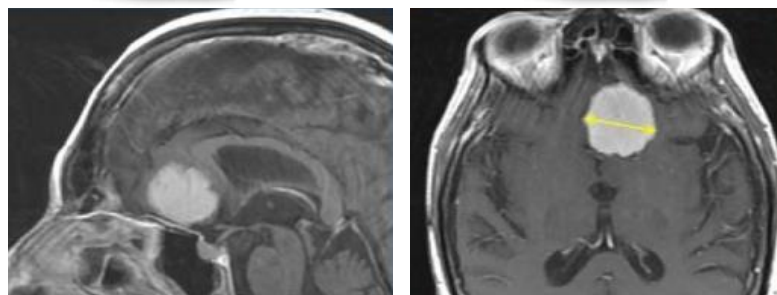
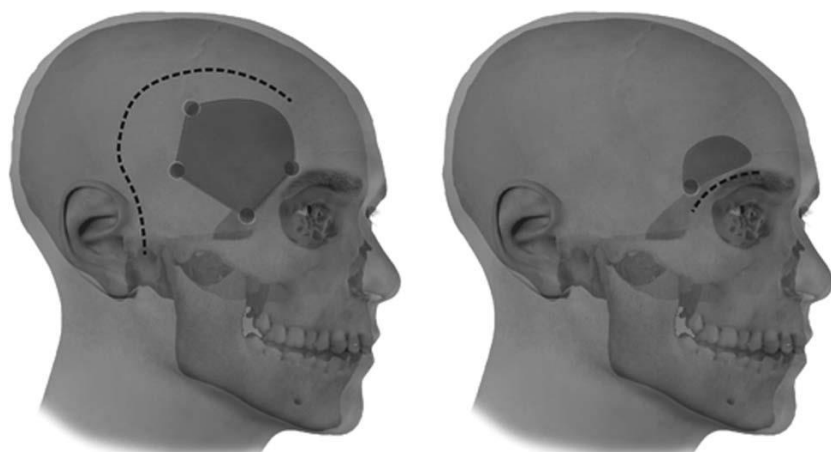
# Why Minimally Invasive Surgery?

- Potential advantages compared with “open” surgery
- May result in
  - Smaller incisions and scars
  - Minimal soft-tissue destruction and scarring
  - Less surgical blood loss
  - Shorter hospital stay
  - Less postoperative pain
  - Less need for postoperative pain medicine
  - Faster return to work and daily activities

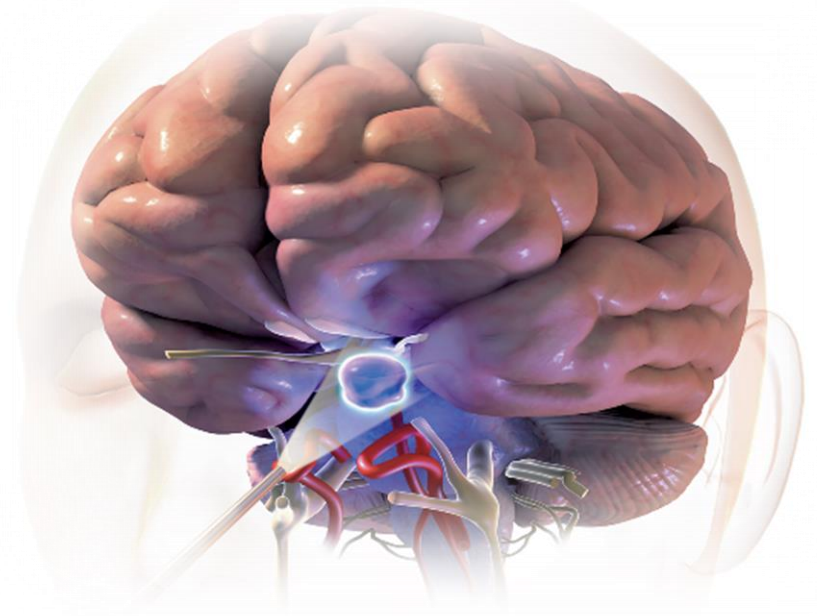


# Keyhole Approach 鎖孔手術

- Minimums brain retraction 減少腦拉扯
- Shorten recovery period 縮短康復期
- Cosmetically more acceptable 外表美觀



# Endoscopic Approach to Anterior Skull Base



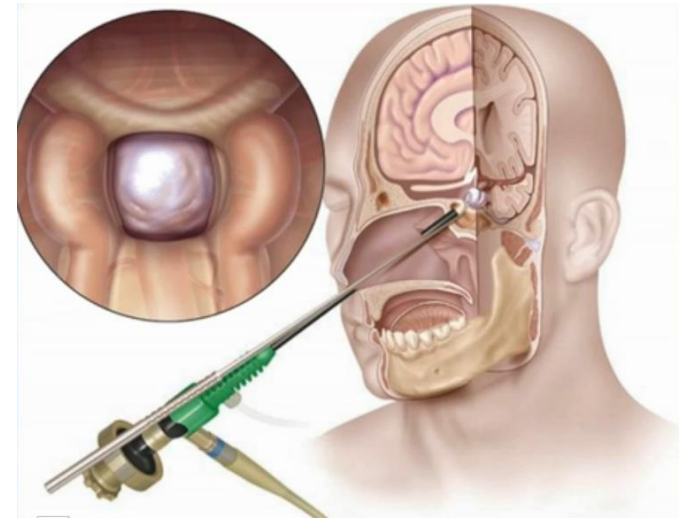
- Potential space from nasal/sphenoid/ethmoid sinus
- Direct accessible without brain tissue in between
- Common origin of pathologies





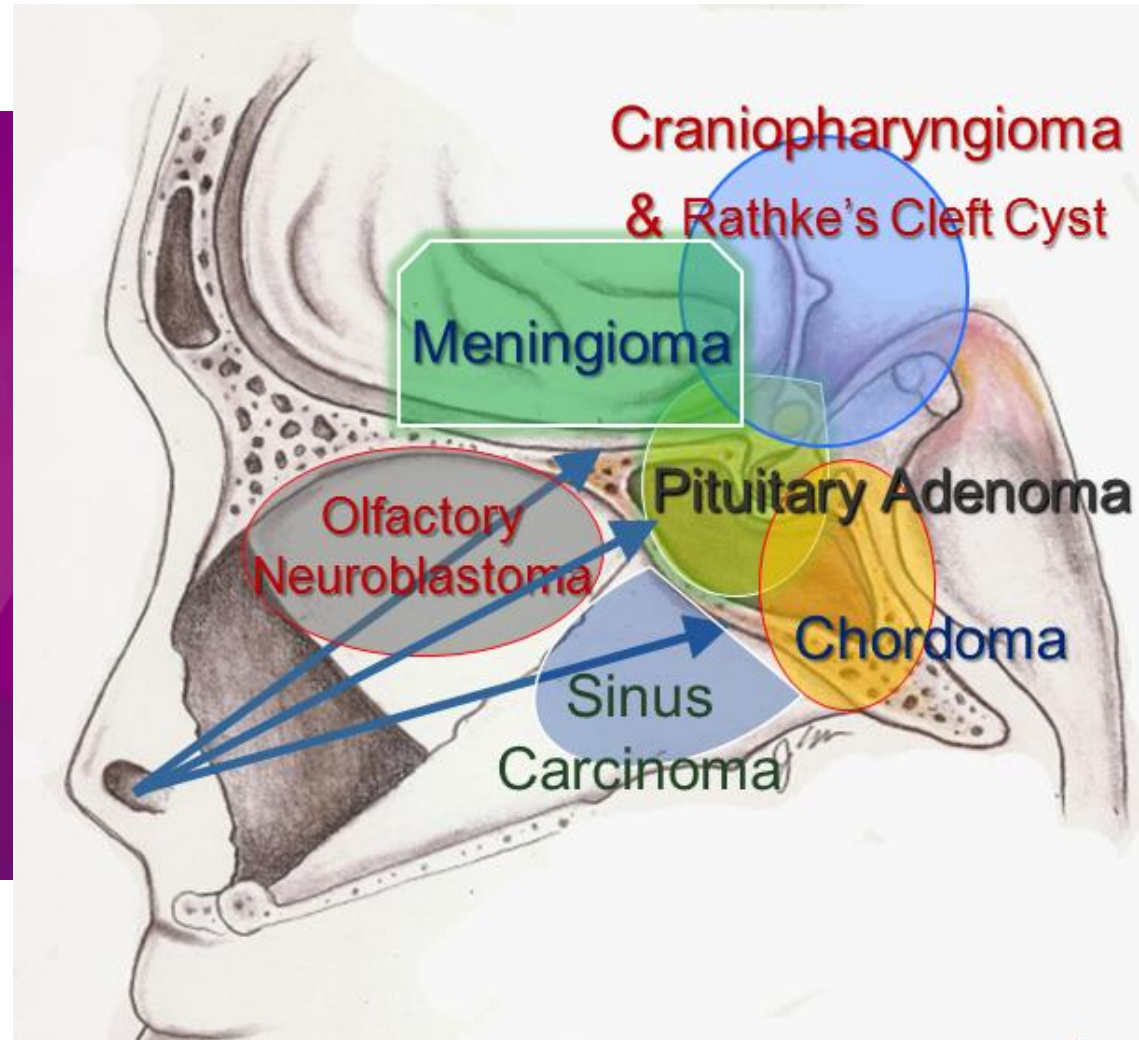
# Advantage of Endoscopic Approach

- Better View
- Most direct route to pathology
- Easier for medial lesion
- No brain retraction
- Less work between neurovascular structure
- Shorten hospital stay
- Better cosmetic result



