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**UNIVERSITÄTSKLINIKUM**  
DER PARACELSUS MEDIZINISCHEN PRIVATUNIVERSITÄT



UNIVERSITÄTSKLINIK FÜR  
Radiotherapie und Radio-Onkologie  
VORSTAND: PRIM. UNIV.-PROF. DR. Felix Sedlmayer

# **IOERT IN ADVANCED ANTERIOR SKULL BASE TUMORS: THE RESULTS OF 46 PATIENTS OVER A 13,5 YEAR PERIOD**

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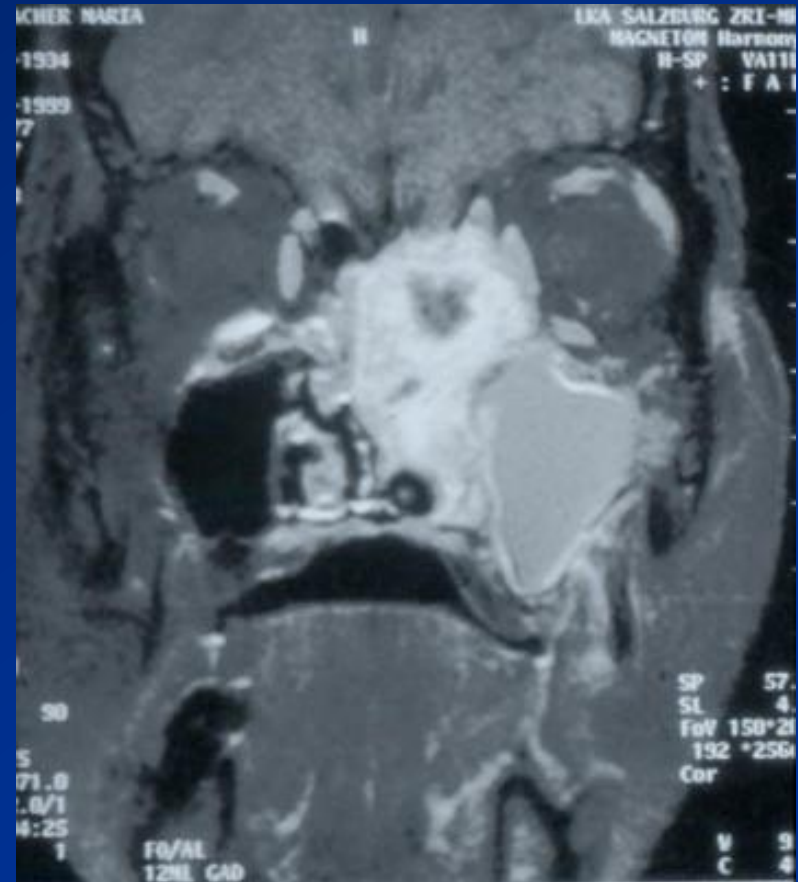
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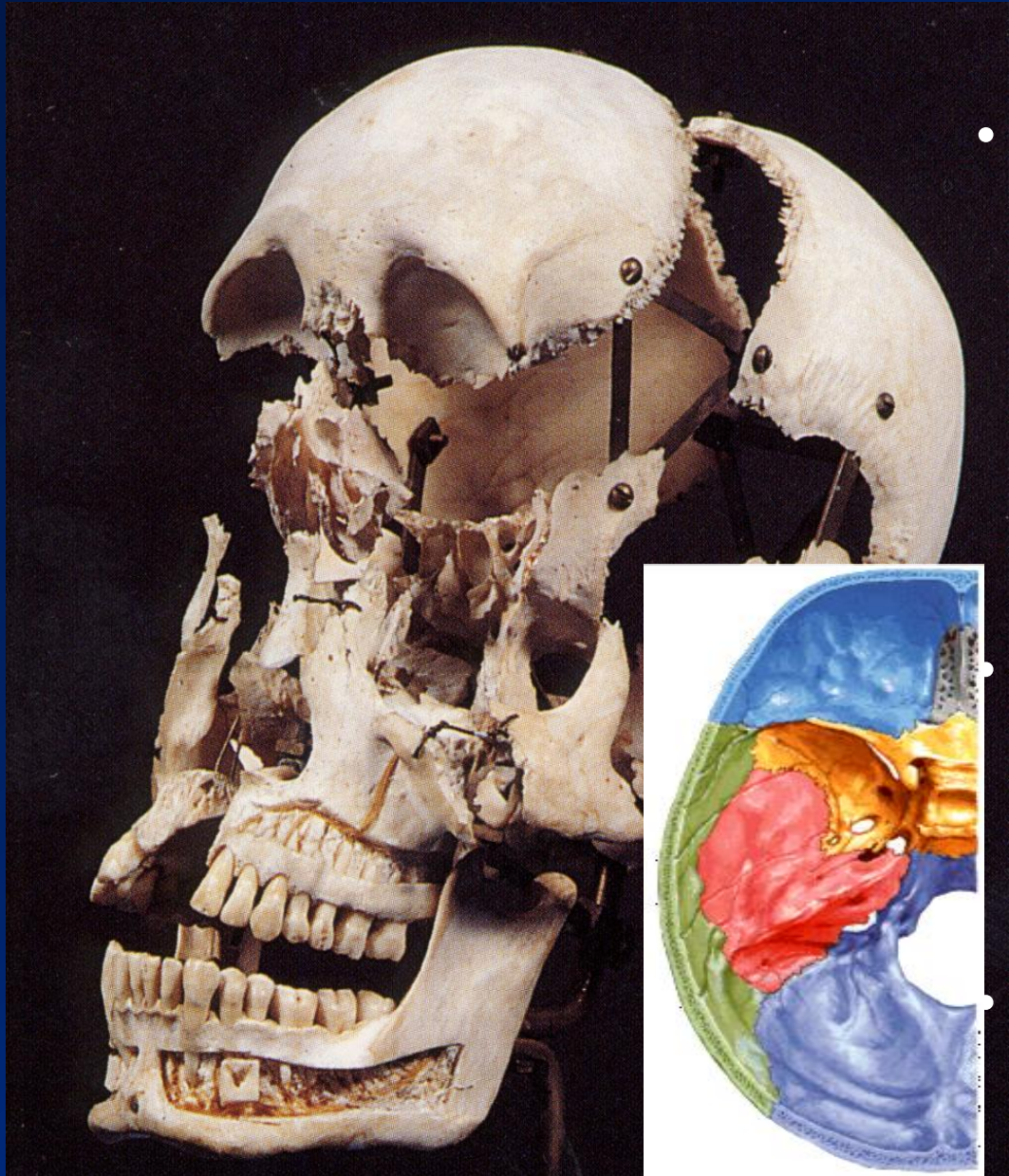
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**Advanced primary tumors, locally recurrent tumors and metastases at the skull base establish a therapeutic challenge**

