

# Hirntumoren

# WHO Klassifikation der intrakraniellen Tumoren

(nach Histogenese)

## ➤ Neuroepitheliale Tumoren

benigne = WHO Grad I und II  
maligne = WHO Grad III und IV

Astrozytom, Oligodendrogliom  
Ependymom, Plexuspapillom  
Glioblastom, Medulloblastom

## ➤ Nervenscheidentumoren

Schwannom z. B. "Akustikusneurinom"

## ➤ Tumoren der Meningen

Meningeom, Melanom

## ➤ Primäre maligne Lymphome

## ➤ Gefäßtumoren

Hämangioblastom

## ➤ Keimzelltumoren

Germinom, Teratom

## ➤ Fehlbildungstumoren, tumorähnliche Läsionen

Kraniopharyngeom, Zysten

## ➤ Vaskuläre Fehlbildungen

Kavernom, arterio-venöses Angiom

## ➤ Tumoren der Adenohypophyse

## ➤ Regionale Tumoren

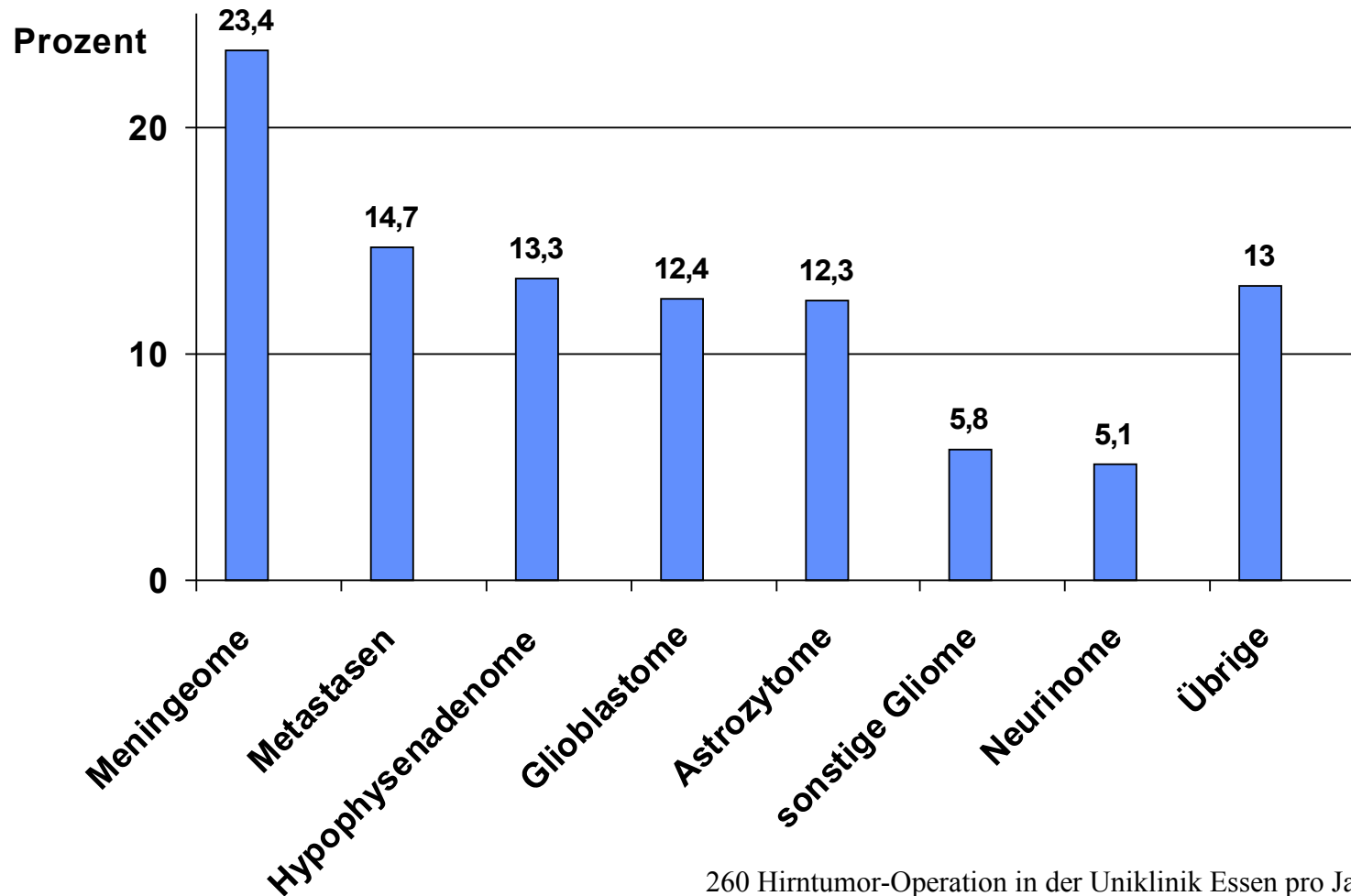
Glomustumor, Chordom

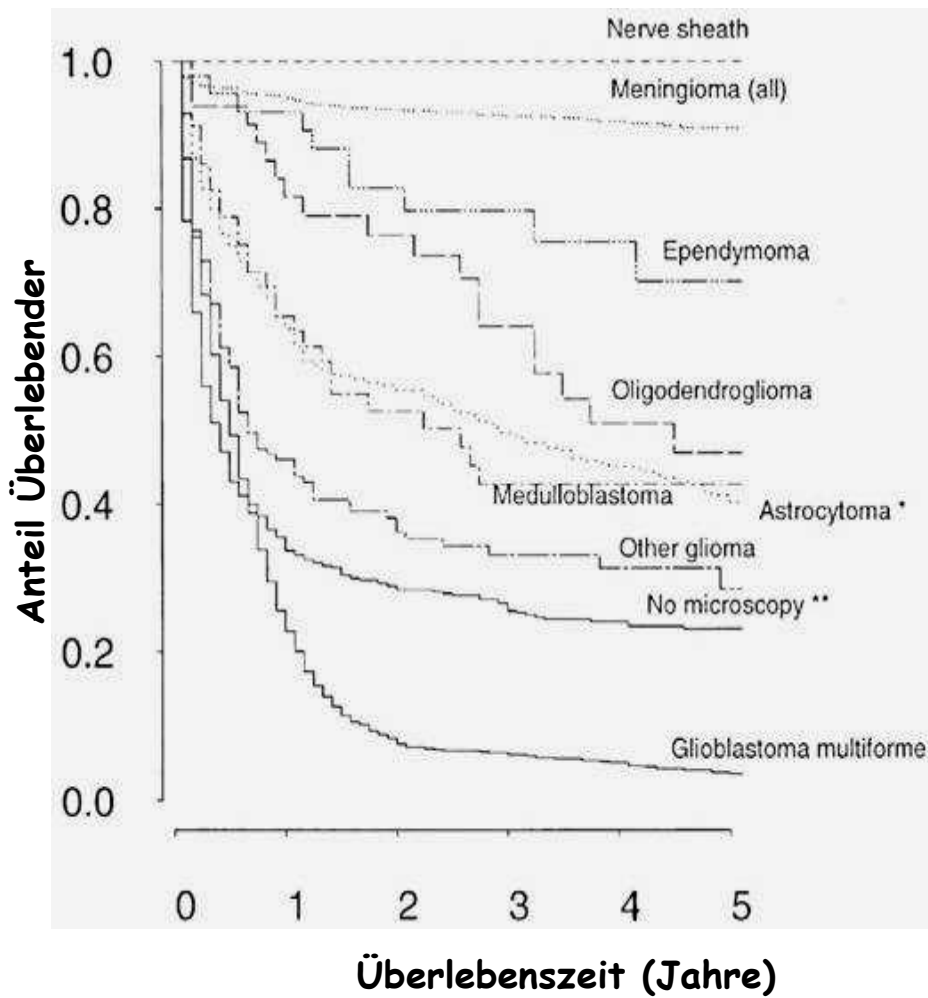
## ➤ Metastasen

## ➤ Unklassifizierbare Tumoren

# Inzidenz primärer Hirntumoren: 15 / 100.000 / Jahr

90 Tumoren auf 600.000 Einwohner (Essen) pro Jahr





Histologie	5-J. Überleben %
Neurinom	95
Meningeom	90
Ependymom	65
Oligodendrogliom	50
Medulloblastom	45
Astrozytom	43
Glioblastom	< 5

# **Allgemeinsymptome**

## **Intrakranielle Drucksteigerung**

**Kopfschmerzen, Übelkeit,  
Erbrechen, Stauungspapille**

## **Anfälle**

**generalisiert tonisch-klonisch,  
fokal, komplex-partiell**

## **Psychosyndrom**

**Antriebsminderung**

# **Herdsymptome**

**Hemiparese (frontal, parietal)**

**Hemianopsie (temporal, occipital)**

**Psychosyndrom (frontal)**

**Visus, Gesichtsfeld (suprasellär)**

**Hirnnerven (Schädelbasis)**

**Hormonstörungen (Sella)**

# Diagnostik

➤ **MRT**

➤ **CT**

➤ **Rö Schädel**

(Verkalkung, Osteolyse, Sella)

➤ **Angiographie**

(Embolisierung)

- **Histologische Diagnose**
- **Beseitigung der lokalen Raumforderung**
- **Reduktion der Tumormasse**

# Prinzipien der Operation

## ➤ *Präoperative Planung*

Lokalisation, eloquente Hirnareale

Vitale Strukturen, Gefäße

Tumorausläufer, Satelliten

## ➤ *Zugangsweg*

## ➤ *Technik*

Mikrochirurgie

Ultraschall-Aspirator

Navigation, Sonographie

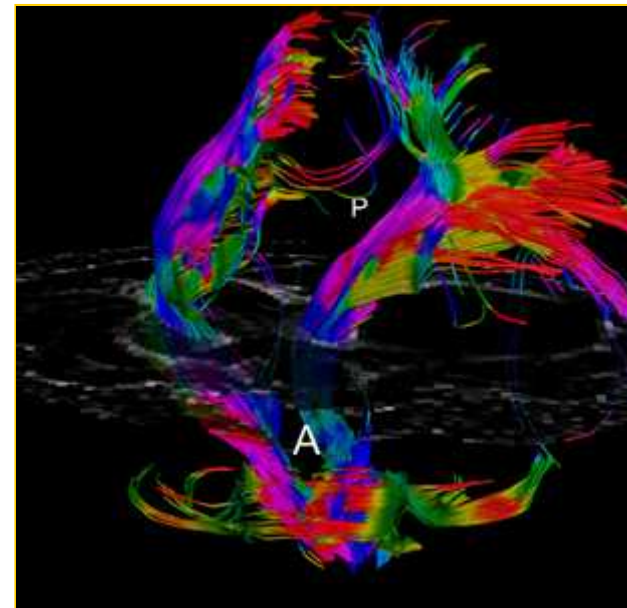
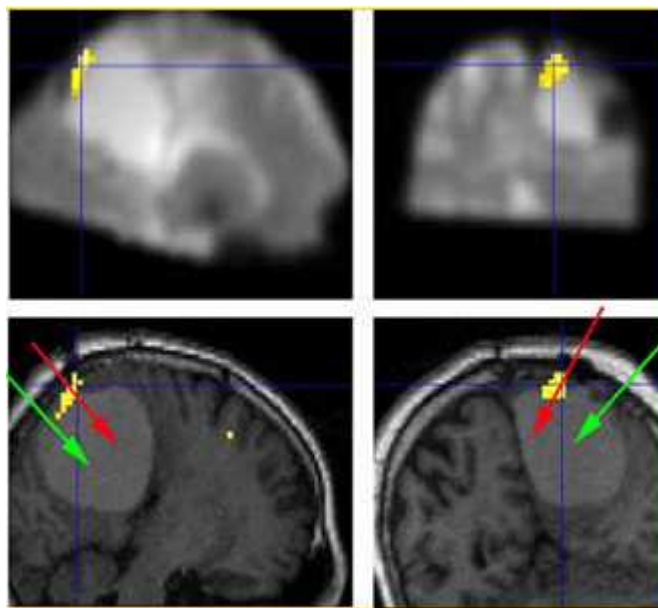
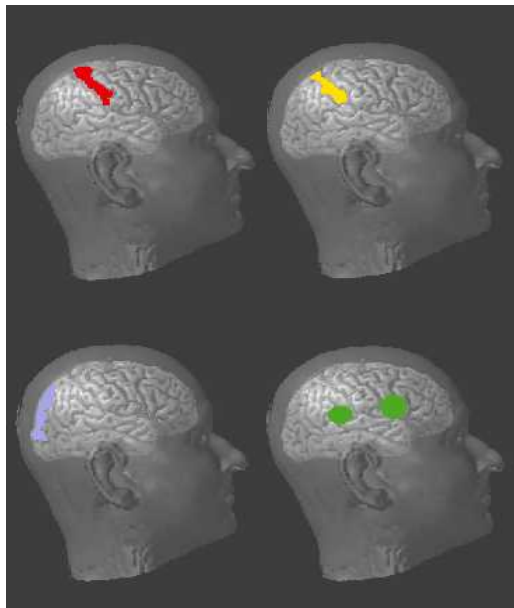
Monitoring, Visualisierung

