بسم الله الرحمن الرحيم

DOPAMINE SCIENTIFIC TEAM

Neurosurgery

FINAL | Lecture 1

﴿إِنِّي تَوَكَّلْتُ عَلَى اللَّهِ رَبِّي وَرَبِّكُمْ ۚ مَّا مِن دَابَّةٍ إِلَّا هُوَ آخِذٌ بِنَاصِيَتِهَا ۚ إِنَّ رَبِّي عَلَىٰ صِرَاطٍ مُّسْتَقِيمٍ﴾

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CLINICAL

رحلة اليقين مع سورة يس

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

أَوَلَمۡ يَرَ ٱلۡإِنسَٰنُ أَنَّا
خَلَقۡنَٰهُ مِن نُّطۡفَةٖ فَإِذَا هُوَ خَصِيمٞ مُّبِينٞ ٧٧ وَضَرَبَ لَنَا
مَثَلٗا وَنَسِيَ خَلۡقَهُۥۖ قَالَ مَن يُحۡيِ ٱلۡعِظَٰمَ وَهِيَ رَمِيمٞ ٧٨
قُلۡ يُحۡيِيهَا ٱلَّذِيٓ أَنشَأَهَآ أَوَّلَ مَرَّةٖۖ وَهُوَ بِكُلِّ خَلۡقٍ عَلِيمٌ
٧٩ ٱلَّذِي جَعَلَ لَكُم مِّنَ ٱلشَّجَرِ ٱلۡأَخۡضَرِ نَارٗا فَإِذَآ أَنتُم
مِّنۡهُ تُوقِدُونَ ٨٠

- أو لم ير الإنسان المنكِر للبعث ابتداء خلقه فيستدل به على معاده، أنا خلقناه من نطفة مرَّت بأطوار حتى كَبِر، فإذا هو كثير الخصام واضح الجدال؟
- وضرب لنا المنكِر للبعث مثلا لا ينبغي ضربه، وهو قياس قدرة الخالق بقدرة المخلوق، ونسي ابتداء خلقه، قال: مَن يحيي العظام البالية المتفتتة؟
- قل له: يحييها الذي خلقها أول مرة، وهو بجميع خلقه عليم، لا يخفى عليه شيء.
- الذي أخرج لكم من الشجر الأخضر الرطب نارًا محرقة، فإذا أنتم من الشجر توقدون النار، فهو القادر على إخراج الضد من الضد. وفي ذلك دليل على وحدانية الله وكمال قدرته، ومن ذلك إخراج الموتى من قبورهم أحياء.

Neurosurgery: Precision, Function & Innovation

Dr Mahmoud Abdallat

Associate Professor of Neurosurgery

Treatment of CNS Disorders

Generally speaking, we treat diseases either by:

Medication

"Neurology"

Focused on diagnosis and treatment of CNS diseases (such as MS, migraines, movement disorders, etc...) via medication.

First line treatment of Parkinson's is replacement therapy of dopamine.

First line treatment of seizures is by medication.

Surgical Intervention

"Neurosurgery"

When surgical intervention is **necessary**.

What if the patient suffers severe side effects from dopamine replacement? What if they stop responding to treatment altogether?

What if medication fails, or does not achieve the desired outcome?

This is where we resort to surgical intervention.

Definition of Neurosurgery

- Diagnosis & surgical treatment of CNS, Spine & PNS
- **Brain, spine**, peripheral nerves
- Combines imaging + precision surgery

Uses the most up-to-date surgical techniques and equipment.

Why Neurosurgery Matters

- Time = Brain / Spinal Cord
- High-impact, life-saving interventions
- Restores function, not just survival

Surgeries are of two types:

Elective surgery

Generally, aims to improve the patient's **quality of life**, by treating non-life-threatening disorders, such as tremors, rigidity, epilepsy, etc...

Urgent surgery

Life-saving interventions.

Main Subspecialties

- Neuro-oncology
- Vascular
- Spine
- Functional
  - Psychosurgery
  - Epilepsy Surgery
- Pediatric
- Skull Base

The different types will be explained in detail in the coming slides.