**sinonasal  
skull base tumor  
SCC T<sub>4</sub>N<sub>0</sub>M<sub>0</sub>**



# SKULL BASE

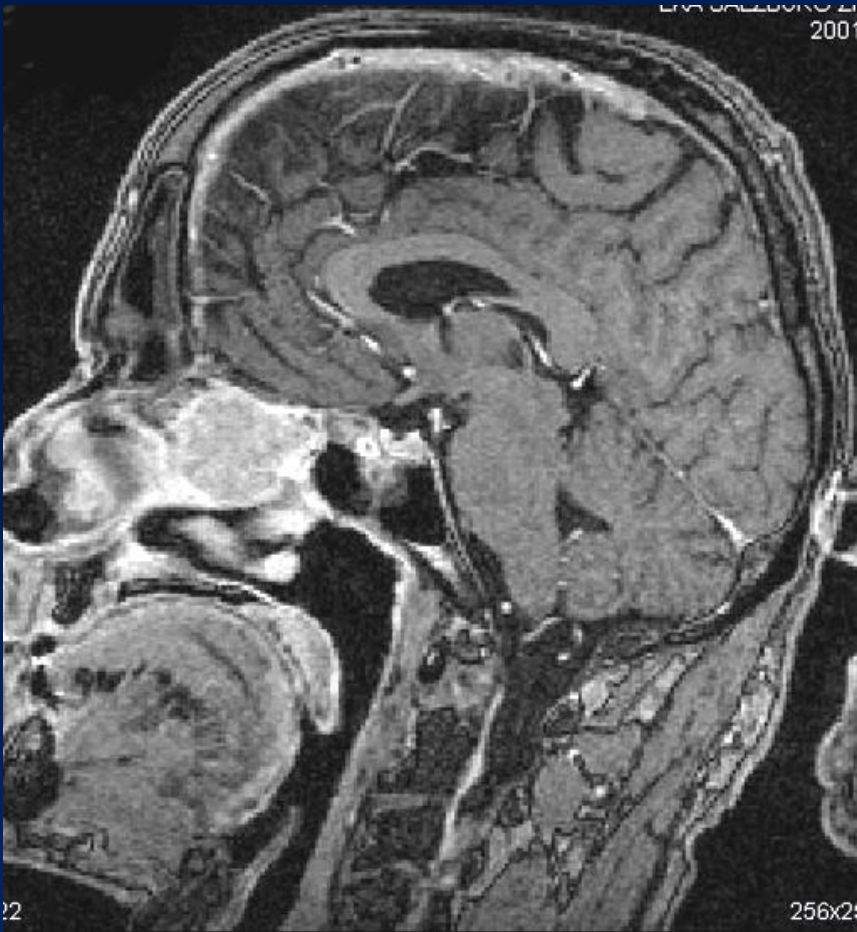


- Anatomically complex region
- Consists of fusion planes of all three embryonic layers
  - Host to an enormous variety of neoplasms derived from multitude of tissue types!

