RadioOnkologie

Behandeln
Forschen
Lehren

HIT Heidelberger Ionenstrahl-Therapiezentrum

GSI

dkfz. GERMAN CANCER RESEARCH CENTER IN THE HELMHOLTZ ASSOCIATION

UniversitätsKlinikum Heidelberg

Clinical Results of Carbon Ion Radiotherapy: *The Heidelberg Experience*

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Carbon ion RT at GSI

- Active beam delivery (raster scan technique)
- Online beam verification with PET
- Biologic plan optimization
- Treatment planning software TRiP
- Physical treatment planning and dosimetry
- Preclinical reseach (cell and animal experiments)
- Clinical research

Cooperation:

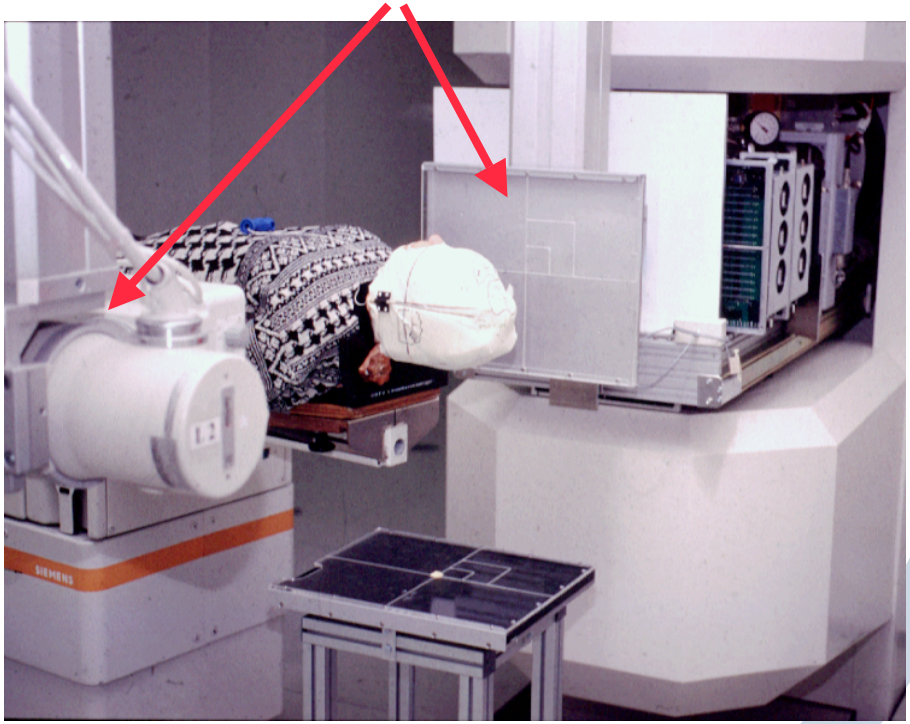
- GSI (Kraft and Co-workers)
- Research Center Rossendorf (Enghardt and Co-workers)
- DKFZ, Div. of Physics in Medicine (Schlegel, Jäkel, Karger and Co-workers)
- DKFZ, Div. of Radiation Oncology (Huber and Co-workers)
- University of Heidelberg and HIT (Debus and Co-workers)

