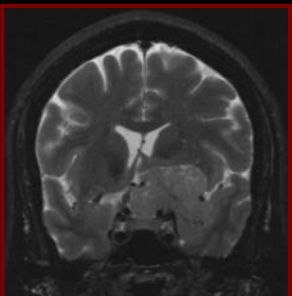
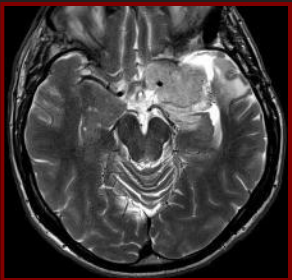
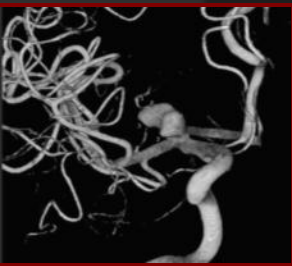


The Sixth Annual International Neurosurgery Conference



Current State of Skull Base Surgery 2010

Manuel Ferreira Jr. MD PhD
Dinesh Ramanathan MD MS
Michael Herbas MD
Rabindranath Garcia-Lopez MD
Laligam Sekhar MD FACS

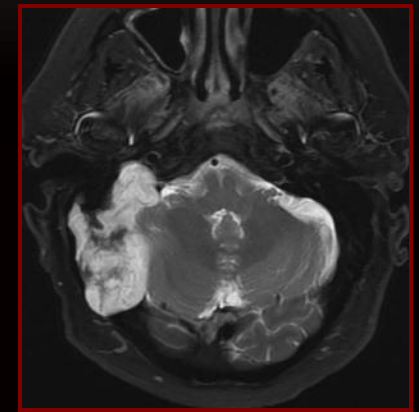


August, 2010



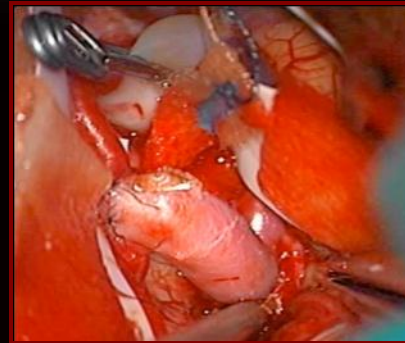
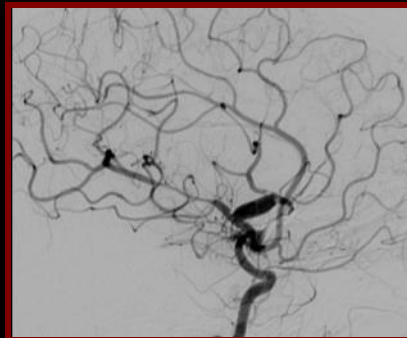
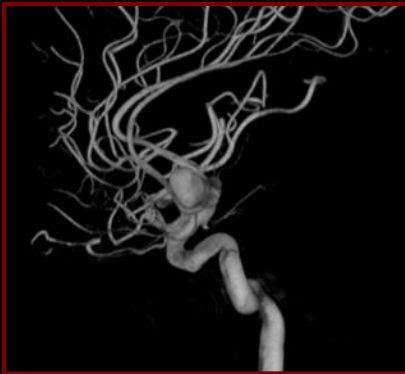
Advances in the Surgical Treatment of Skull base tumors

1. Improvements in microsurgical technique
2. Endovascular embolization
3. Neuronavigation
4. Endoscopic/minimally invasive techniques
5. Neuromonitoring
6. Newer tools: Flexible CO2 laser, Gamma knife radiosurgery



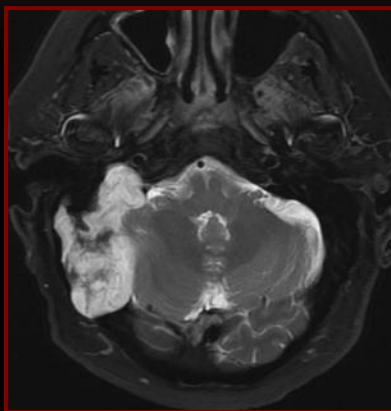
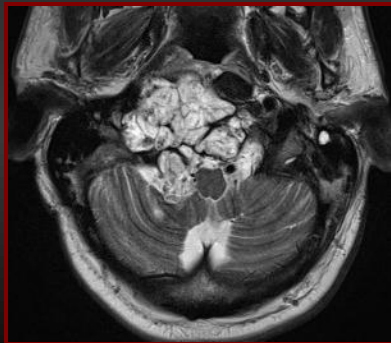
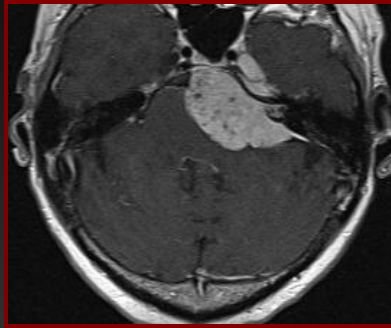
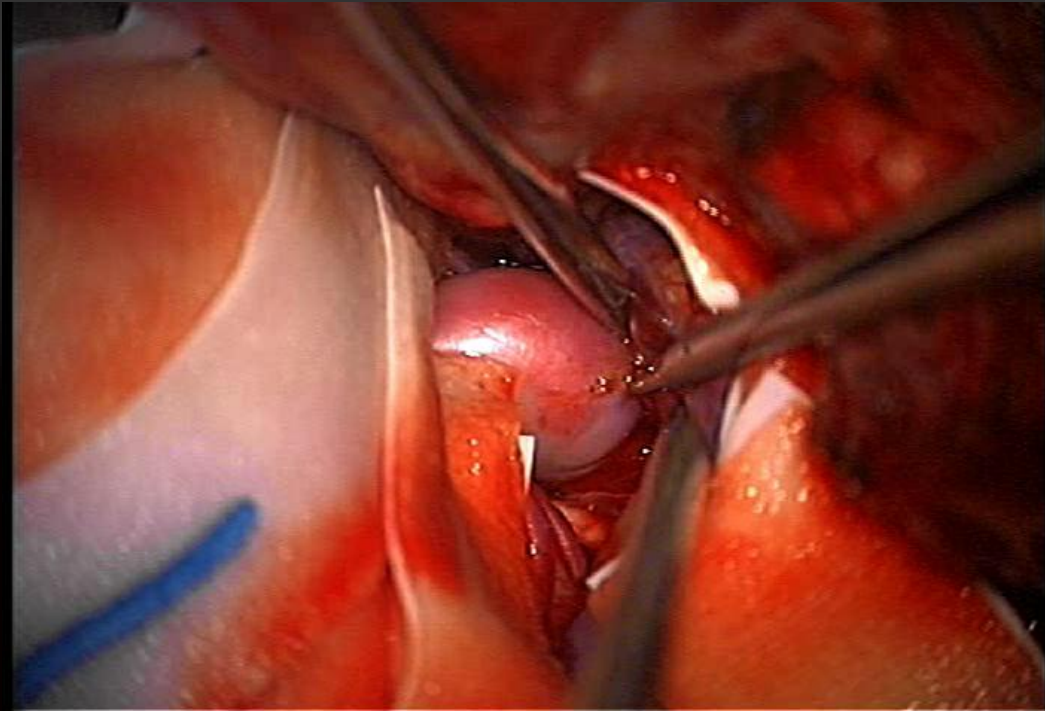
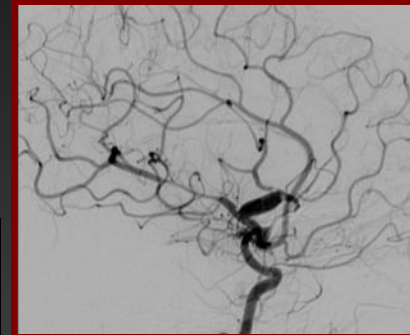
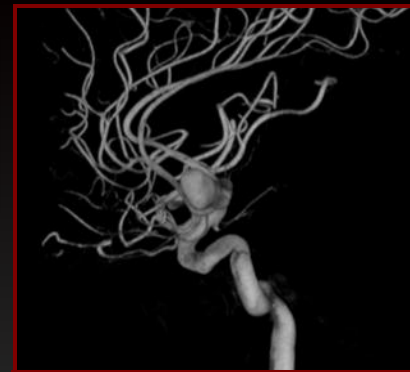
Advances in the Surgical Treatment of Complex Vascular Lesions

1. Improvements in microsurgical technique (bypass techniques)
2. Endovascular technique
3. Neuromonitoring
4. Newer tools: ICG angiography
5. Medications: nimodipine, papavarine



Current State of Skull Base Surgery

Tumors and Vascular Microsurgical technique By-pass technique



Current State of Skull Base Surgery

Tumors and Vascular

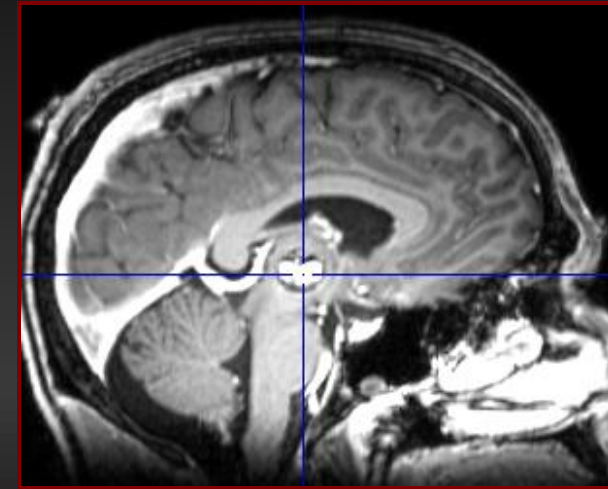
Endovascular
technique
Embolization



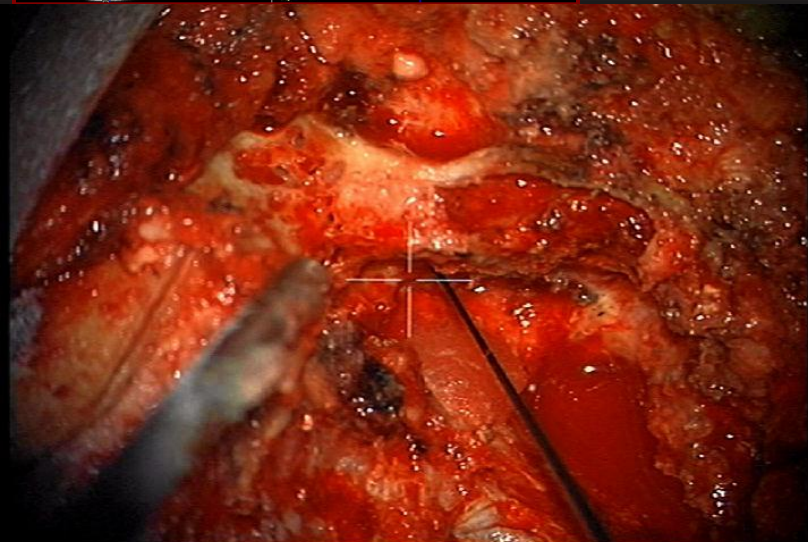
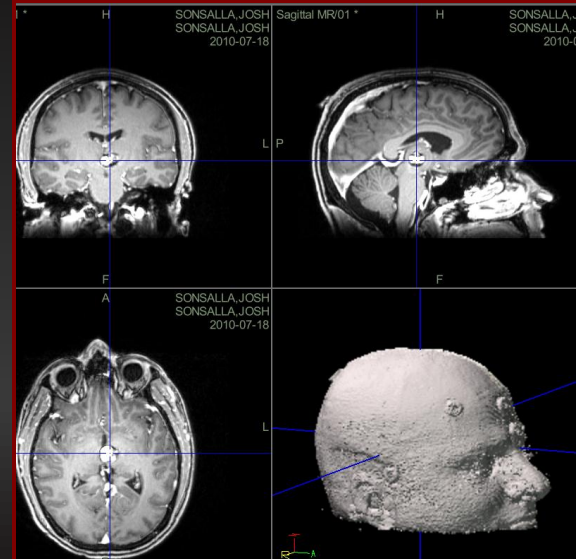
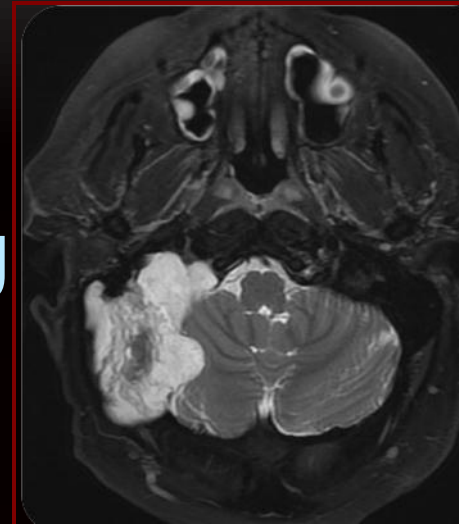
Current State of Skull Base Surgery 2010

