Rudolf Probst
Department of Otorhinolaryngolgoy,
Head&Neck Surgery

Sommerschule:

Skull Base / Facial Nerve

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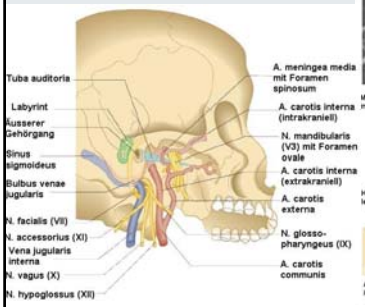
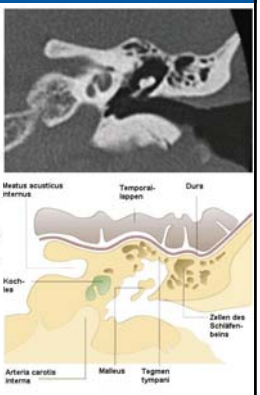
Lateral skull base





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Lateral skull base

- Lifeline for the brain.
- Exit of many cranial nerves.
- Thin boarder between endocranial and mucosal compartments.

Major pathologies:

- Infections and infammation – otitis media
- Trauma with typical fractures
- Tumors – mostly benign but with local destruction

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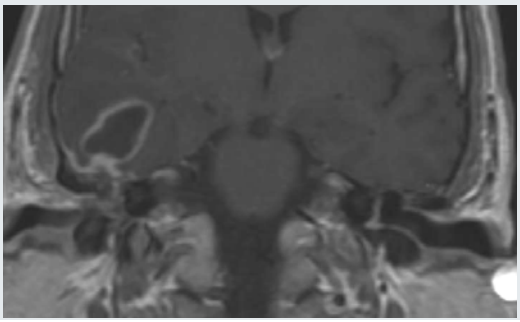
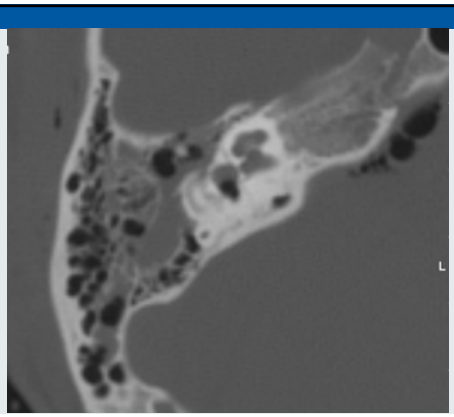
Lateral skull base - infection





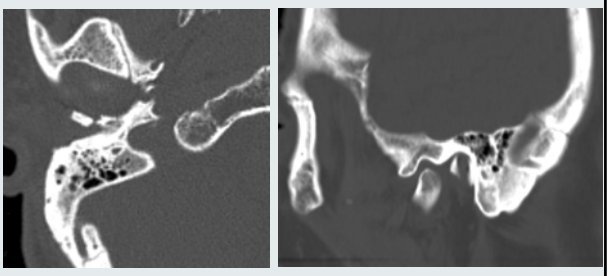
Temporal bone fractures

Mostly blunt trauma – “cracking”
Do not forget: trauma to the inner ear (noise, contusion)

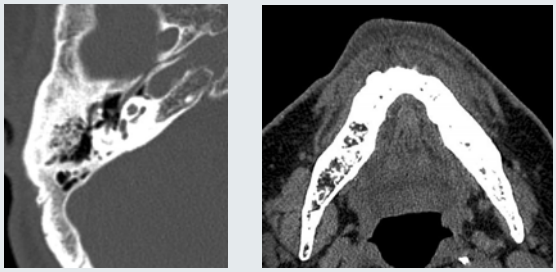
Presentations:

- Isolated fracture of the outer ear canal
- Squama-mastoid fracture (lateral)
- Longitudinal fracture of the t.b. / pyramid
- Transverse fracture of the t.b. / pyramid
- Complex fracture

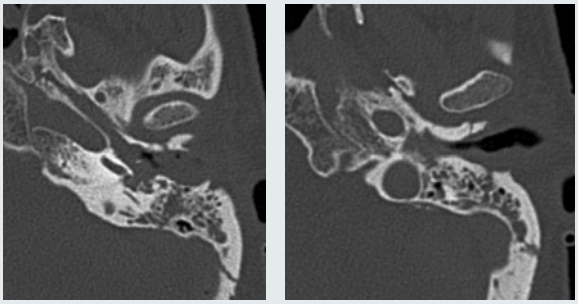
TB fractures: Isolated fracture of the outer ear canal

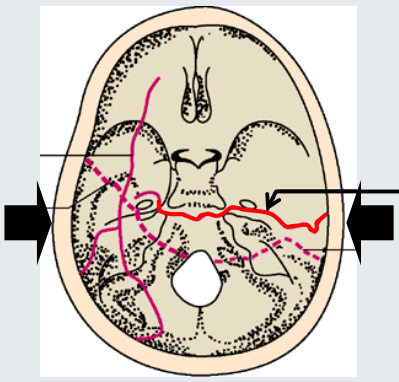


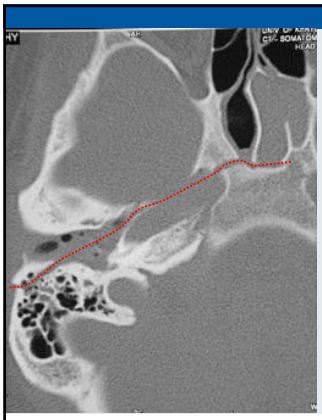
TB fractures: Isolated fracture of the outer ear canal



TB fractures: Squama-mastoid fracture (lateral)







Longitudinal fracture:

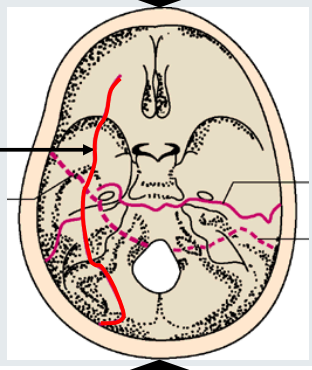
- Outer ear canal
- Tympanic space
- Carotid canal
- Sphenoid sinus

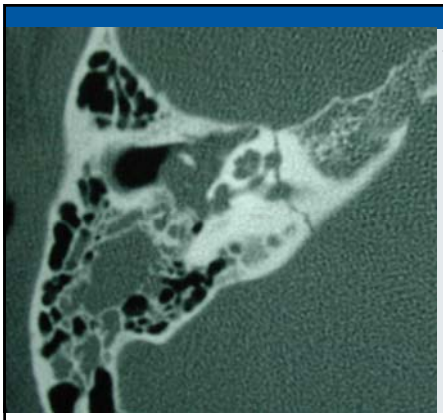
Rupture of TM

Blood / CSF:

- Outer ear canal
- Nose

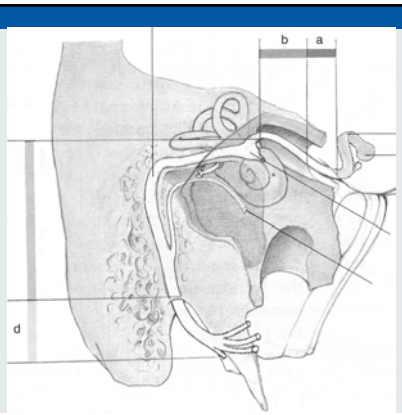
transverse fracture





Transverse fracture:
- Labyrinth
- Meatus
- TM intact

Blood / CSF:
- Eustachian tube
- Nose

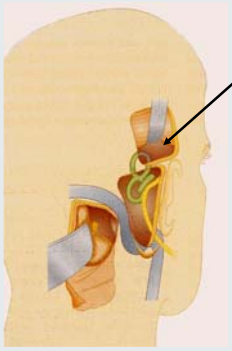


Lesion of the facial nerve:

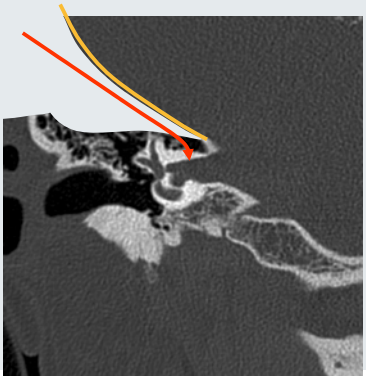
transverse 50%

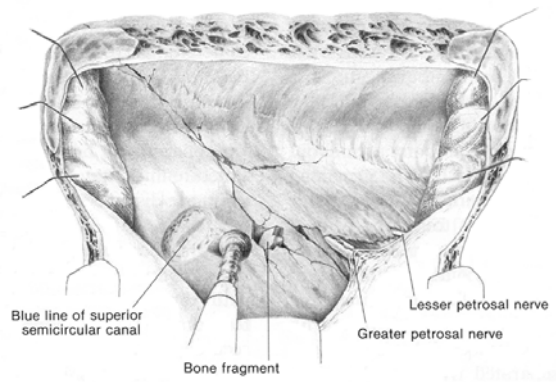
longitudinal 20%

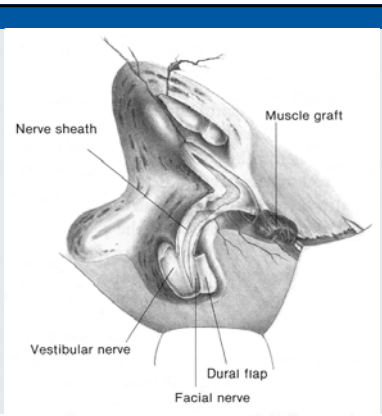
Tympanal and labyrinthine segment



Transtemporal approach







Facial Nerve – Paralysis

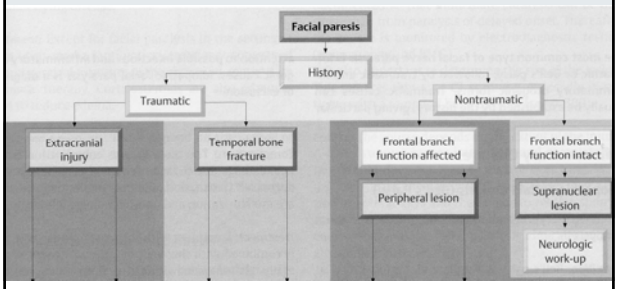
First major division: traumatic – non-traumatic

Second major division (non-t): idiopathic - symptomatic

Presentations:

- Bells Palsy
- Herpes zoster oticus (Ramsay Hunt)
- Tumors
- Otitis-related

Facial Nerve – Paralysis



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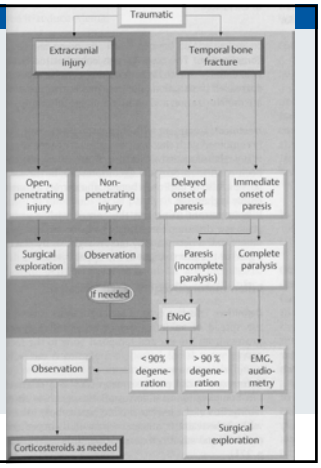
Facial Nerve – Paralysis Trauma