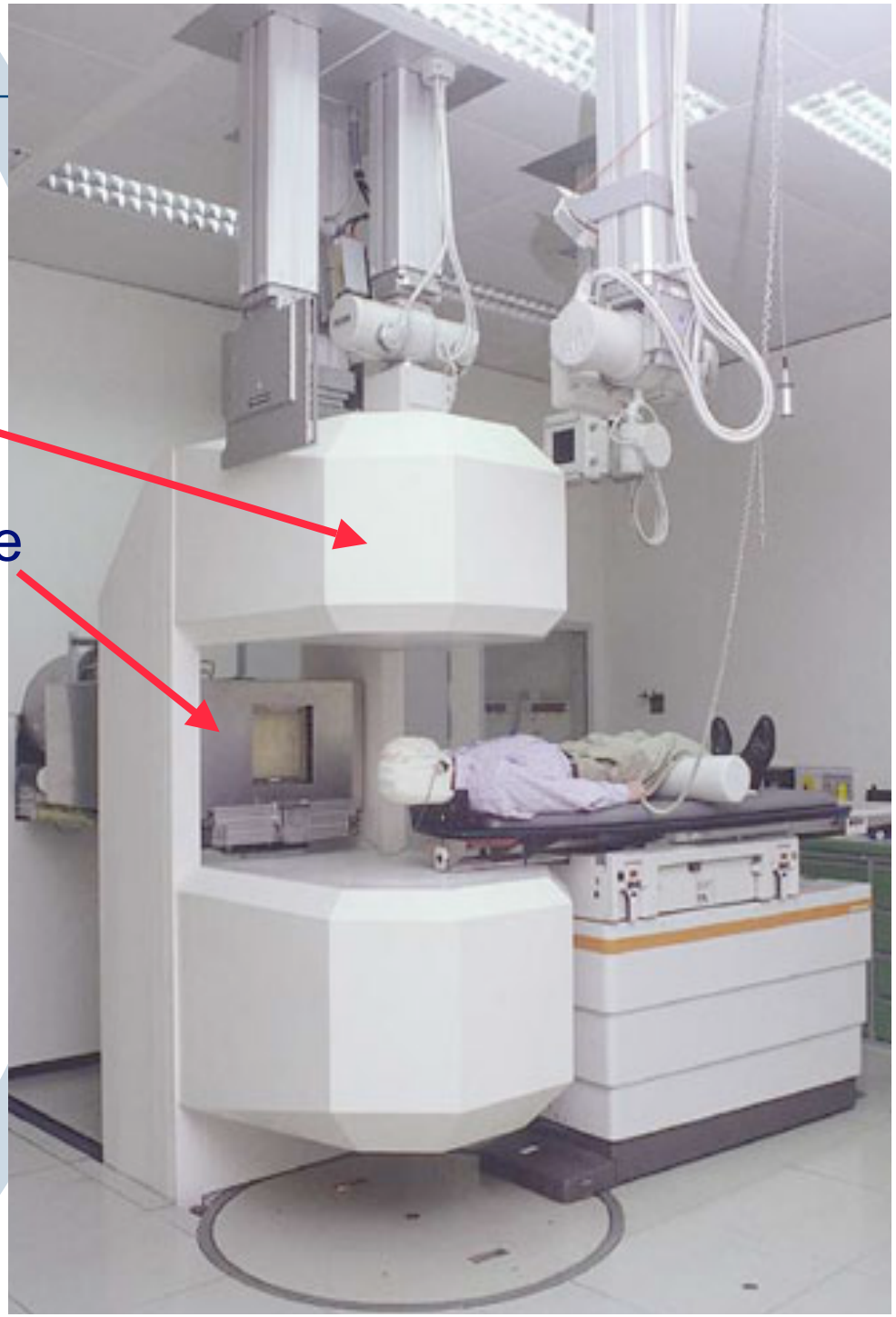
Patient setup and treatment at GSI

PET-camera

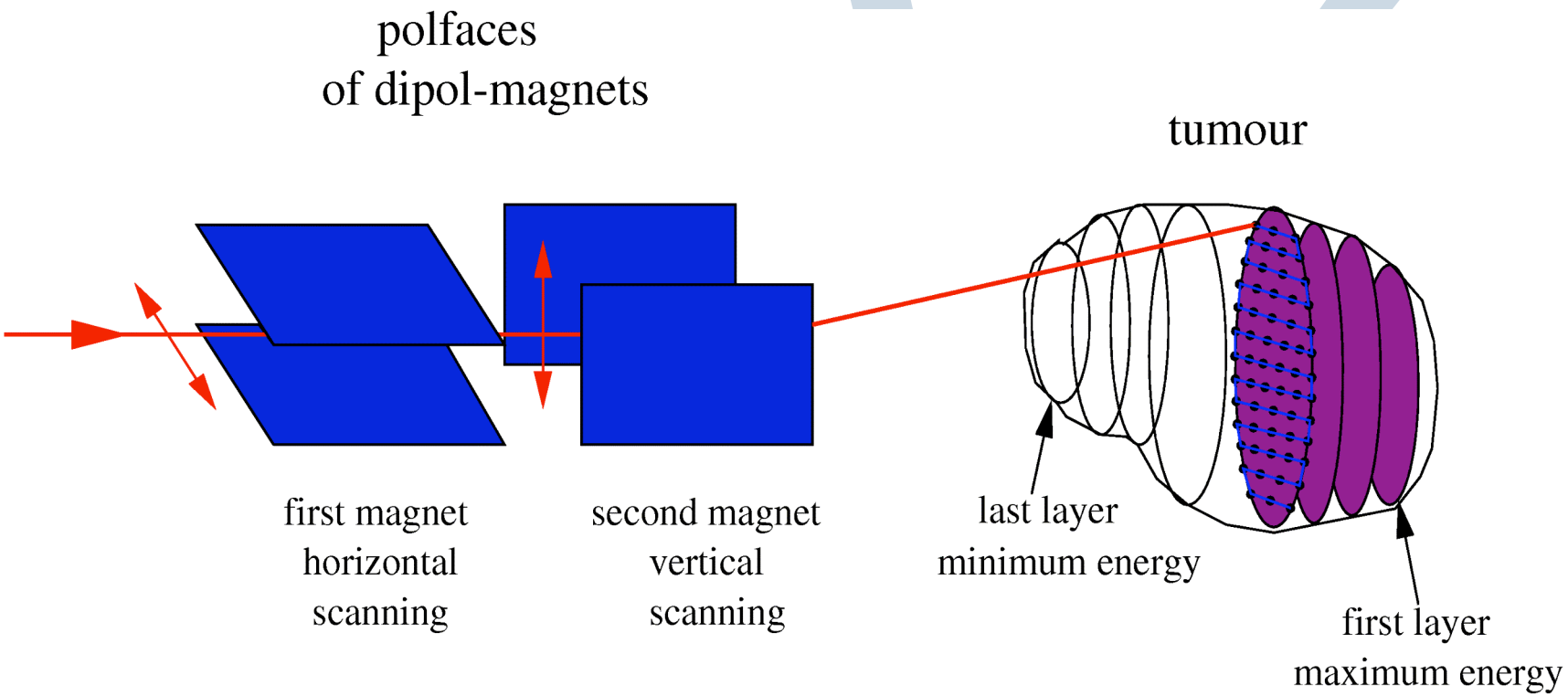
X-ray system

Beam line





3D Active beam scanning at GSI:
Principle of raster scanning



Intensity Controlled Raster Scanning with heavy charged particles:

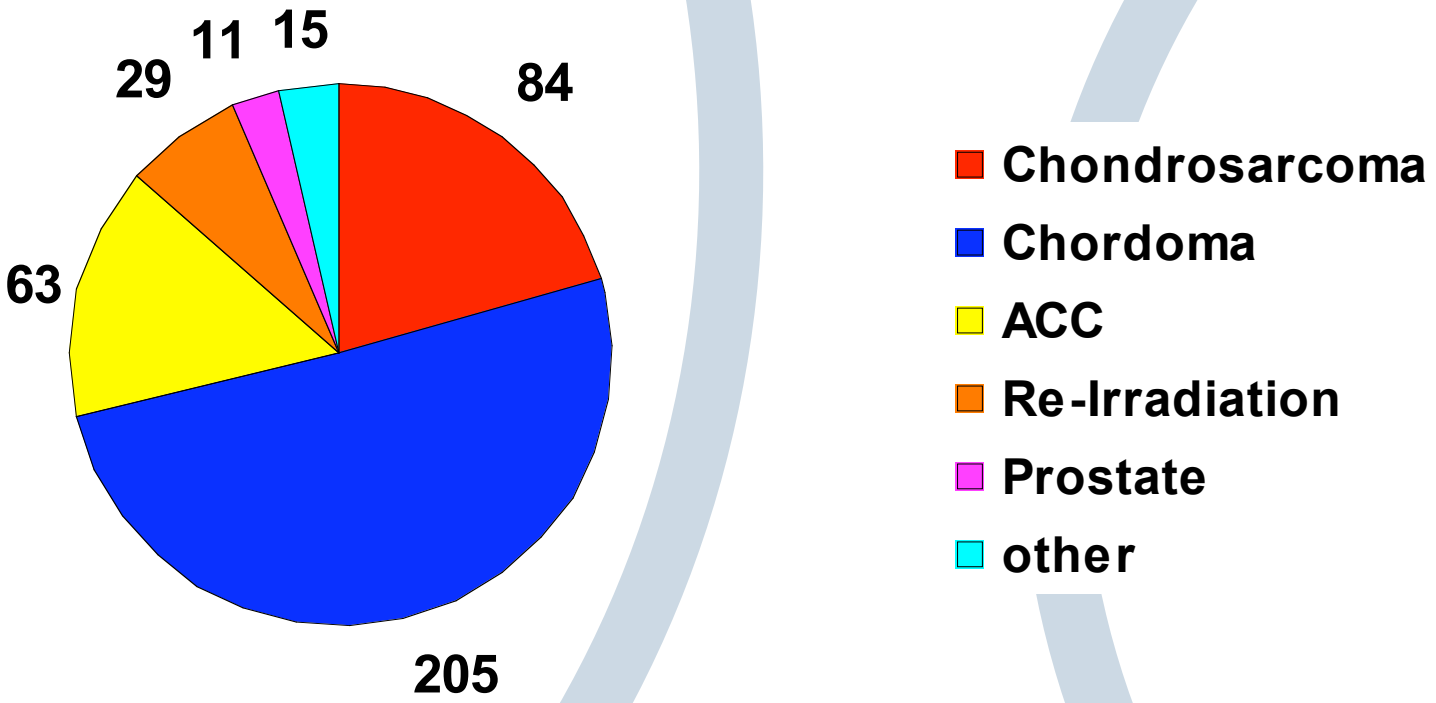
Verification film irradiated with C-12 in 1996