Tumors and Vascular

Neuronavigation



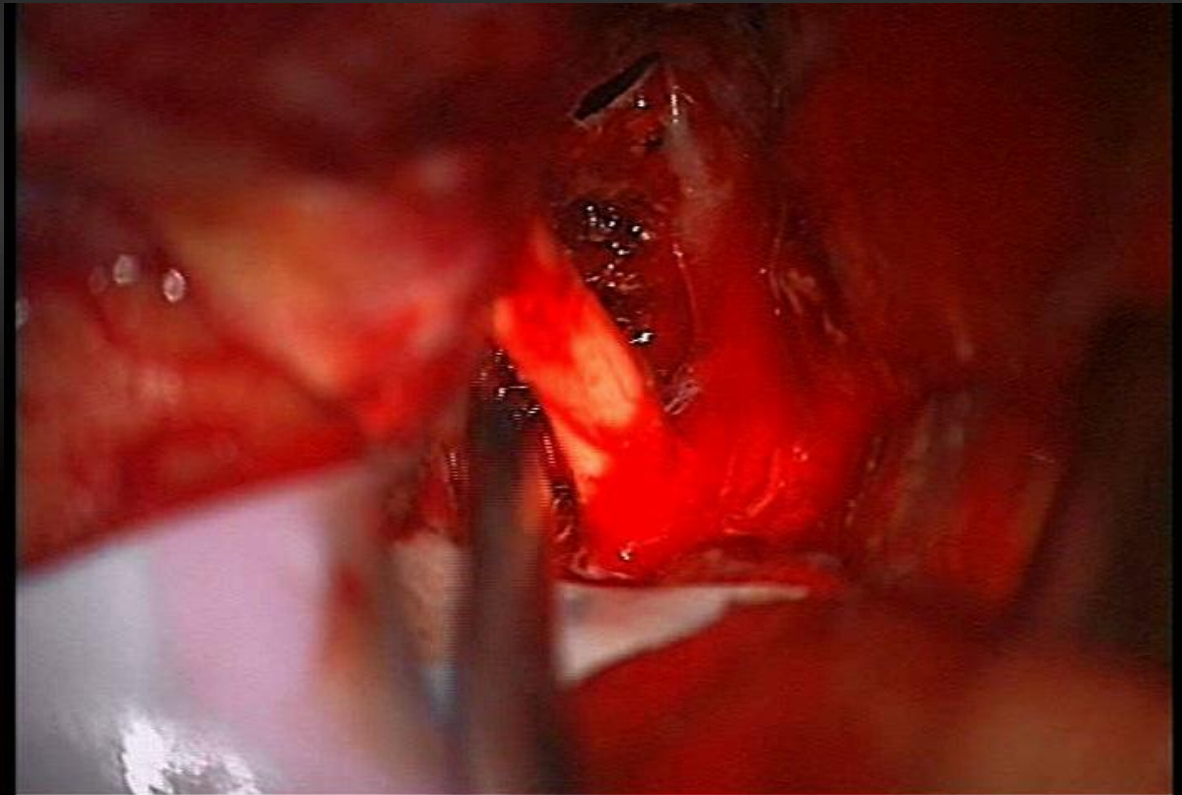
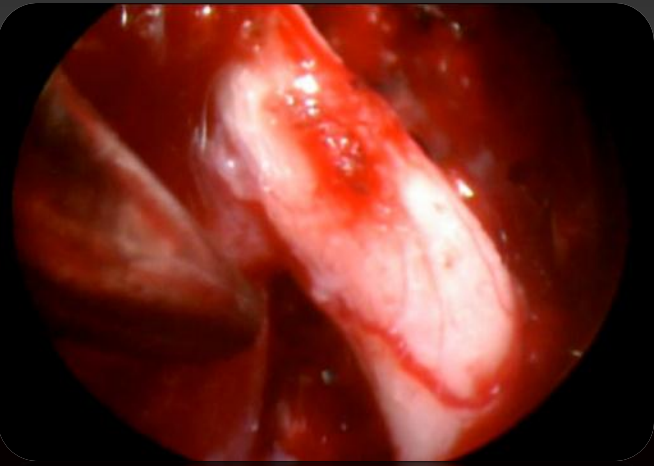
Neuromonitoring



Current State of Skull Base Surgery 2010

Tumors and Vascular

Endoscopic minimally invasive

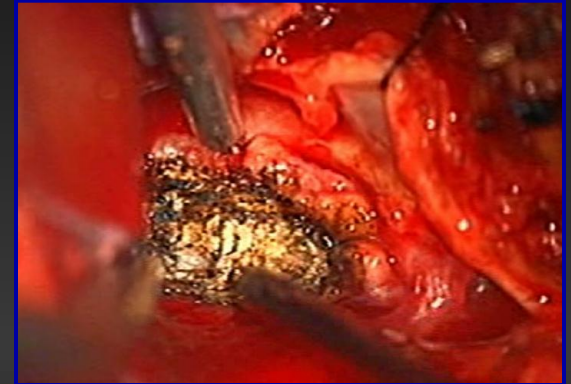


Current State of Skull Base Surgery 2010

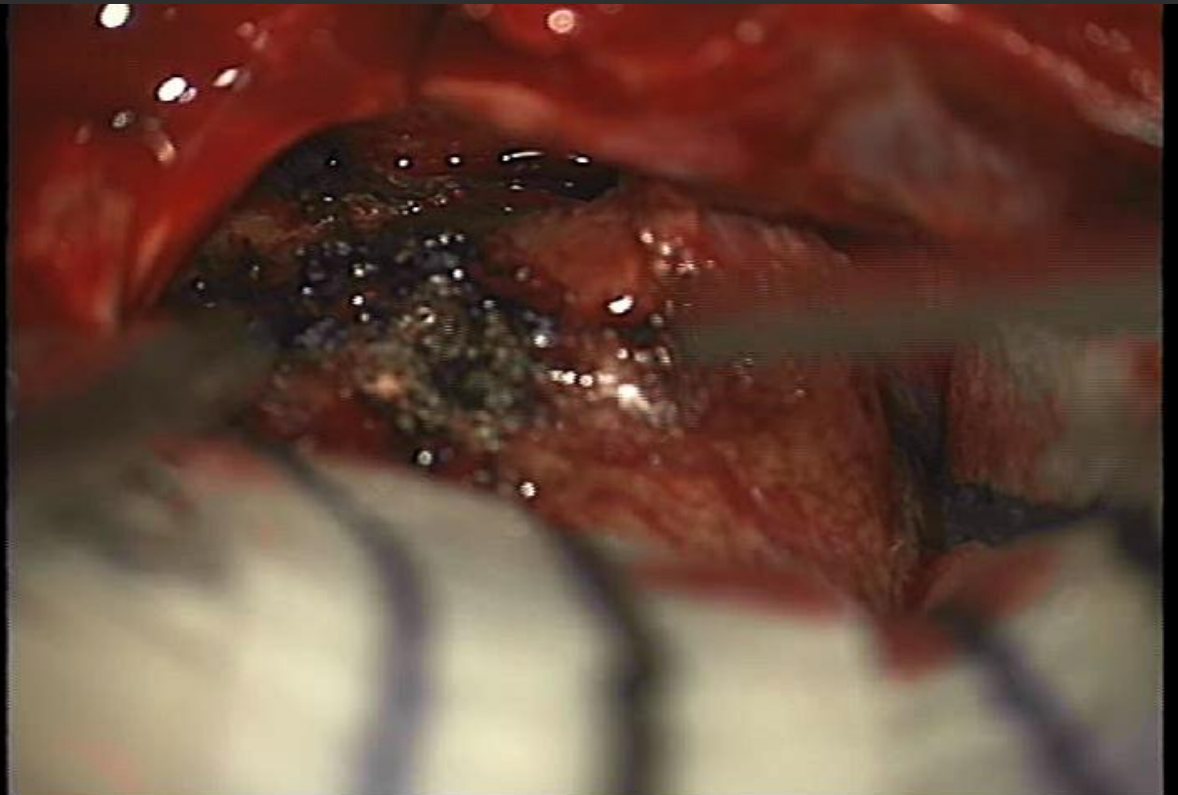
Tumors and Vascular

Others tools:

Flexible CO2 laser

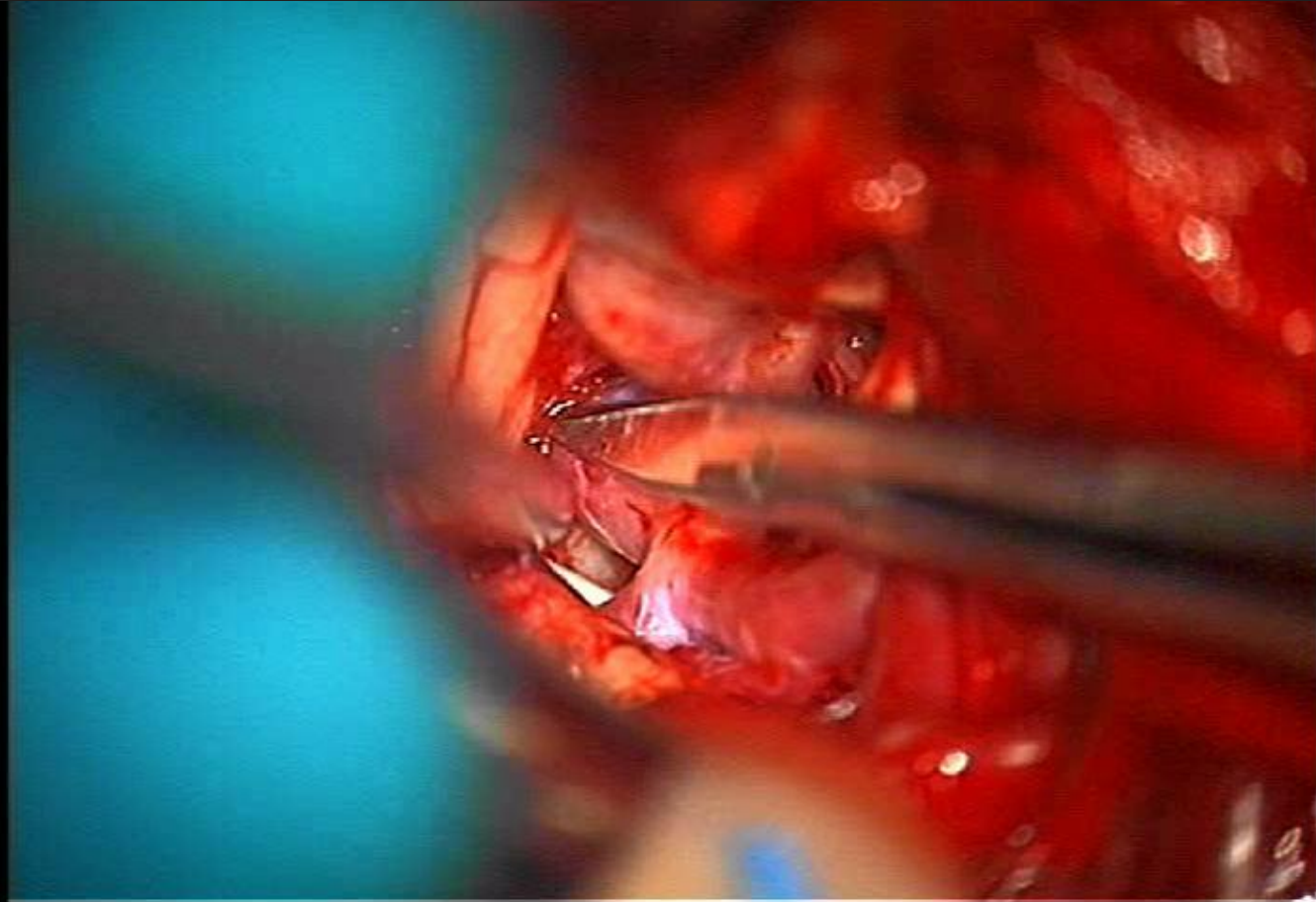


Gamma knife
neurosurgery



Current State of Skull Base Surgery 2010

Tumors and Vascular



ICG (Indocyanin Green Dye)