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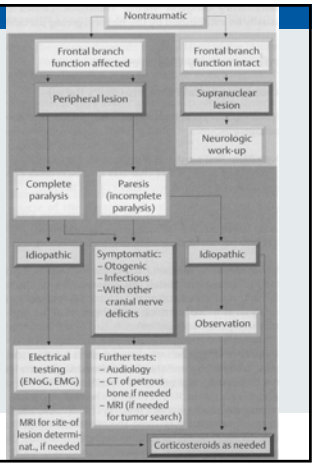
Facial Nerve – Paralysis Nontraumatic



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Paragaglioma of the lateral skull base

Main forms:

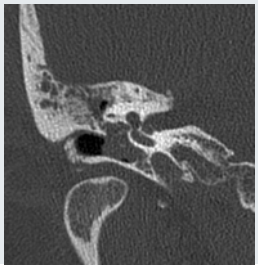
- Glomus tympanicum:
  - Early symptoms – more a tumor of the middle ear than the lateral skull base
- Glomus caroticum
  - Present as cervical tumor – head&neck tumor more than lateral skull base
- Glomus jugulare
  - Late symptoms – typical lateral base tumor
- Glomus vagale

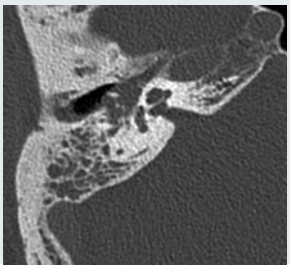
Paragaglioma of the lateral skull base

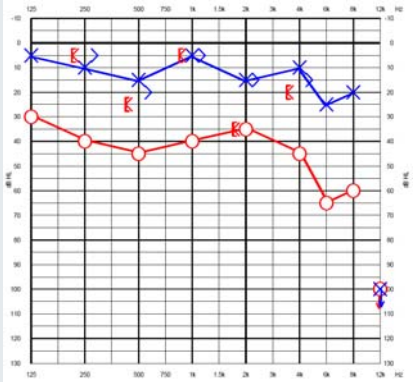
Sanna&al 1999

Paragaglioma Glomus tympanicum

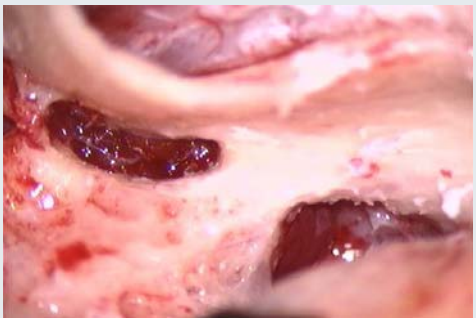
- Early symptoms – more a tumor of the middle ear than the lateral skull base