Clinical Experience:

Protons:
PSI, CH: > 350 patients
Carbon-ions:
GSI, D: 407patients

Clinical Feasibility

Carbon Ion Radiotherapy at GSI
n=407



Introduction

Chordomas

- orininate from embryonal remnants of the notochord
- 1-4% of all malignant bone tumors
- 35% localized in the skull base region

Chondrosarcomas

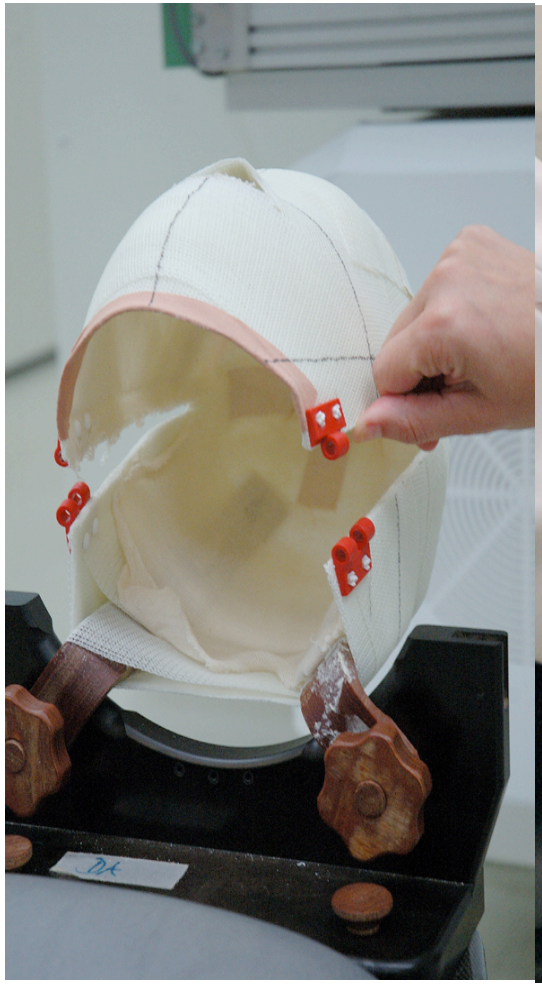
- 10% of all malignant bone tumors
- 5-12% localized in the head-and-neck region

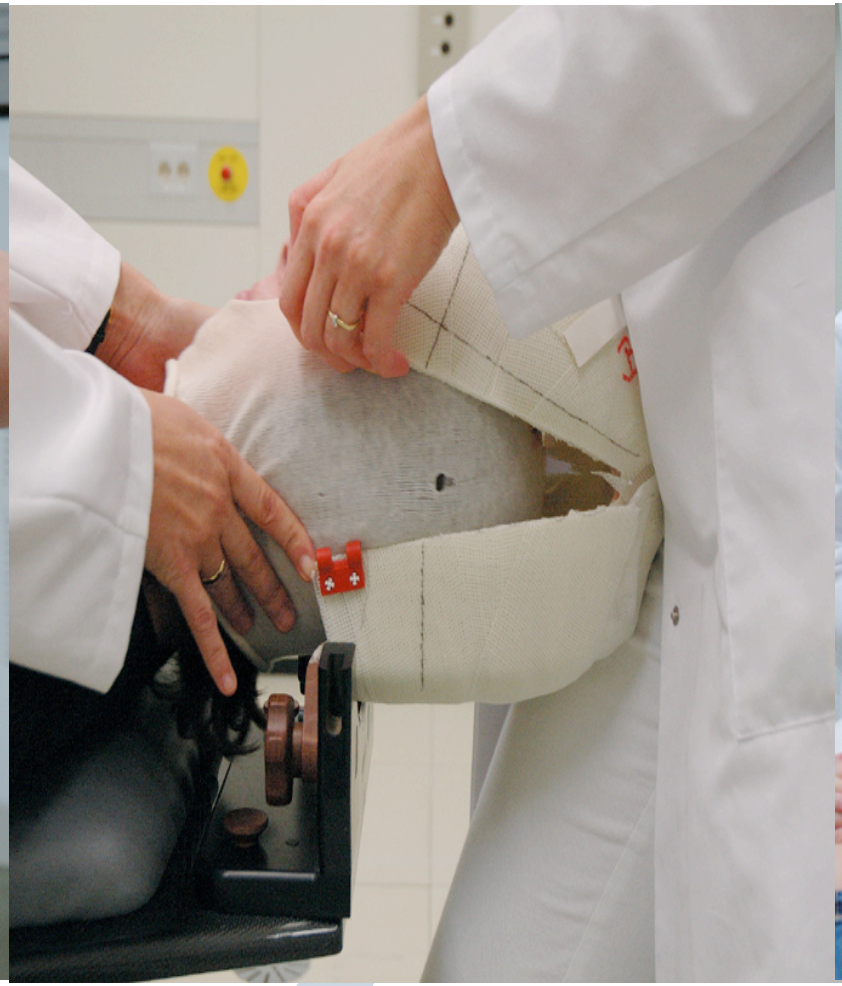
Central role of proton RT for the treatment of chordomas and chondrosarcomas of the skull base

Carbon ion RT in skull base chondrosarcomas Clinical Phase I/II trial 1998-2001

- Intensity-modulated carbon ion RT
- Active beam delivery
- Biological plan optimization
- Stereotactic target point localization
- Total dose 60 CGE, fractionation 7 x 3.0 CGE
- BED 75 CGE (75-96 CGE)