Current State of Skull Base Surgery 2010

Tumors and Vascular

Medications:

Nimodipine

Papaverine



Skull Base

VASOSPASM AFTER CRANIAL BASE TUMOR RESECTION: PATHOGENESIS, DIAGNOSIS, AND THERAPY

Ghassan K. Bejjani, M.D.,* Laligam N. Sekhar, M.D., F.A.C.S.,† Ann-Marie Yost, M.D.,†
William O. Bank, M.D.,‡ and Donald C. Wright, M.D.†

**Department of Neurosurgery, University of Pittsburgh Medical Center, Pittsburgh,
Pennsylvania †Department of Neurosurgery, ‡Department of Radiology, Interventional and
Therapeutic Neuroradiology, George Washington University, Washington, DC*

A Tale of Five Lesions 1986 - 2010

- Interesting to Look at the Evolution of Treatment of 5 Lesions which may require skull base surgery

Clivus Chordoma

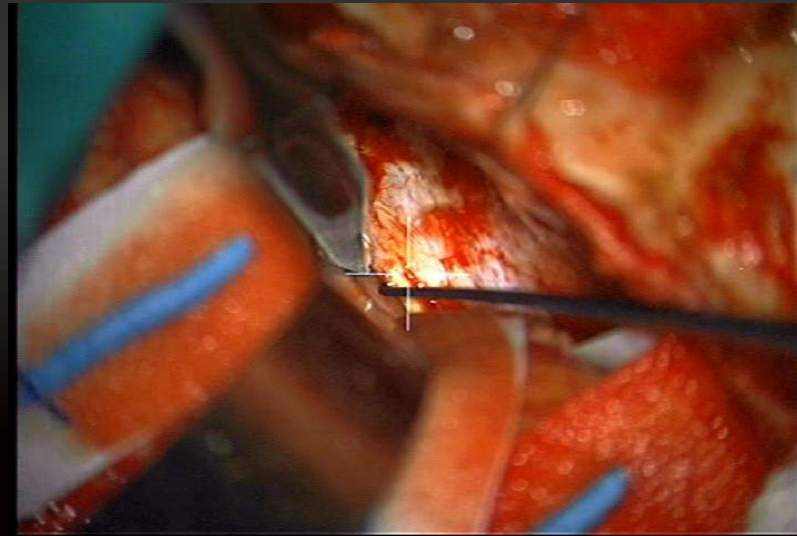
Petroclival and

Foramen Magnum Meningioma

Vertebro Basilar Aneurysms

Cavernous Sinus Tumor

Acoustic Neuroma



**Current State of
Skull Base Surgery**

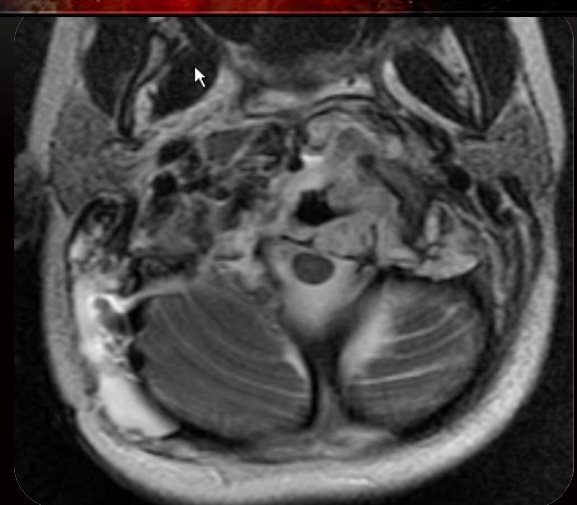
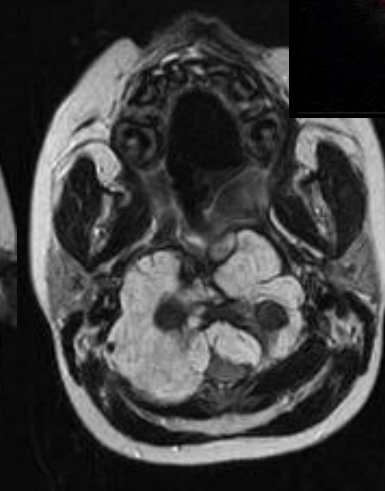
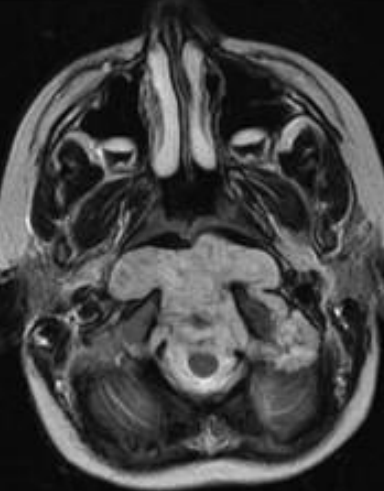
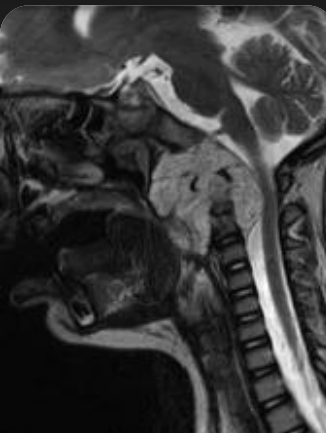
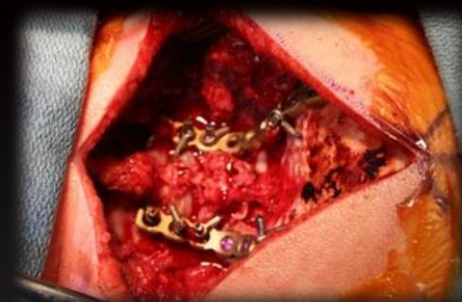
Clivus Chordoma

- 1980s -2000 Development of many skull Base Approaches.
- Considerable debate about partial vs total resection, Proton beam Radiotherapy for all vs recurrent tumors.
- 2008 Endoscopic vs Skull Base resection?
- 2000 -2010 Multiple chromosomal abnormalities discovered, no specific gene has been identified.

Current State of
Skull Base Surgery

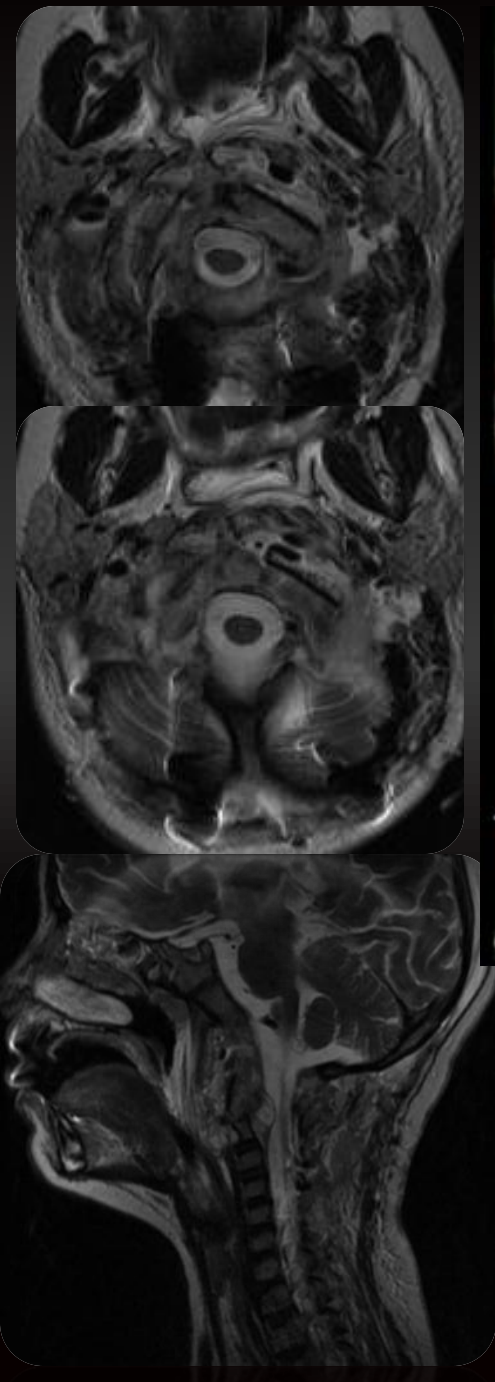
Clivus Chordoma

5 F, severe neck and shoulder pain and inability to keep head up straight, inability to eat, dragging of both feet, particularly the right side.



Current State of Skull Base Surgery

Post resection after first surgery



Extreme lateral transcondylar approach.

07-15-2010

Clivus Chordoma Second surgery

Current State of
Skull Base Surgery

Petroclival and Foramen Magnum Meningiomas

- 1980 to 1990
 - Development of Petrosal and Extreme Lateral Approaches.
- 1990 to 2000
 - Radiosurgery becomes established for control of Small Tumors (<2.5cm).
- 2000 to 2008
 - Many controversies about
 - Simple (retrosigmoid) vs Complex Approaches
 - Patient Outcomes of Tumor resection
 - Complete Resection vs Partial Resection
 - Observation of Tumor Remnants vs Radiosurgery

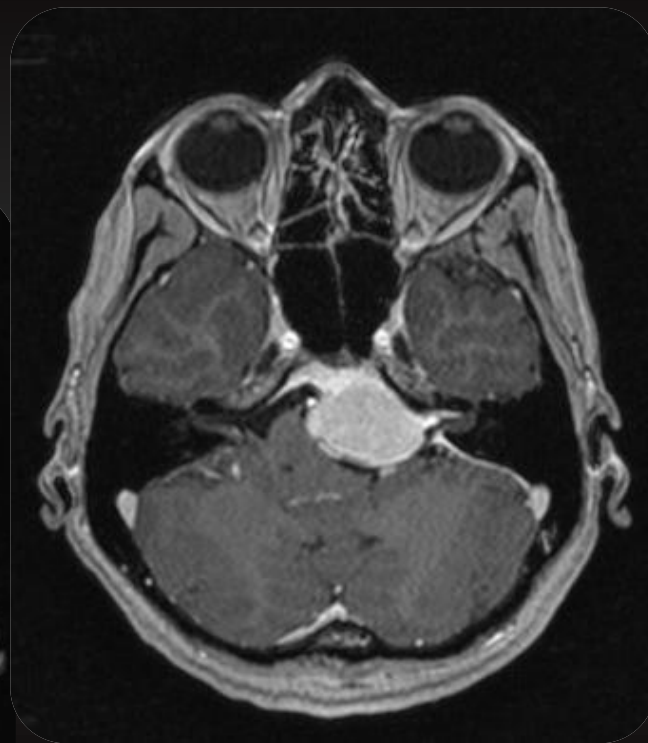
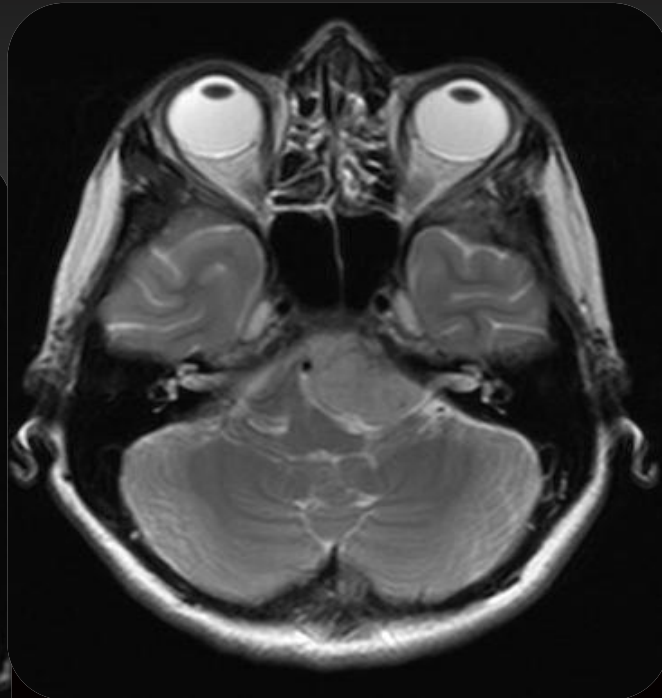
Akagami, et al. Patient evaluated Outcomes after surgery for basal meningiomas
Neurosurgery 50:941, 2002