## ➤ *Probleme*

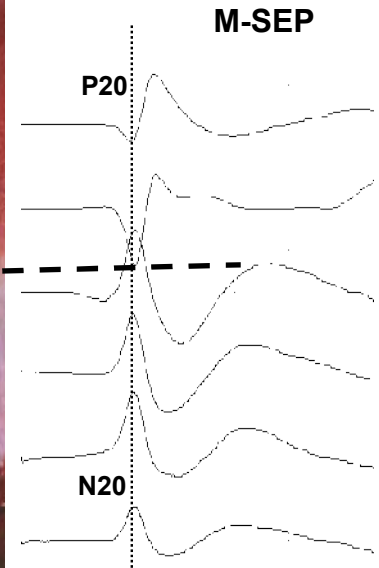
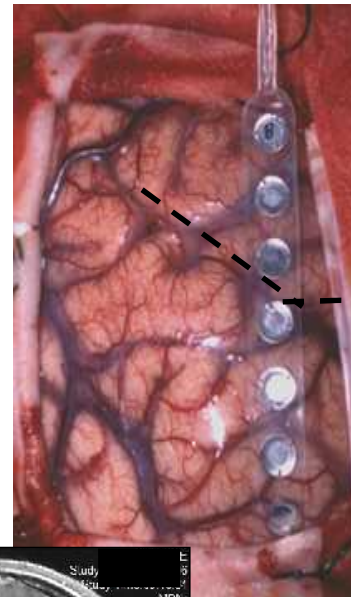
Tumorrandzone, Satelliten



# F-MRT



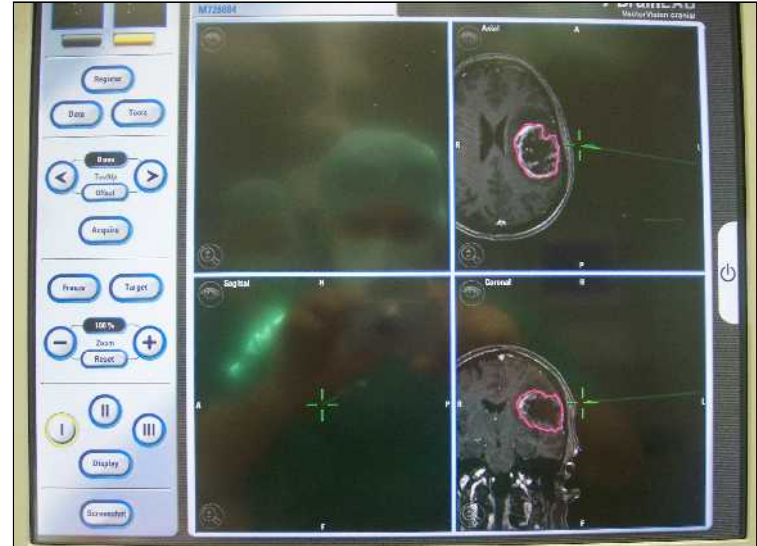
# *Intraoperative Neurophysiology*



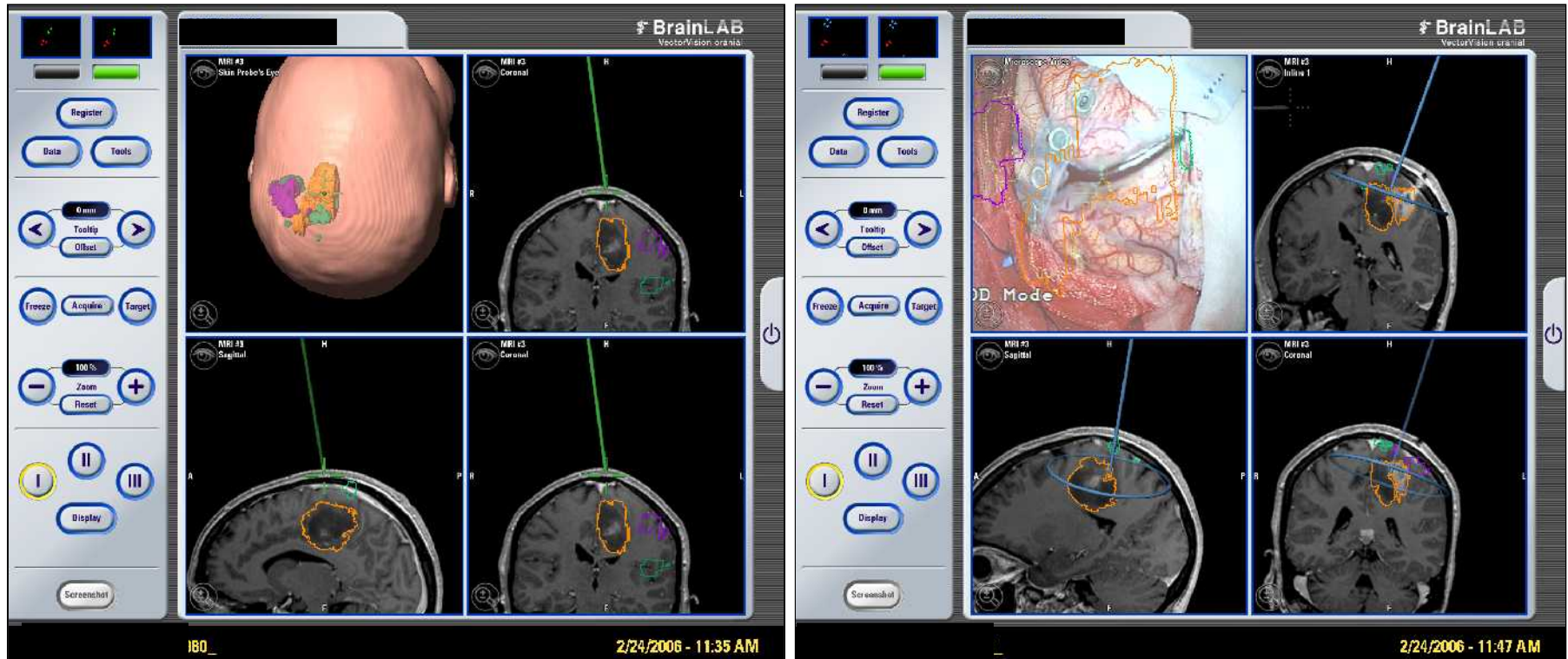
# *Intraoperative Sonographie*



# *Navigation*



# *fMRT – Navigation - Neurophysiologisches Monitoring*



# Astrozytom II (benigne, low-grade)

"benigner" neuroepithelialer  
Tumor

Gipfel um 45. Lbj.

Anfälle

fokales neurol. Defizit

MRT / CT:

hypointens

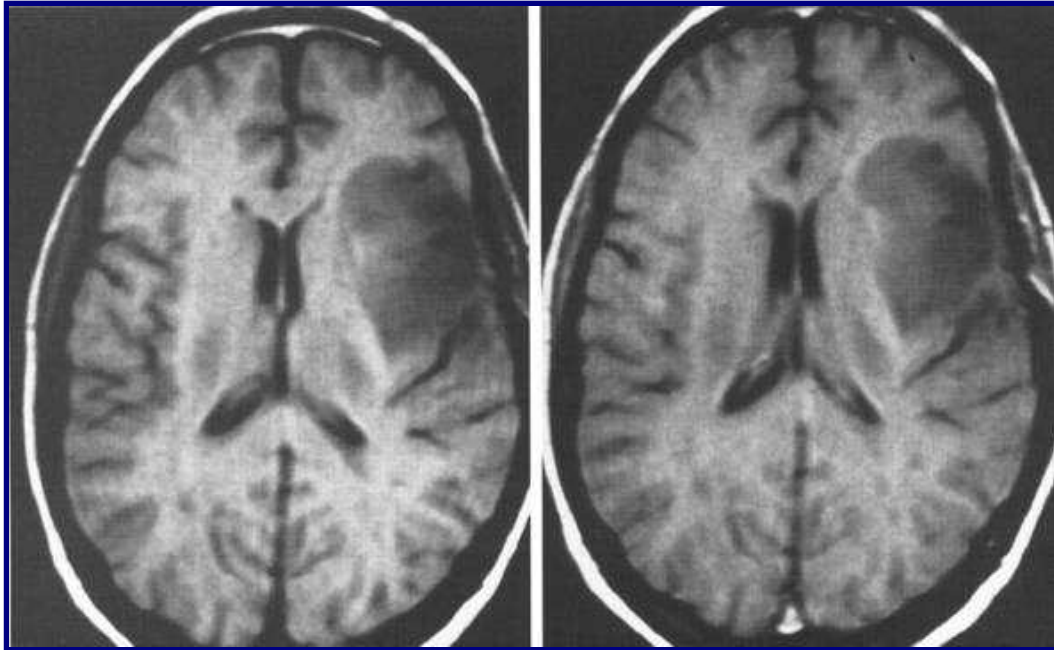
keine KM-Anreicherung

geringe Raumforderung

Operation

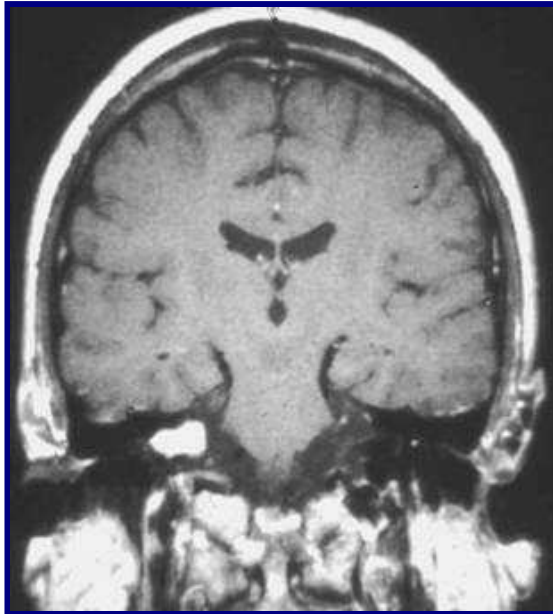
Beobachtung

5-J.-Überleben 45%



ohne KM

mit KM



# **Akustikusneurinom (Schwannom des N. vestibularis)**

**benigner Tumor  
des peripheren Nerven**

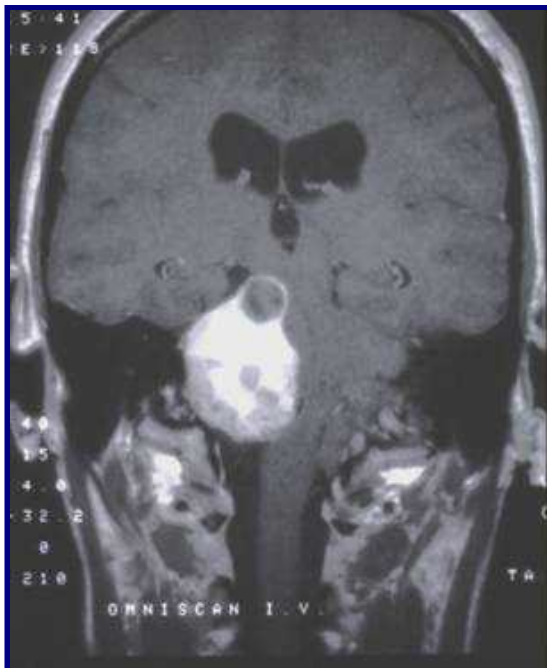
**Hörverlust, Tinnitus  
Gleichgewicht**