Immobilization for Precision Radiotherapy



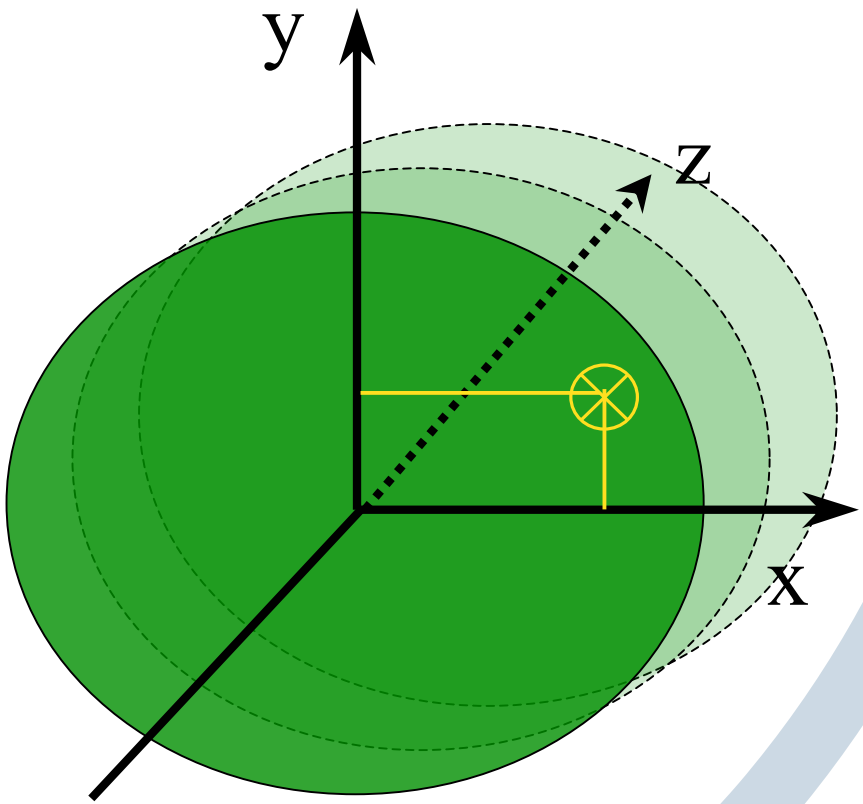


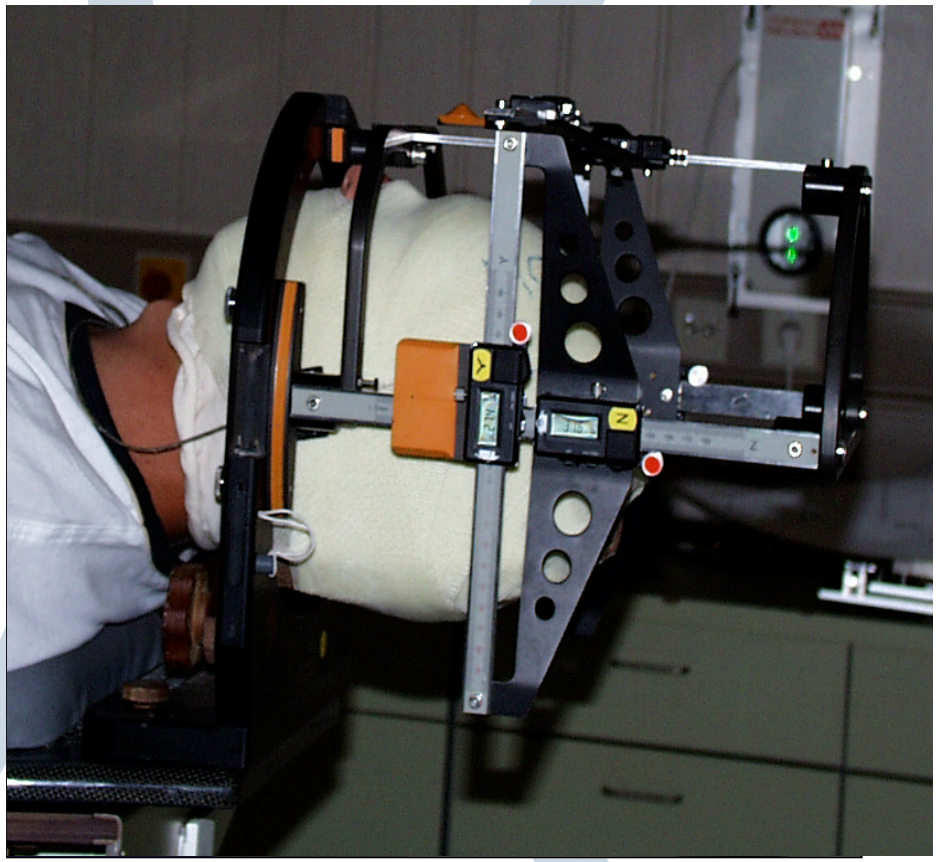
Patient positioning and stereotactic definition of treatment volume