Natarajan et al, Petroclival Meningiomas : Multimodality treatment and outcomes at long term follow up, Neurosurgery 60:965,2007

**Current State of
Skull Base Surgery**

Petroclival Meningiomas

43 yr old woman
Presented with difficulty
walking downstairs and
flickering of eyelid

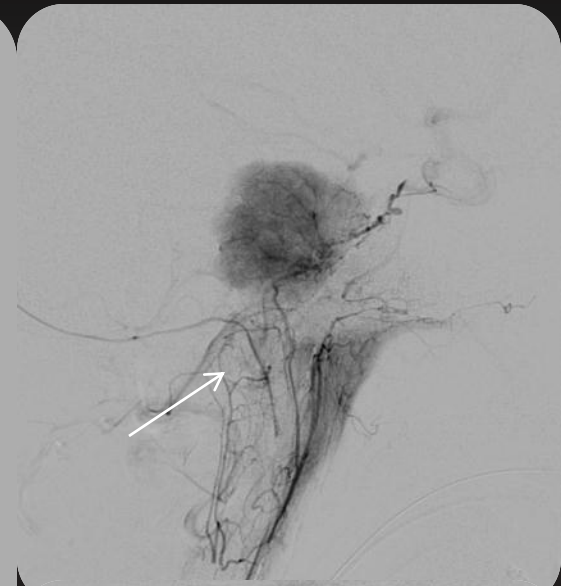
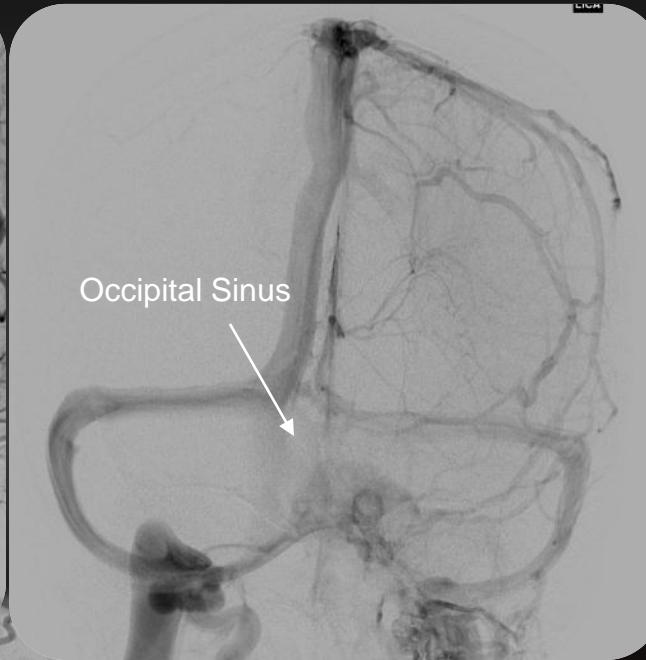
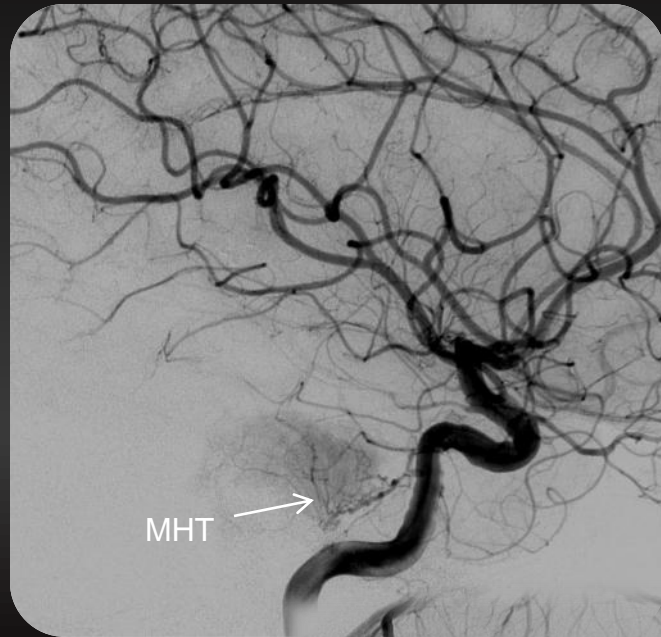


Current State of
Skull Base Surgery

Petroclival Meningiomas

Current State of
Skull Base Surgery

Arteriogram and Venogram



Preop Embolization



Petroclival Meningiomas

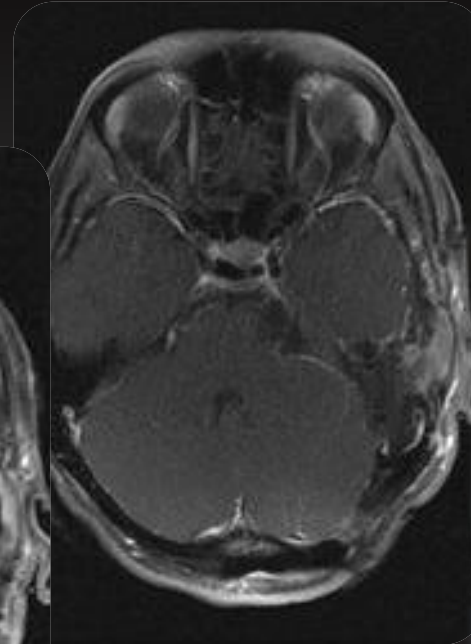
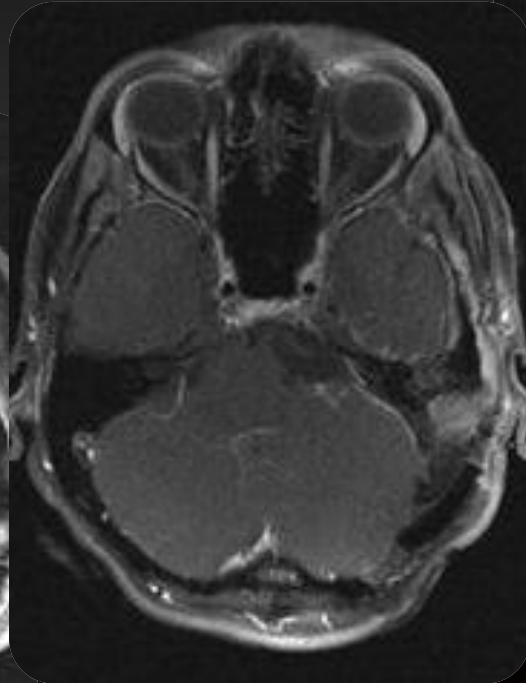
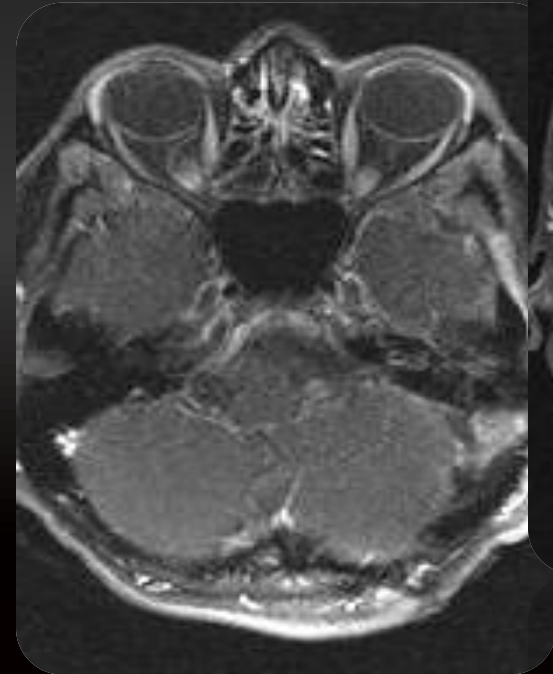
Transpetrosal and Retrosigmoid Approach



Current State of
Skull Base Surgery

Petroclival Meningiomas

Post Operative MRI



1 month
post surgery

Patient discharged home after 2 weeks,
ambulatory. No neurological deficits,
Partial 6th nerve palsy, recovering.

**Current State of
Skull Base Surgery**

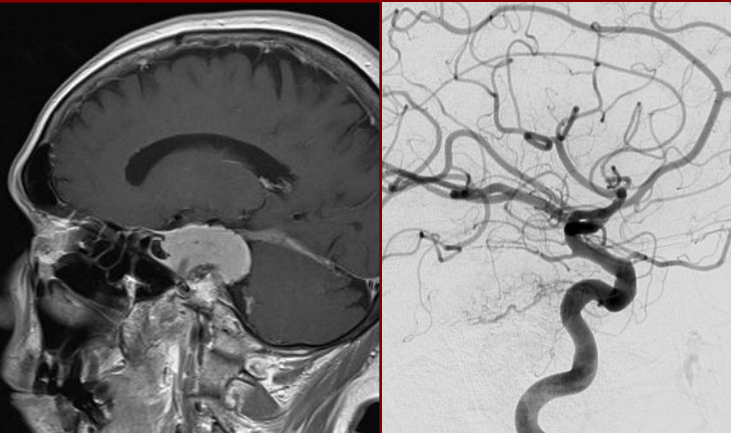
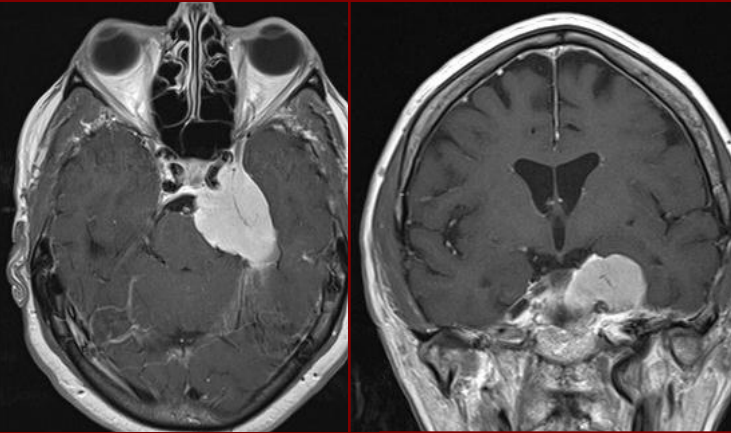
Petroclival Meningiomas

Female, 70-year-old

Occasional headaches since 2004 and
double vision.