Pathway for critical structures

- Cranial nerves
- Blood supply to the brain

Borders: Brain / Bone / Soft tissues



**sinonasal  
skull base tumor  
Adeno-Ca T<sub>4</sub>N<sub>0</sub>M<sub>0</sub>**



**hypernephroma metastasis  
skull base T<sub>4</sub>N<sub>0</sub>M<sub>1</sub>**

**current standard therapy**

**R<sub>0</sub>-resection proven by frozen  
section histology**

**+**

**postoperative radiotherapy**

# New standard in advanced carcinomas T3/4

**R<sub>0</sub>-resection**

**+**

**Intraoperative Radiotherapy**

**+**

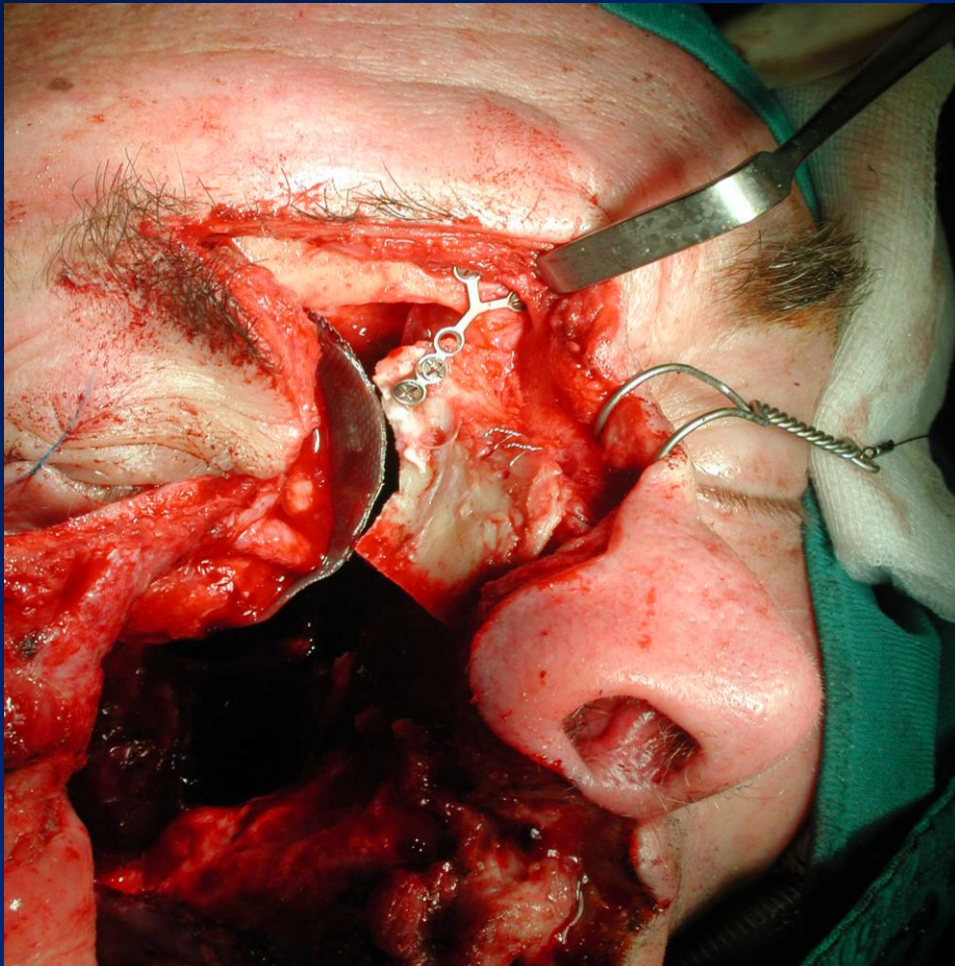
**postoperative Radiotherapy**

(+ Chemo in selected cases)

# ADENO-CARCINOMA



# LATERAL RHINOTOMY





# PREREQUISITE FOR SKULL BASE IOERT

- **Highest Skill** in ALL SURGICAL APPROACHES TO THE SKULL BASE
- **INTERDISCIPLINARY TEAM !!!!**
  - ENT
  - NEUROSURGERY
  - PLASTIC SURGERY
  - MAXILLO - FACIAL SURGERY
  - OPHTHALMOLOGY
  - ANESTHESIOLOGY/ INTENSIVE CARE UNIT
  - RADIOLOGY
  - RADIOTHERAPY – ONCOLOGY
  - PATHOLOGY

# Challenge:

- **Local recurrences are the most common cause of failure and mortality ( > 50 % )**
- IOERT offers the possibility of dose escalations in very sensitive high risk areas
- **Aim of combined treatment:**
  - Improving local tumor control
  - improved quality of life
  - decrease of radiotherapy complications  
( *radio-osteonecroses, optic nerve atrophy..* )