Pediatric Neurosurgery

- Surgery can be used to correct many pediatric problems.
- For example, in **hydrocephalus** of any cause:

➢ Usual treatment is to redirect excess CSF to another cavity to regulate intracranial pressure. Most commonly to the abdomen via a Ventriculoperitoneal shunt (VP Shunt) but also may be to the pleura or atria.

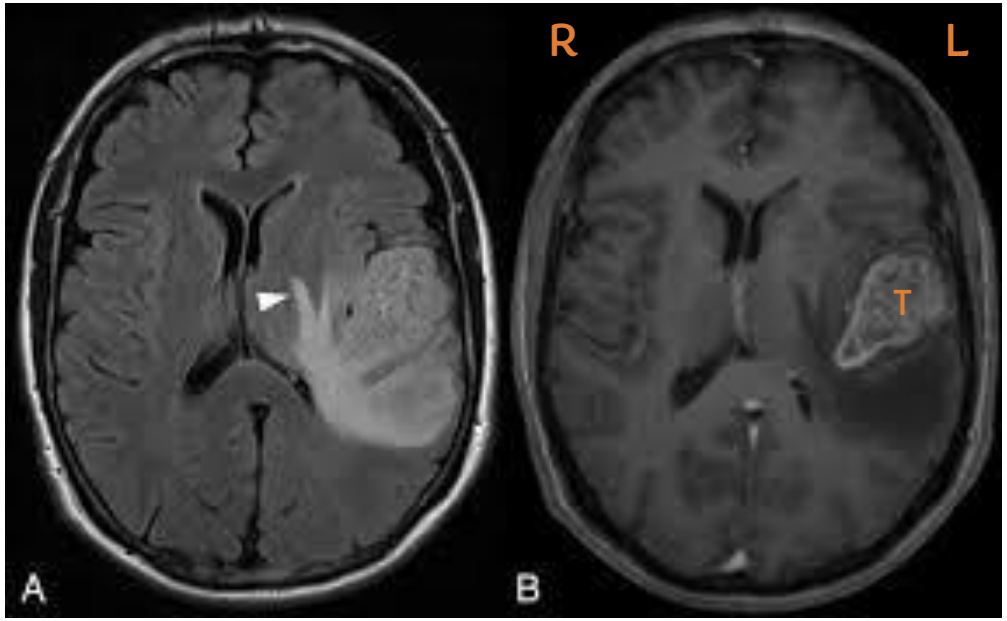
Neuro-Oncology

- Glioma, meningioma, metastasis
- Principle: maximal safe resection
- Balance tumor removal vs function

Depending on the tumor, we may not choose to remove it surgically, sometimes we perform surgery just to get a biopsy specimen for evaluation, and the tumor itself may be treated with chemotherapy, such as in lymphomas.

We must remove as much of the tumor as possible, while taking care not to cause unnecessary damage to underlying brain structures.
"T" in the MRI image refers to a mass in the left temporal lobe. Removal of the tumor risks damage to structures related to speech (Wernicke's area)

Brain parenchyma lacks pain receptors, therefore, sometimes we can perform surgery while the patient is awake, which allows us to evaluate the outcome of the surgery even as we are performing it.



Lobectomy

- There are certain areas in the brain termed “eloquent areas”, removal of which poses serious loss-of-function risk (such as the motor area, speech area, and other areas that control special functions). When removing a temporal lobe (for treatment of epilepsy for example) we steer clear of areas responsible for speech.
- Removal of the mesial temporal lobe (responsible for memory and emotion) may mildly affect memory, however eventually the other side compensates.