contrast-enhanced CT and MRI scans

image fusion

target delineation





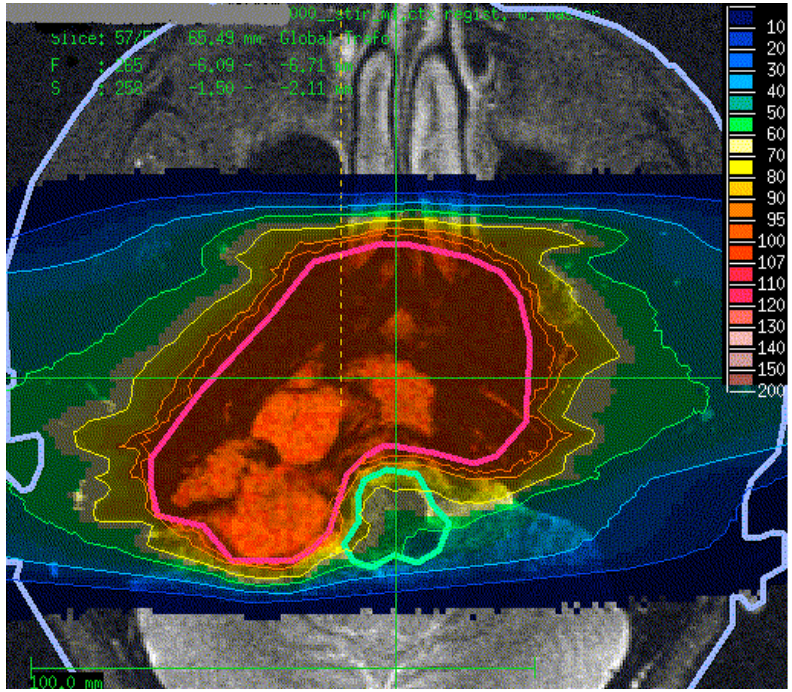
Patients‘ characteristics

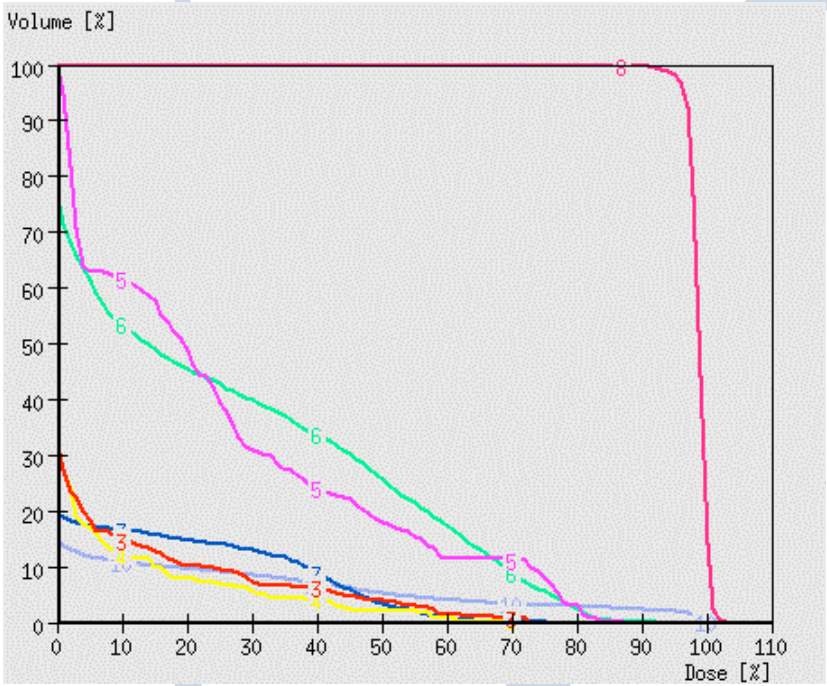
- n=54 chondorsarcoma patients treated between 1998 and 2005
- median age 46 years (6-74)
- m:w = 1:1
- macroscopic tumor in all patients
- WHO-Classification (G1-3, EMC, mesenchymal)

G1	23 (42.6%)
G2	12 (22.2%)
G1/2	5 (9.3%)
well diff.	14 (25.9%)

- Myxoid 7
- Mesenchymal 1

Carbon ion radiotherapy for skull base chondrosarcomas



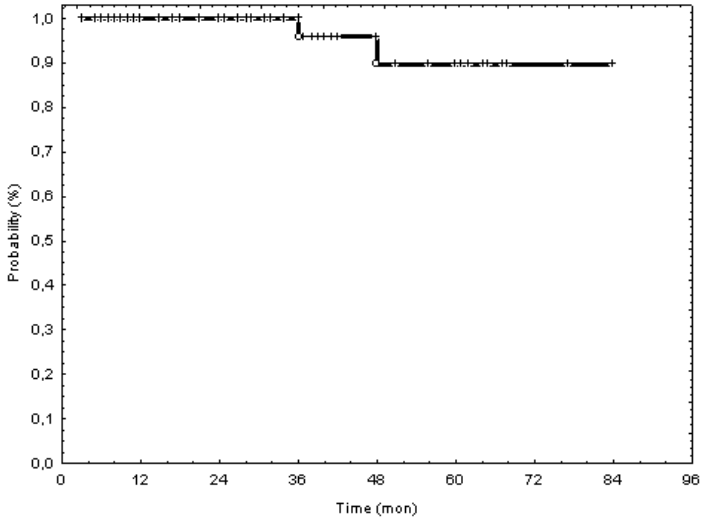


- 54 patients analyzed
- GD = 60 Gy E, 7 x 3Gy E/week

Schulz-Ertner et al. IJROBP, 2007

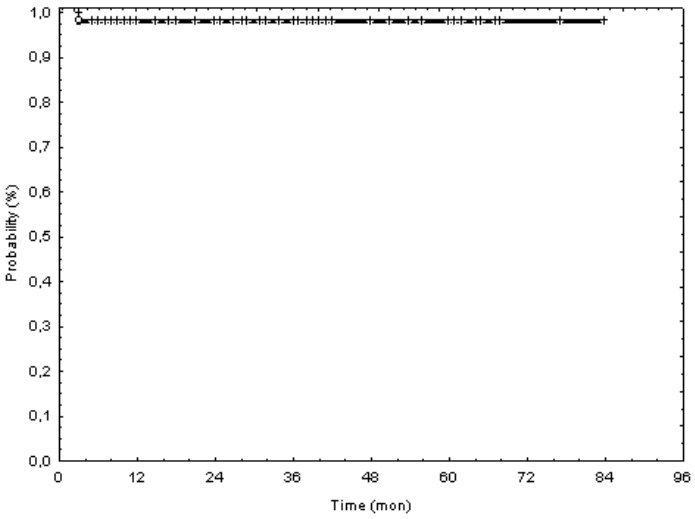
Carbon ion radiotherapy for skull base chondrosarcomas