**N. facialis, N. trigeminus, Hirnstamm**

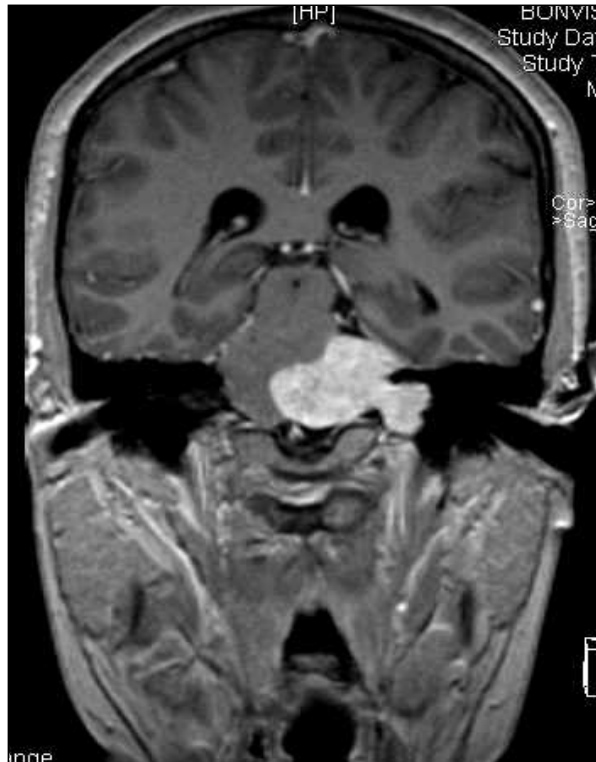
**bilateral bei NF 2**

**MRT / CT: KM-Anreicherung,  
Meatus acusticus internus**

**Operation  
mit Erhalt des N. facialis  
und z.T. des N. cochlearis**

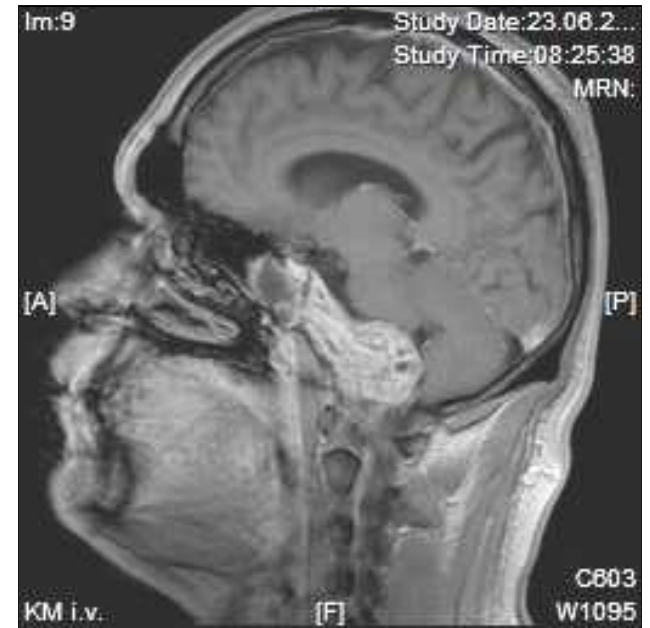
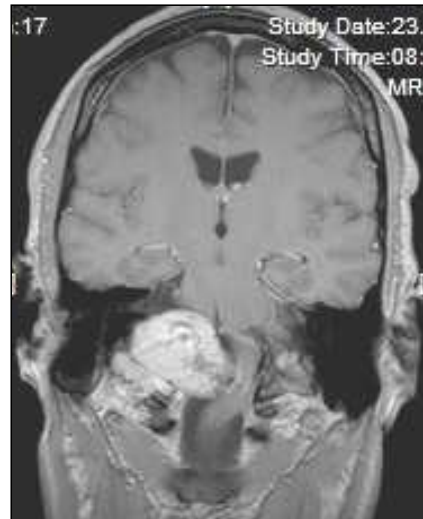
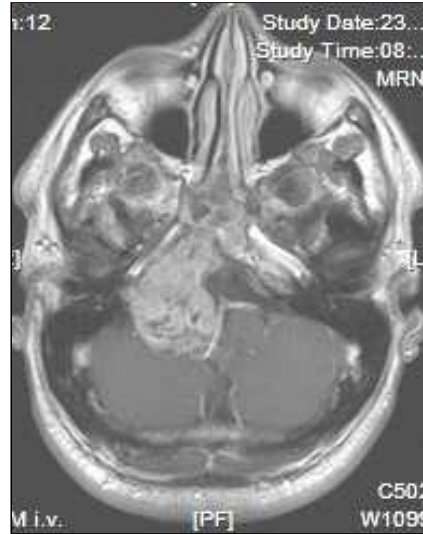
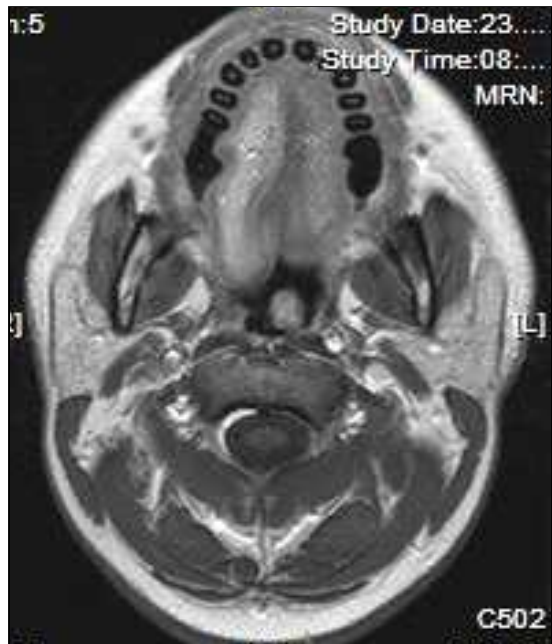


# *Akustikusneurinom*





# *Hypoglossusneurinom*

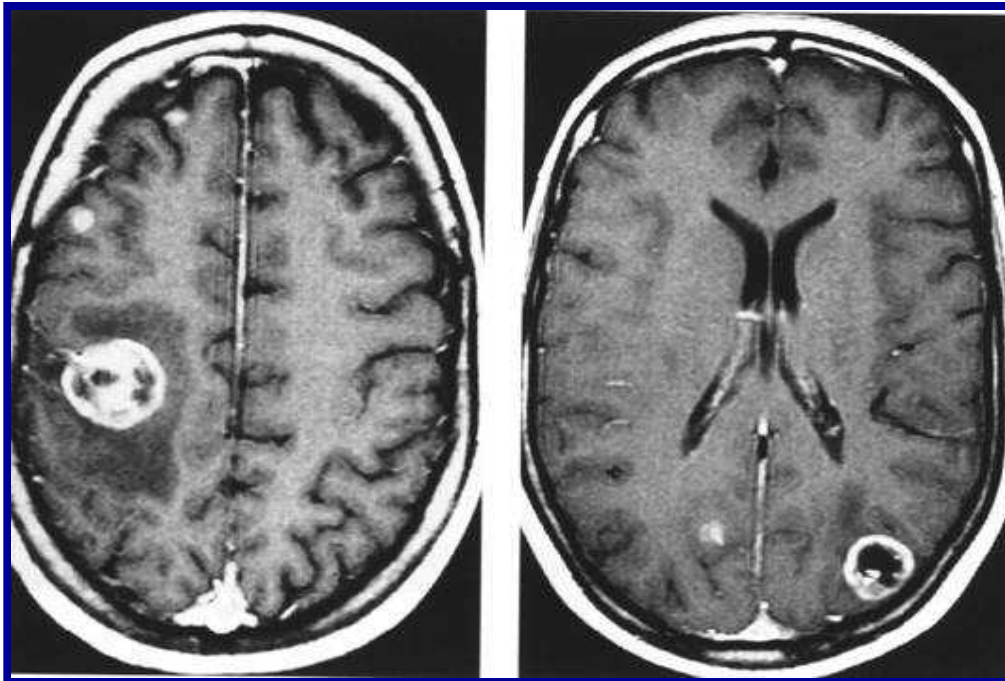


# Hirnmetastase

**Hirndruck, Anfälle,  
fokales neurol. Defizit**

**MRT / CT:  
KM-Anreicherung,  
perifokales Ödem  
scharfe Abgrenzung  
multiple Herde**

**Operation  
+ Strahlentherapie**



<b>Lunge</b>	<b>55%</b>
<b>Mamma</b>	<b>15%</b>
<b>Darm</b>	<b>10%</b>
<b>Nieren</b>	<b>9%</b>
<b>Melanom</b>	<b>3%</b>
<b>sonst.</b>	<b>8%</b>