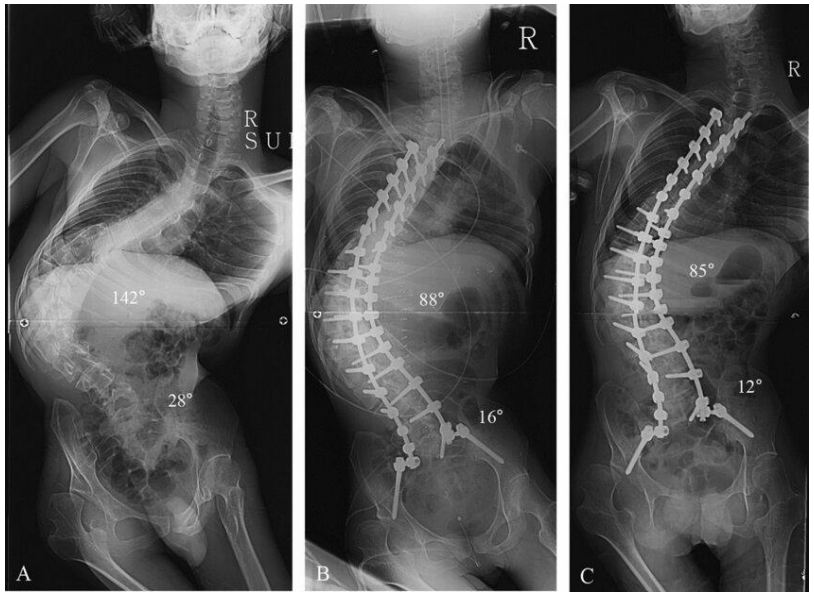
Spine

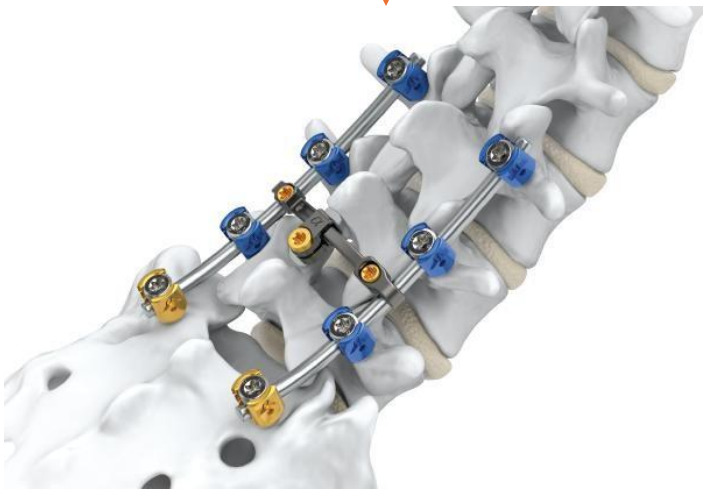
- Degenerative Spine like: disc herniation
- Trauma ➔ We treat broken spines via screws that hold the vertebra in place
- Tumors
- Deformities

Corrective surgery, in principle, is similar to teeth braces.

Nowadays navigation devices exist that aid the surgeon in precisely finding tumors, correct placement for spinal screws, etc..., similar to GPS devices we use daily

Scoliosis





Herniated Disc surgery

- Spinal surgeries have changed a lot since the past, what used to be a major surgery that requires the doctor to create a massive incision in the back, count vertebra from the sacrum until they reach the diseased disc for treatment, and sometimes have to manually check the discs one level above and below the target, can now be done simply with small incisions and endoscopes, and navigation devices, thanks to modern imaging techniques like X-Rays and MRIs.

Vascular Neurosurgery

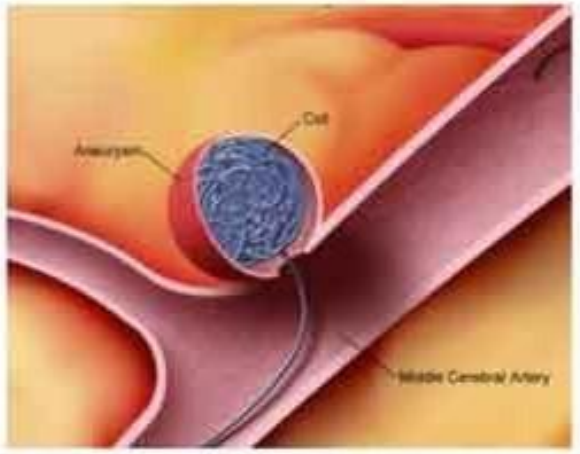
- Aneurysm, AVM, hemorrhage, Cavernoma*
- Clipping vs endovascular
- Emergency decision-making