## **Skull base tumors: IOERT experience in Salzburg**

- since January 2001 : **65** patients with advanced primary and recurrent tumors of the whole skull base
- **46 / 65** patients with tumors of the anterior skull base
- **all Stage IV** (AJCC): T3N+; T4

# Patient characteristics

<i>age</i>	35 -73 years
<b>median</b>	<b>56.76 years</b>
<i>gender</i>	
<b>male</b>	<b>34 pts.</b>
female	12 pts.
<i>disease-status</i>	
primary	30 pts.
<b>recurrent</b>	<b>15 pts.</b>
metastases	1 pts.
<i>EBRT</i>	
previous RT	10 Pts.
preoperative RT	1 Pts.
<b>postoperative RT</b>	<b>31 Pts.</b>
IOERT only	3 Pts.
EBRT for recurrent tumor following IOERT	1 Pts.

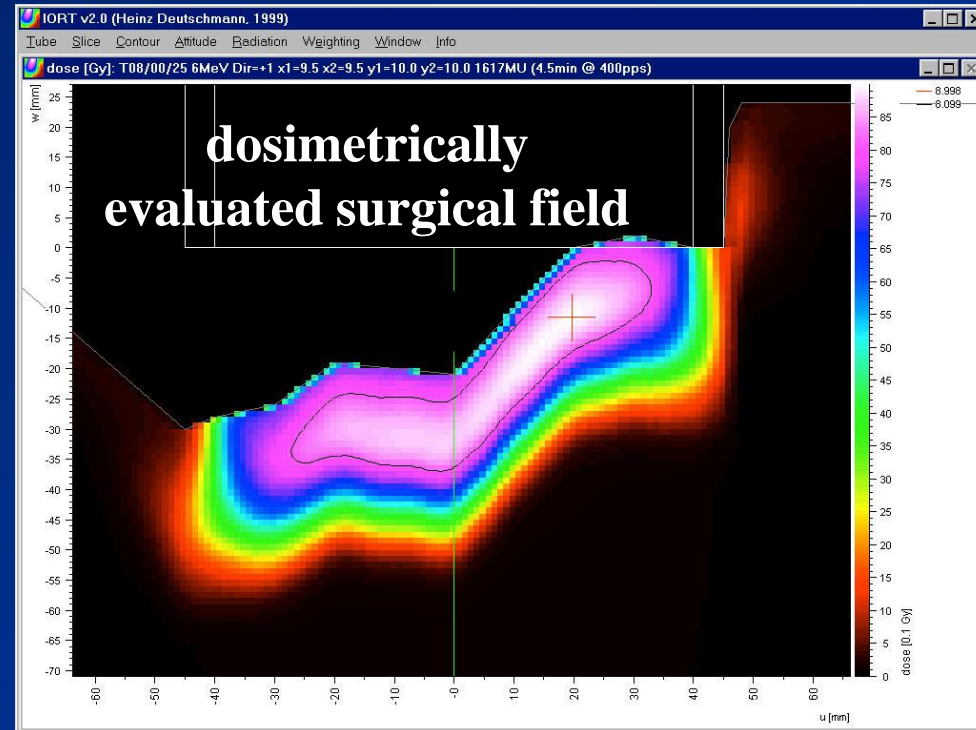
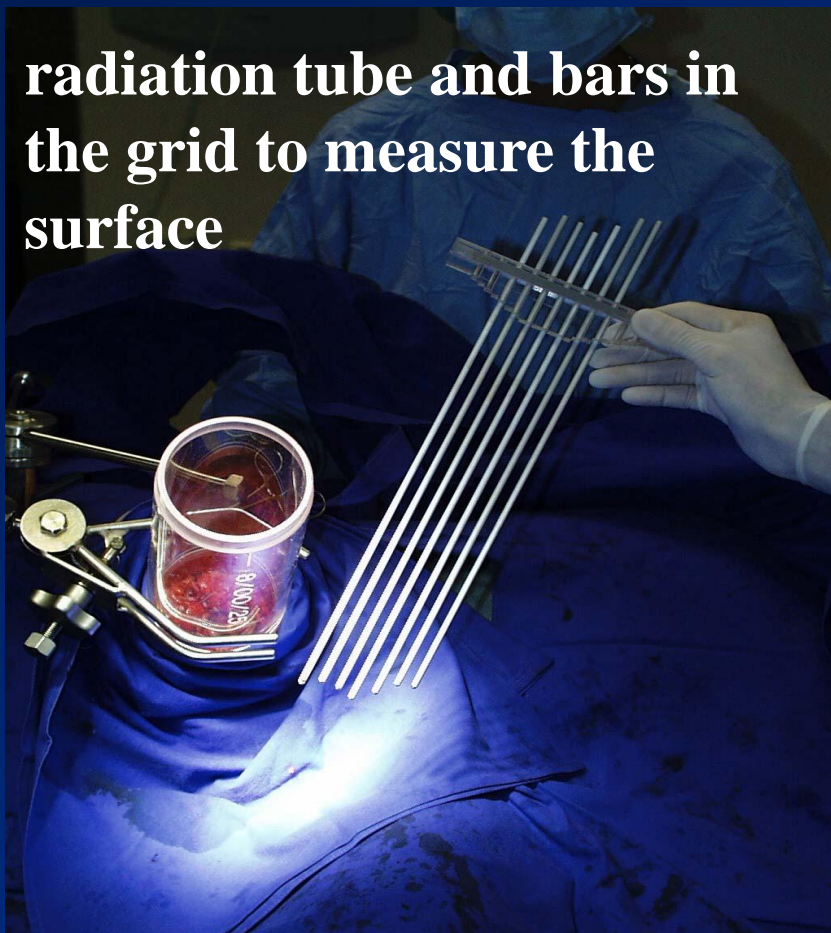
# Methods