Local Control



96.2% and 89.8% @ 3 and 4 years

Overall Survival



5-years OS 98.2%

2 recurrences (mesenchymaler histology): n=1 in-field
n=1 field border

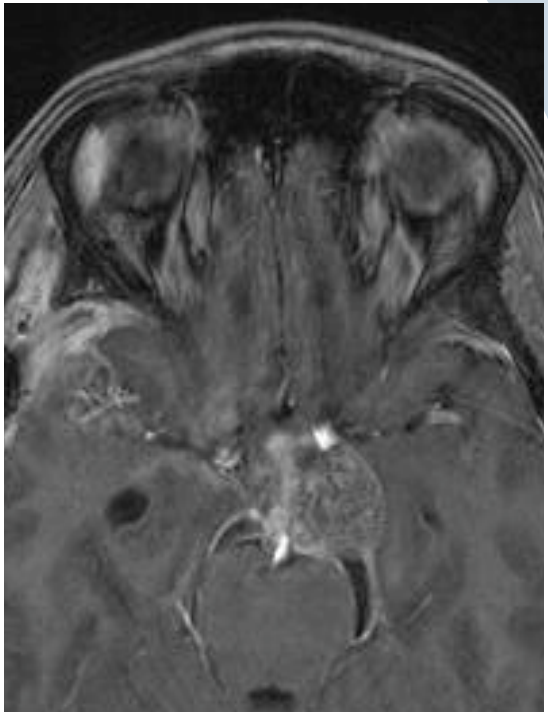
Schulz-Ertner et al. IJROBP, 2007

Particle therapy for chondrosarcomas

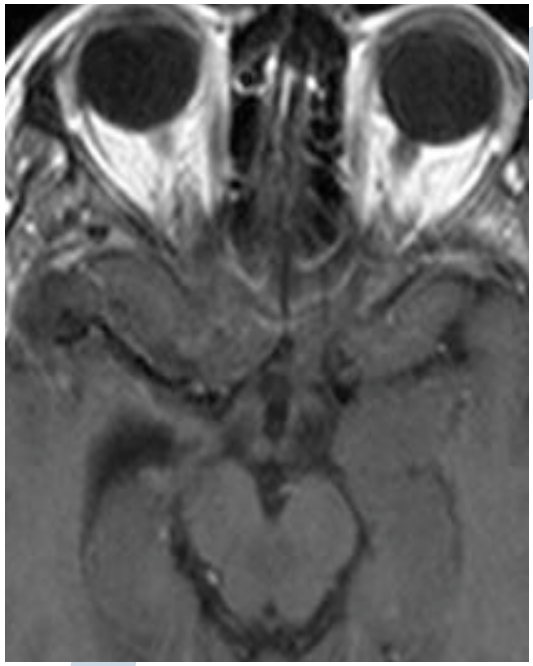
Author, year	n	RT	dose	LC
Rosenberg, 1999	200	Prot. (+ Phot)	72.1 ´	98% / 5y
Hug, 1999	25	Protons	70.7	23/25 / 5y
Weber, 2005	11	Protons	68	100% / 3y
Castro, 1994	27	He	65	78% / 5y
Noel, 2003	18	Prot + Phot	67	85% / 3y
Schulz-Ertner, 2007	54	C12	60*	89% / 4y

*FX 75 CGE

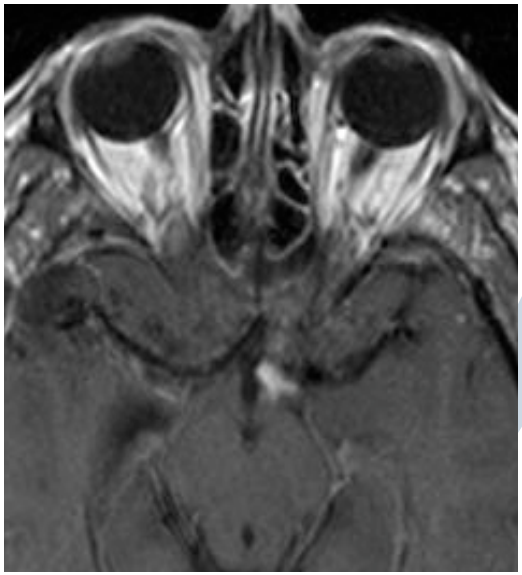
Prior to C12:
rt. hemianopsia
60 GyE



PR



12 months
hemianopsia

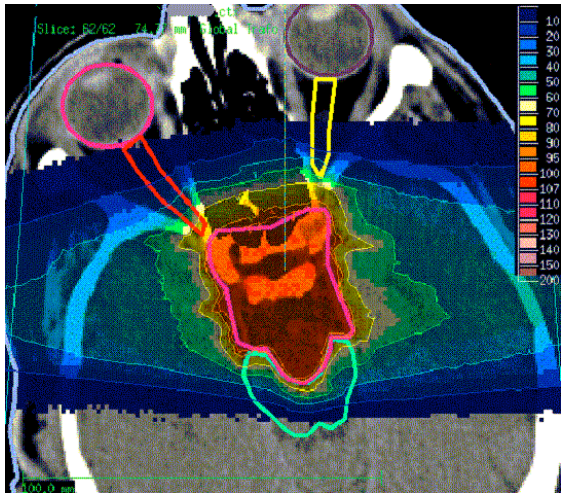


20 months
moderate
improvement

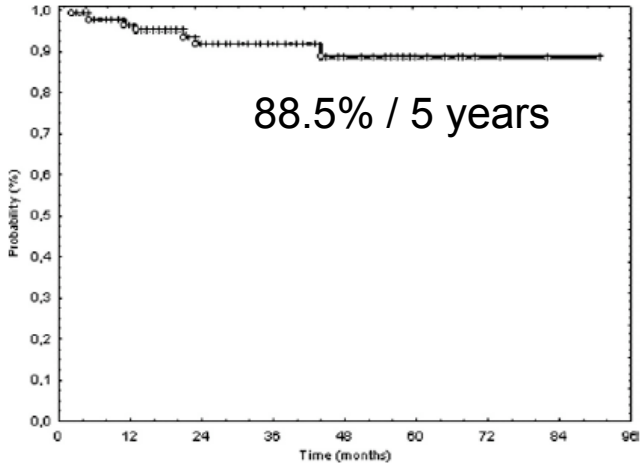
Carbon ion RT in skull base chordoma prospective phase I/II trial (1998-2001)

- 1998 – 2005, n=96 with macroscopic tumor
- Total dose 60 – 70 CGE, weekly fractionation 7 x 3.0 CGE (a/ß=2 Gy) corresponding to BED of 75-96 CGE
- Intensity-modulated carbon ion RT, active beam delivery
- Biologic plan optimization
- Prospective clinical phase I/II trial: 43 patients, 53 further patients
- Median FU 31 months
- Regular FU with MRI scan

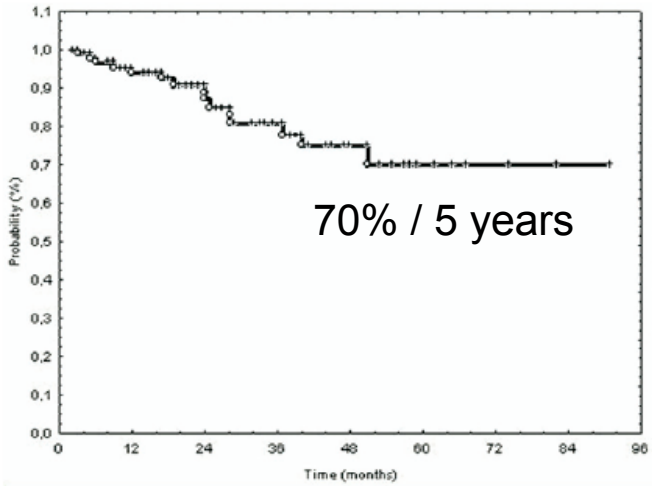
Carbon ion radiotherapy for skull base chordomas