- Underlined word is Hyperlinked

Surgical treatment of Cavernoma is removal

Clipping

Coiling

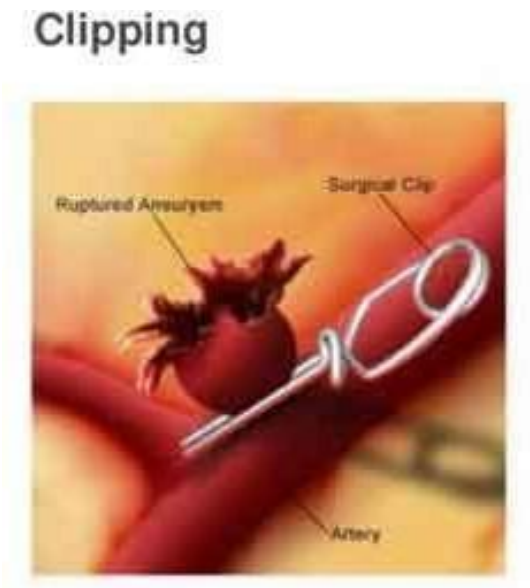


Recall that an aneurysm's wall is weak, which causes the visible outpouching in the images. Weakened walls risks hemorrhage and stroke.

Surgical treatment of Aneurysm

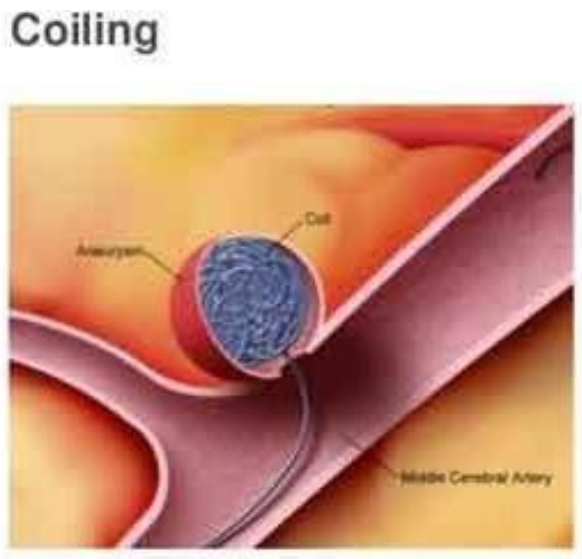
Clipping

- We enter through the skull, and close off the lumen of the aneurysm with a clamp fastened at its neck.



Coiling

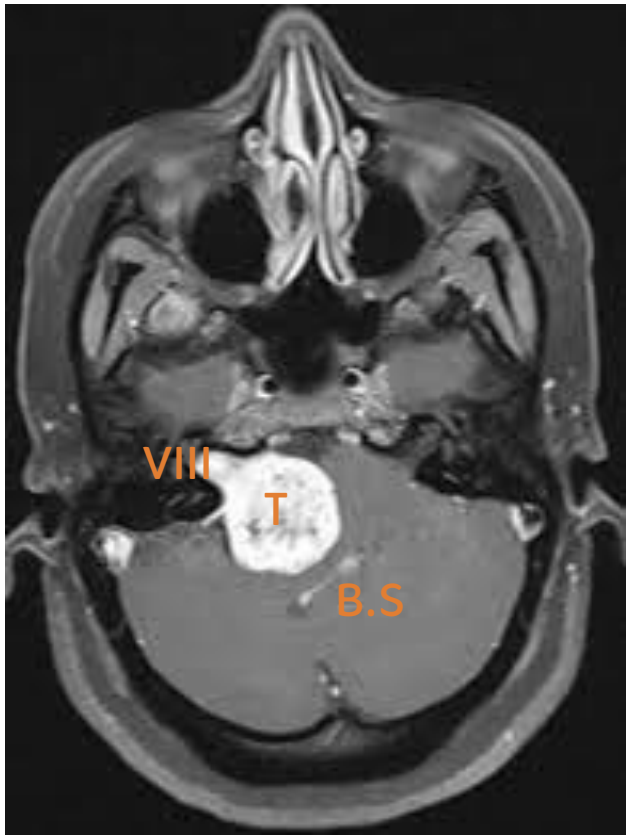
- We enter through a major artery and ascend to the brain into the site of the defect. We then clog the aneurysm with a fine coil.