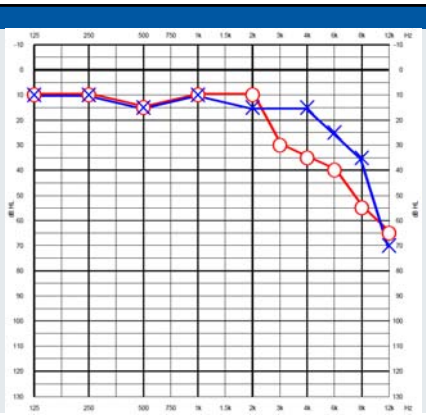






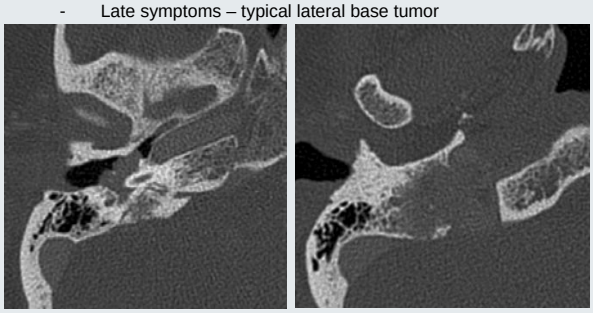
Paragaglioma Glomus tympanicum



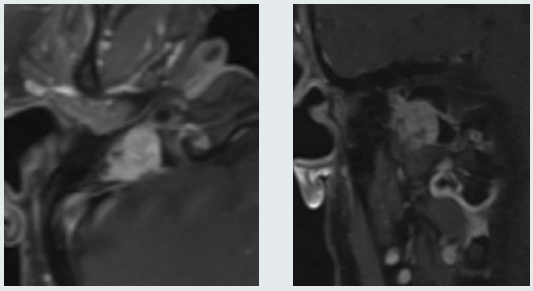


Paragaglioma – Glomus jugulare

- Late symptoms – typical lateral base tumor

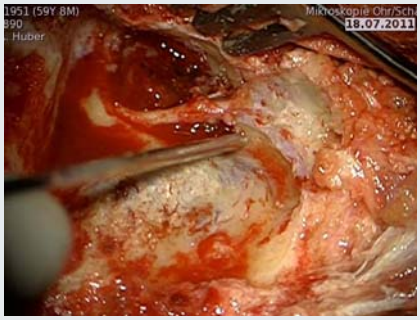


Paragaglioma – Glomus jugulare

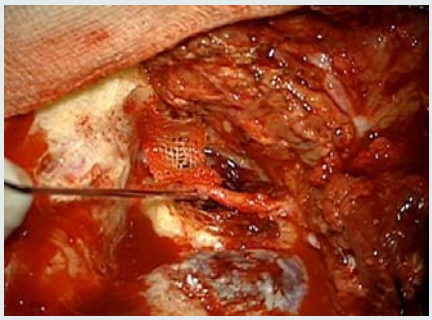


Paragaglioma – Glomus jugulare – OP

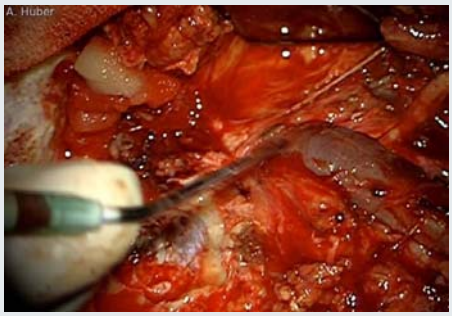
Paragaglioma – Glomus jugulare – OP



Paragaglioma – Glomus jugulare – OP

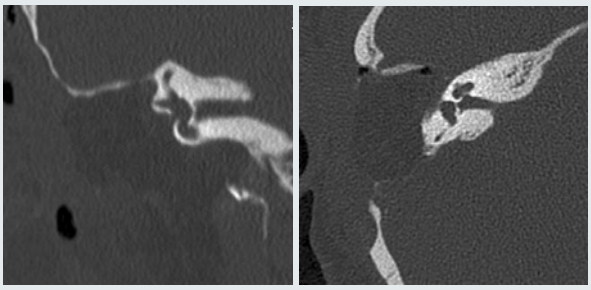


Paragaglioma – Glomus jugulare – OP

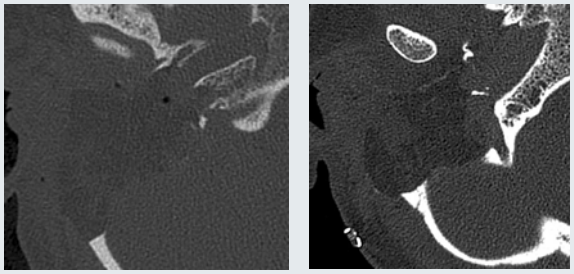


Paragaglioma – Glomus jugulare – OP

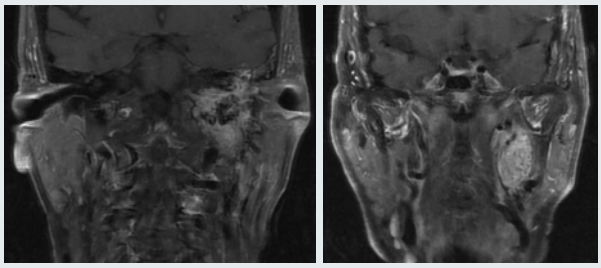
Paragaglioma – Glomus jugulare – postop



Paragaglioma – Glomus jugulare – postop



Paragaglioma – Glomus vagale



Paragaglioma – Glomus vagale

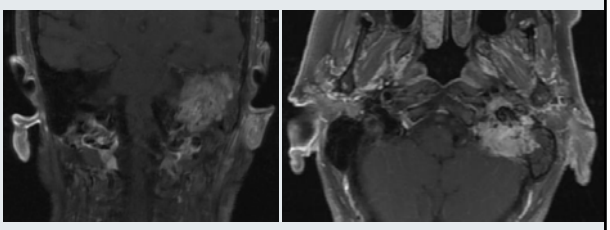


Table 1 Classification System of Temporal Bone Paragangliomas

Class A	Tumors arise along the tympanic plexus on the promontory of the middle ear. Blood supply is from the tympanic artery, a branch of the ascending pharyngeal artery. They produce minimal erosion of the promontory.
Class B	Tumors originate in the canalis tympanicus of the hypotympanum and invade the middle ear and mastoid. The carotid foramen and canal are intact. These tumors invade bone, but the cortical bone over the jugular bulb is intact. The distinction between class B tumors and a C1 tumor may be difficult.
Class C	Tumors arise in the dome of the jugular bulb and destroy the overlying cortical bone. They spread inferiorly along the jugular vein and lower cranial nerves, posteriorly into the sigmoid sinus, superiorly toward the otic capsule and IAM, laterally to the hypotympanum and middle ear, medially to the jugular foramen and CPA. Subclassification is made according to the degree of erosion of the carotid canal: • C1: erode carotid foramen but do not invade the carotid artery • C2: destroy the vertical carotid canal between the carotid foramen and carotid bend • C3: grow along the horizontal portion of the carotid artery but do not reach the foramen lacerum • C4: grow to the foramen lacerum and along the carotid artery to the cavernous sinus
Class D	Tumors that have intracranial extension are further subclassified as follows: • De: intracranial but extradural: De 1: displace posterior fossa dura < 2 cm De 2: displace posterior fossa dura > 2 cm • Di: intracranial with intradural extension: Di 1: intradural extension < 2 cm Di 2: intradural extension > 2 cm Di 3: intradural extension that makes the tumor unresectable

IAM, internal auditory meatus; CPA, cerebellopontine angle.

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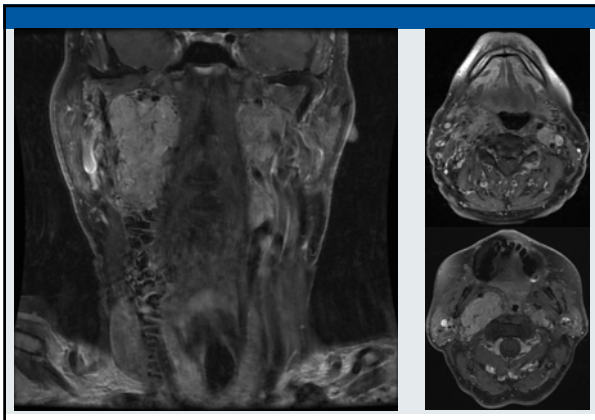