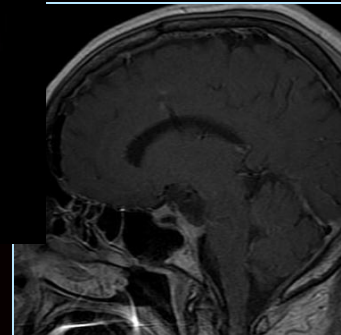
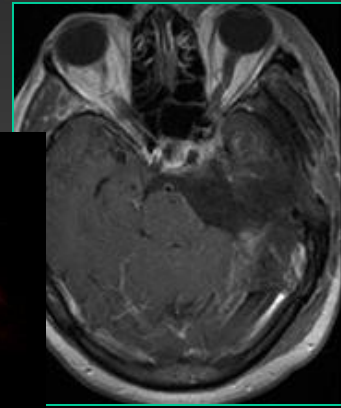


Use of carbon dioxide laser
neuronavigation



Left frontotemporal craniotomy and
Zygomatic osteotomy
Subtemporal approach

07-09-2010

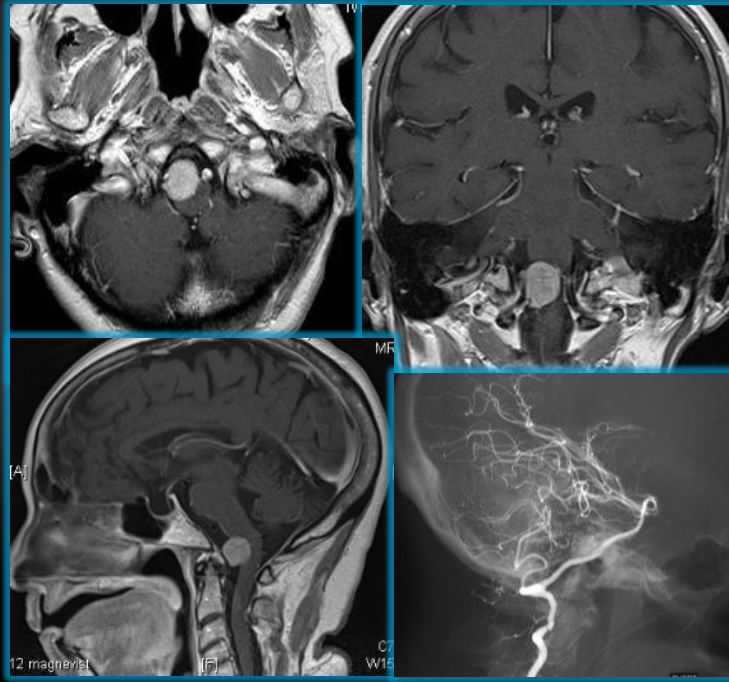


**Current State of
Skull Base Surgery**

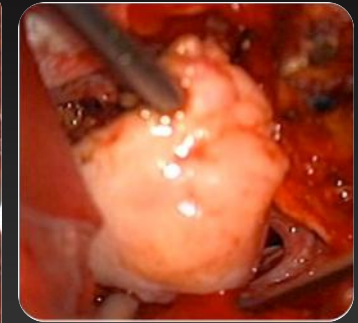
Postoperative MRI

Foramen Magnum Meningiomas

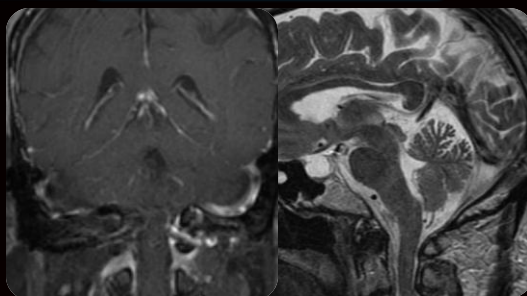
72 y.o. female
Foramen magnum meningioma
with severe compression of the
spinomedullary junction.



She underwent a Far lateral transcondylar approach.



Her post-op
MRA shows a
total resection
of tumor.



HARBORVIEW MEDICAL CENTER

Retrosigmoid craniotomy
and craniectomy.

Far lateral transcondylar approach
July 19, 2010.

Vertebro Basilar Aneurysms

- 1986-90
 - Many cerebrovascular surgeons skeptical about the value of skull base approaches.
- 1990 – 2000
 - The improved access to many of these aneurysms (and other lesions) persuades several neurosurgeons such as Spetzler, and de Olivera to adopt these approaches routinely including fronto-orbital, orbitozygomatic, Transpetrosal Anterior Petrosal, and Extreme Lateral.
- 2000- 2008
 - Endovascular Surgery is Progressively Diminishing the Need for Open Microsurgery for these Lesions.
- 2008
 - Complex Posterior Circulation Vascular Lesions are still Operated, and Skull base Approaches are routinely Employed.

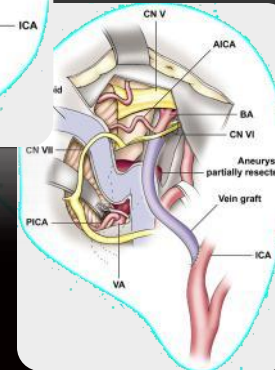
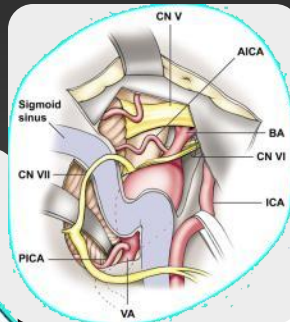
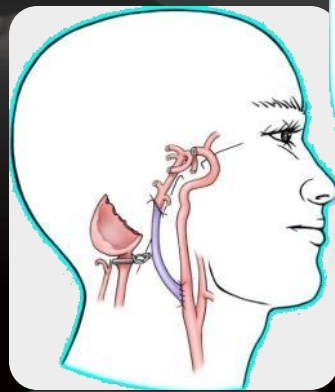
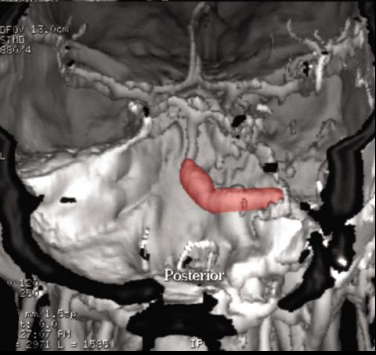
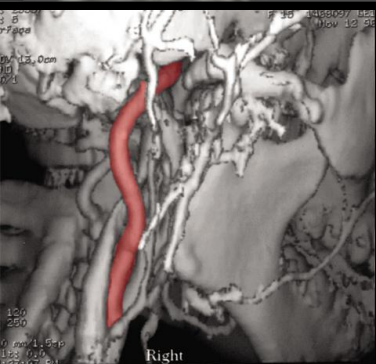
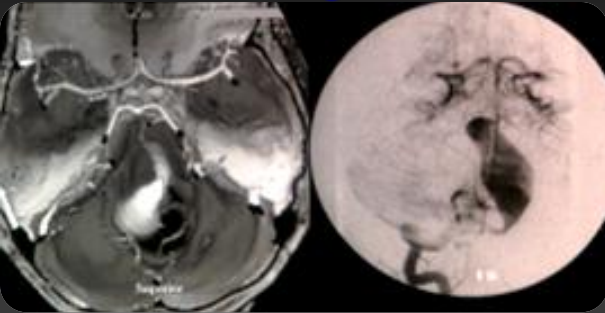
**Current State of
Skull Base Surgery**

Vertebro Basilar Aneurysm

Current State of Skull Base Surgery

16 y.o. female with a giant fusiform VA-BA

She underwent a cervical ICA to BA bypass using a SVG and trapping of the aneurysm



Her post-op MRA shows a widely patent graft and filling of the posterior circulation.

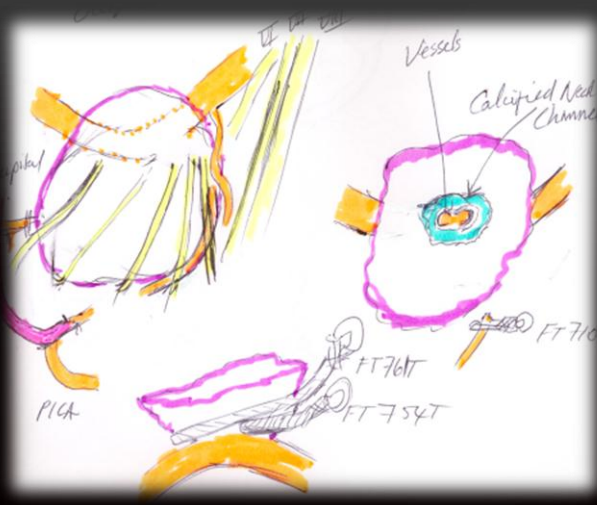
At last follow-up she has a House Grade-II facial paresis and Right hearing loss.



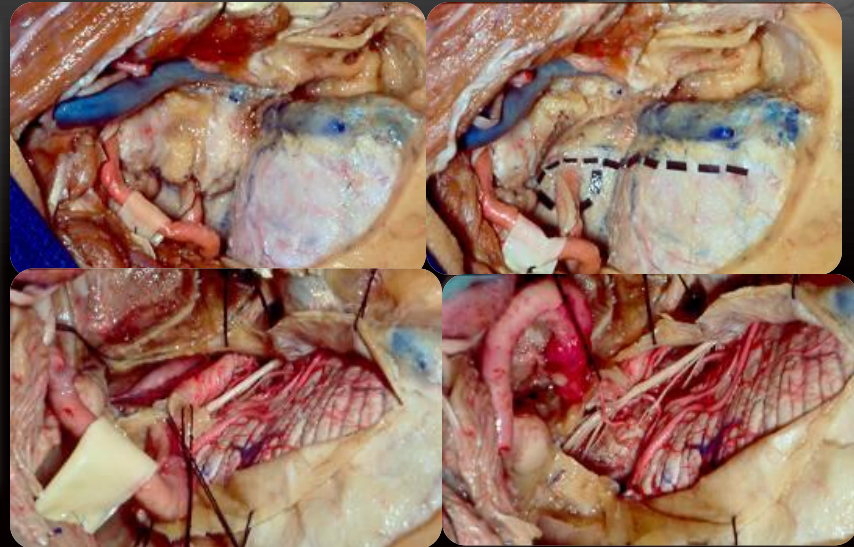
Vertebro Basilar Aneurysm

- 32-week pregnant lady with giant vertebro-basilar aneurysm

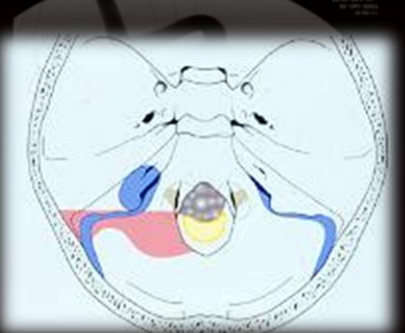
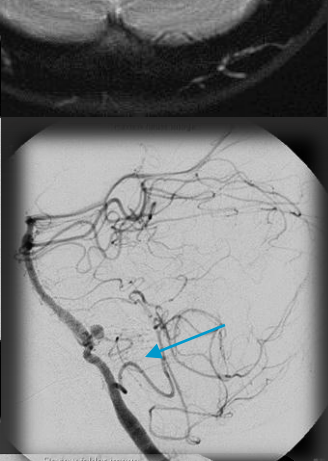
Left retrosigmoid craniotomy, far-lateral partial transcondylar approach.
Left OC-PICA bypass procedure.
Excision of aneurysm with Endo-aneurysmorrhaphy and clipping of aneurysm neck heavily calcified.



Current State of Skull Base Surgery

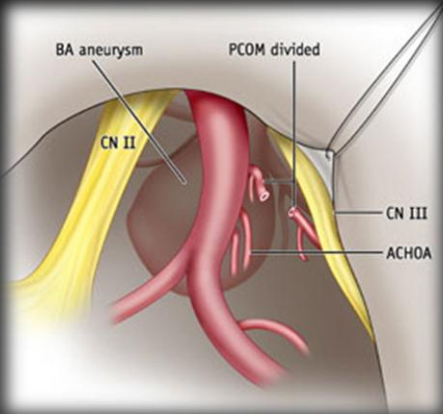
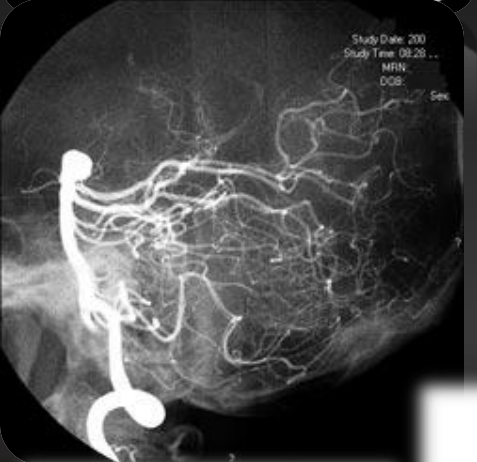


Aneurysm remnant on angiography after a week ;coil embolization; Good recovery.