- 45 x : **1 field**; 1 x : 2 fields
- Energies between 4 and **6 MeV**
- IOERT dose: **10 Gy** ( 8-10 Gy)
  - surface dose: 75 - 93 %
  - dose in 2 cm : 70 - 100 %
  - inhomogeneity: < 10 %
- Diameter **4- 5 cm**
- Bevel angle **0- 15 degrees**
- **Soft docking !**
- **radiation time: 8 - 22 min**
- **total additional time: 30 - 45 min**



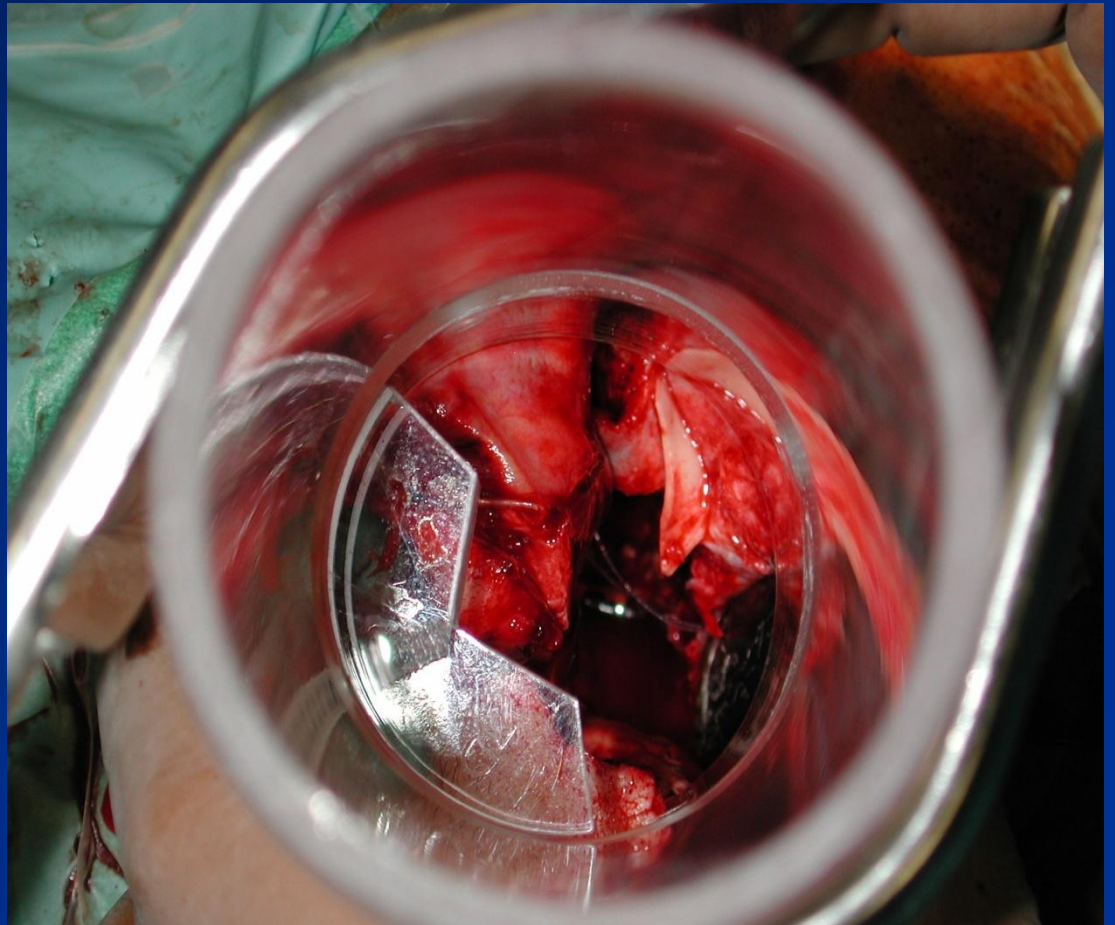
# optimized surface dosimetry

radiation tube and bars in  
the grid to measure the  
surface



