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

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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$_4$N$_0$M$_0$
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 $T_4N_0M_0$

hypernephroma metastasis
skull base $T_4N_0M_1$
current standard therapy

$R_0$-resection proven by frozen section histology + postoperative radiotherapy
New standard in advanced carcinomas T3/4

\[ R_0 \text{-resection} + \text{Intraoperative Radiotherapy} + \text{postoperative Radiotherapy} \]

(+ 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
• 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

**age**  
median  
35 - 73 years  
56.76 years

**gender**  
**male**  
34 pts.  
**female**  
12 pts.

**disease-status**  
**primary**  
30 pts.  
**recurrent**  
15 pts.  
**metastases**  
1 pts.

**EBRT**  
**previous RT**  
10 Pts.  
**preoperative RT**  
1 Pts.  
**postoperative RT**  
31 Pts.  
**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
dosimetrically evaluated surgical field
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 %; 96 mths: 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

Kaplan-Meier survival rate

Survival time [months]

Percentage survival rate

30 mths: 53%

96 mths: 48%
Follow up of 136 month, 38% (11 years, 4 month in 46 patients)
Overall Survival, 33%, follow up of 163 month,
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
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