# **Neurofibromatose Typ 1 (NF 1, M. v. Recklinghausen)**



**hereditär, autosomal dominant  
(NF1-Gen auf Chromosom 17)**

**Gliom des N. opticus**

**Neurofibrome peripher, spinal**

**Astrozytome, Meningeome**

**Cafe-au-lait Flecken**

**Pigmentstörungen**

**Irishamartom (Lisch-Knötchen)**

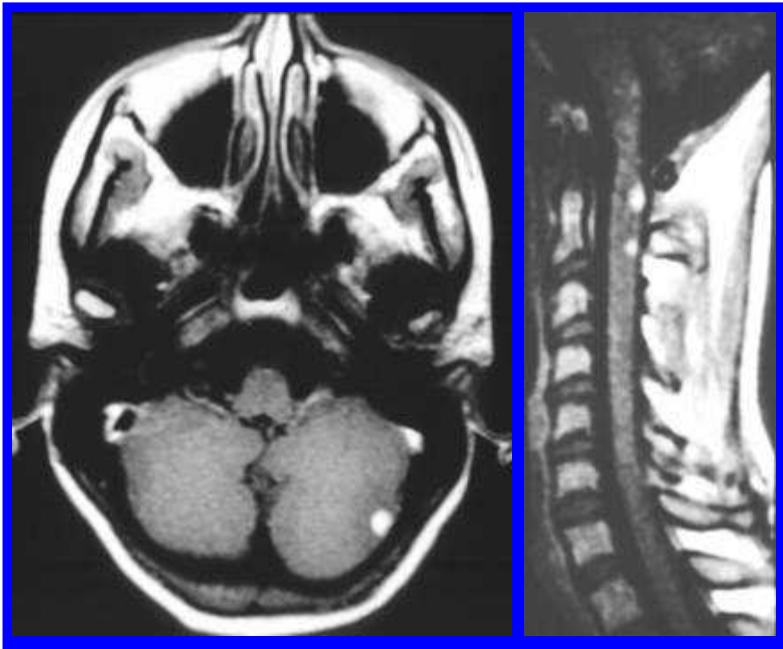
**Neurofibrome der Haut**

**Knochendysplasie (Keilbeinflügel)**

**Knochendefekt der Orbita**

**Kyphoskoliose**

**erhöhte Inzidenz maligner Tumoren  
Neuroblastom, Sarkom, Wilms Tu.**



## **Hämangioblastom (Lindau-Tumor)**

**sporadisch oder hereditär**

**Hirndrucksymptome**

**Verschußhydrozephalus**

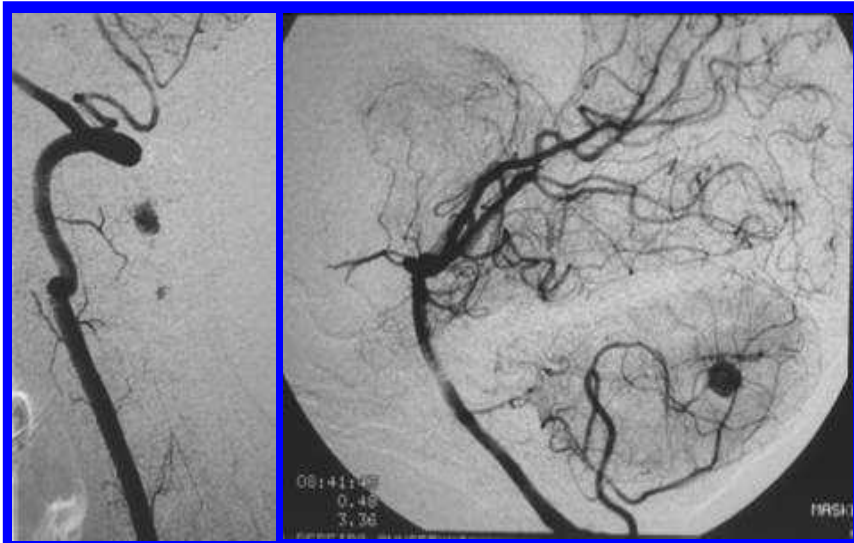
**spinale und zerebelläre Symptome**

**MRT / CT:**

**solide, runde KM-Anreicherung**

**Zyste**

**Exstirpation**



**M. von Hippel-Lindau**

**Hämangioblastom**

**Angiome der Retina**

**Risiko für:**

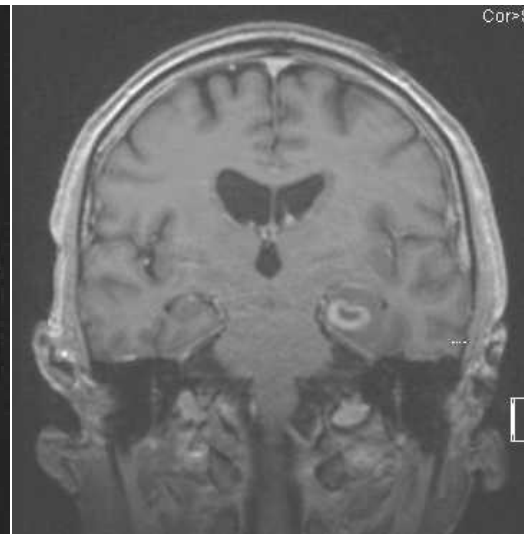
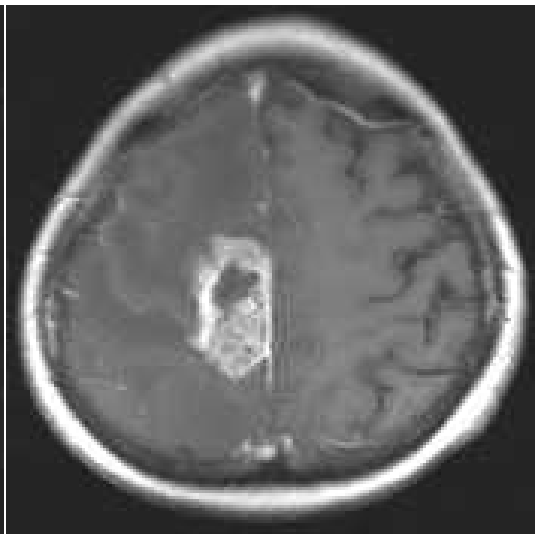
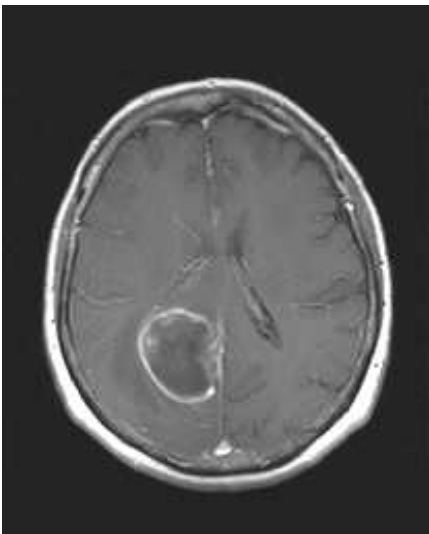
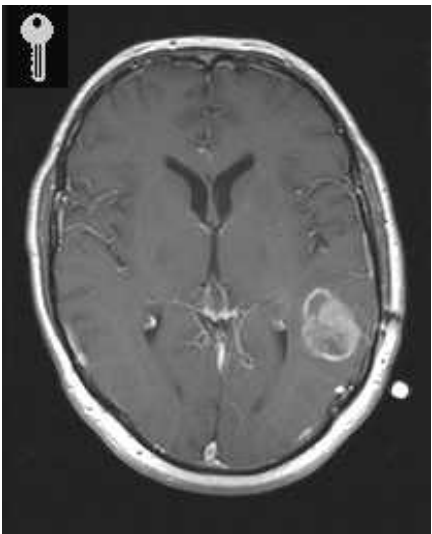
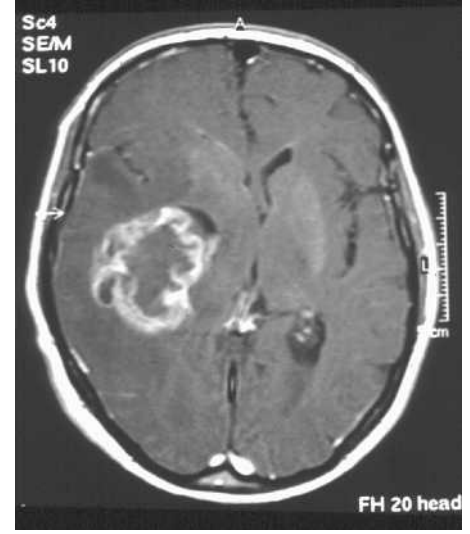
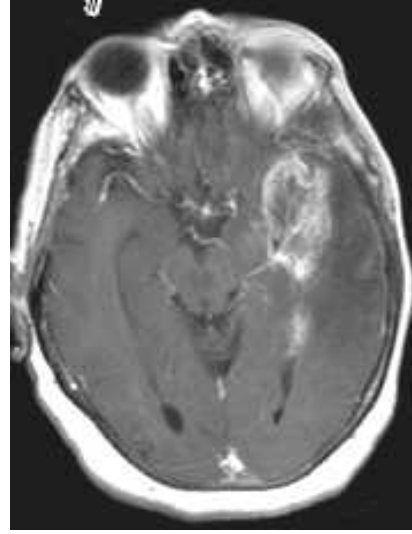
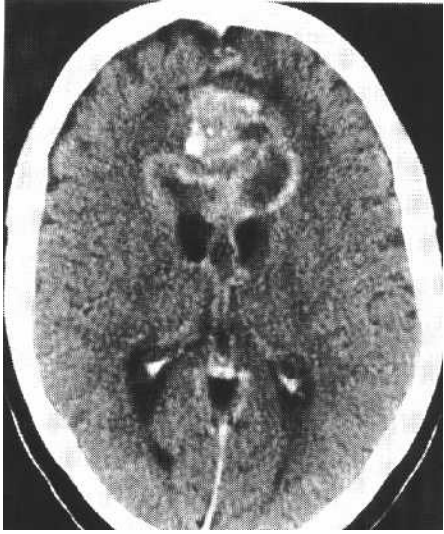
**Nierenzellcarcinom**

**Phäochromozytom**

# Glioblastom



# Glioblastome

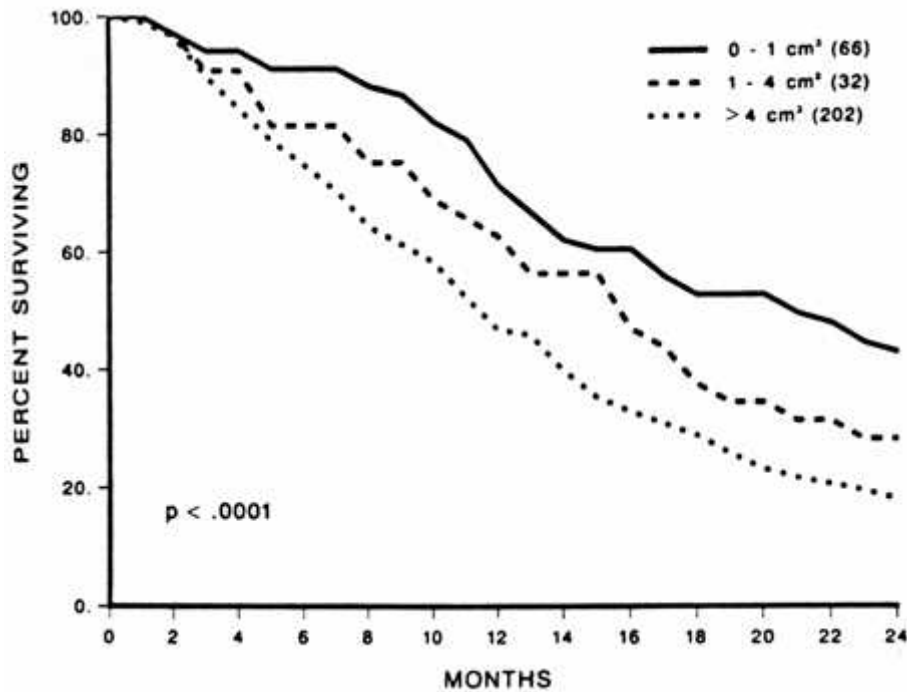


- **Lebensalter**
- **KPS score**
- **Radikale Tumorresektion**
- **Progressionsfreies Intervall**

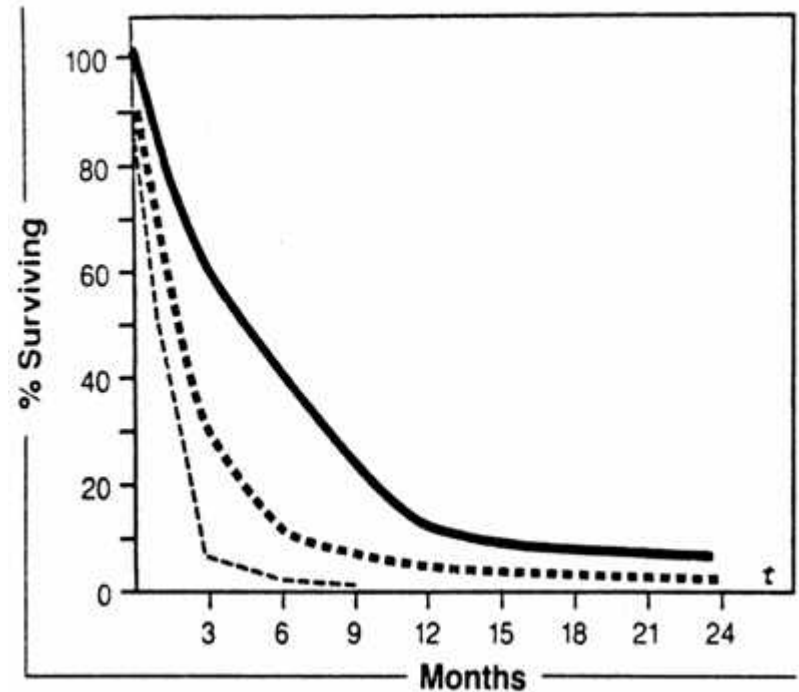
**Glioblastom < 12 Monate (mittlere Überlebenszeit)**



# Radikalität und Überlebenszeit



Überleben abhängig von der Grösse des Resttumors bei 300 malignen Gliomen.



Überleben abhängig vom Ausmass der Resektion bei 603 Glioblastomen bei Totalresection vs. Teilresektion vs. Biopsie

## **Fluoreszenz-gestützte Operation**

- **Intraoperative Visualisierung von malignem Gliomgewebe**
- **Orale Applikation von 5-Hydroxy-Aminolävulinsäure**  
3 Stunden vor Narkoseeinleitung, oral 20 mg/kg
- **Anreicherung von fluoreszierenden Metaboliten (PP IX)  
in malignen Zellen**
- **Intraoperative Visualisierung durch Verwendung einer  
Blaulichtquelle im Operationsmikroskop**  
(Anregung mit Blaulicht, 400 nm; Emission von Rotlicht, 630 nm;  
Kontrastverstärkung durch Gelbfilter)

➤ **Operation**

**Tumorexstirpation**

total, subtotal

**Biopsie**

offen, stereotaktisch

**Liquorshunt**

➤ **Strahlentherapie**

**konventionell**

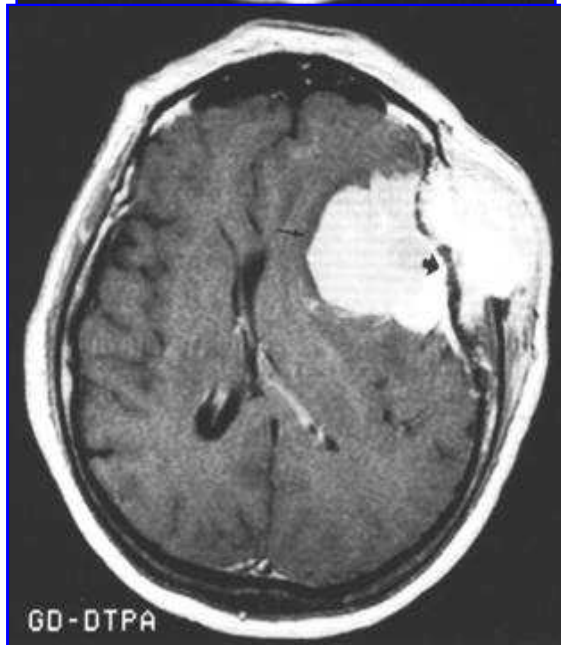
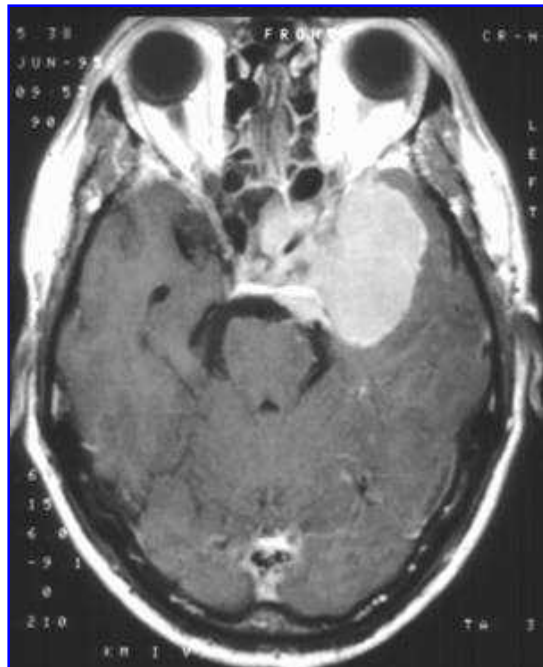
**fokussiert („Gamma-Knife“)**