Skull Base Surgery

- Tumors near cranial nerves
- Complex anatomy
- Multidisciplinary approach

MRI Imaging shows a tumor (T) at the base of the skull, arising near the Vestibulocochlear nerve (CN VIII), compressing the brainstem (B.S). Treatment options vary depending on tumor size, location, symptoms, etc...; one of these options is surgical removal.



Functional Neurosurgery

- Treats circuits not lesions
- Parkinson's, tremor, epilepsy
- Precision targeting

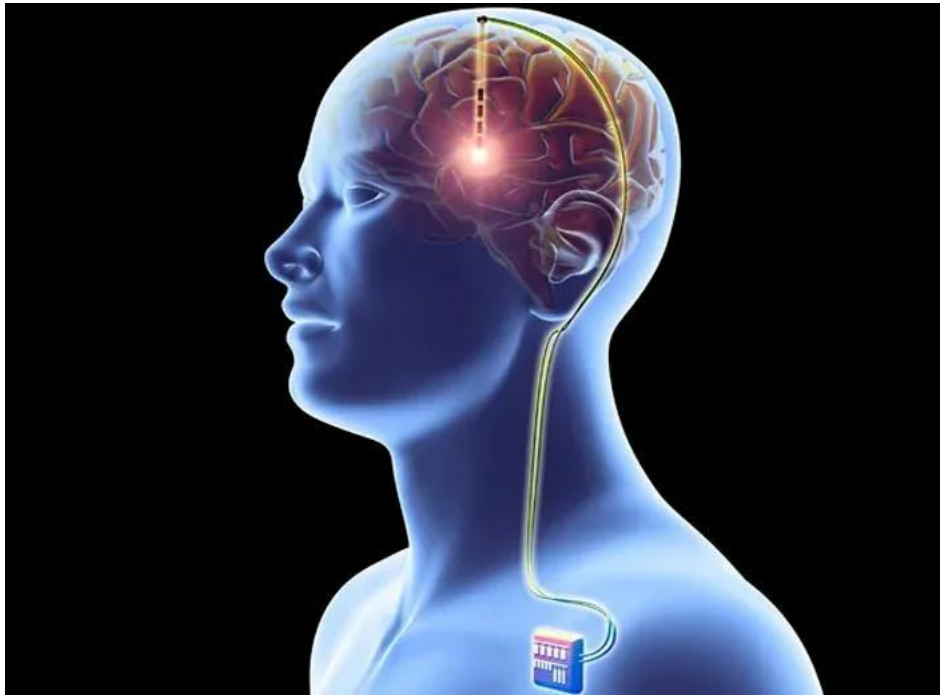
In such diseases, our first line treatment is medication. If it fails, surgical options may be considered.

In cases where there is no definitive treatment that improves disease outcome, such as in Parkinson's, surgical intervention may improve the overlying symptoms (tremor, rigidity, bradykinesia, etc...) and general quality of life of the patient, such as deep brain stimulation.

Deep Brain Stimulation

- Electrodes in deep nuclei
- Adjustable & reversible
- Improves motor function

For Parkinson’s disease.



Epilepsy Surgery

- Drug-resistant epilepsy
- Resection(1) or disconnection(2)
- Goal: seizure freedom

(1) **Resective surgery** is generally curative and the patient lives seizure free afterward.

(2) **Disconnective (palliative) surgery** aims to either reduce the frequency of seizures, or to reduce intensity (for example, turning generalized seizures to focal ones).

Again, in the case of epilepsy, surgical intervention happens after failure of antiepileptics. **Our main aim in epilepsy surgery is "freedom of seizures", where the patient remains epilepsy-free for at least a year after the operation.** Otherwise, we aim to reduce the intensity and/or frequency of attacks.