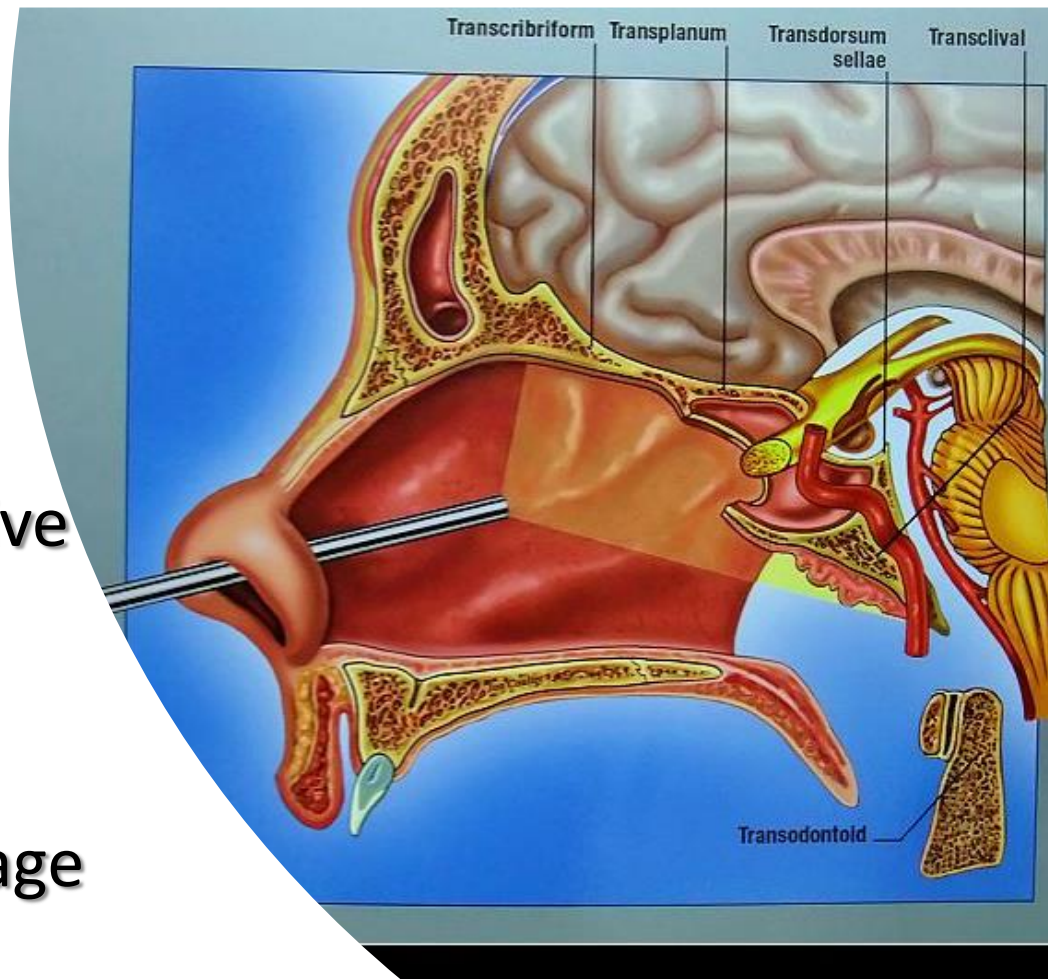


# Tumours Commonly Encounter

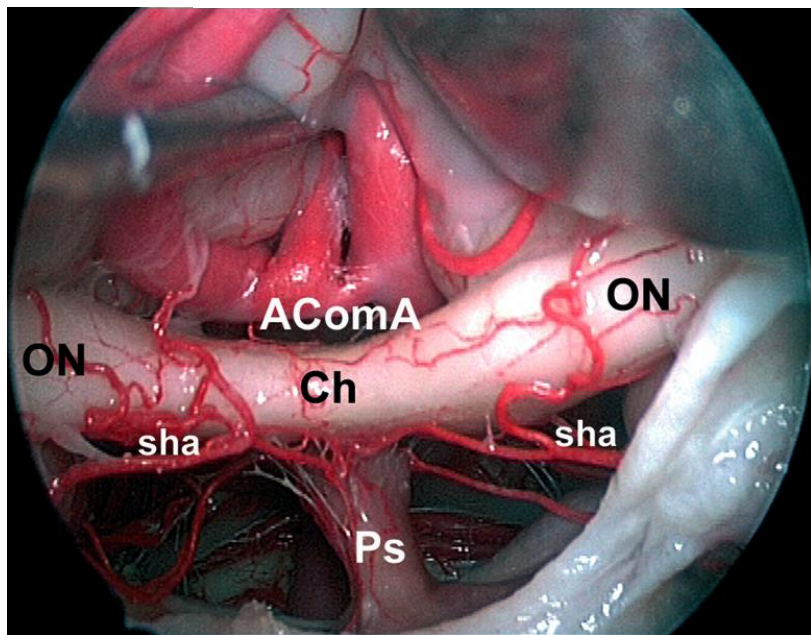
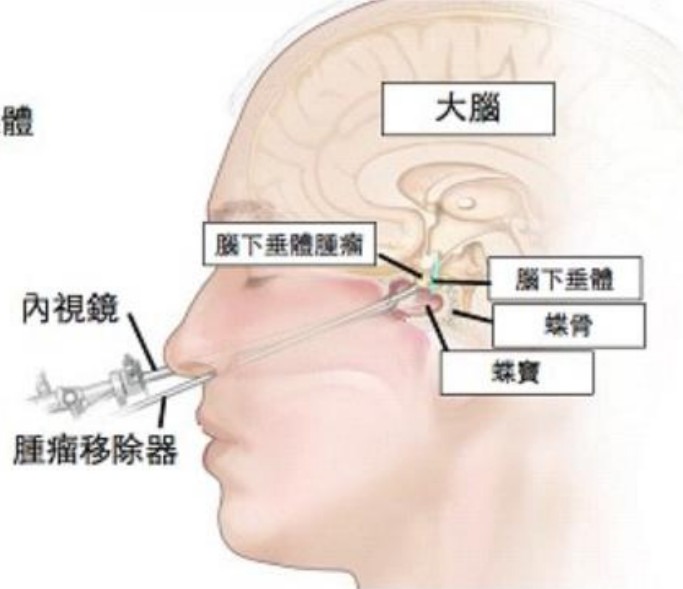
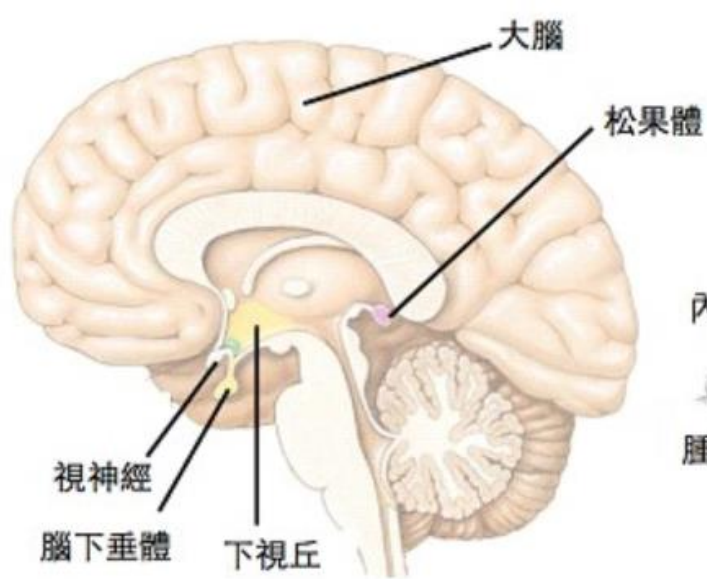


# Essentials of Endonasal Surgery

- Good visualization
- Specific equipment
- Solid knowledge of endoscopic anatomy
- Good exposure of operative field
- Ability to use 3/4 hands techniques
- Management of CSF leakage

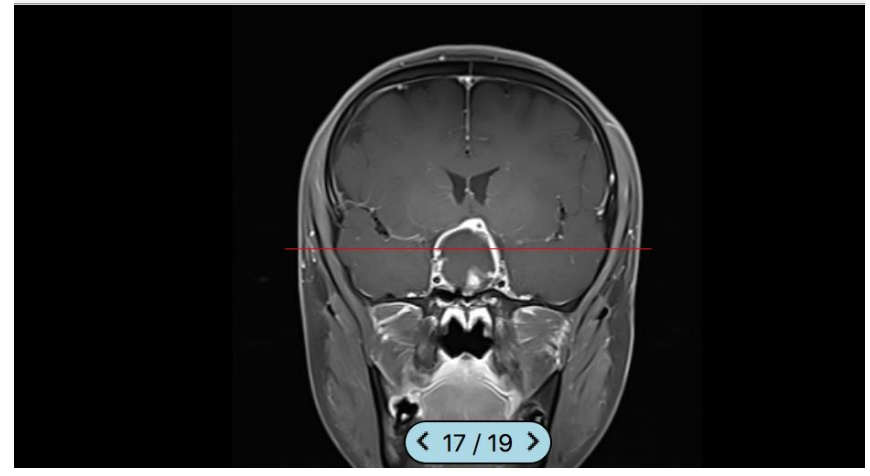
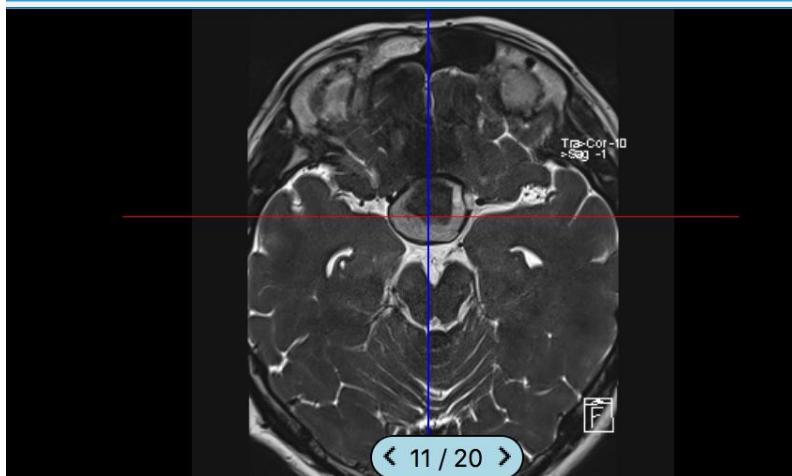
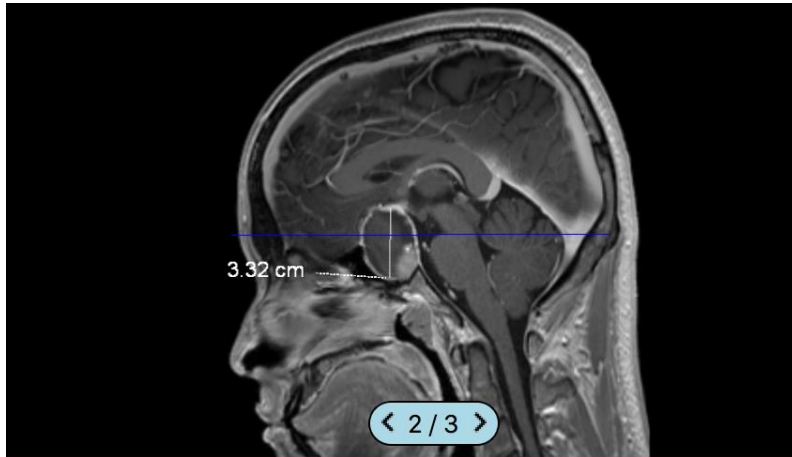