➤ **Chemotherapie**

**systemisch**

**intrathekal**

# Meningeome



# Meningeom

**benigner Tumor der  
arachnoidalen Deckzellen**

**Anfälle, fokales neurol. Defizit**

**MRT / CT:**

**Beziehung zur Dura**

**Invasion von Knochen und Dura**

**KM-Anreicherung**

**Lokalisation:**

**Konvexität, Falx, Tentorium**

**Keilbeinflügel, Schädelbasis**

**Operation**

**vollständige Exstirpation**

**Teilexstirpation**

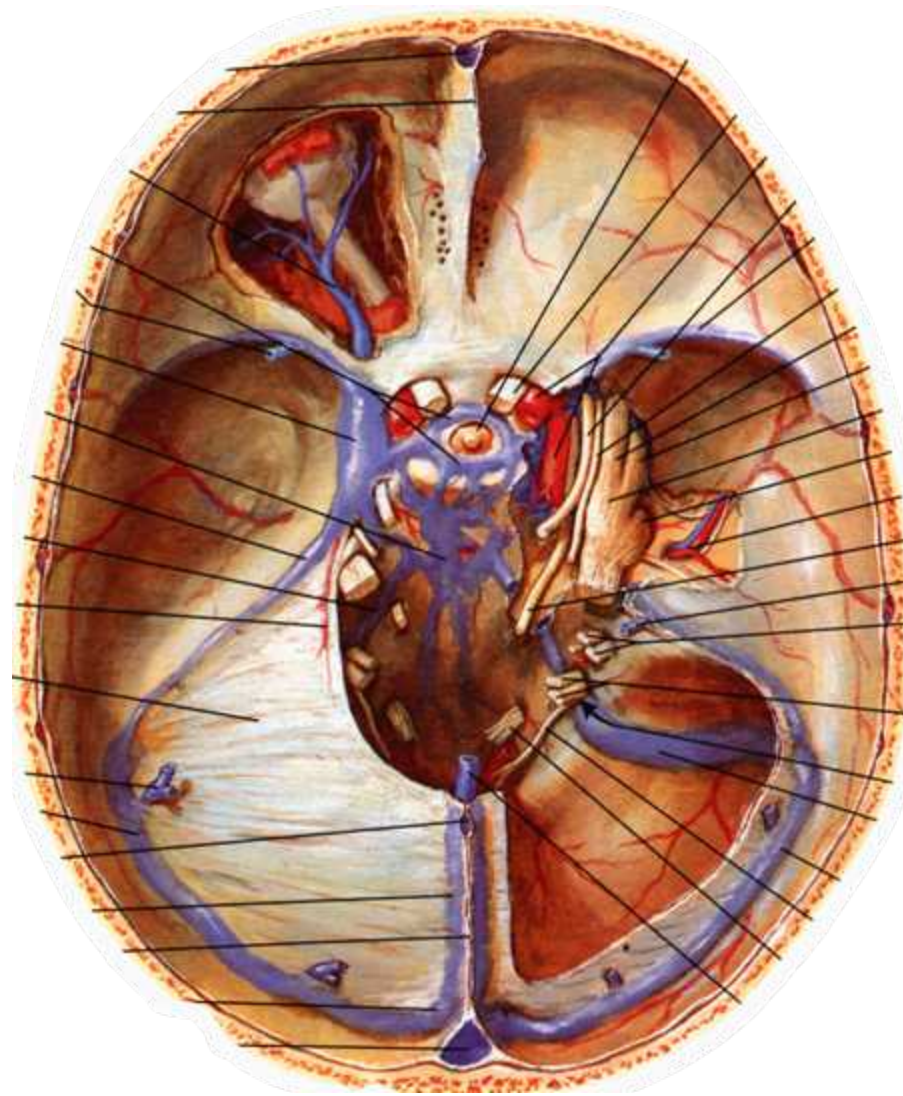
**5-J.-Überleben > 90%**

**WHO-Klassifikation 2000**  
**Tumoren des Nervensystems**  
**Meningotheliale Tumoren (Meningeome)**

	WHO Grad
Meningotheliales Meningeom	I
Fibroblastisches Meningeom	I
Transitionales Meningeom	I
Psammomatöses Meningeom	I
Angiomatöses Meningeom	I
Mikrozystisches Meningeom	I
Sekretorisches Meningeom	I
Lymphoplasmazellreiches Meningeom	I
Metaplastisches Meningeom	I
<u>Klarzelliges Meningeom</u>	II
<u>Chordoides Meningeom</u>	II
<b>Atypisches Meningeom</b>	II
<u>Papilläres Meningeom</u>	III
<u>Rhabdoides Meningeom</u>	III
<b>Anaplastisches Meningeom</b>	III

**Atypisches Meningeom = WHO II (5%)**

**Anaplastisches = malignes Meningeom, WHO III (< 3%)**



**Olfactoriusrinne**

**Optikusscheide**

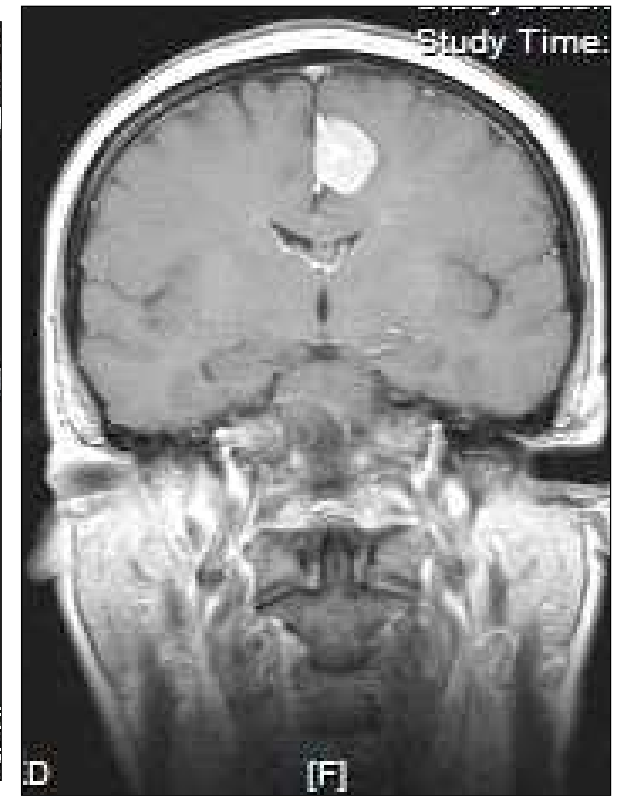
**Sella / Clinoid**

**Sphenoid - Orbita**

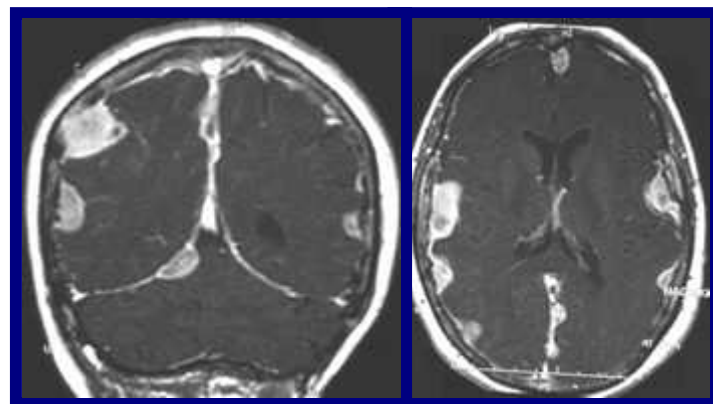
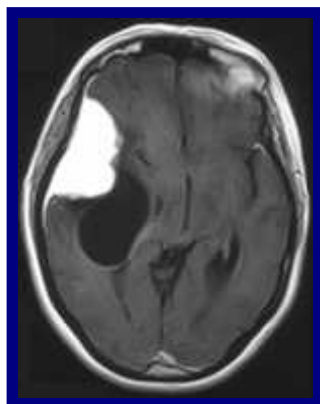
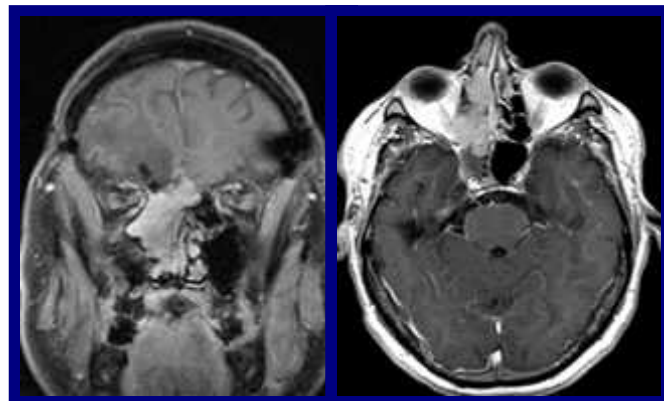
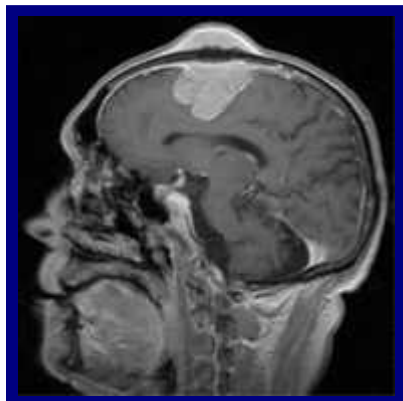
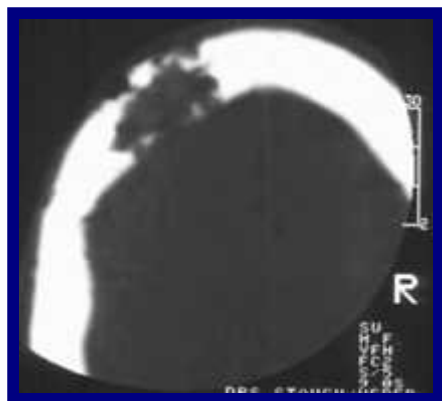
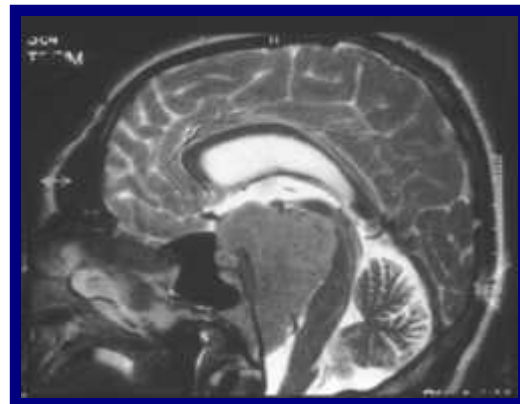
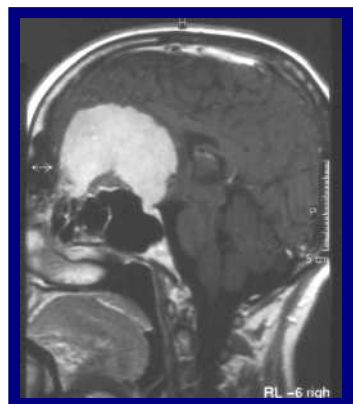
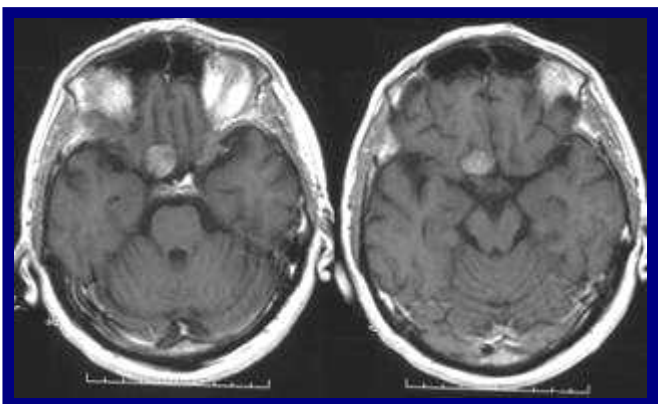
**Sinus cavernosus**