# IOERT

*In-field* shielding



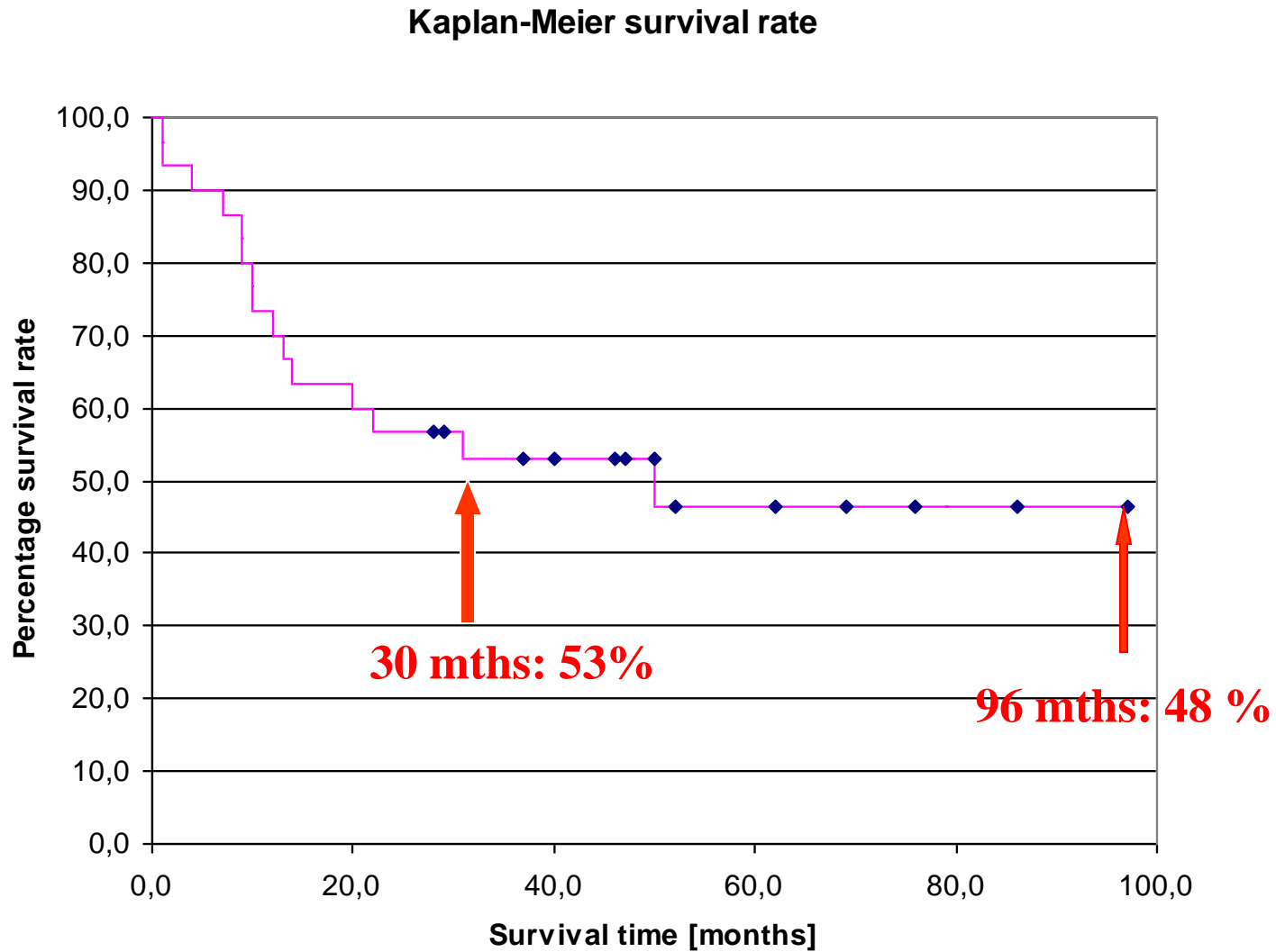
# Results

- Median Follow-up: 67,28 mths
- Local (*locoregional*) recurrences: 8
  - 5 in-field -LR;
  - 5 out-field ( including marginal)-LR
- Deaths: 29
  - 10 LR,
  - 6 metastasis
  - 7 sec. tumors
  - 5 intercurrent diseases
- Overall survival: 30 mths: 53 %; 96mths: 48 %; 136 mths: 38 %, 163 mths: 33 %, 17 pts alive, 16 pts ned, 1 with bone metastases cerv.spine, 11 primary, 6 recurrent
- No G3/4 side effects