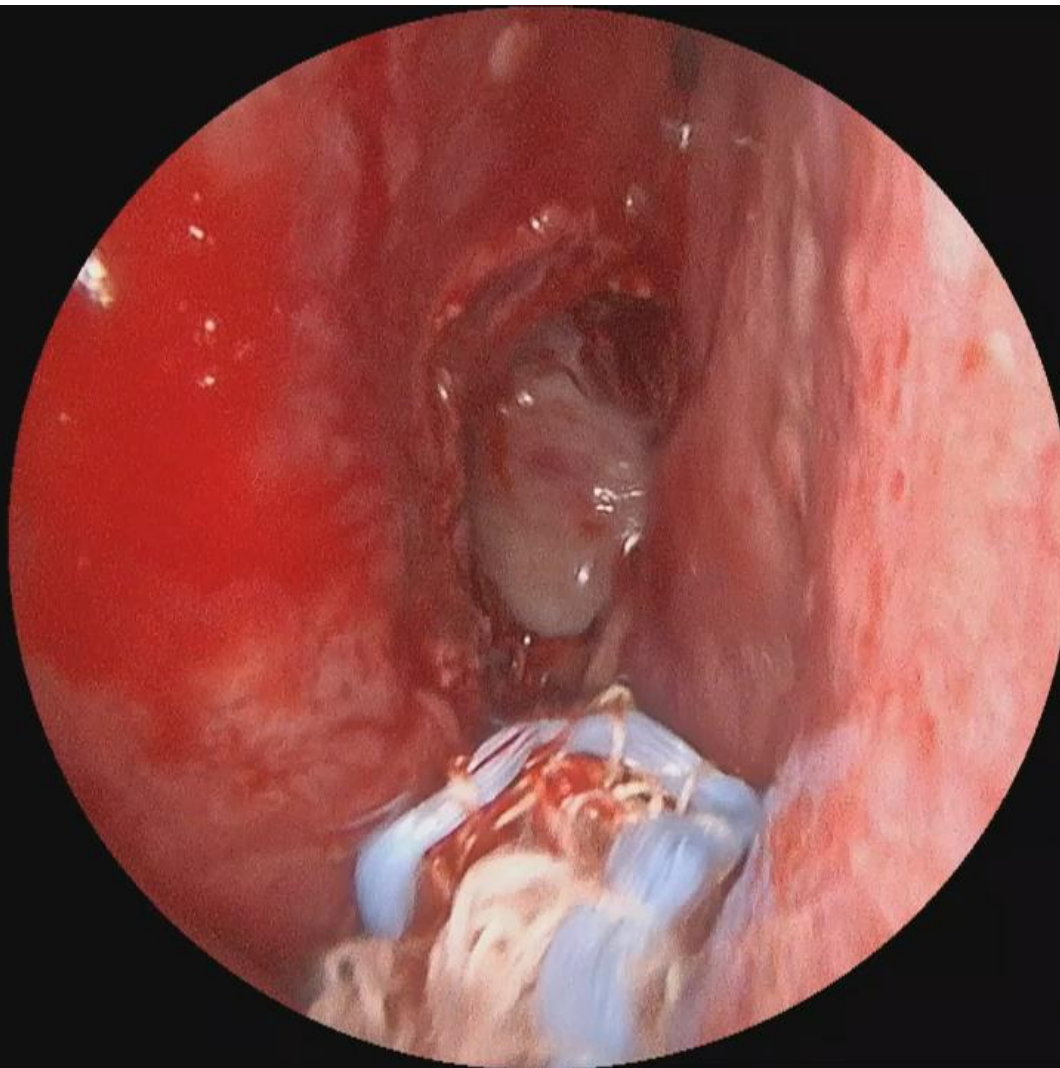




# Case Demonstration: Craniopharyngioma

- Present with visual impairment
- MRI brain showed large cystic pituitary region tumor





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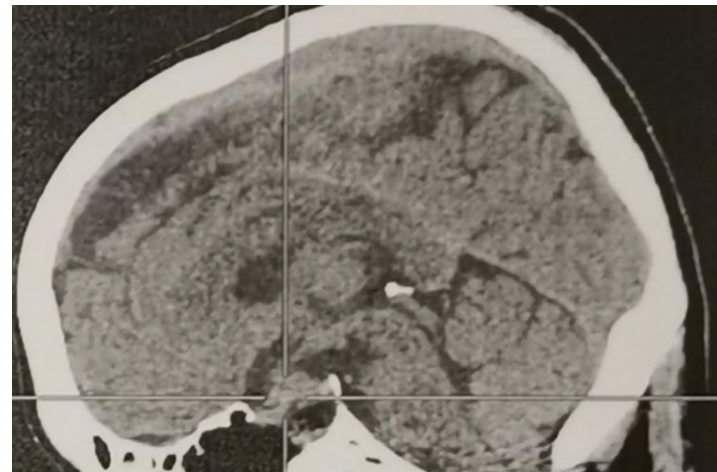
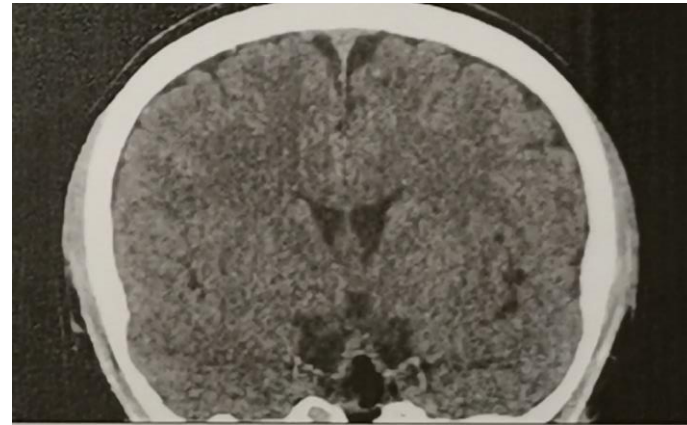
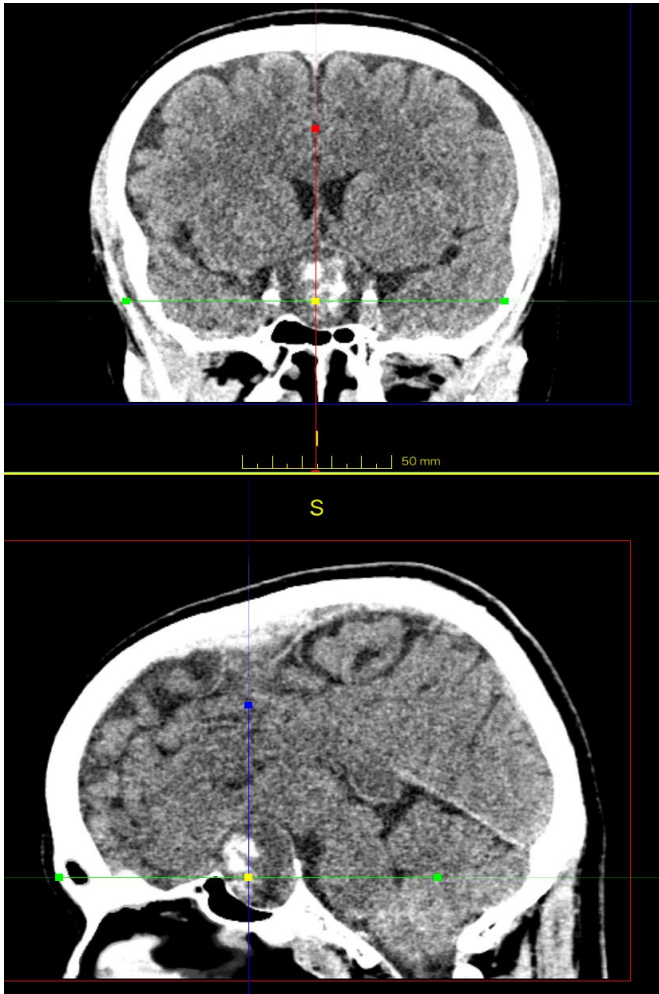


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# Post op scan



# Patient Meningioma

**32/F**

> Blurring of vision for 2 months

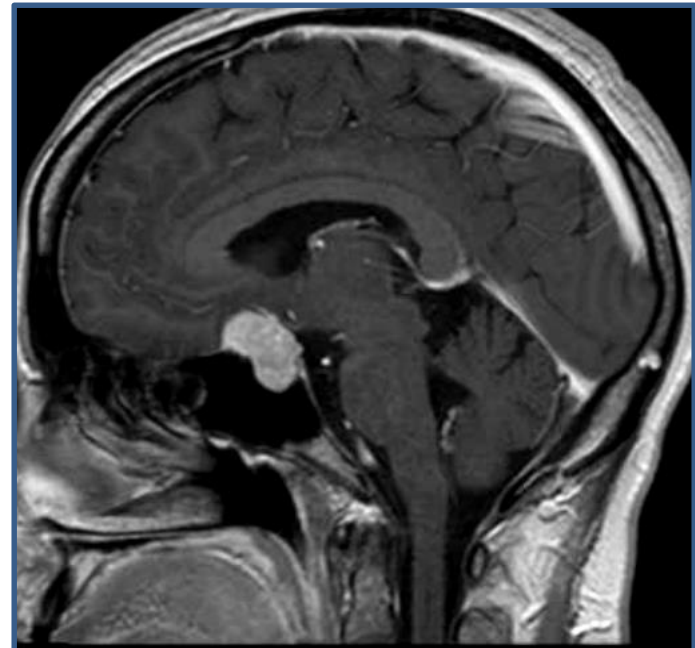
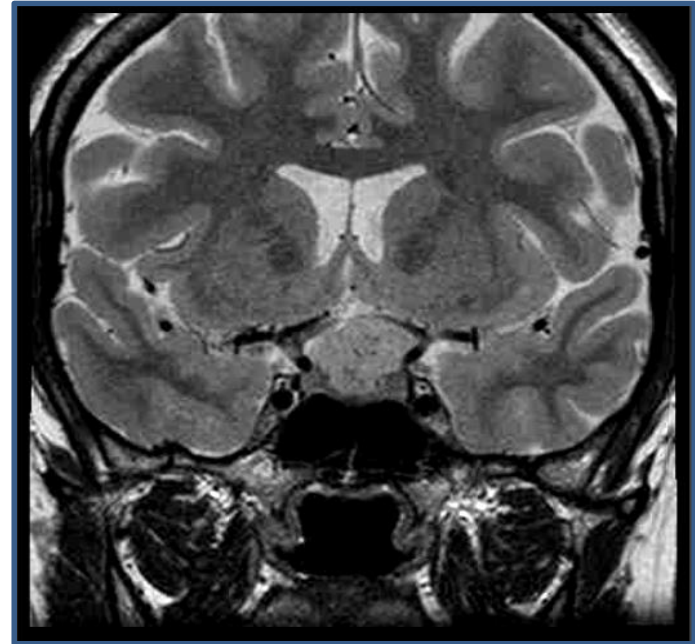
Physical examination