**Petroclival**

**Foramen magnum**

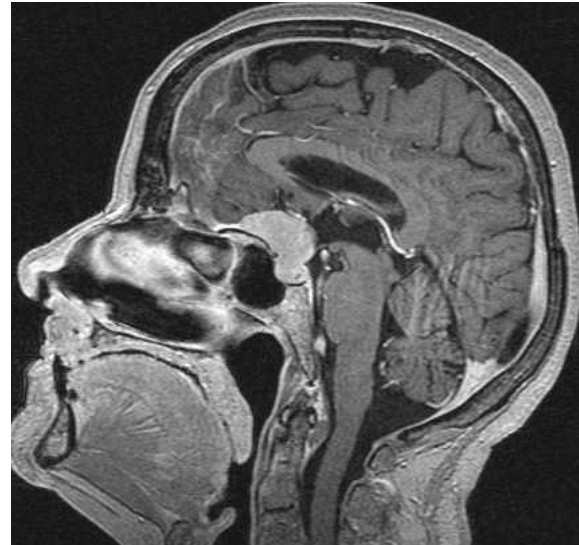
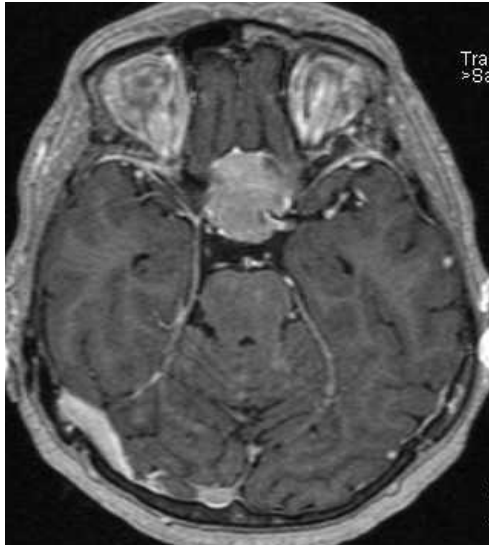






## Subfrontaler Zugang

## Tuberculum sellae Meningeom

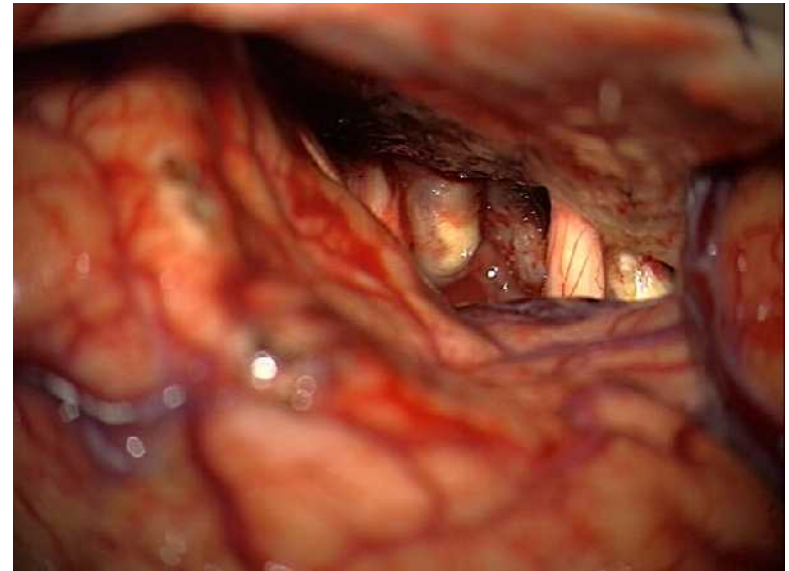
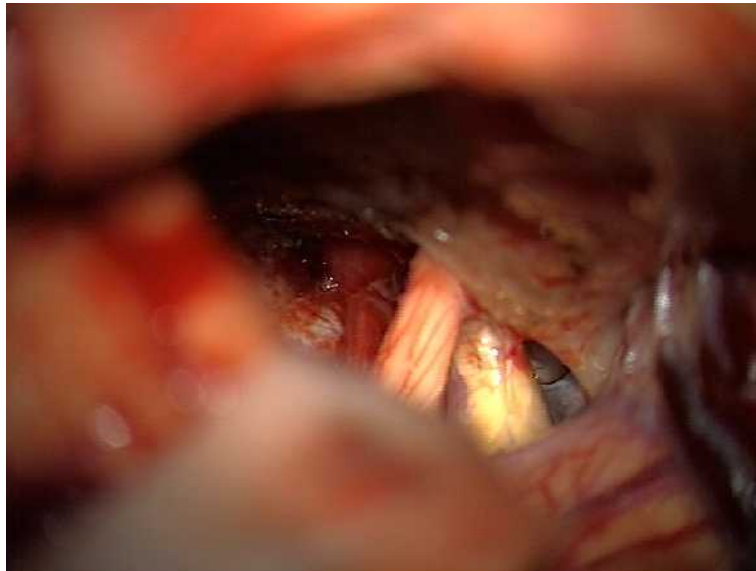
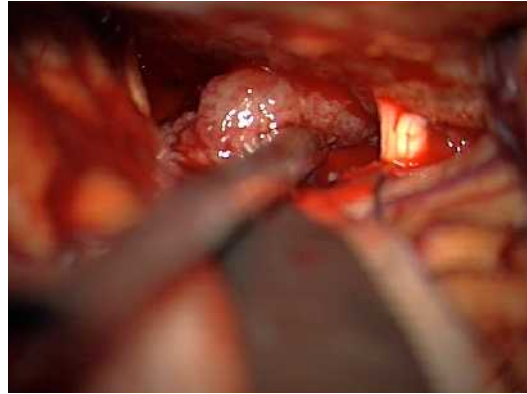
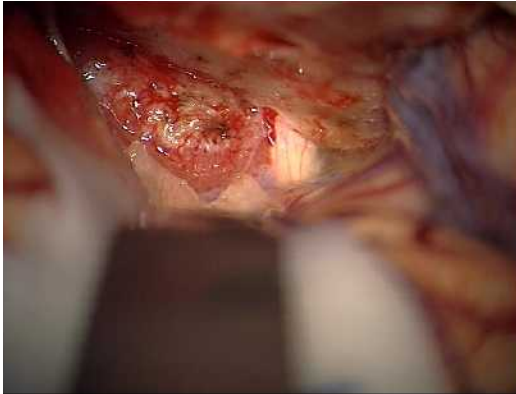


**MRT:** Triplanare Darstellung  
+/- KM

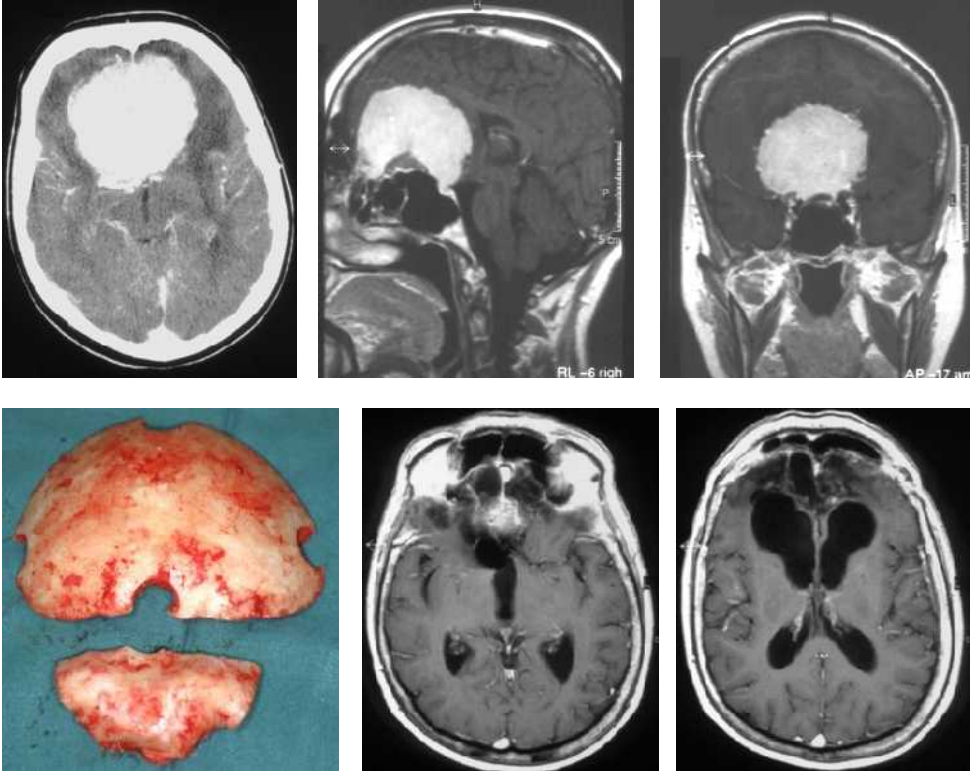
**CT:** Knochenfenster  
2 mm

## Subfrontaler Zugang

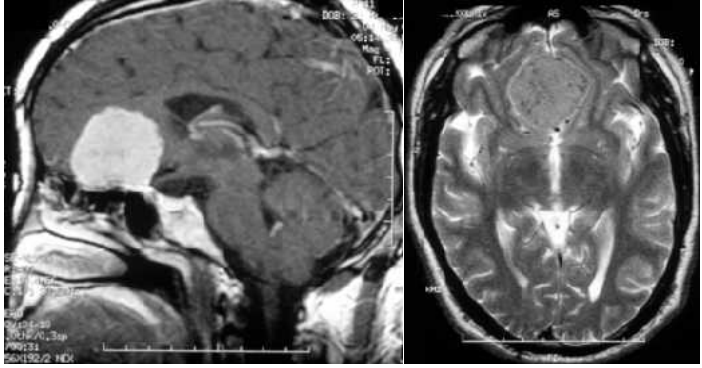
## Tuberculum sellae Meningeom



# Subfrontaler Zugang



# Olfactoriusmeningeom

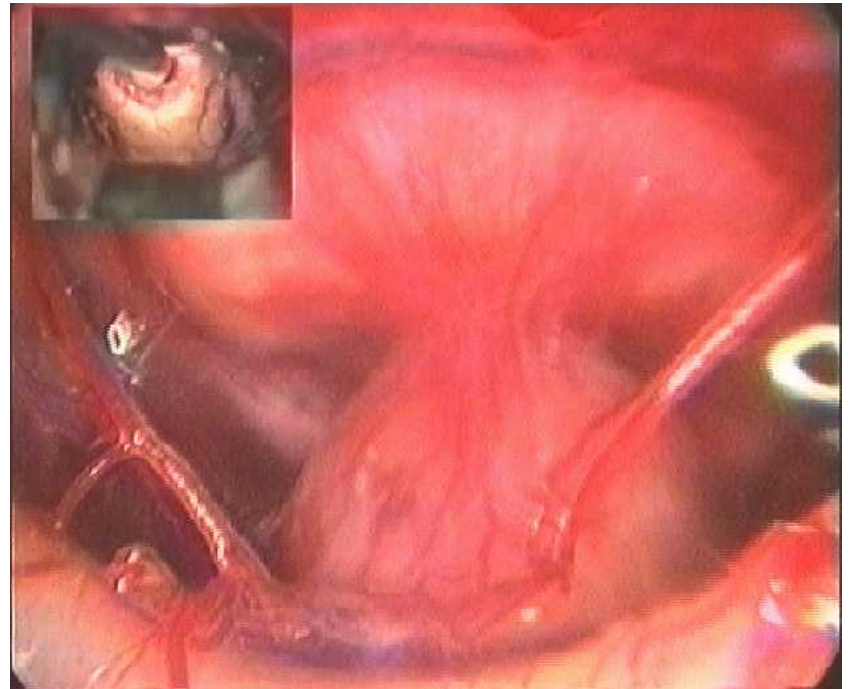
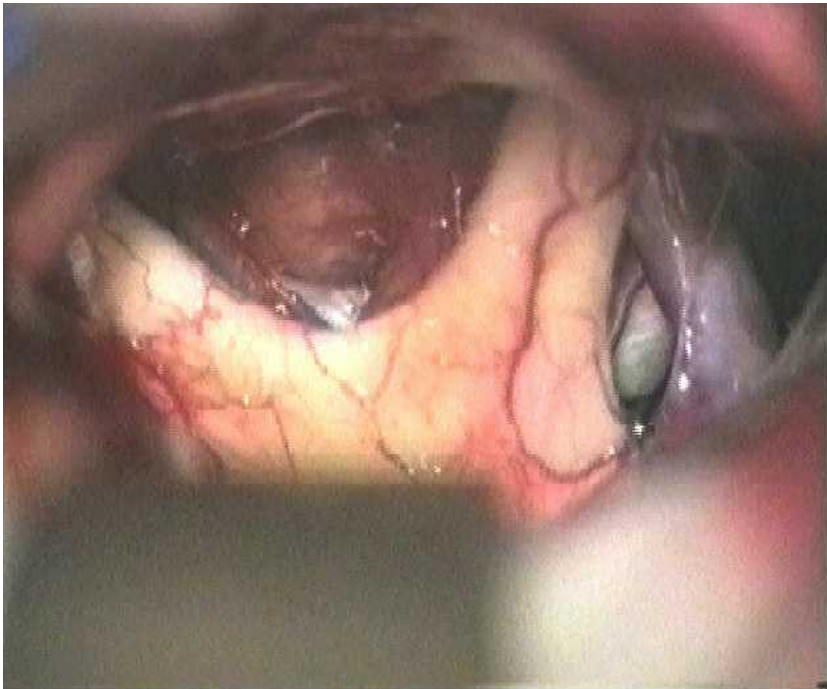