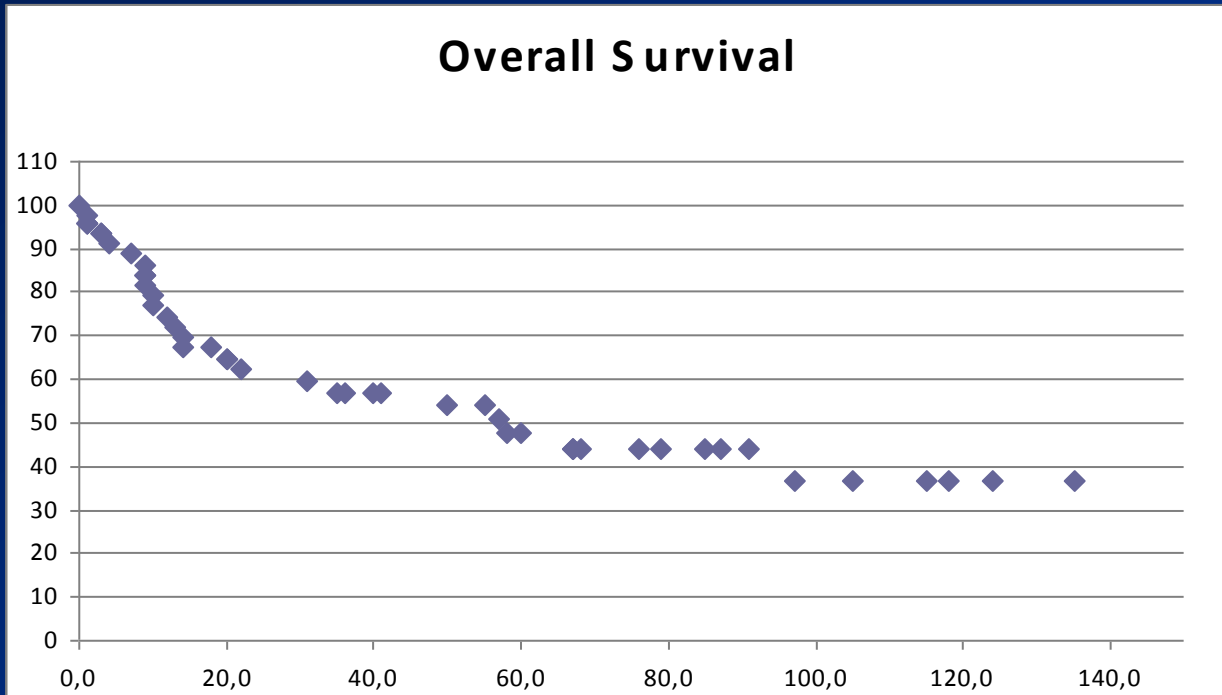


# Results

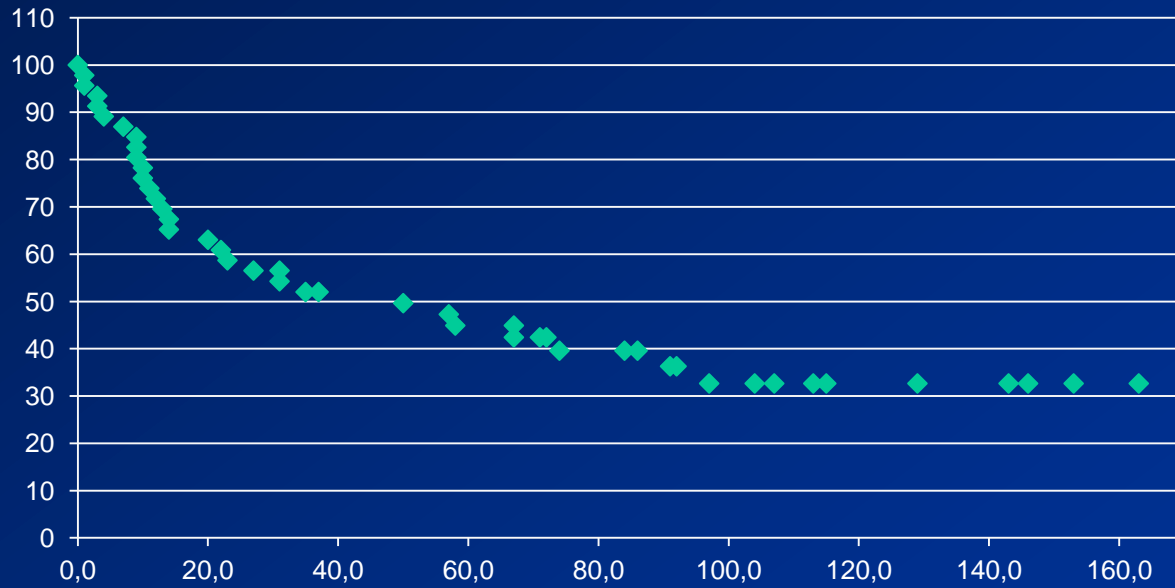
## OS in Stage IV base of skull tumors



Follow up of 136 month, 38%  
(11 years,4 month in 46 patients )



## Overall Survival, 33%, follow up of 163 month,



# Discussion

Clinical reports are scarce !