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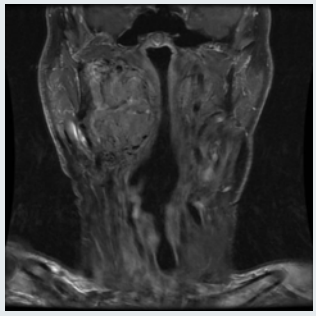
Multiple Paragaglioma



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Paragaglioma of the lateral skull base

Therapy:

- Watchful waiting:
  - Small tumors, no symptoms
- Embolisation
  - Shrink tumor and prevent further growth
- Surgery
  - Depending on tumor stage
- Radiotherapy
  - Prevent further growth

Tumors of the lateral skull base

Main tumors:

- Schwannom – Neurinom
- Paraganglioma
- Petrous bone cholesteatoma
- Rare tumors

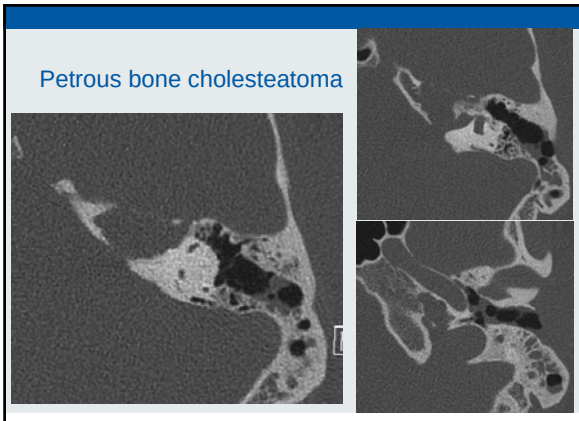
Petrous bone cholesteatoma

- “Retrolabyrinthine” cholesteatoma
- Usually “congenital” cholesteatoma, but can also be aquired.
- Leading often to inner ear and facial nerve deficits.

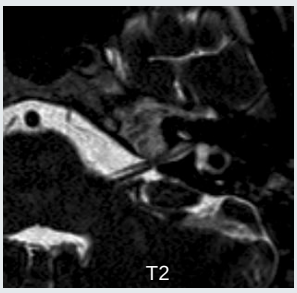
Main forms:

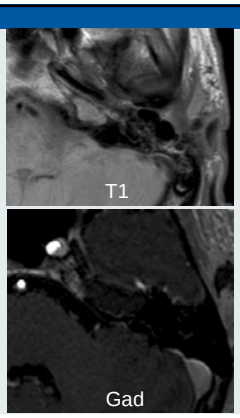
- supralabyrinthine
- infralabyrinthine
- apex

Petrous bone cholesteatoma

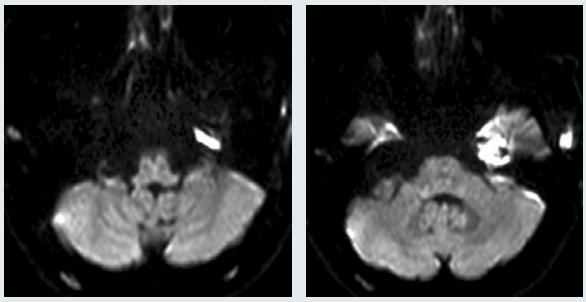


Petrous bone cholesteatoma

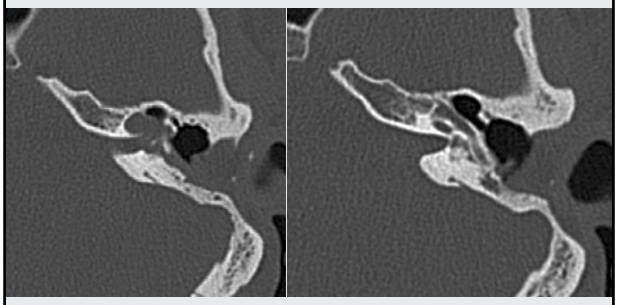




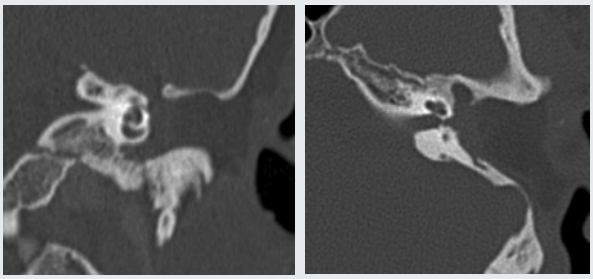
Petrous bone cholesteatoma – diffusion MRI



Petrous bone cholesteatoma - supralabyrinthine



Petrous bone cholesteatoma - supralabyrinthine

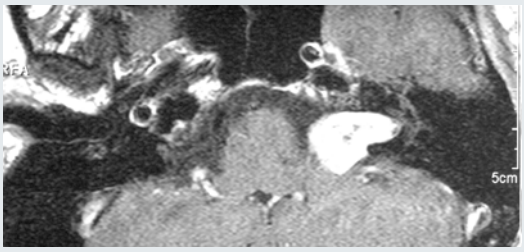


Petrous bone cholesteatoma - classification

Table 1. Sanna classification of PBC

Class	Location	Spread
Class I: supralabyrinthine	geniculate ganglion of facial nerve	anterior: horizontal part of ICA posterior: posterior bony labyrinth medial: IAC, petrous apex inferior: basal turn of the cochlea
Class II: infralabyrinthine	hypotympanic and infralabyrinthine cells	anterior: ICA vertical part, petrous apex, clivus posterior: dura of the posterior cranial fossa and sigmoid sinus medial: IAC, lower clivus, occipital condyle inferior: jugular bulb, lower cranial nerves
Class III: infralabyrinthine-apical	infralabyrinthine compartment, ICA reaching up to petrous apex	anterior: ICA vertical ± horizontal parts posterior: posterior fossa through the retrofacial air cells medial: petrous apex, clivus, sphenoid sinus, rhinopharynx inferior: jugular bulb, lower cranial nerves
Class IV: massive	entire otic capsule	anterior: ICA vertical ± horizontal parts posterior: posterior fossa dura and IAC medial: petrous apex, superior and mid clivus, sphenoid sinus inferior: infralabyrinthine compartment
Class V: apical	petrous apex	anterior: Meckel's cave area and may involve the V nerve posterior: IAC and posterior cranial fossa medial: superior or mid clivus, sphenoid sinus inferior: infralabyrinthine compartment