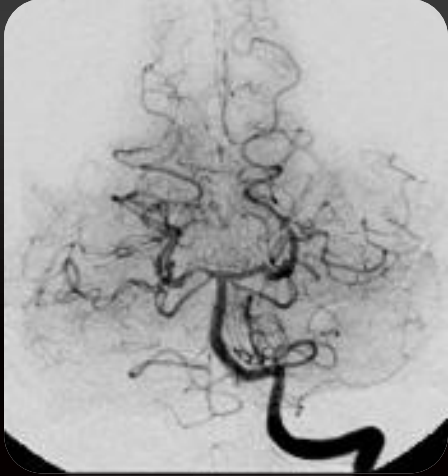
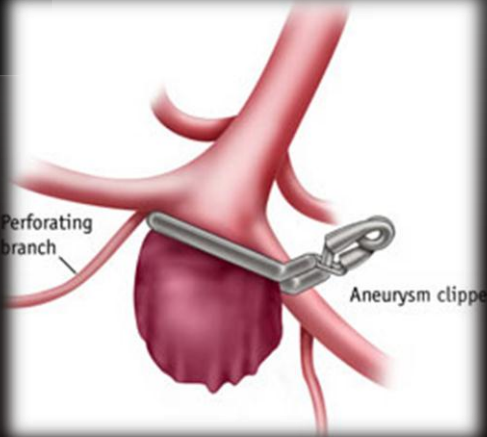
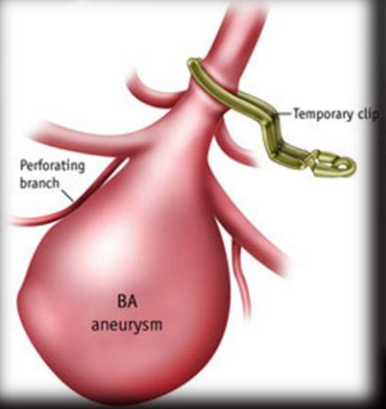
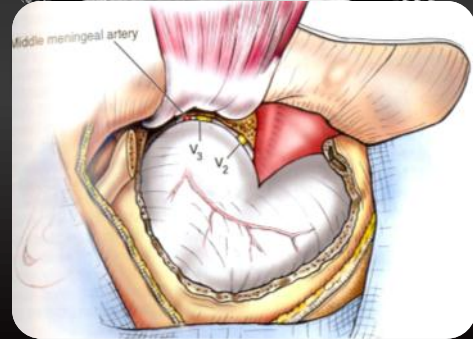


Vertebro Basilar Aneurysms

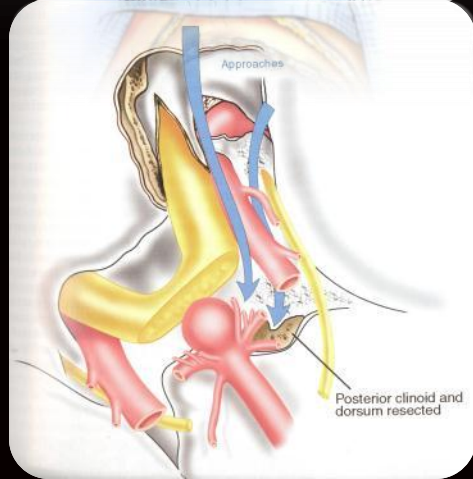
Current State of Skull Base Surgery



Basilar Tip Aneurysm
History of headache, H & H Gr. 1
Three Dimensional CTA and intra-arterial DSA revealed a 0.8 cm basilar artery bifurcation aneurysm with a broad neck.



Post Op Angiogram
Excellent recovery
No deficits
No recurrence at 2 years

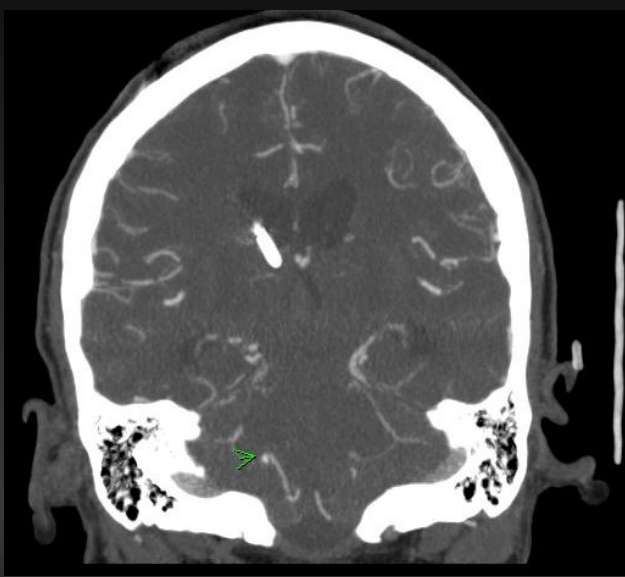
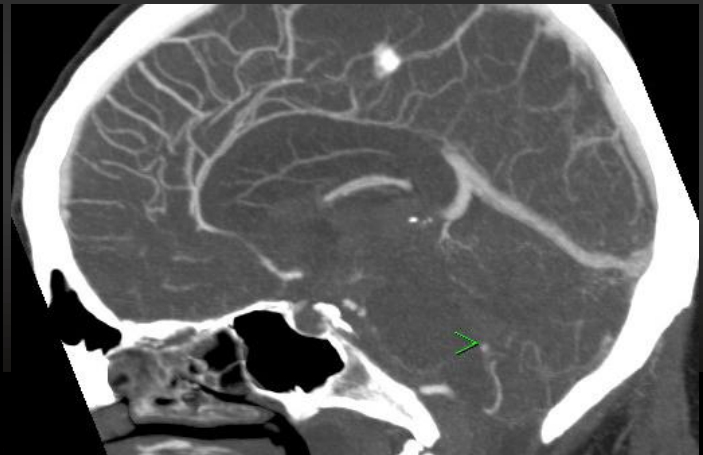


Because of the unfavorable dome/neck ratio, surgical clipping was elected.

Vertebro Basilar Aneurysms

Current State of Skull Base Surgery

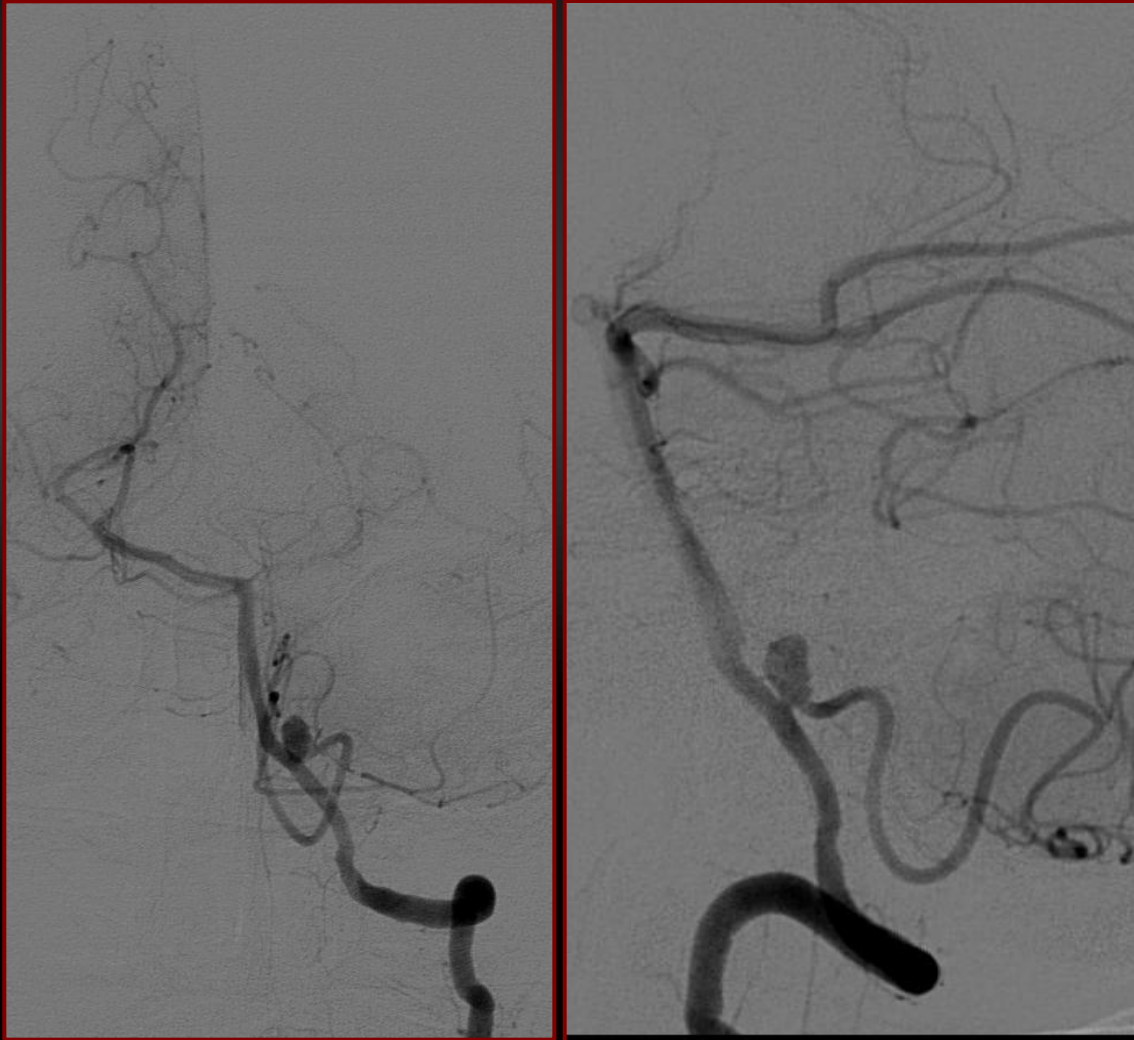
Women age 62 years, presenting a sudden crisis, vomiting without regaining alertness, carried unconscious to the emergency, and it is intubate on the way to hospital.



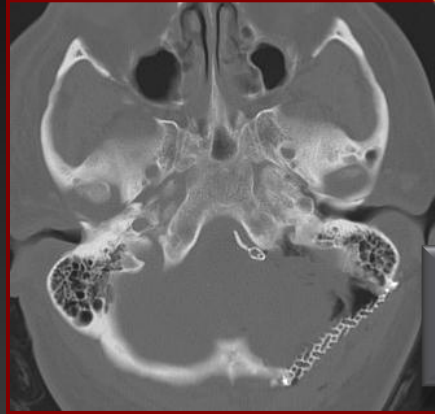
Vertebro Basilar Aneurysms

Current State of
Skull Base Surgery

Left retrosigmoid craniotomy,
far-lateral partial
transcondylar approach.

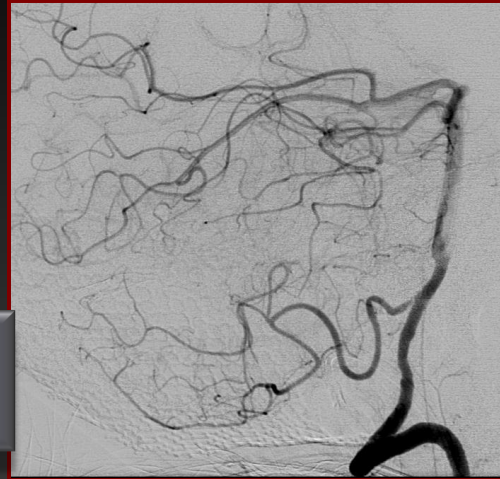


Vertebro Basilar Aneurysms



Current State of
Skull Base Surgery

Post Op Angiogram



Cavernous Sinus Tumors

1982-86

Dolenc Revived interest in Cavernous Sinus Tumor and Aneurysm Surgery (CS and paraclinoid).

1986 – 96

Vascular bypasses (ICA/ECA to ICA/MCA) perfected to deal with difficult tumors, and unclippable aneurysms.

1990 -2000

Developments in Radiosurgery, Endovascular Surgery.

2008 CS

Meningiomas Surgery with RS, or RS only CN V
Schwannomas Microsurgery vs RS.