Pinheiro AD et al. (Rochester) *Head Neck* 2003 :  
IORT for „advanced“ head and neck and skull base cancer  
Results OS (2a) 32% for SCC (n= 34)  
52% for non SCC (n= 10)

Chen AM et al. *IJROBP* 2007: Carcinomas of the paranasal sinuses and nasal cavity treated with radiotherapy at a single institution over five decades ..

127 pat, 1960-2005, all stages ( T1-T4 ),

EBRT reflects change over time: 2D – 3D – IMRT; no IORT

5-a Survival rates in the 5 decades since 1960 :

46%, 56%, 51%, 53% ,49%

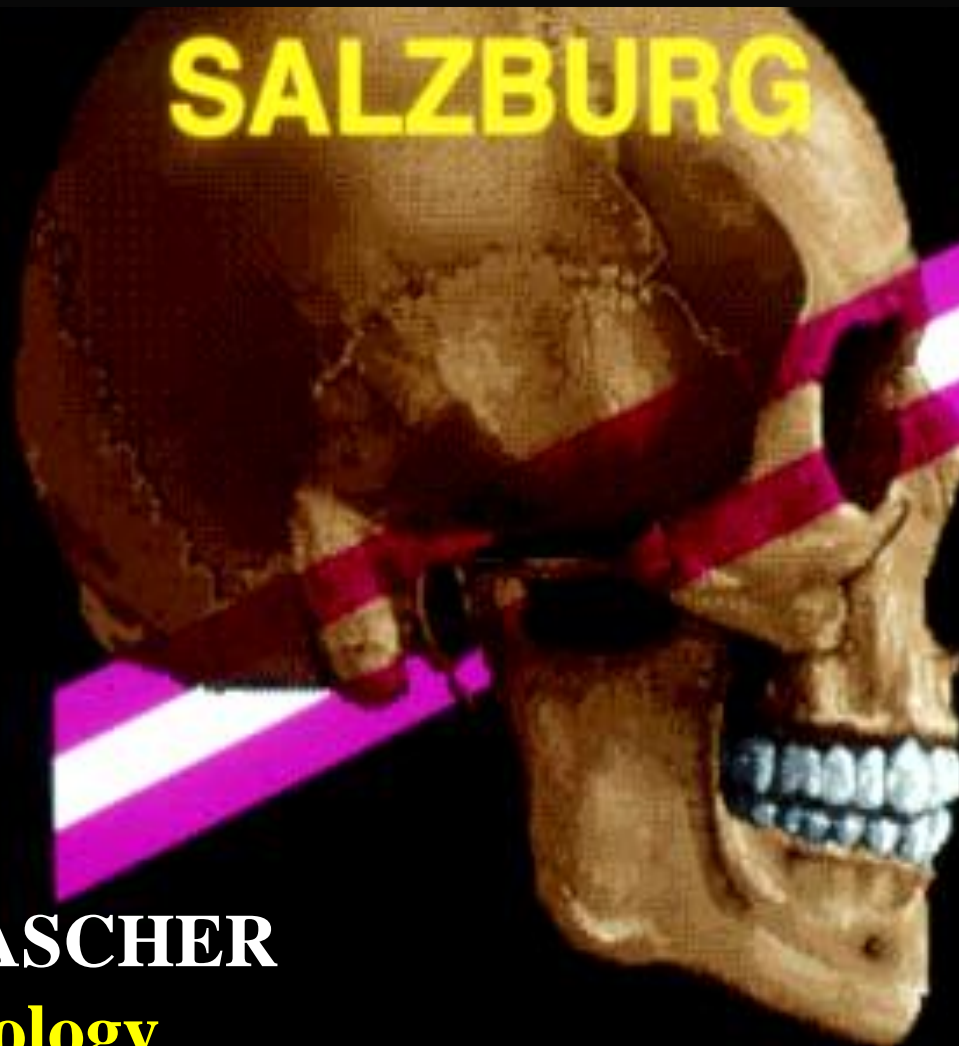
No survival gain, better QoL

# Conclusions :

- IOERT at the skull base is feasible with **high-skill, adapted surgical techniques** ( maximal surgery including microscope, R0 resection ) and **optimized IOERT conditions:**
  - Linac within in the operating room
  - optimized IORT planning and application system ( surface dosimetry, shielding of critical structures)
- Improvement in **local control** and **2,5, 8 ,11 and 13.5 year survival rates** for stage IV tumors
- Reduction of the number of locally recurrent tumors
- Few treatment complications: **improved quality of life**

# CENTER FOR SKULL BASE SURGERY

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- **Otolaryngology**  
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