# Endoskopisch-assistierte Mikrochirurgie



**Transspheoidaler Zugang**  
**Supraorbitaler Zugang**  
**Subchiasmale Region**  
**Neurovaskuläre Dekompression**  
**Akustikusneurinom**  
**"Tiefes Schlüsselloch"**

# Endoskopisch-assistierte Mikrochirurgie





**Simpson's Classification  
of the Extent of Resection of Intracranial Meningiomas**

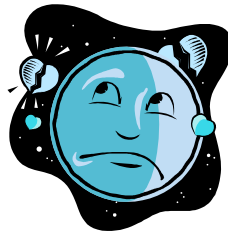
(J Neurol Neurosurg Psychiatry 1957; 20: 22-39. 265 tumors, retrospective review)

<b>Grade</b>	<b>Extent of Resection</b>	<b>Recurrence Rate</b>
<b>I</b>	<b>Gross total resection of tumor including dural attachments and bone</b>	<b>9 %</b>
<b>II</b>	<b>Gross total resection of tumor coagulation of dural attachments</b>	<b>19%</b>
<b>III</b>	<b>Gross total resection of tumor dural attachment and/or extradural extension left behind (invaded sinus, bone)</b>	<b>29%</b>
<b>IV</b>	<b>Partial resection of tumor</b>	<b>44%</b>
<b>V</b>	<b>Decompression or biopsy</b>	

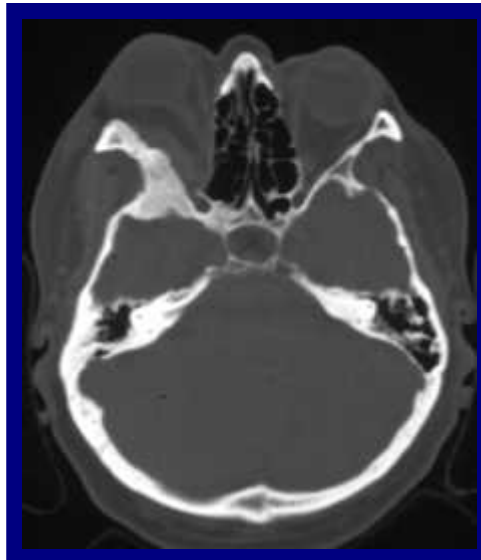
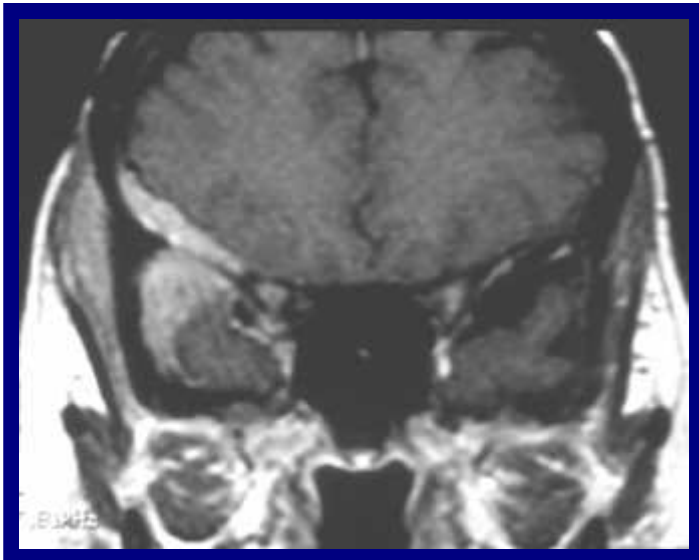


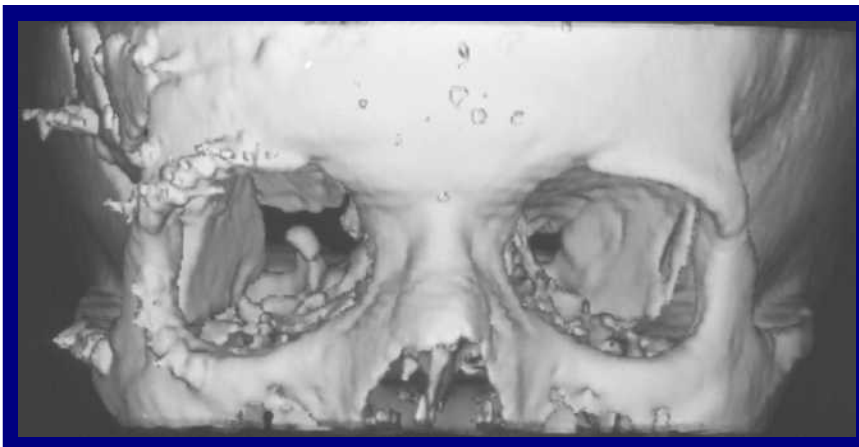


**Arachnoidale Grenzschicht  
zum Hirngewebe**



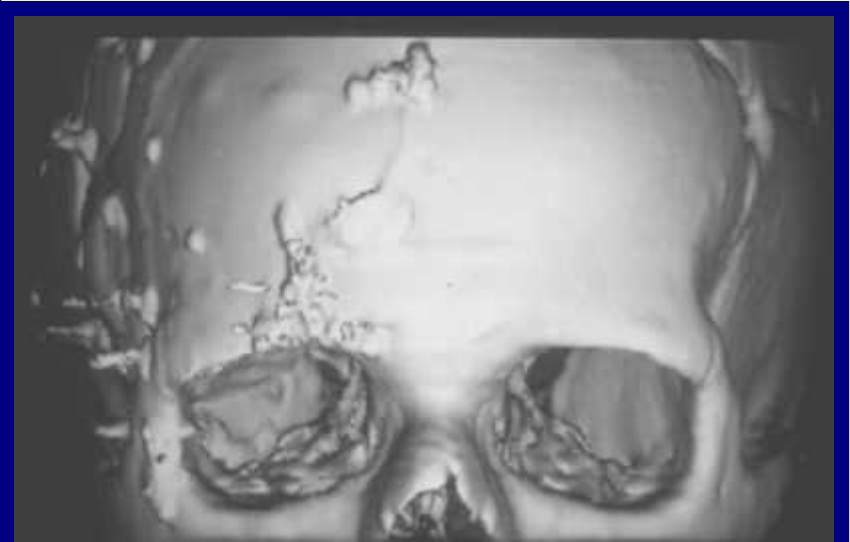
**Infiltration von  
Dura, Knochen, Gefäßwand, Hirnnerven**

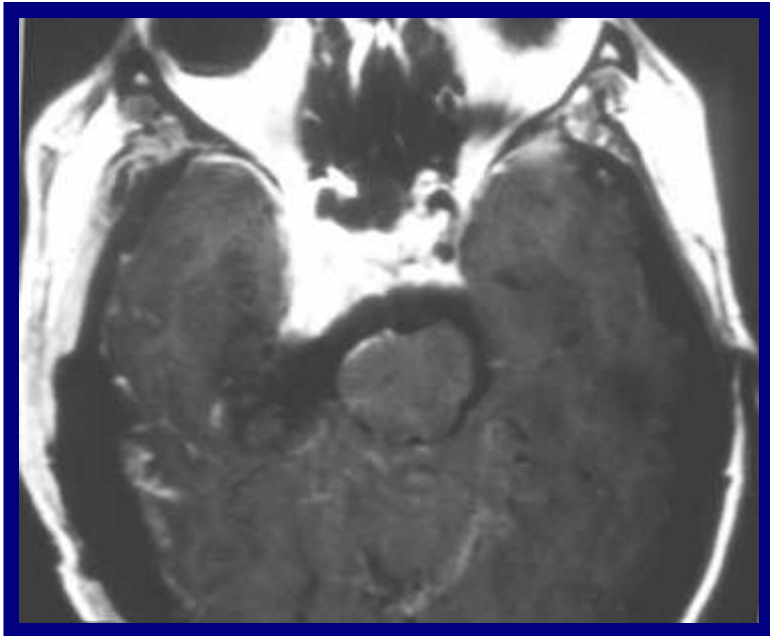
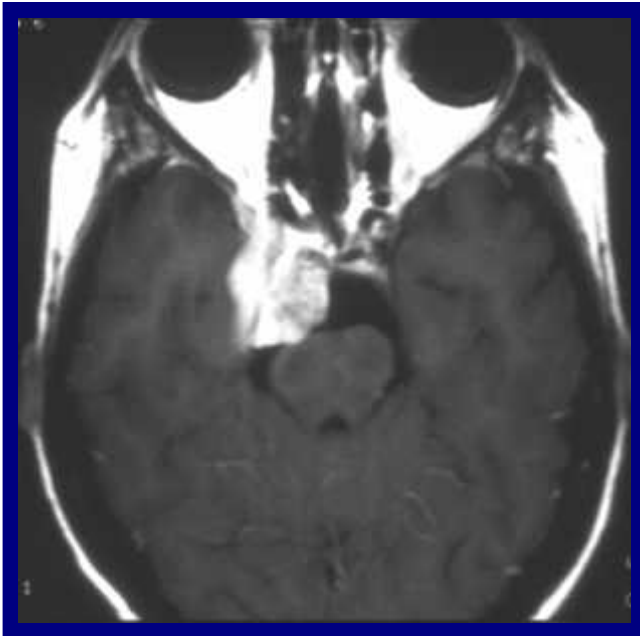
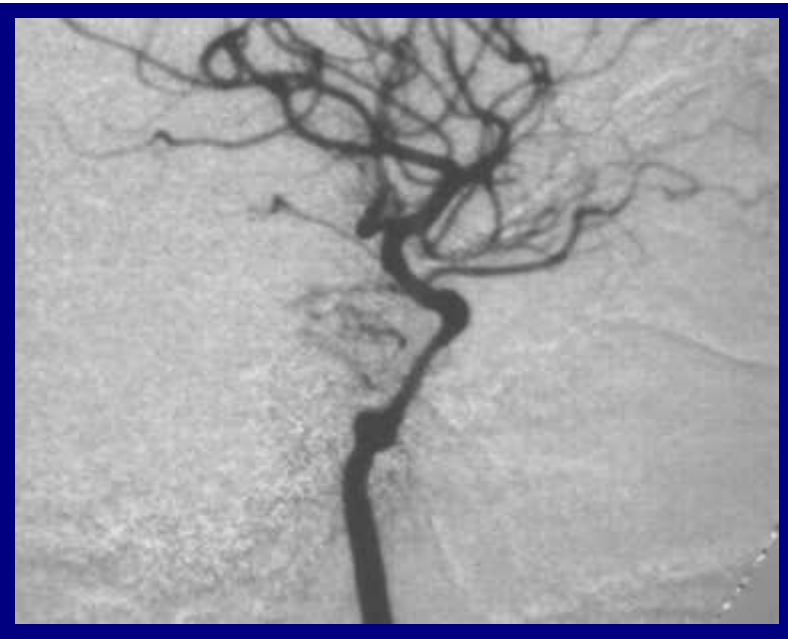
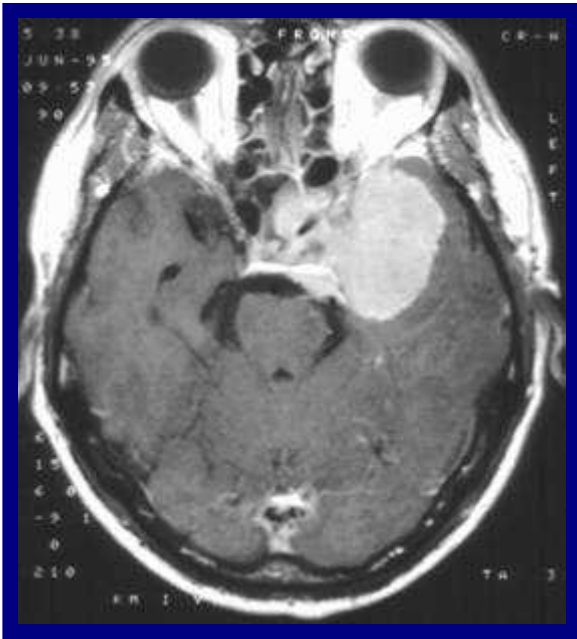