Vestibular Schwannoma (Acoustic Neuroma)



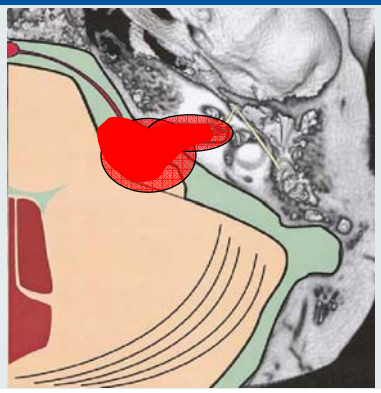
Distribution of CPA-tumors

(N = 162)

• Vestibular Schwannoma	125	(77%)
• Meningeoma	25	(15%)
• Epidermoidcyst	4	(2%)
• Trigeminus Schwannoma	3	(2%)
• Others (Lipoma, Angioma)	5	(4%)

Treatment options of VS

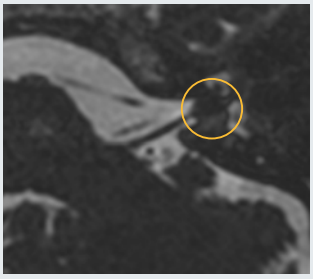
- Depending on size, general condition, age, hearing function, and symptoms.
- Surgery:
  - translabyrinthine
  - transtemporal (middle fossa)
  - subocciptal / retrosigmoidal
- Radiation therapy:
  - radiosurgery (one stage procedure, Cyberknife)
  - stereotactic radiation
- Wait & Scan

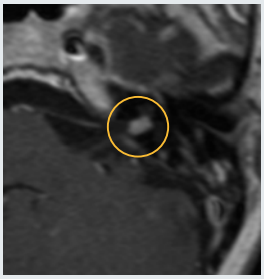


CPA:
Medial
Tumors

Meatus:
Lateral
Tumors

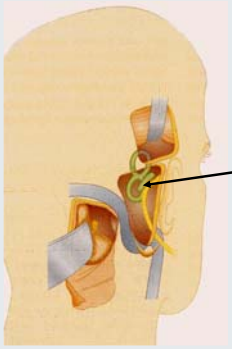
Internal auditory meatus VS (IAM)





Internal auditory meatus VS (IAM)

- IAM-tumors cause early cochleovestibular symptoms.
- Symptoms can be transient (sudden HL, “vestibular neuronitis”).
- Internal auditory meatus tumors grow significantly slower (< 0.5 mm/ year) than CPA-tumors (~ 1-2 mm/year).
- Function improves very rarely after treatment.



Translabyrinthine approach

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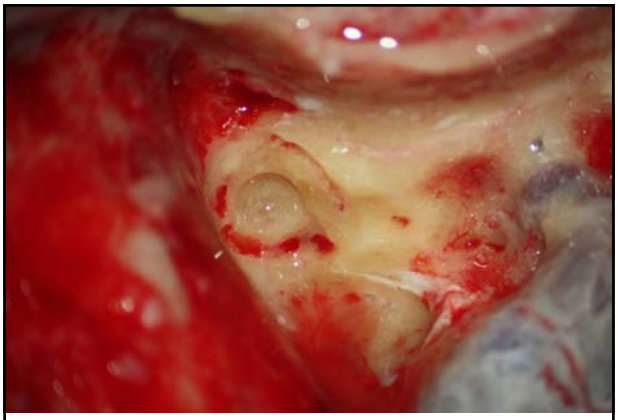