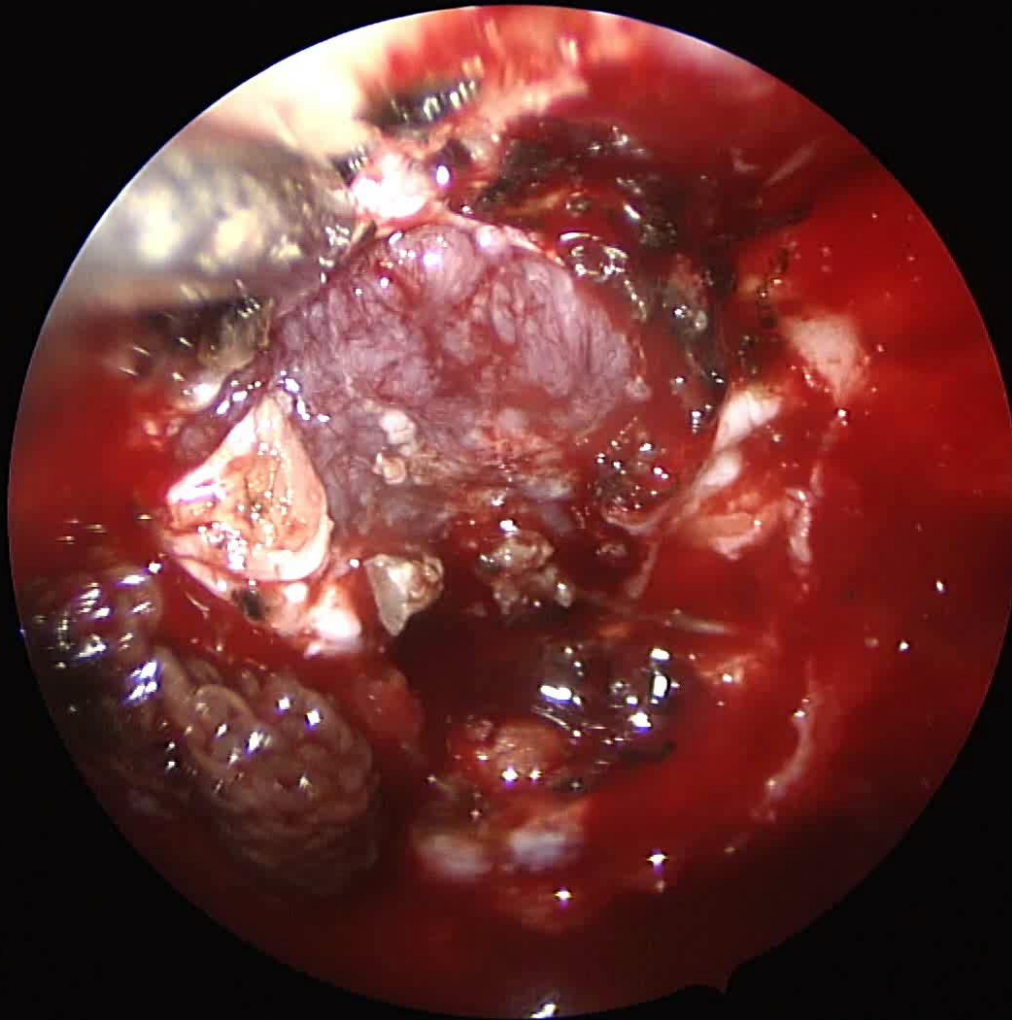
> **VA:** RE 20/25

LE light perception only

> **VF:** RE intact

LE loss of temporal side







# Patient post op

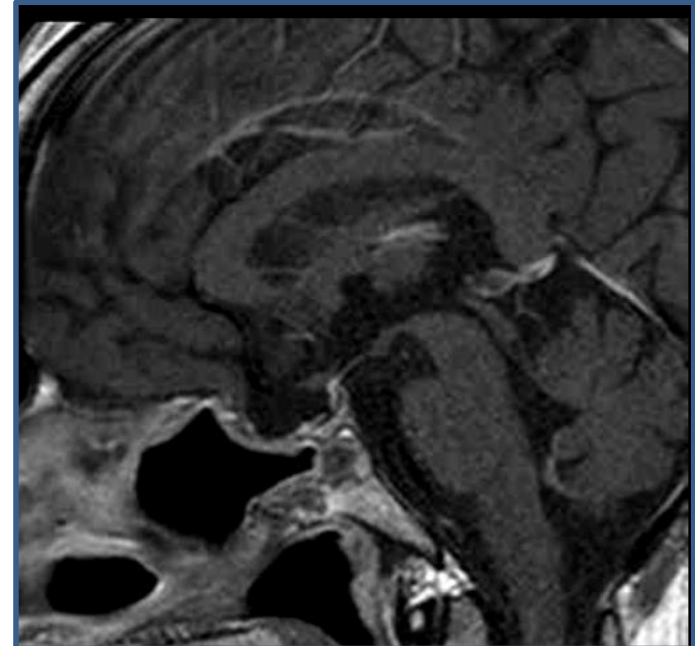
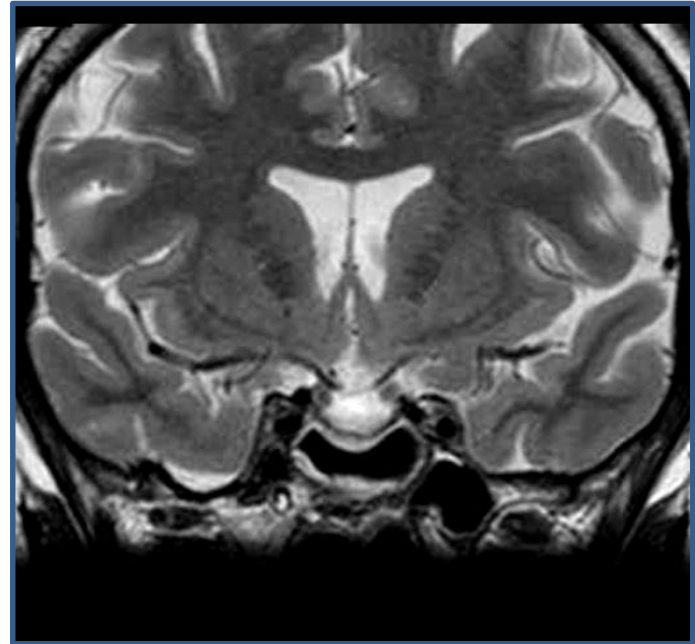
> Latest follow up in 9/2017

Physical examination

> **VA:** RE 20/30 LE 20/70

> **VF:** full by confrontation

> No CSF leak/ DI



# Endoscopic endonasal skull base surgery: analysis of complications in the authors' initial 800 patients

Amin B. Kassam, M.D.,<sup>1,2</sup> Daniel M. Prevedello, M.D.,<sup>1</sup> Ricardo L. Carrau, M.D.,

- Pituitary adenomas (39.1%) and meningiomas (11.8%) were the 2 most common pathologies.
- **A postoperative CSF leak** represented the most common complication, occurring in **15.9%** of the patients. All patients with a postoperative CSF leak were successfully treated with a lumbar drain and/or another endoscopic approach, except for 1 patient who required a transcranial repair.
- The incidence of postoperative CSF leaks decreased significantly with the adoption of vascularized tissue for reconstruction of the skull base (**< 6%**).

**J Neurosurg 114:1544–1568, 2011**



# Nasal Flap Flap and Skullbase Reconstruction



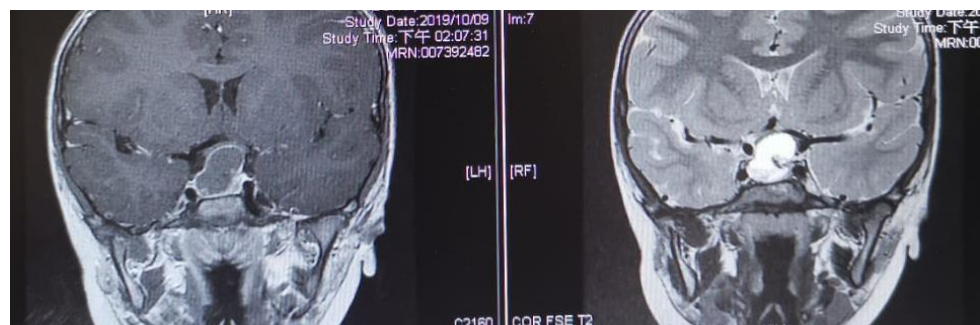
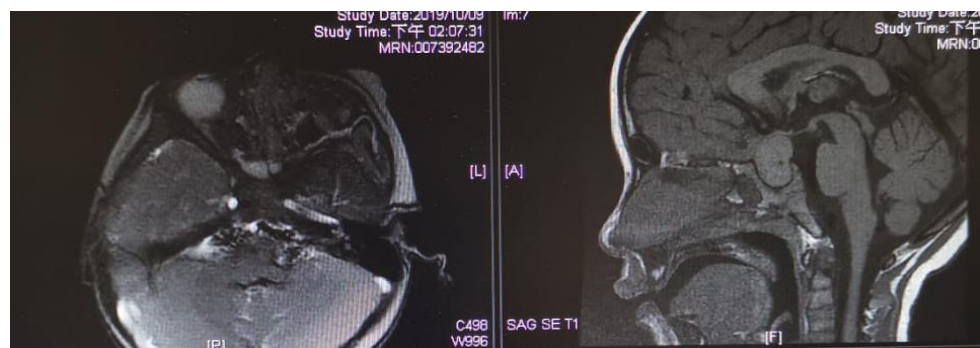
Anterior cranial base defect