Current State of
Skull Base Surgery

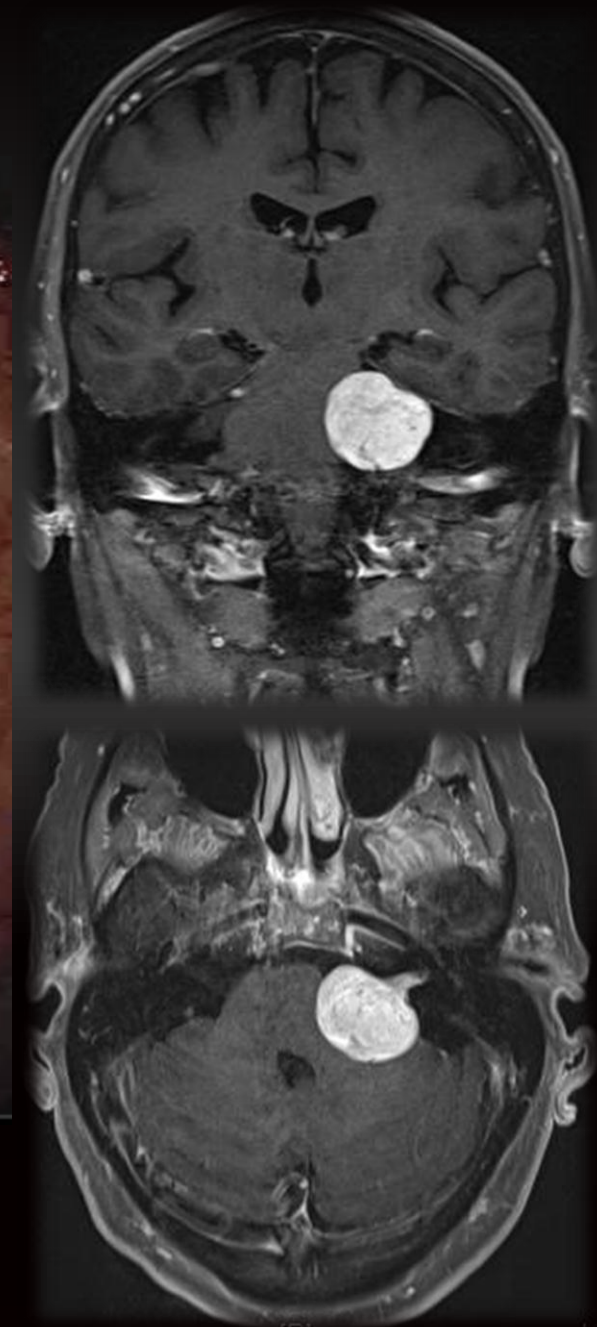
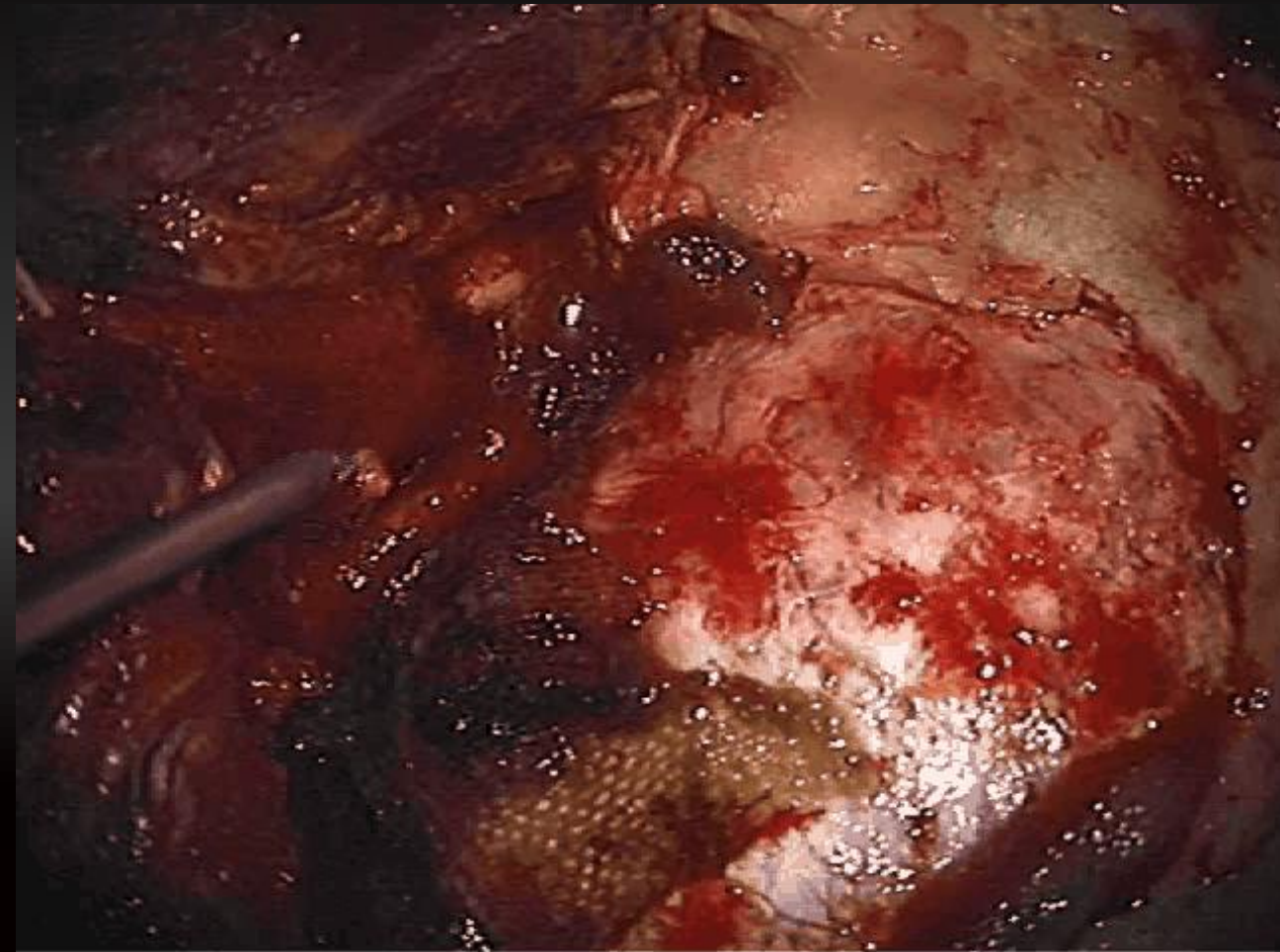
Cavernous Sinus Tumors (cont.)

- Intracavernous Aneurysms –observation, Endovascular Coiling, Stents with coils, Bypass and trapping.
- Paraclinoid and Ophthalmic Aneurysms – Endovascular Coiling, Cavernous Sinus Operative Techniques (anterior clinoidectomy, CN2 decompression).
- Basilar Tip Aneurysms – Endovascular Techniques, Orbitotomy or OZO, with Posterior Clinoidectomy with Sonopet, Fibrin Glue Injection into CS to stop venous bleeding.

Acoustic Neuroma

- 1970s to 1990 Debate ranges about Translab vs Middle Fossa vs Retrosigmoid Approach
- 1984 to 1992 Collaborative Surgery becomes the norm for many vestibular schwannomas
- 1990s Retrosigmoid Approach gains prominence because of hearing preservation, Gene for NF2 (Schwannomin) discovered, Radiosurgery gaining ground, Brain Stem Auditory Implant introduced and increasingly used in NF2 patients
- 2008 Majority of VS <2.5 cms are treated by Radiosurgery, Difficult to train surgeons in VS Microsurgery
- 2008 Radiosurgery is being attempted for large VS as primary modality, or after “debulking microsurgery” with diminishing number of surgeons able to achieve good results for CNs 7 and 8 after tumor resection
- Nimodipine treatment to Improve results of hearing preservation?

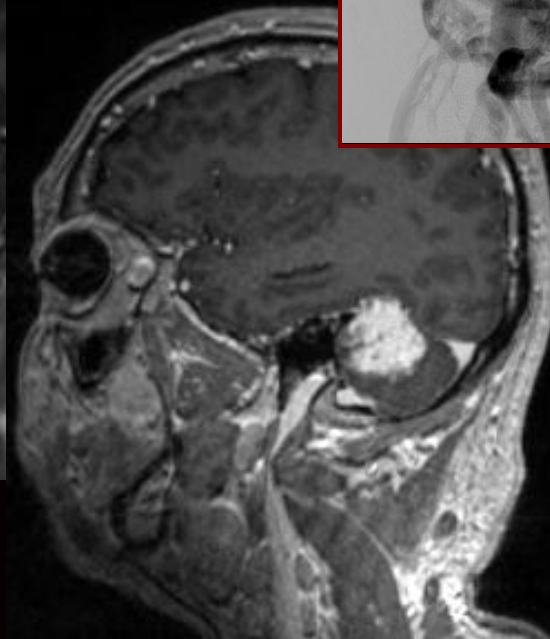
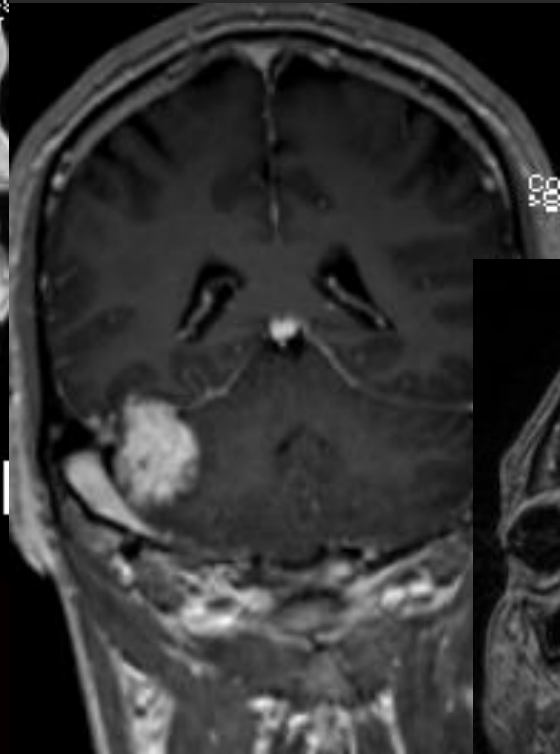
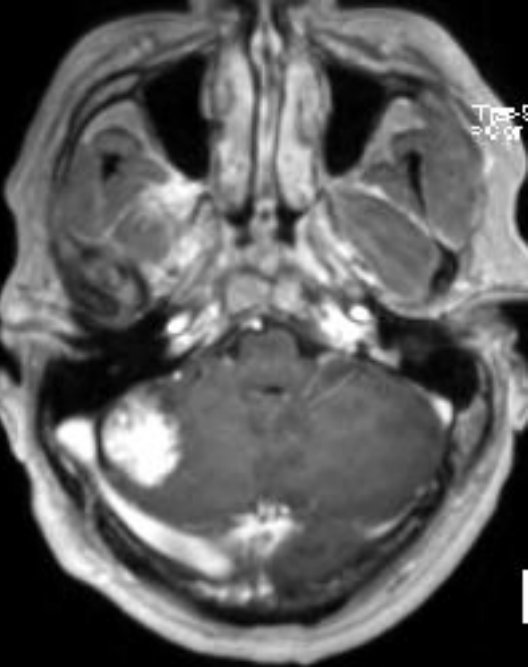
Acoustic Neuroma