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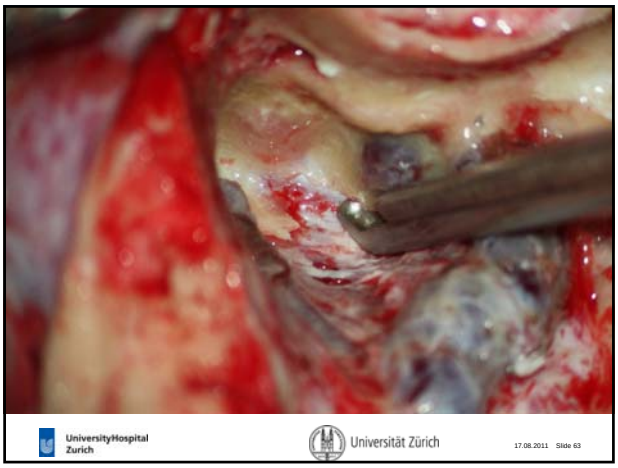
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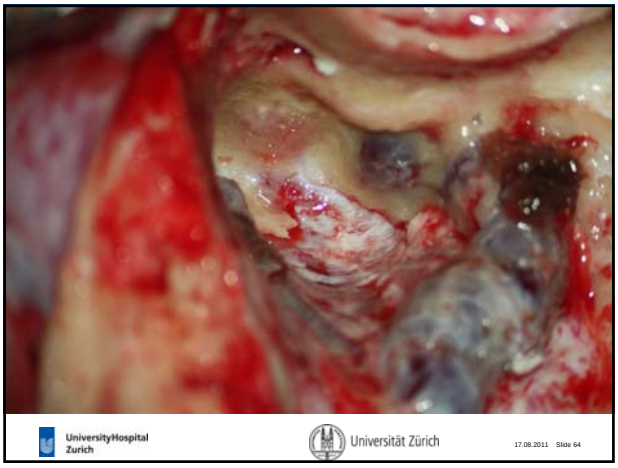
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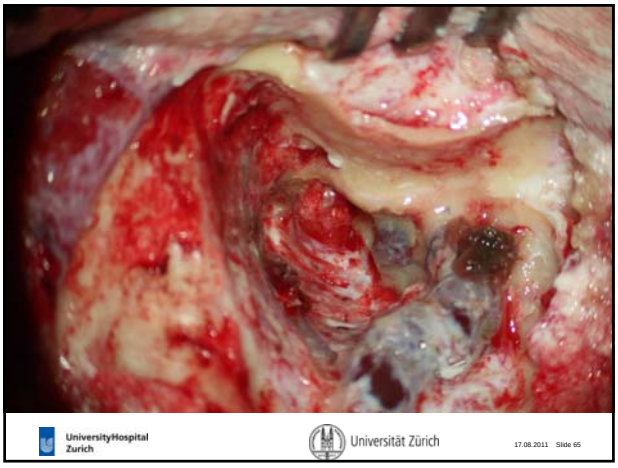
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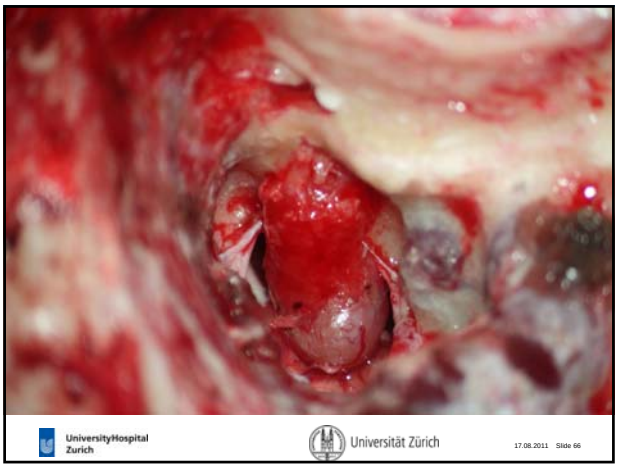
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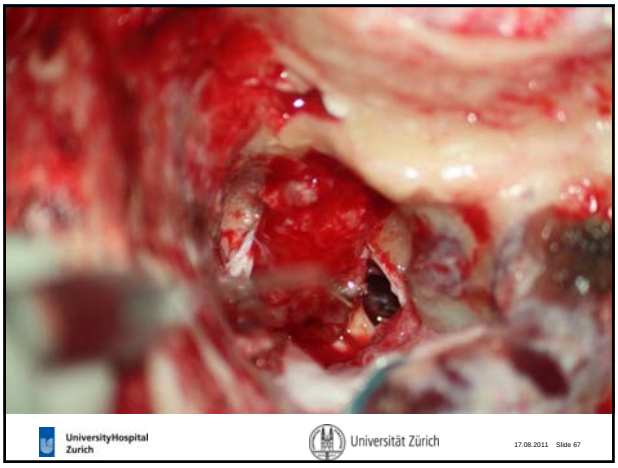
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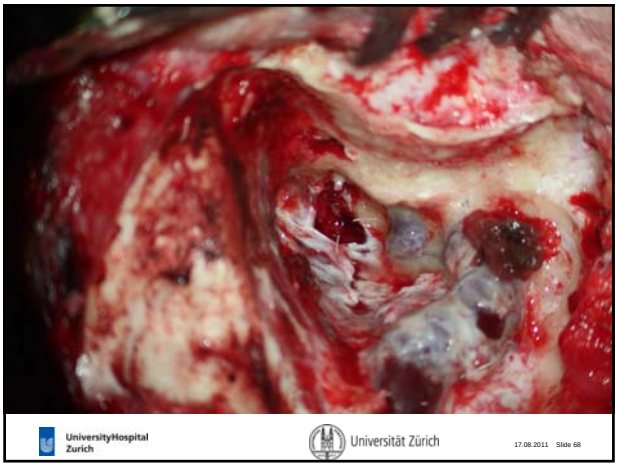
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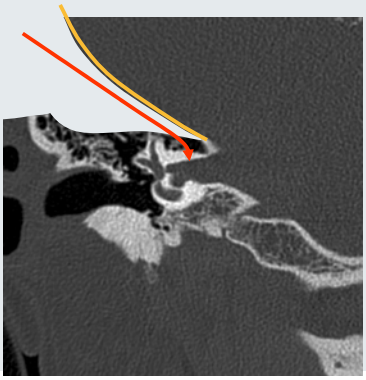
Translabyrintine Approach

Pro

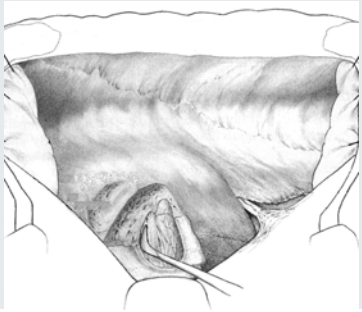
- Good exposure of small intrameatal-lateral tumors
- Facial nerve can be identified easily at its distal part
- Low morbidity, less headache
- Approach can be expanded – exposure of cochlea

Contra

- Always total cochleo-vestibular loss
- Exposure of intracranial parts are less ideal



Postoperative facial nerve function



Saami&Draft 1989

Postoperative facial nerve function

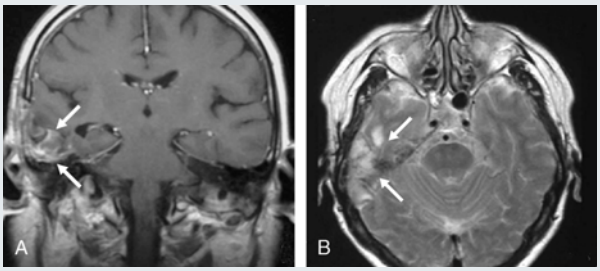
Facial function after one year similar after transtemporal and retrosigmoid approach (HB I / II in >80%).