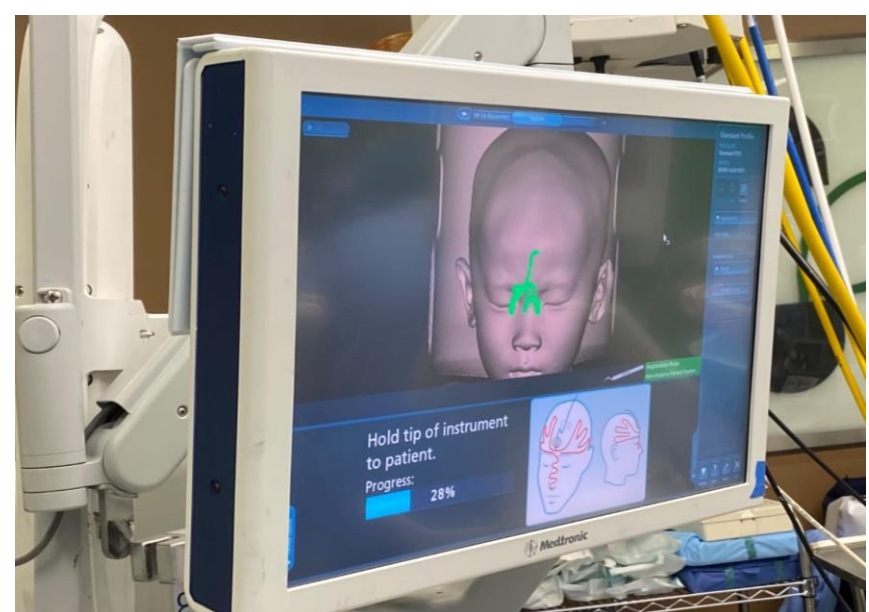


# Collaborate work with Macau Team

- 4 years old boy presented with polyuria and arrest in growth
- Paediatric work up: pan-hypopituitarism
- MRI showed large cystic tumour
- Challenge:
  - Small kid, higher risk for craniotomy
  - Endoscopic approach: small nose and poor pneumatization



# Neuronavigation assisted Endoscopic Endonasal resection of tumour - with Macau Neurosurgeons and ENT surgeons







- **Minimal transfusion needed**
- **Regain full consciousness without deficit**
- **No added complications**
- **Fast discharge plan**

### 經鼻內視鏡手術的優點

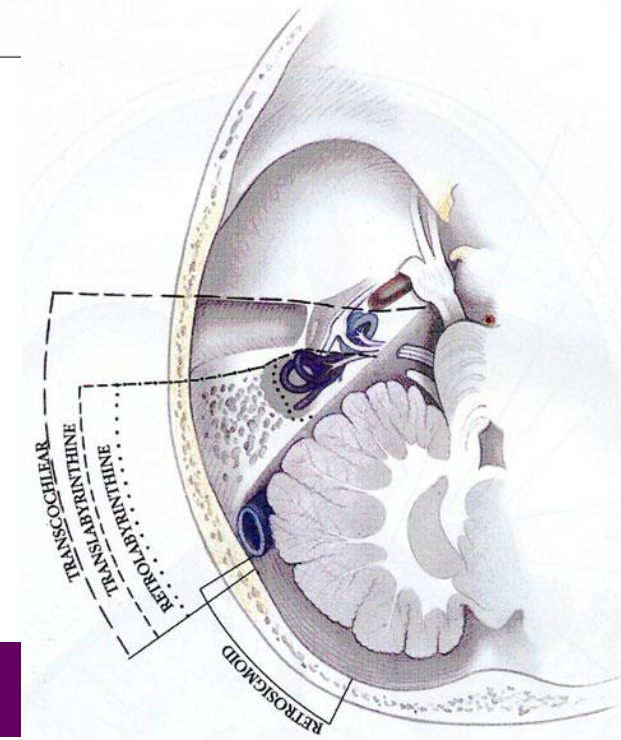
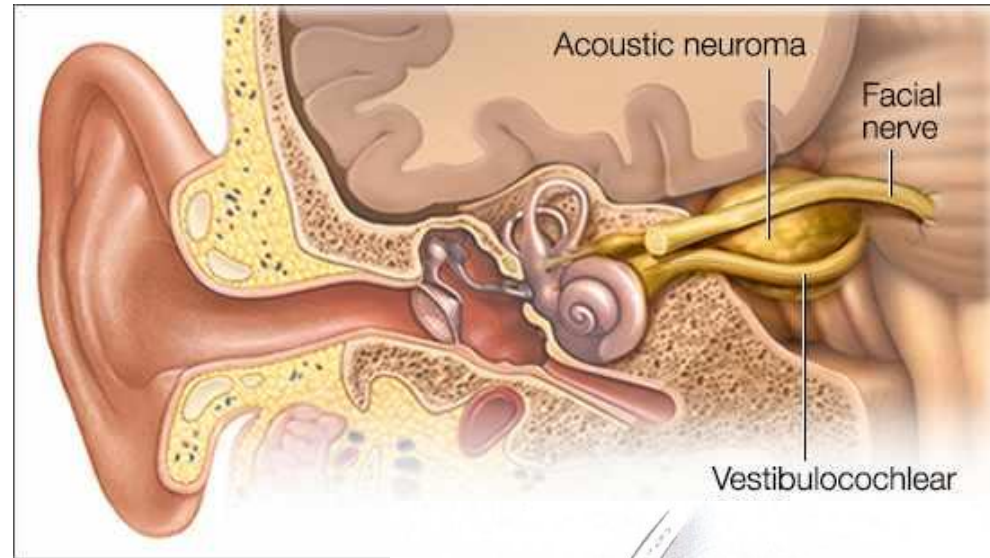
不需在鼻中隔作切割，對鼻腔粘膜的破壞較低，故手術後病患的不適感會較少見。另外內視鏡的優點是解析度較高，故手術中醫師可以看得比較清楚，並可利用30度內視鏡檢查是否腫瘤有完全切除。目前有研究顯示內視鏡手術較傳統手術有較高的腫瘤切除率與較低的併發症。





# Endoscopic tumour removal through the ear

- Acoustic neuroma is one of the commonest brain tumour
- Large tumour compress on brainstem and cause hydrocephalus
- Large tumour still need craniotomy for excision
- Small tumour can consider SRS or transcanal approach





使用威力導演編輯



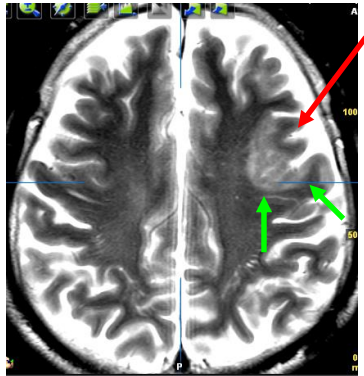
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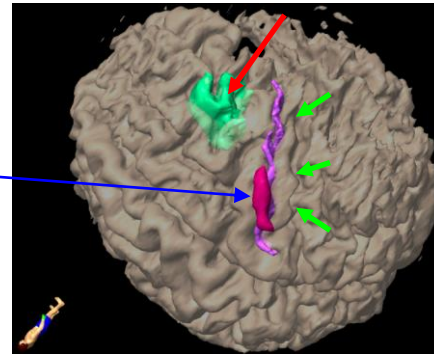
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# Functional MRI, Neuronavigation, Awake craniotomy 清醒開顱術 and Intra-op cortical mapping 腦部重要功能區的定位

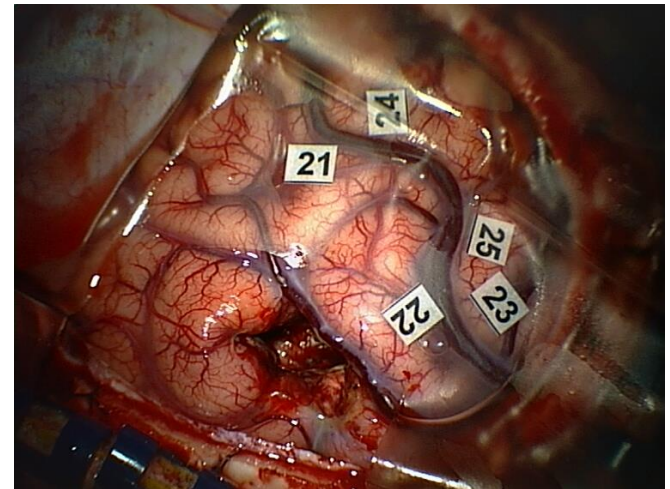
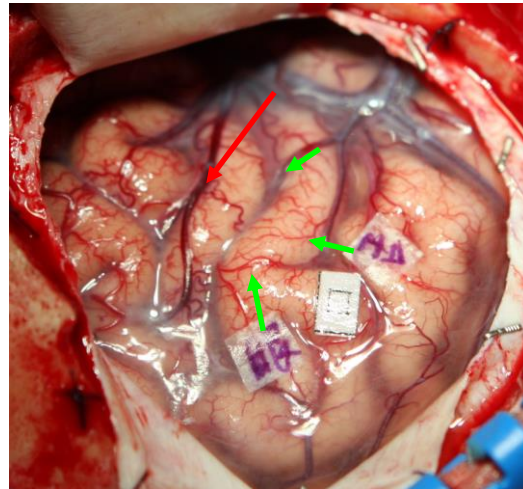