Mesial Temporal Sclerosis:

- Scarring and gliosis of mesial part of temporal lobe due to longstanding febrile seizures during childhood.
- Generally treated via temporal lobectomy.
- Considered a type of epilepsy surgery.

Psychosurgery

- Recall that it is a type of Functional neurosurgery
- Treatment of Tourette syndrome, medically refractory* depression, anorexia nervosa, medically refractory* OCD…

**unresponsive to standard treatment*

Pre-Surgical Evaluation

- MRI
- EEG / Video EEG
- Neuropsychology
- PET/SPECT

Important techniques, especially for epilepsy surgery.

Imaging in Neurosurgery

- CT: bleeding, trauma
- MRI: tumors, spine
- Essential for decision-making

This image shows a CT scan of the brain. As you can see it does not reveal as much detail as an MRI. However, CT scans remain vital in emergency scenarios, as they only take 1-2 minutes in contrast to the 30-minute (in minimum) MRI image. Visible hemorrhage is seen (Red arrow). Craniotomy* and drainage should be promptly performed.

**Recall that craniotomy is temporary removal of a section of the skull, while craniectomy is permanent.*

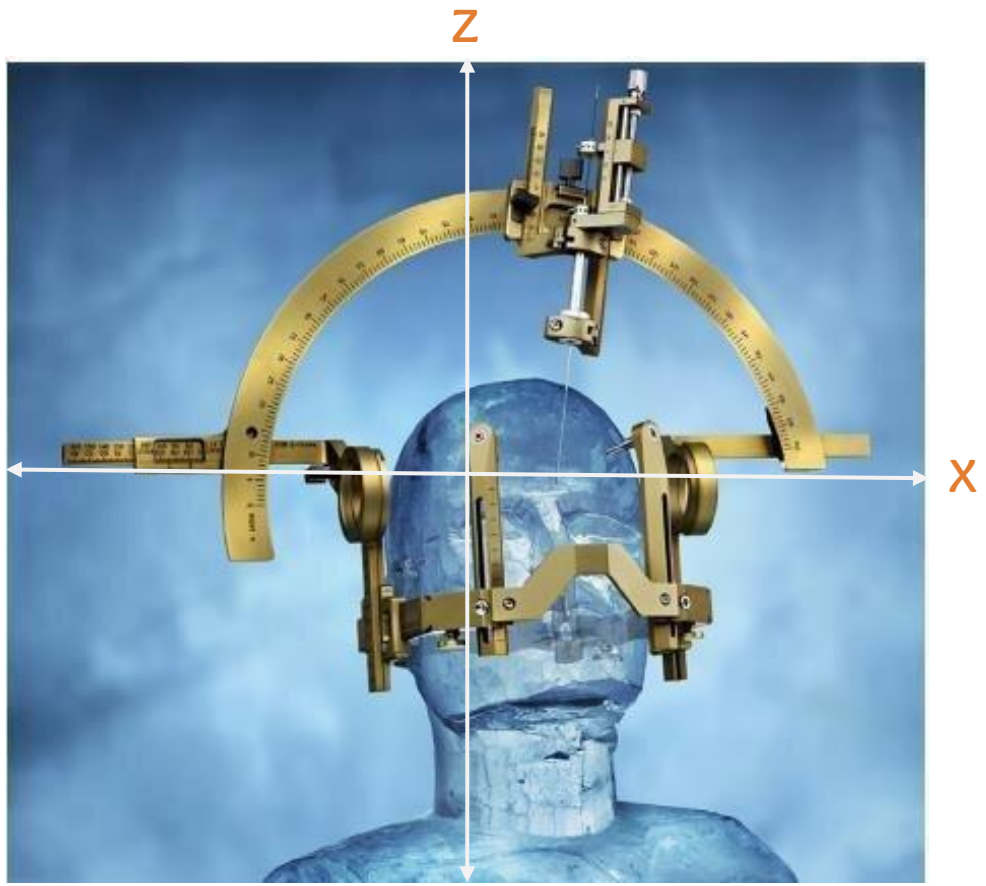
Major risks in neurosurgery

- Hypovolemic shock (due to massive bleeding) is generally not a major concern in neurosurgery, because the volume of CNS cavities is quite small, so life-threatening loss of blood is uncommon.
- However, also due to the small size of the cavities, your main concern becomes increased intracranial pressure, brought on by increases in amounts of CSF, brain tissue, and blood. This extra pressure poses life-threatening complications by compressing the brainstem and other vital brain structures.