HB I / II on the 1. postoperative day:

- 52 % after retrosigmoid approach
- 15 % after transtemporal approach

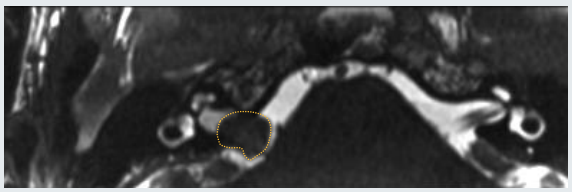
Heimberg & Probst, 2004

Gliosis after transtemporal surgery



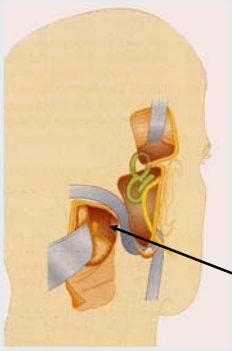
Schick et al: Otology & Neurotology29:39-45, 2007

Cerebro-Pontine Angle VS (CPA - VS)



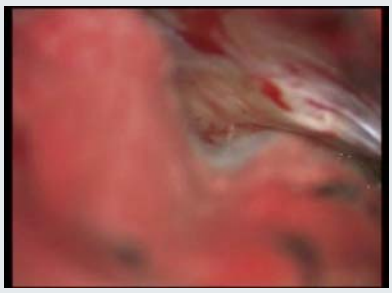
Cerebro-Pontine Angle VS (CPA - VS)

- CPA-tumors cause relatively few cochleovestibular symptoms.
- Symptoms can be transitory, the relationship to tumor growth is poor.
- CPA tumors grow faster than IAM-tumors, but also with a wide individual range.
- Small CPA-tumors can be removed with a relatively high chance of hearing preservation.

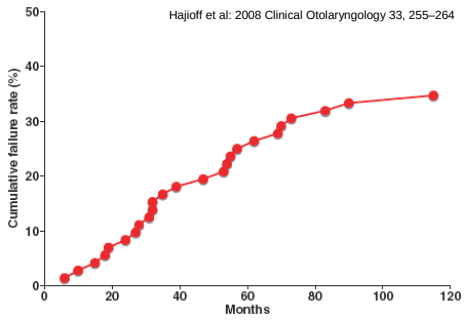


Retrosigmoid approach

VD-1965: surgery 2009

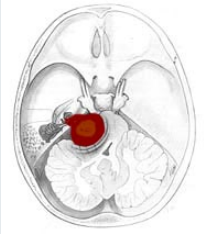


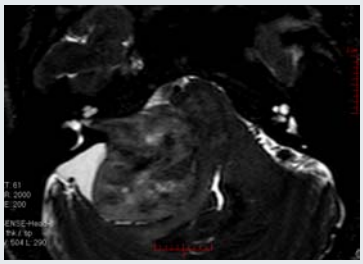
“wait & scan” – failure rates



Radiation therapy

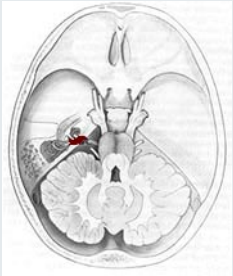
VS: Large Tumors





- Surgery unavoidable

VS – Options in small tumors



Good Hearing	⟷	Deafness
Old	⟷	Young
High Comorbitity	⟷	Healthy
IAC	⟷	CPA
Wait&Scan		**Treatment**

Individual decision

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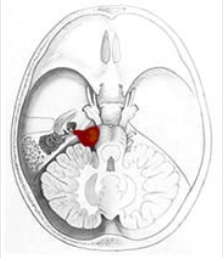
VS: tumor growth / medium size tumor



Old	⟷	Young
High Comorbidity	⟷	Healthy
Radiotherapy		**Surgery**

Individual decision

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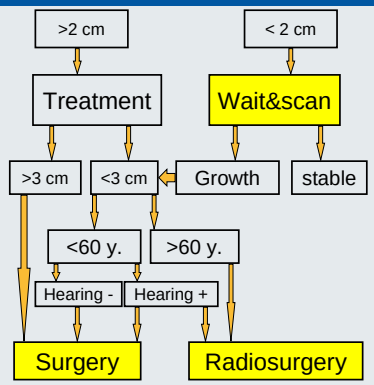

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Further recommended reading

- de Almeida J et al: Combined Corticosteroid and Antiviral Treatment for Bell Palsy – A Systematic Review and Meta-analysis. JAMA. 2009;302(9):985-993
- Quant C et al: The benefits of steroids versus steroids plus antivirals for treatment of Bell's palsy: a meta-analysis. BMJ 2009;339:b3354
- Gjuric M, Gleeson M: Consensus Statement and Guidelines on the Management of Paragangliomas of the Head and Neck. Skull Base 2009;19:109–116
- Sanna M et al: Petrous Bone Cholesteatoma: Classification, Management and Review of the Literature. Audiol Neurotol 2011;16:124–136
- Benjamin J et al: A review of treatment modalities for vestibular schwannoma. Neurosurg Rev 2011; 34:265–279