Current State of
Skull Base Surgery

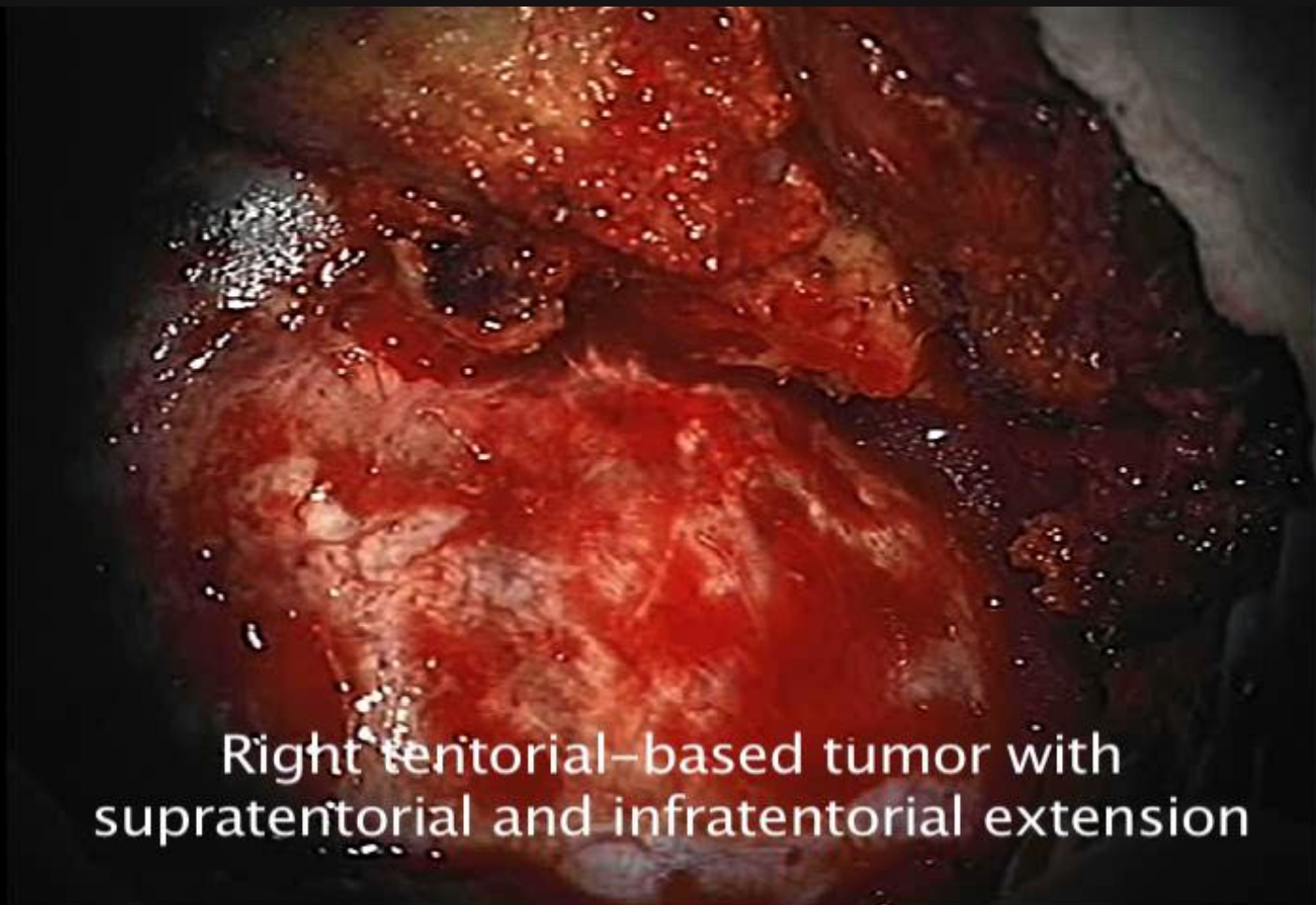
Tentorially-based Hemangioma

- 48 year old.
- Without neurological deficit

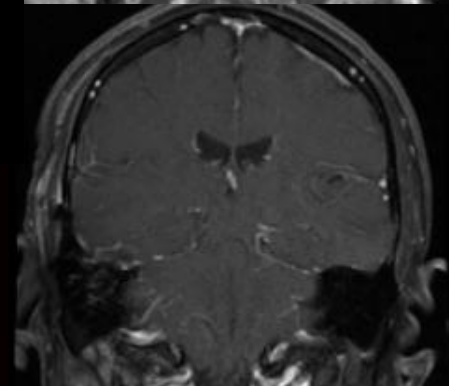
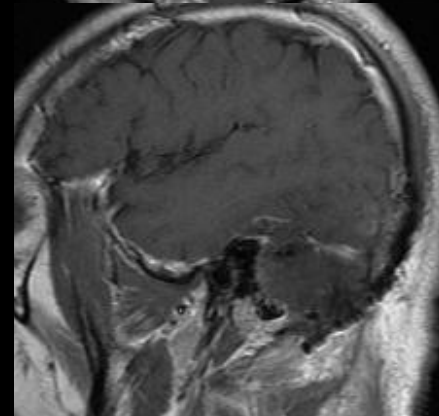
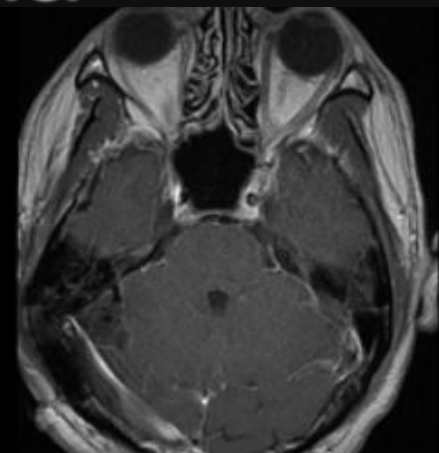


Current State of
Skull Base Surgery

Tentorially-based Hemangioma



Right tentorial-based tumor with supratentorial and infratentorial extension



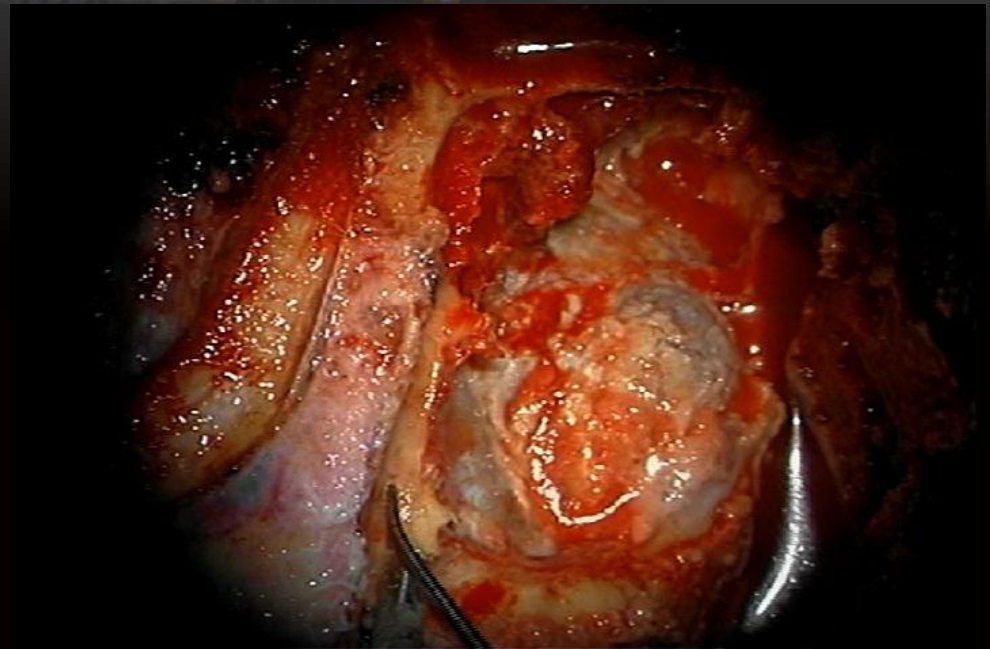
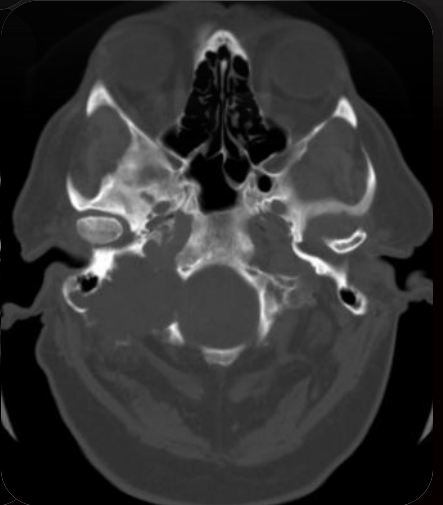
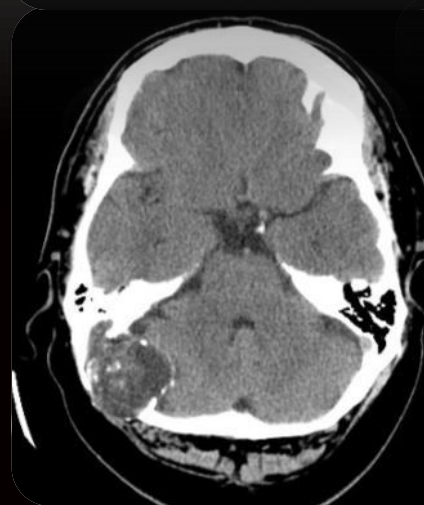
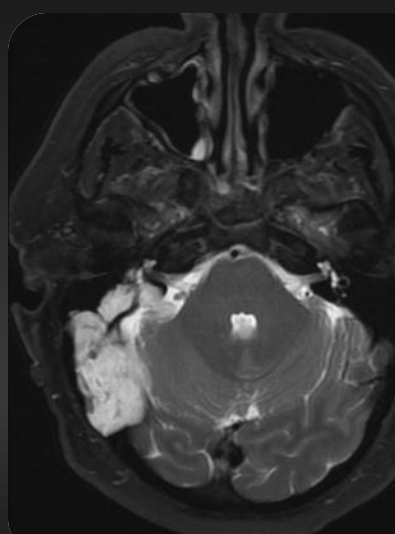
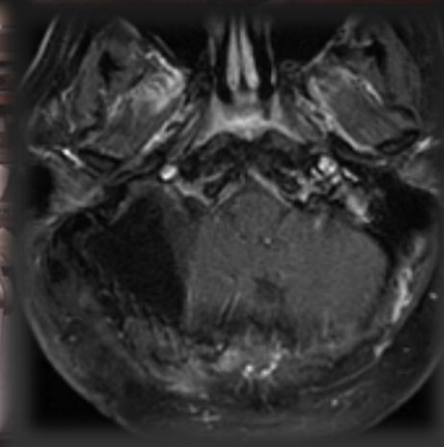
Current State of Skull Base Surgery

Postoperative MRI

Epidermoid cyst



59 M. Several years of progressive fullness in the right ear.
Facial weakness. House-Brackmann 3/5 right-sided weakness.



Advantages of Endoscopic Surgery

- Surgery through natural Orifice without cranial/facial incision.
- No Brain Retraction.
- Visualization better than the Operating Microscope in some cases.
- CSF leakage has been improved with septal mucosal flap, and other techniques.
- Patient discharged Earlier.

Disadvantages of Endoscopic Surgery

- Surgery occurs in a much deeper & narrower space than microsurgery.
- 2-D vs 3-D Vision.
- Due to Bleeding and Irrigation, the lesion is seen only about 30% of the time.
- Need for 2 Active Surgeons in Collaboration.
- Dissection, cutting, bipolar cautery, etc. in a much deeper environment, instruments inadequate.
- Vascular Injury is a major problem, if it occurs.
- Postoperative CSF leak remains Problematic.
- Relies on Radiosurgery of Tumor Remnants rather than the principle of Total Tumor Resection.

Complications of Microsurgery 2010

- Morbidity of Microsurgery for most Skull base Tumors is very low at present.
- Brain retraction is reduced by skull base techniques, and good quality microsurgery.
- Ability to deal with vascular and CN injuries immediately.
- CSF leaks are <5% in present day experience (endoscope may be used to repair CSF leak).

Endoscopic Surgery.... Hype or Better?



- No Comparative Studies of Morbidity, Resection Extent, or Complications
- Is it better to keep the patient in the hospital longer with a bigger incision and craniotomy/osteotomy vs. Operate twice as long, with a higher risk of CSF leak, take the risk of vascular injury, and accept partial resection, but with a shorter discharge in many (but not complication) patients?
- How does a Good Surgeon decide what is best for the patient?

Current State of
Skull Base Surgery

Endoscopic Surgery- Current Perspectives

- Skull Base Surgeons must train and learn to perform Endoscopic Skull base Surgery.
- This surgery seems ideal for many (but not all) Pituitary tumors.
- For other lesions, a step wise progression of training/performance as recommended by Kassam & Snyderman may be followed.
- Conversely, Endoscopic Surgeons need to learn Well Established Skull base and Microsurgical Techniques.
- Honest Reporting of Results and Complications, and External Review will help allay much of the skepticism.

Rehabilitation of Skull base Surgery Patients

- In performing long term studies of Meningiomas, Chordomas, and Aneurysm patients, we found that many patients' lives can be improved by simple rehab measures.
- Some of the patients developed spontaneous Adjustments to disabilities.
- Rehab of such patients is complex, and requires the efforts of Multiple specialties.
- Resources Available, and Physicians interested are quite limited.
- The Skull Base Surgeon has to be an Active Advocate for the patient, life long.

Genes, Proteins, and Antibodies

- For many skull base tumors, we are just starting to understand some of the genetic mechanisms involved.
- Developments in this area are likely to be quite slow, due to the need for eventual Human Experimentation.

Targeted Therapy????

- Skull Base Tumors and Aneurysms do not receive the research attention that most the the most common cancers receive.
- Relatively rare disease states.
- Whole genome wide screens/sequencing projects needed to shed light on the mechanisms of pathogenesis.

Further Developments in Skull base Surgery

- Operating through a smaller space safely has advantages for many lesions.
- Robotic/ Assisted Techniques are being developed.
- Endovascular techniques are improving at an exponential rate.
- Radiation techniques are improving....Wider availability of Proton Beam therapy, development of Carbon Ion Therapy, etc...

Current State of Skull Base Surgery

Skull Base Laboratory Training



THANK YOU



HARBORVIEW
MEDICAL
CENTER



UW Medicine