Stereotactic Neurosurgery

- 3D coordinate targeting
- Millimetric precision
- Foundation of modern techniques

This is a method that aids in precision during surgery. Say you found a tumor on an MRI of the brain; it has relative coordinates that the apparatus in the image will help you find during surgery. It creates a precise coordinate system that aids you in, for example, collecting a biopsy specimen.

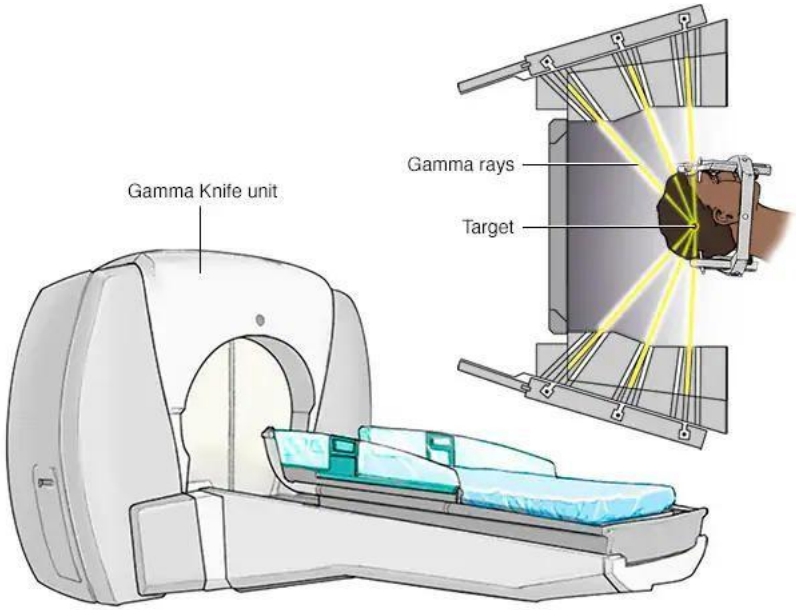


X: Right vs Left
Y: Anterior vs Posterior
Z: Superior vs inferior

Gamma Knife Radiosurgery

- No incision
- Focused radiation beams
- High precision treatment

Instead of irradiating the whole of the brain and hoping the tumor will be caught in the crossfire (conventional radiotherapy), this technique targets precise; focused radiation beams at specific coordinates. So, with the help of Stereotactic methods, you can accurately target a tumor with minimal damage to surrounding brain tissue.



Treatment Principles

- Decompression
- Resection
- Stabilization
- Modulation

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Modern Neurosurgery

- Microsurgery

Using endoscopes and microscopes

- Minimally invasive

Without massive destruction of underlying tissue (recall herniated disc example)

- Radiosurgery

Gamma knife Radiosurgery

- Image-guided surgery

Instead of a massive craniotomy site, navigation devices help by increasing precision and decreasing damage.

Key Message

- Precision + Technology + Physiology
- Restore function

  especially in movement disorder surgeries
- Improve quality of life

CLINICAL QUIZ LECTURE 1

رسالة من الفريق العلمي

اللهم إن عمر عطية في ذمتك وحبل جوارك، فقِه من فتنة القبر وعذاب النار،
أنت أهل الوفاء والحق، فاغفر له وارحمه إنك أنت الغفور الرحيم.

اللهم حرر المسجد الأقصى من الصهاينة وأعوانهم، اللهم عليك بهم فإنهم لا يعجزونك يا عزيز.

اللهم اغفر للمؤمنين والمؤمنات، والمسلمين والمسلمات، الأحياء منهم والأموات،
إنك سميع قريب مجيب الدعوات مولانا رب العالمين.

Scan the QR code or click it for FEEDBACK

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			