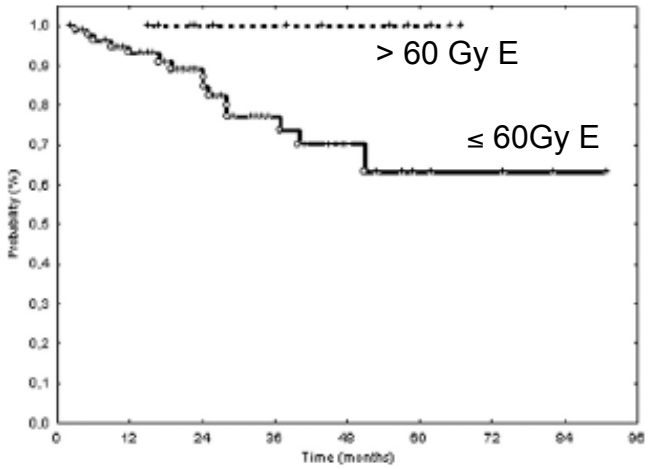
Overall Survival



Local Control



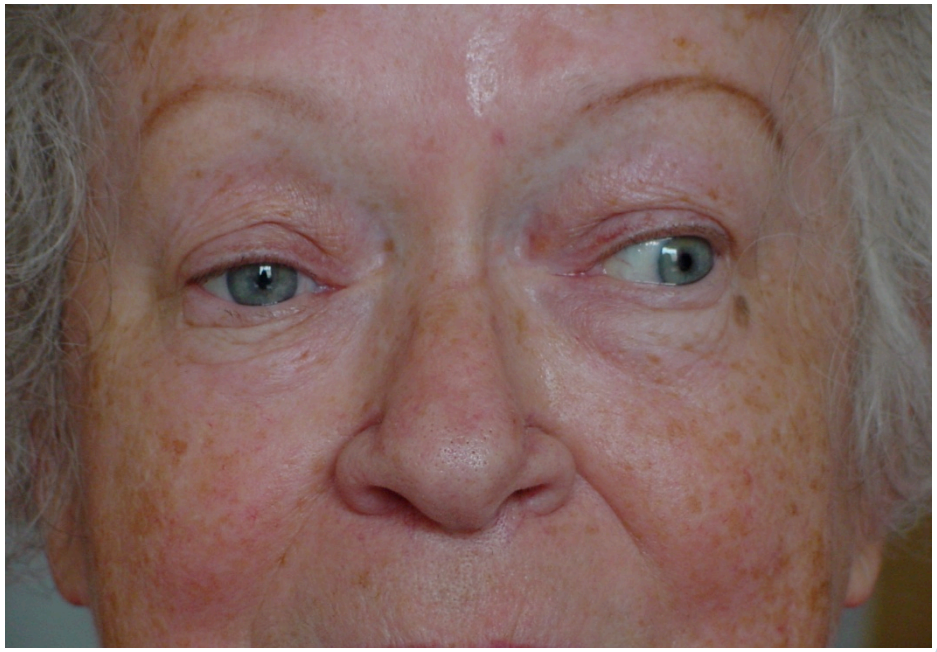
Dose-response relationship



Schulz-Ertner et al. IJROBP, 2007

Chordoma of the Skull Base

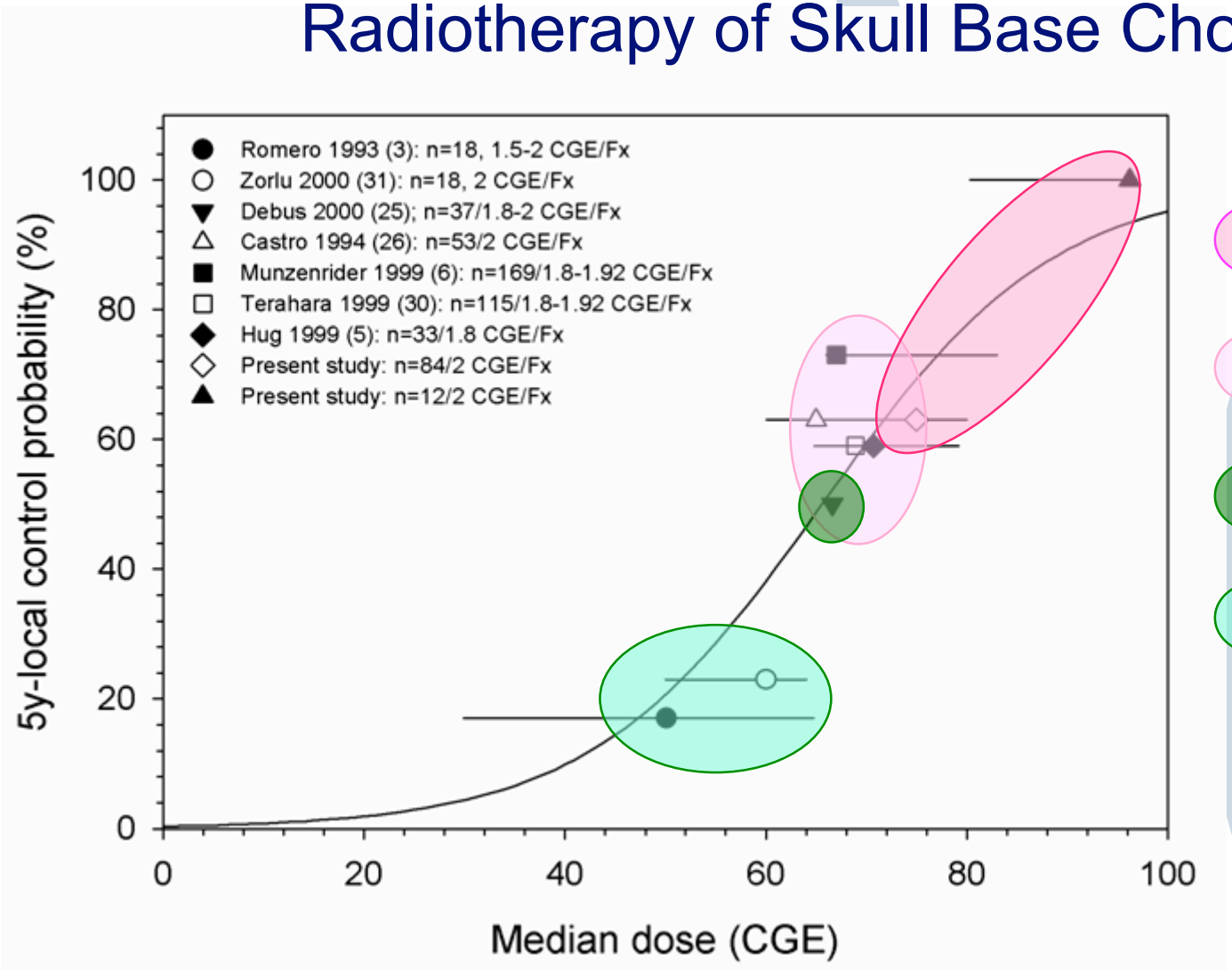
patient with intended left lateral gaze



Before RT: diplopia

6 Months after RT resolution of diplopia

Motivation: Dose Response Relationship Radiotherapy of Skull Base Chordomas



C-Ions

Protons

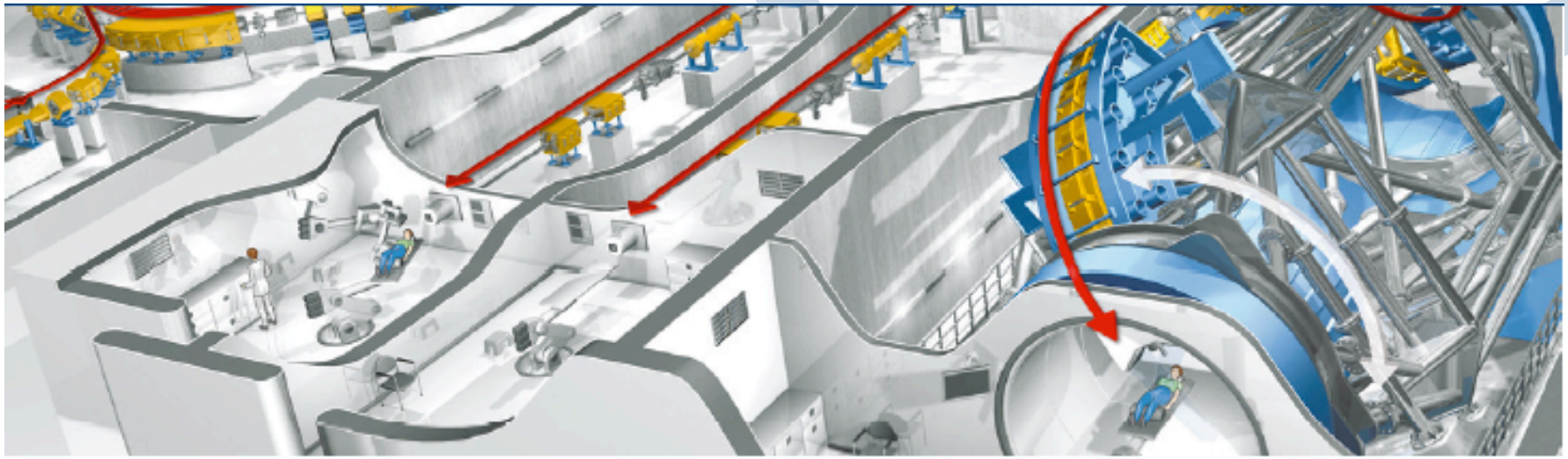
FSRT

conventional RT

[Schulz-Ertner, IJROBP 2007]

Carbon ion Radiotherapy at GSI

- Clinical feasibility and safety was shown
- excellent local control rates for chordomas/chondrosarcomas of the skull base with low toxicity
- superior results for photon treatment for adenoidcystic carcinomas (boost treatment)