Hand  
movement  
on fMRI



Lesion  
→

Motor  
cortex  
→







# Awake Craniotomy 清醒開顱手術

使用威力導演編輯



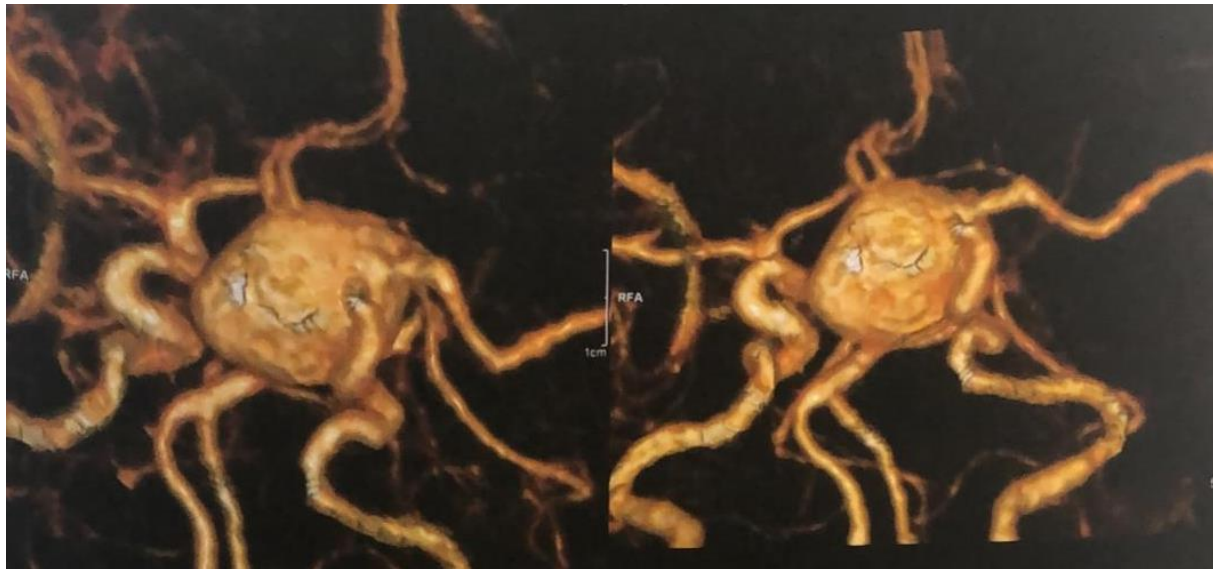
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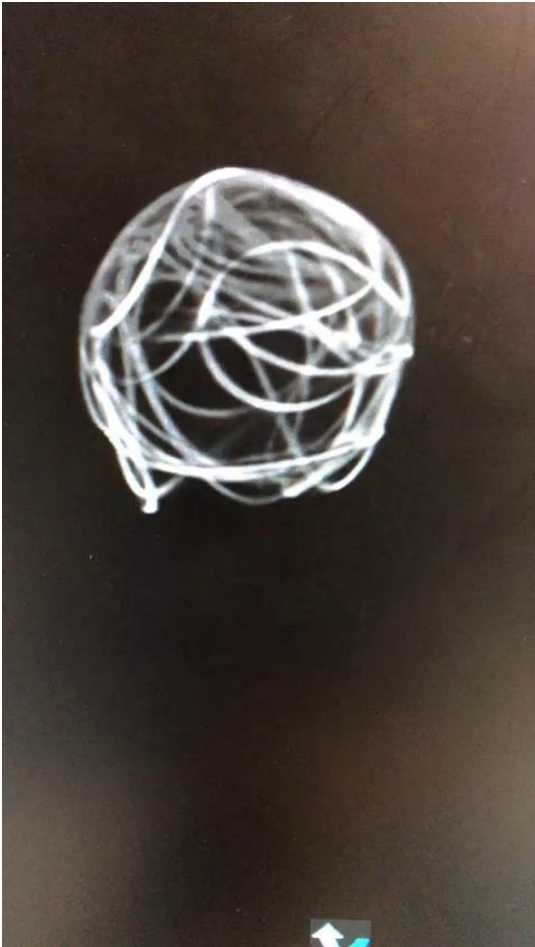
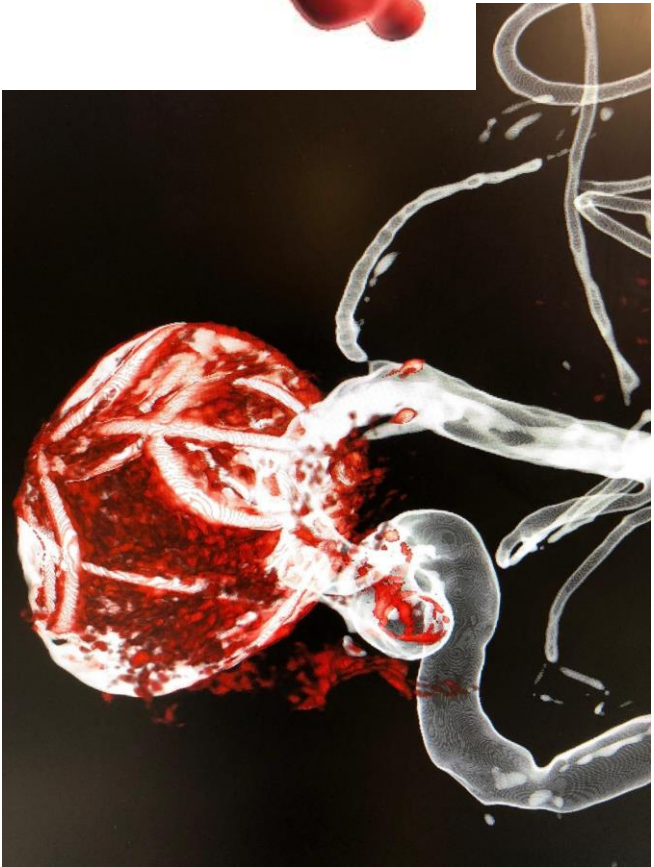
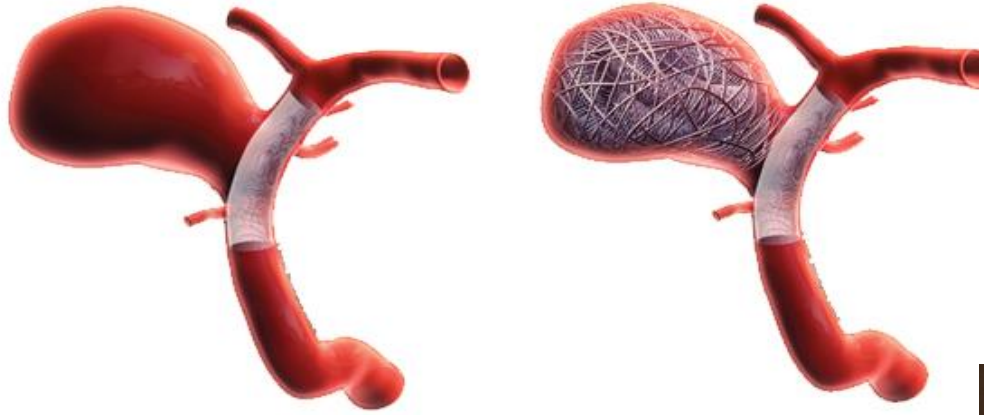


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# Advancement in Endovascular Treatment for Cerebral Vascular Diseases

- Advance of Endovascular technique improve surgical outcome of complex vascular lesion
- E.g. : Giant cerebral aneurysm can be treated with Stent assisted (Flow Divertor) Coiling







# Minimally Invasive Spine Surgery MISS

## *The Dimensions of Back Pain*

- More than 65 million Americans annually suffer from lower back pain
- Third most-frequent reason for surgery overall
- Approximately 250,000 lumbar spinal fusions performed
- Approximately 400,000 lumbar spinal decompression procedures performed

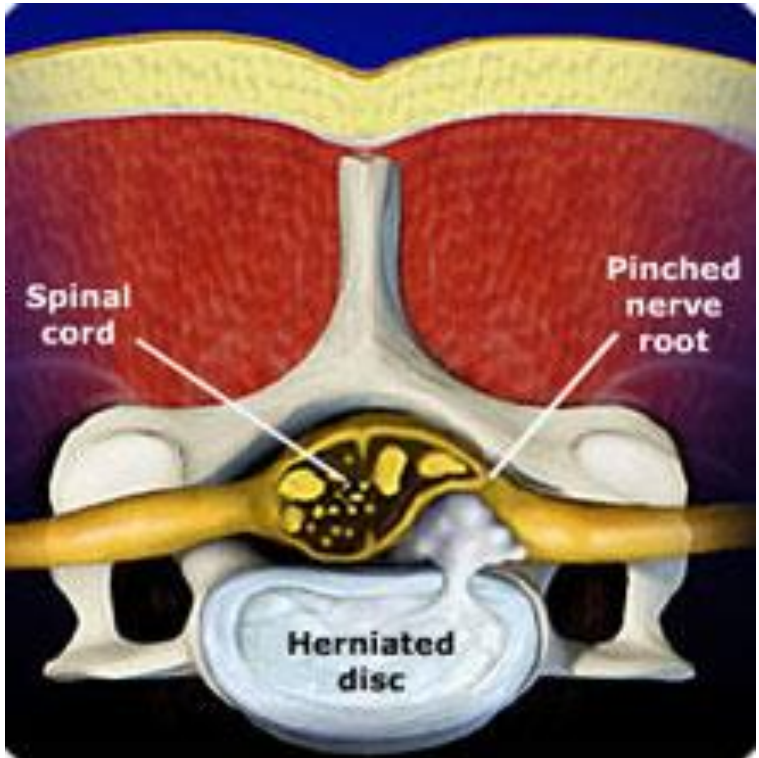
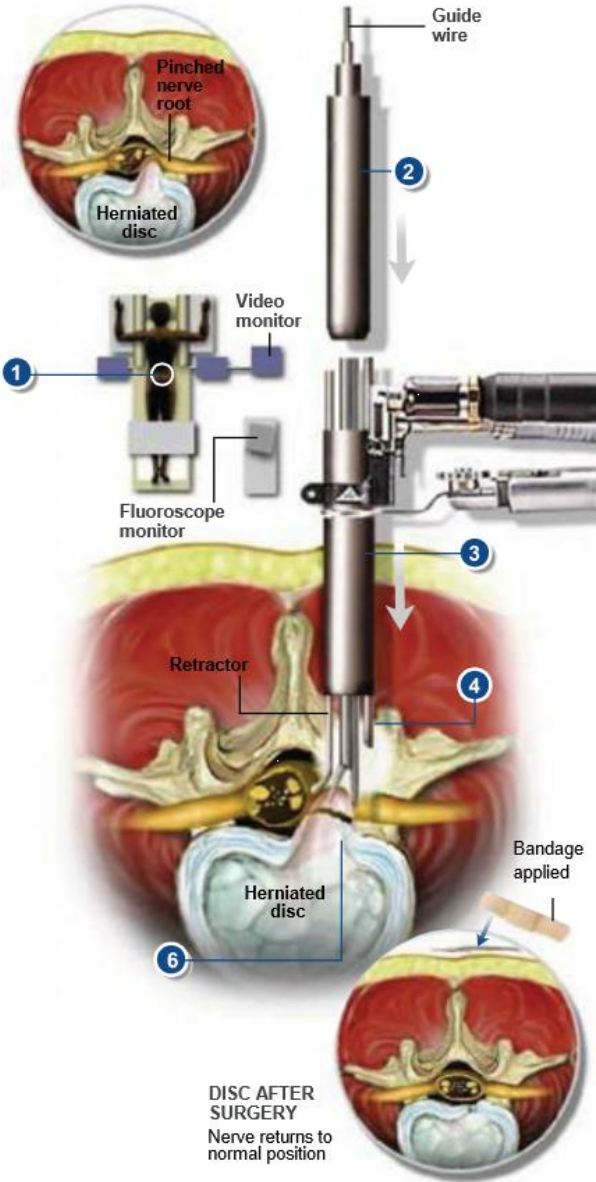


# Type of Spine diseases can be treated with MISS

- Degenerative disease
- Herniated discs
- Spinal stenosis
- Spinal tumour
- Scoliosis