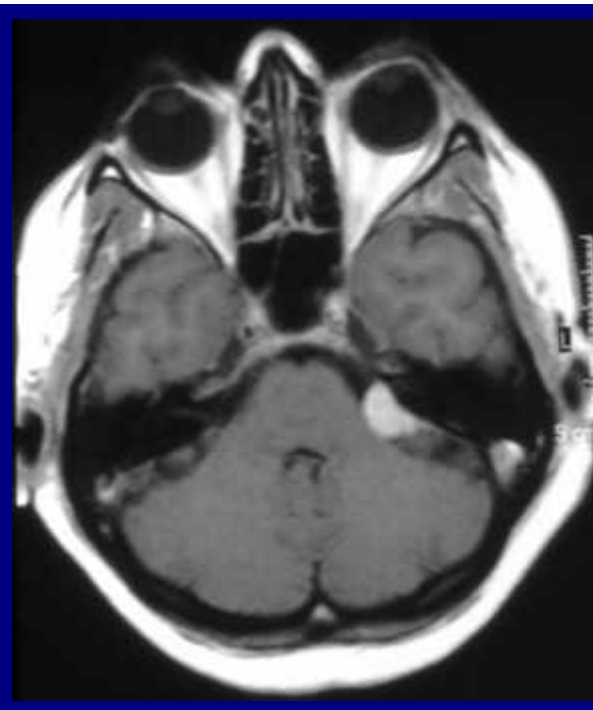
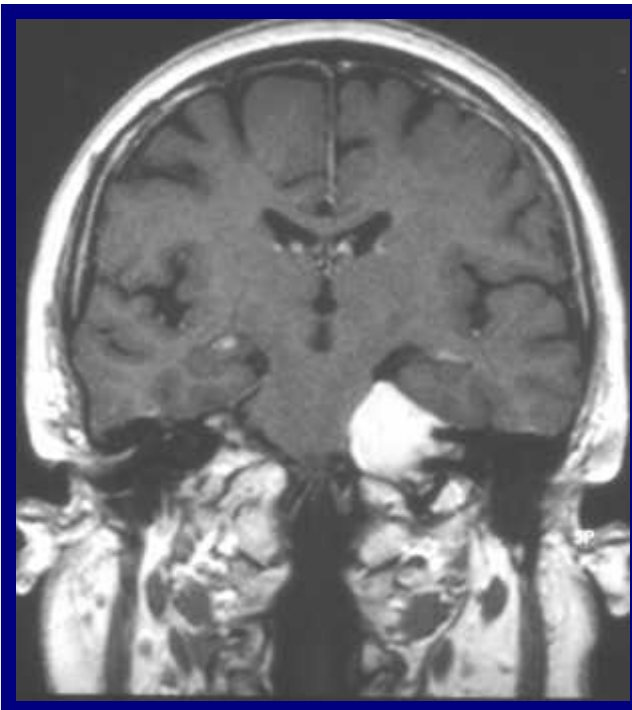
*preop*

*postop*

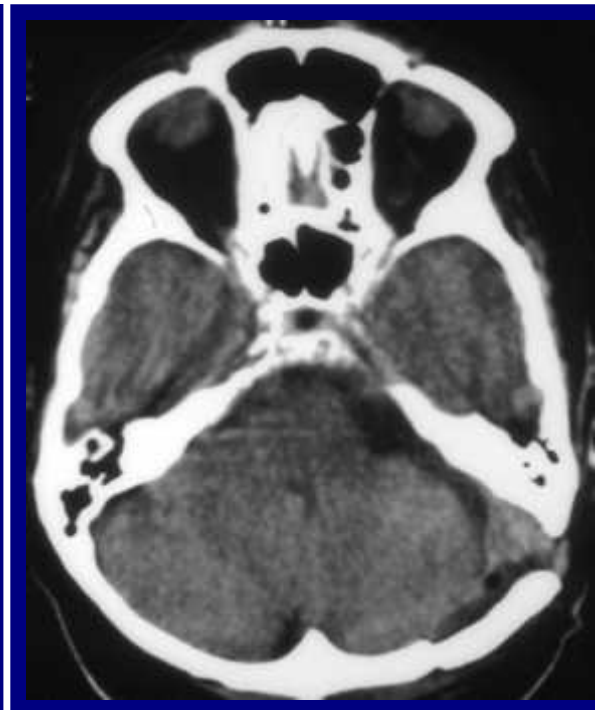




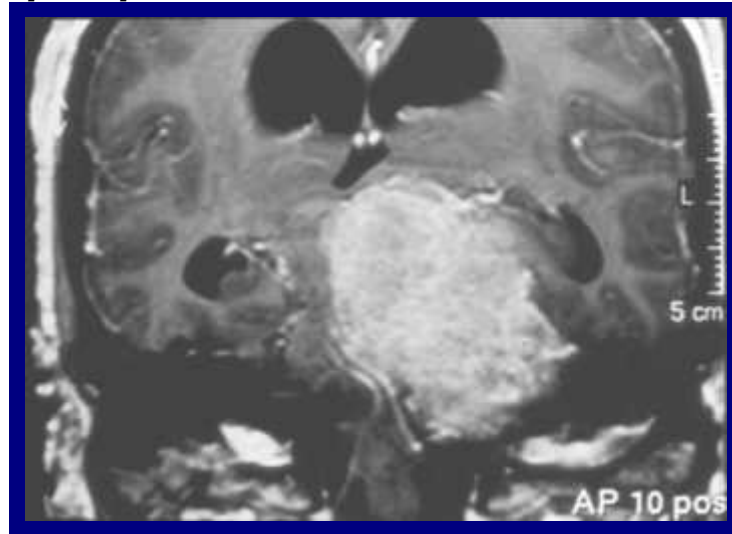
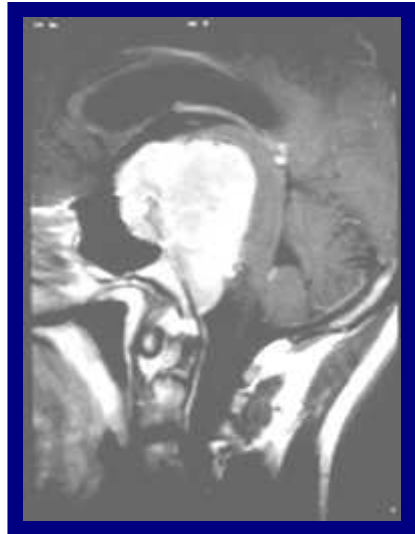
*preop*



*postop*



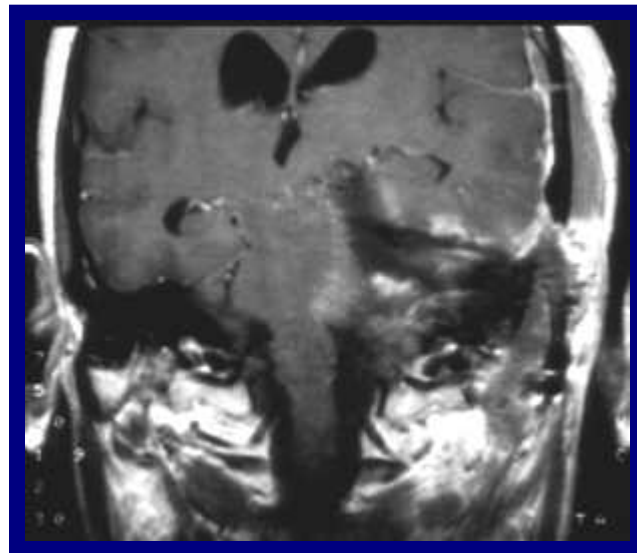
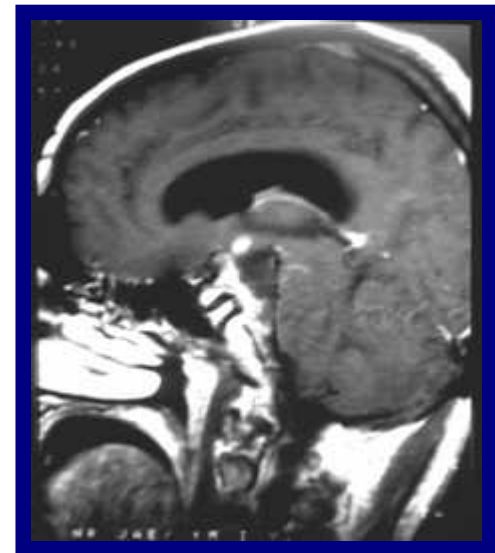
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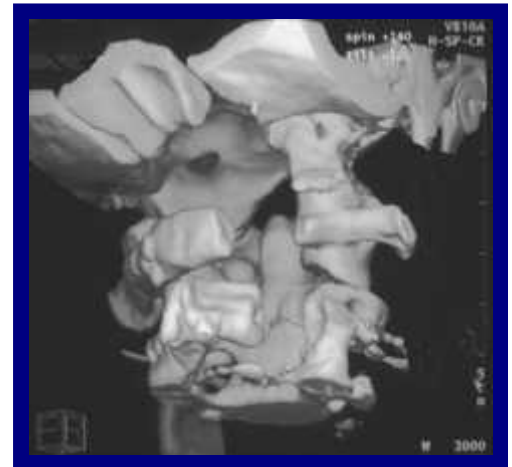
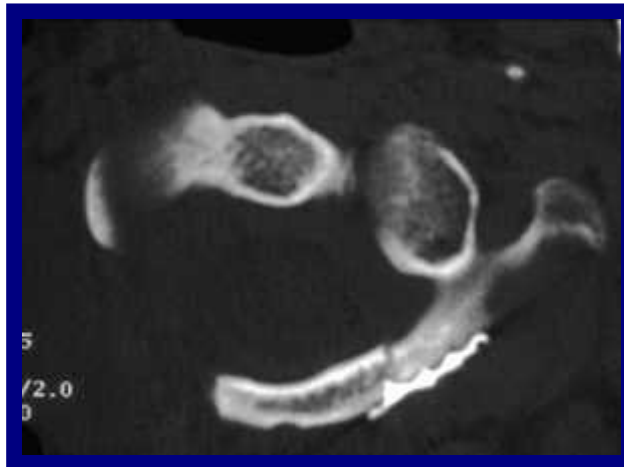
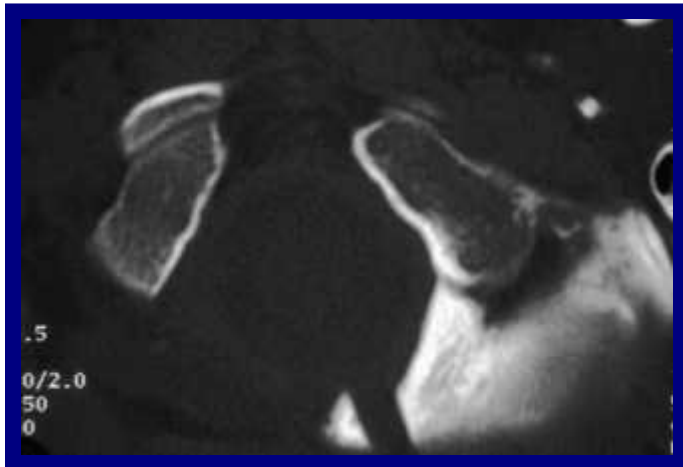


*presigmoidal, transtentorial*



*postop*







- **Radikale Resektion von Meningeomen bei akzeptabler Morbidität.**
- **Subtotale Resektion / Dekompression bei bestimmten Lokalisationen (Sinus cavernosus, ACI, BA, N. opticus und andere HN).**
- **Primäre postoperative Strahlentherapie bei malignen Meningeomen.**
- **Radiochirurgie vs. Beobachtung nach subtotaler Resektion.**
- **Bei Rezidiv: Zweitoperation + Radiochirurgie vs. Radiochirurgie allein.**

***Notwendige Nachbeobachtung > 10 Jahre***

# Grundprinzipien

## **1. Planung, Zielsetzung**

## **2. Exposition, Zugangsweg**

„ Knochen-Resektion vs. Hirn-Retraktion„

## **3. Tumorresektion**

Totalresektion, Tumorkontrolle, Dekompression

Arachnoidale Grenzschicht

## **4. Rekonstruktion**

Liquorfistel, Kosmetik