- currently study on prostate cancer (boost treatment)
- further studies on carbon ion RT required
- for skull base chordomas and chondrosarcomas, randomized trials comparing proton and carbon ion RT are needed



PTCOG 48: September 21st – September 25th, 2009

48th Annual Meeting of the Particle Therapy Co-Operative Group (PTCOG)

University Hospital of Heidelberg,
Department of Radiation Oncology,
Heidelberg Ion Therapy (HIT) Center Heidelberg, Germany

Contact Information

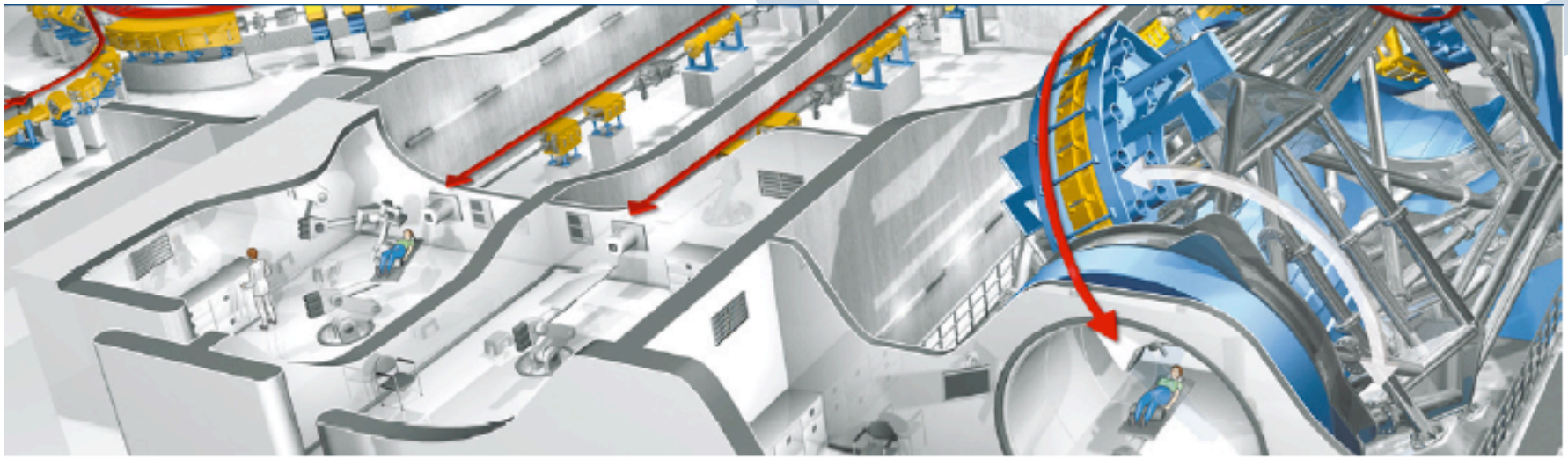
Meeting homepage

- meeting venue
- progamme updates
- hotel and travel
- sightseeing and entertainment

www.klinikum.uni-heidelberg.de/ptcog2009

Local organizing committee – Send us and e-mail!

ptcog.2009@med.uni-heidelberg.de



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