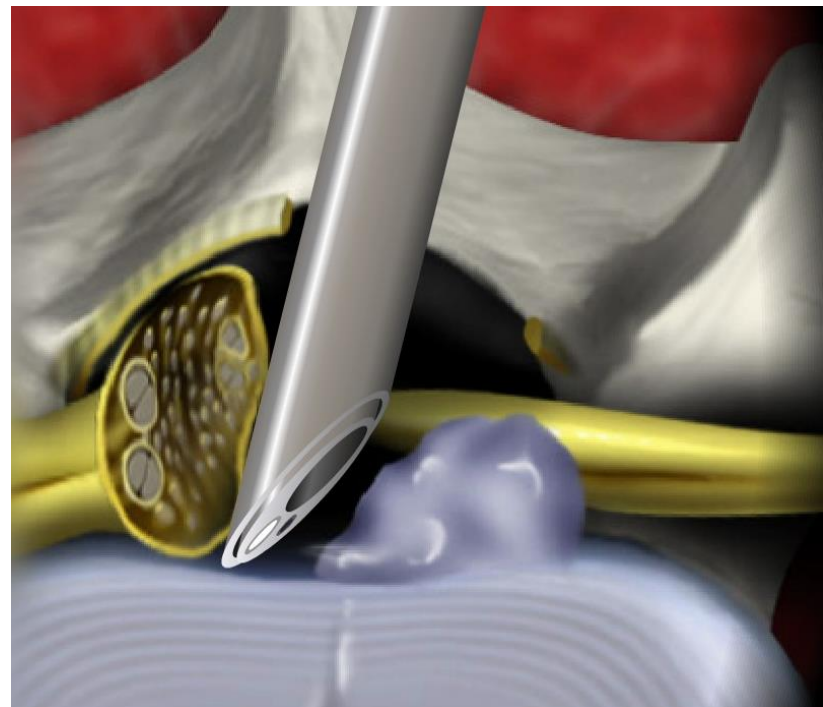
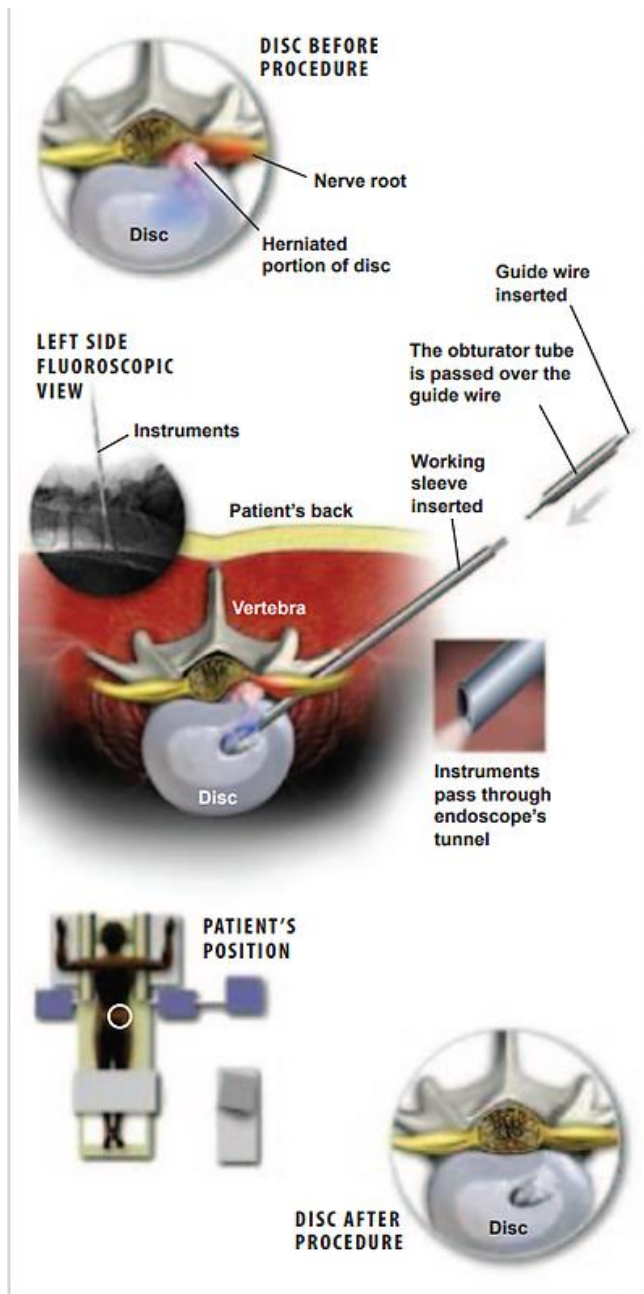


# Tubular Microdisectomy

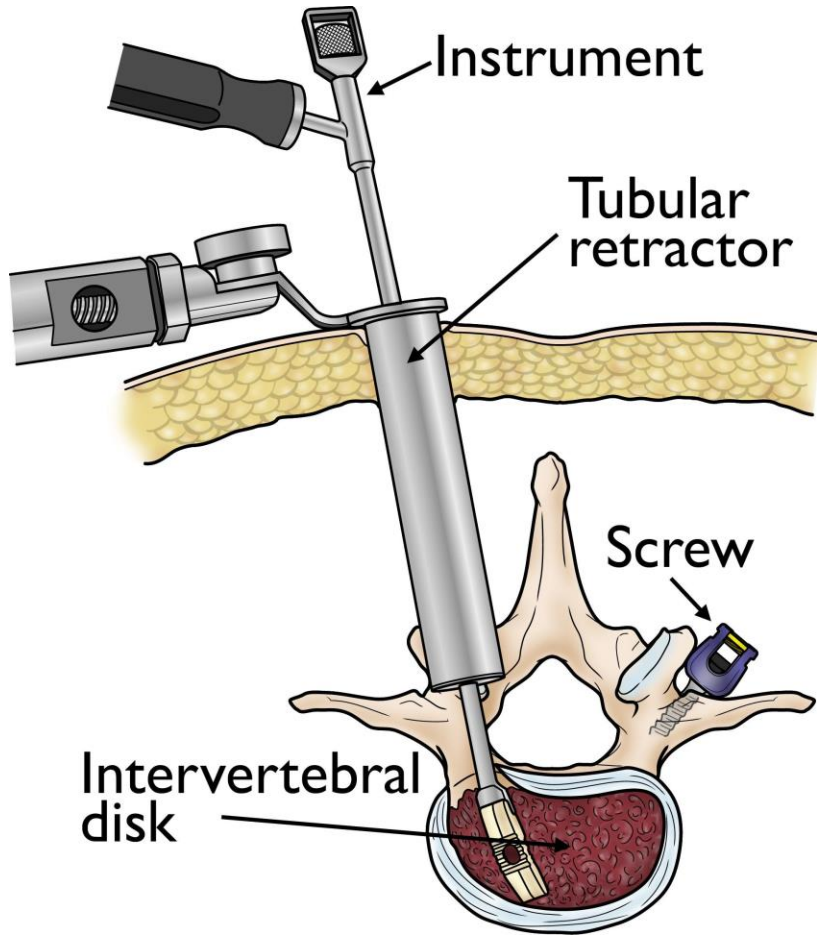




# Percutaneous Endoscopic Lumbar Dissectomy PELD



# Navigation Guided Spinal Instrumentation



Medtronic Navigation

2/25/2019 10:00 AM^^  
Tumor Resection (EM)

The interface displays a multi-view navigation system for a tumor resection. It includes:

- TRAJECTORY 1** (top-left): Axial CT scan view with a blue trajectory line.
- SAGITTAL** (top-right): Sagittal CT scan view with a blue trajectory line.
- AXIAL** (bottom-left): Axial CT scan view with a blue trajectory line.
- 3D** (bottom-right): 3D model of a cylindrical instrument with a blue trajectory line.

**Instruments Panel:**

- Navigation Pointer**: PROJECTION
- CYLINDER**:
  - Opacity: 65%
  - Width (mm): 3.5
  - Length (mm): 5, 1, 0, 1, 5
- Navigate:  Instrument  Projection
- Stylet
- TRACER Pointer**

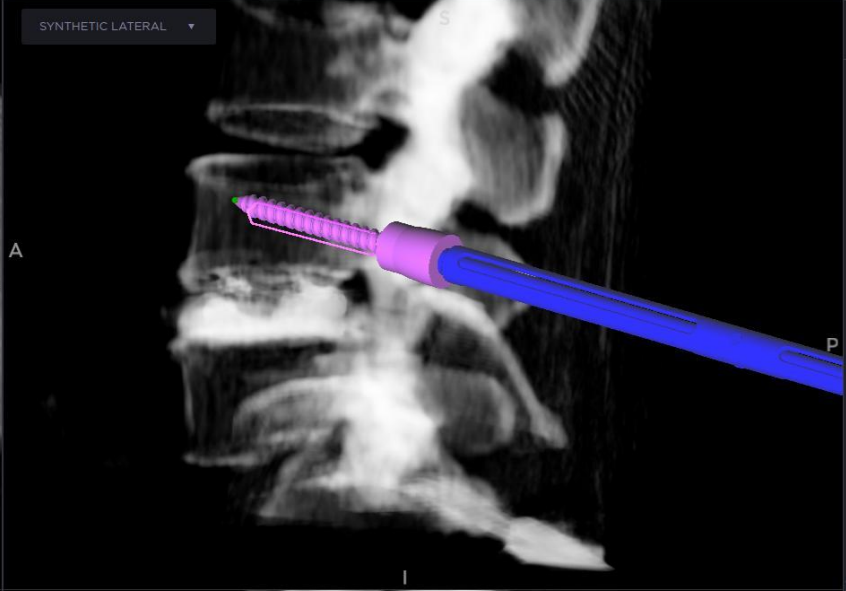
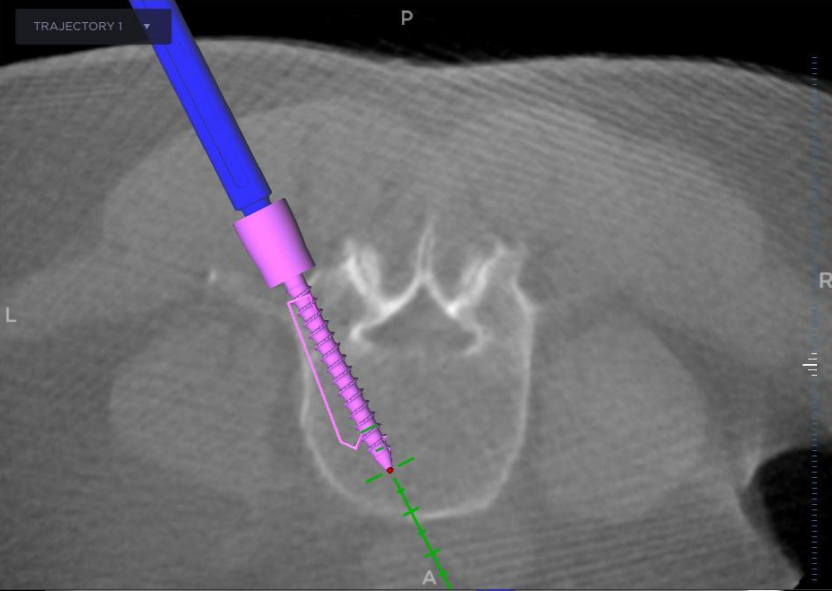
VERIFICATION:

Navigation Pointer | Non-Invasive Patient Tr...

Navigation projection: 0.0 mm

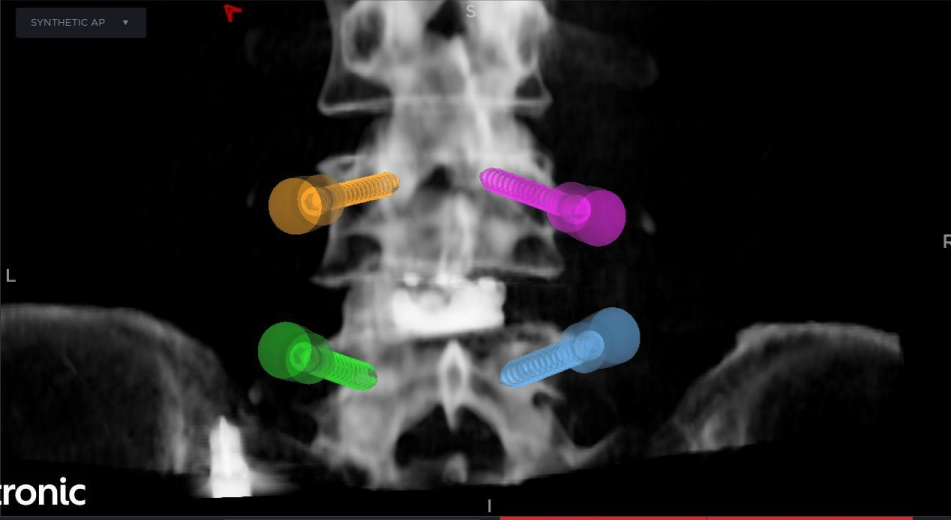
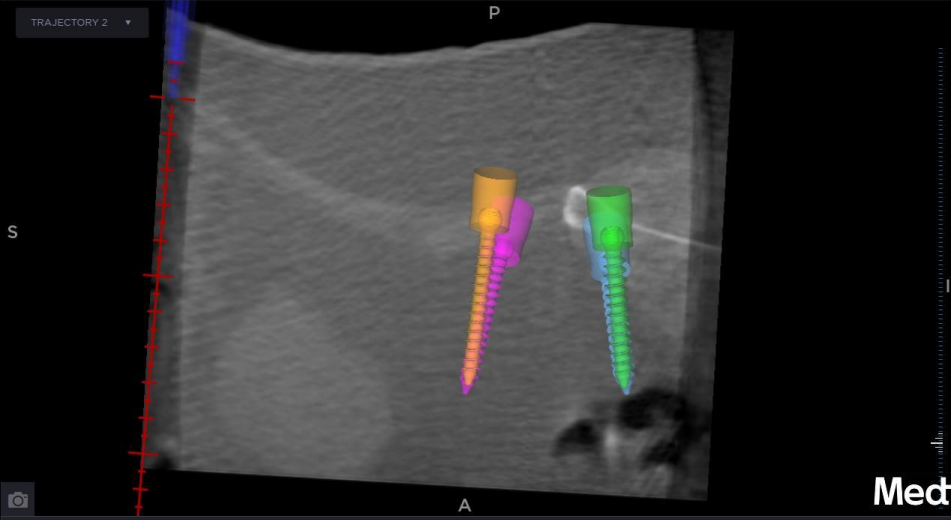
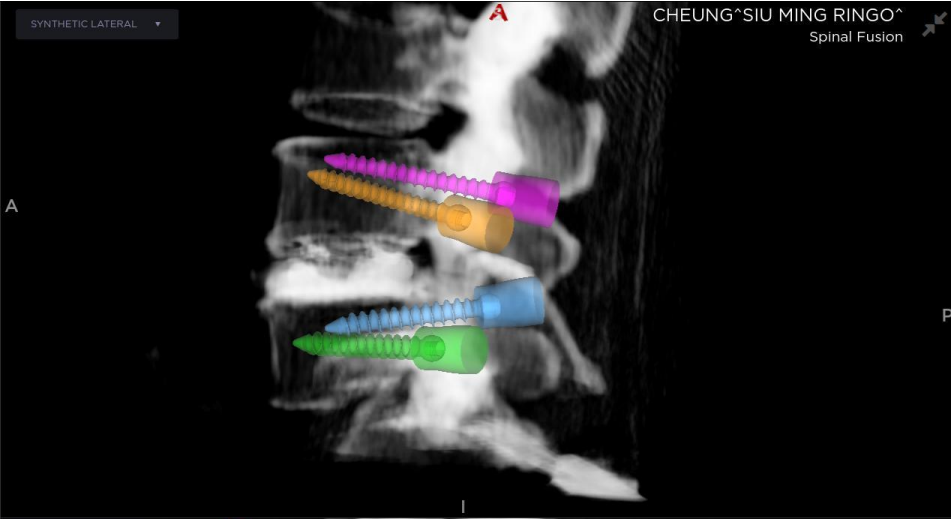
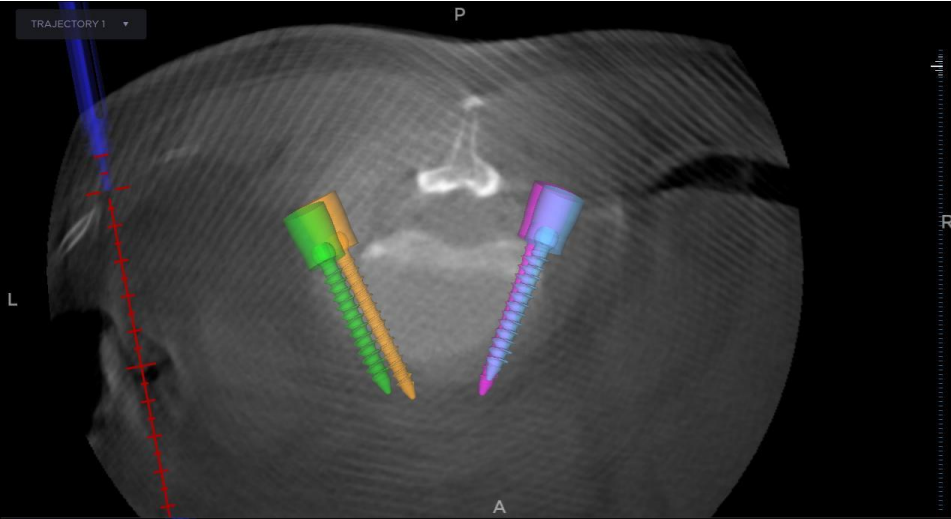


- Cycle Layouts
- Level Width
- Browse
- Zoom
- Move
- Rotate
- Flip
- Invert
- Recenter
- Measure
- Footswitch
- Record
- Snapshot
- Help



...linder 5: 5.5 mm x 35.0 mm - Projection: 6.5 x 0.0  
Screw: 5.5 x 45 (Legacy 5.5)





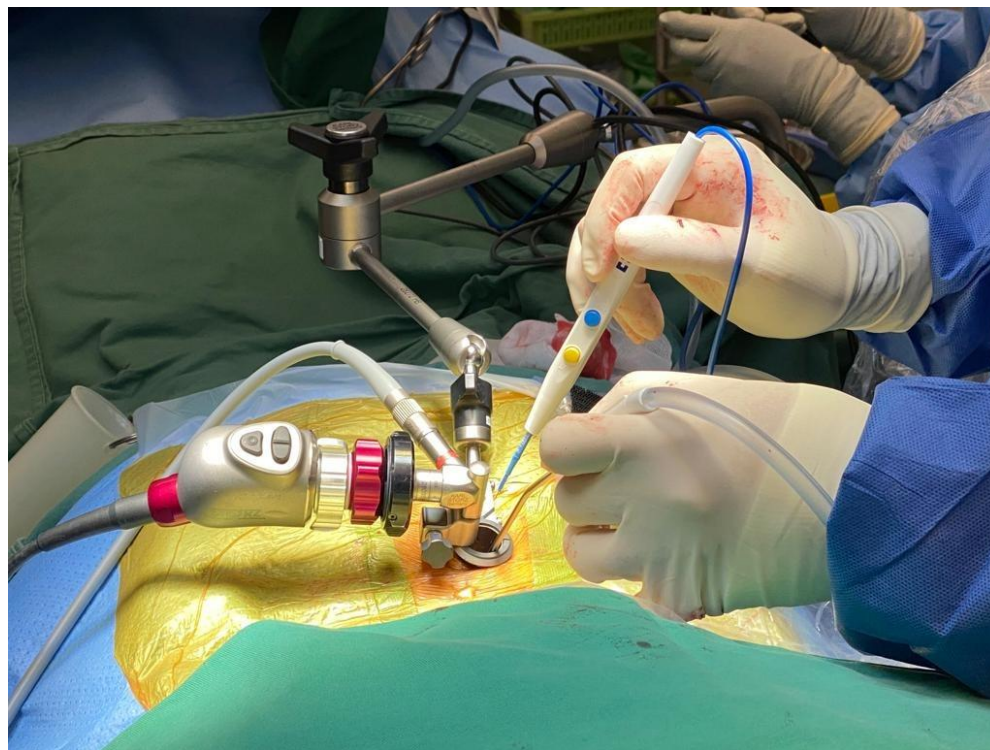
Medtronic

Help
Screw 4: 6.5 x 40
NavLock Violet Legacy 5.5 Reduction Driv...
Small Passive Frame



# Endoscopic assisted Spina tumour removal

- VS Conventional surgery has bigger wound and larger laminectomy







# Future Robotic Arm Spinal Surgery

- *Combine navigation with robotic arm*



# Conclusion

- Advancement of medical knowledge, technologies support and surgical techniques promoted MIS procedures
- MIS is not only about smaller wound, but more safe surgery and faster recovery
- Endoscopic surgery provide small access and clear visualization
- Neuronavigation help in accurate localization and avoidance of complications
- Robotic surgery is rapid development, and likely will be the future direction of Minimally Invasive Brain and Spine Surgery

