

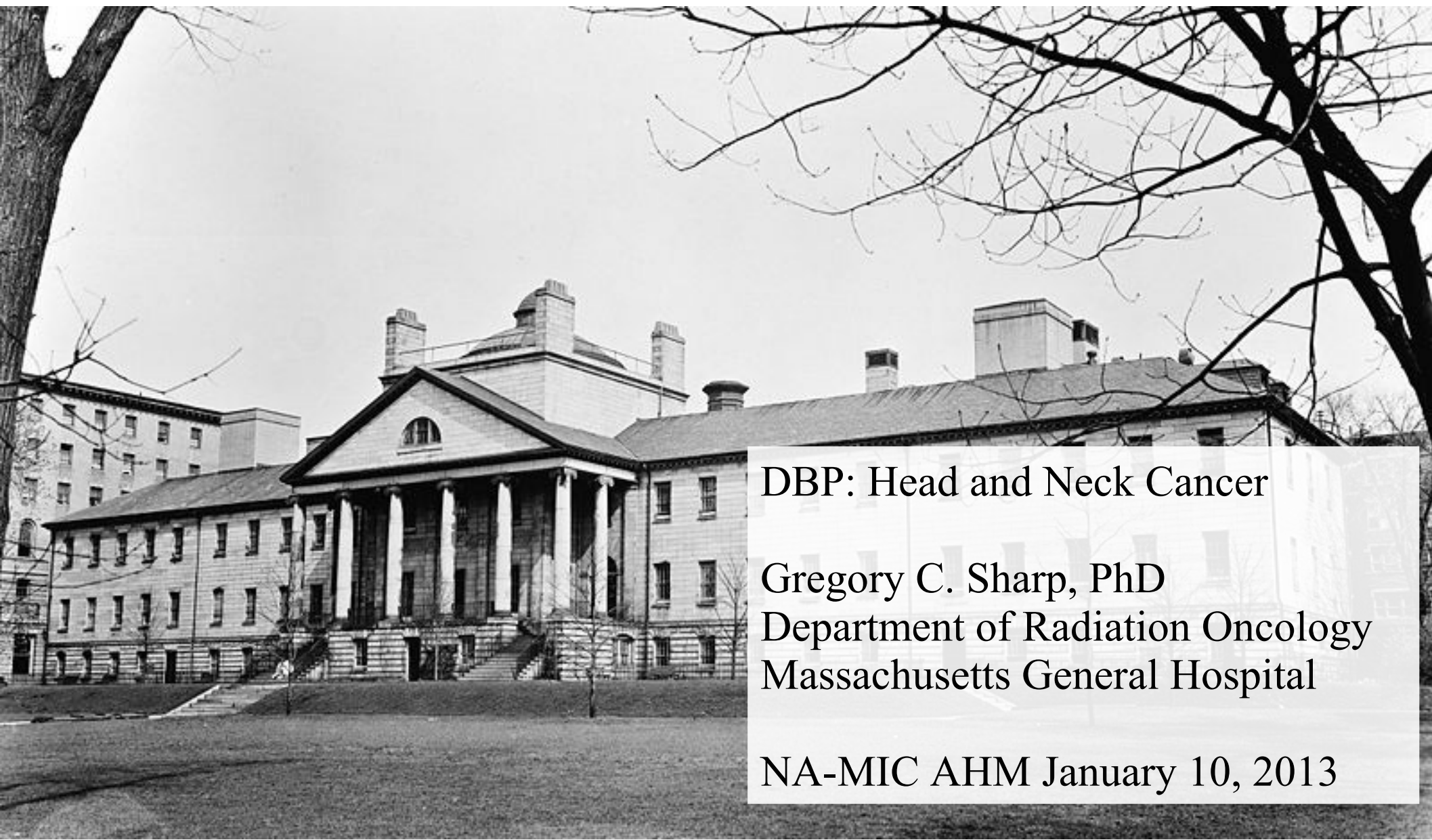


MASSACHUSETTS
GENERAL HOSPITAL

RADIATION ONCOLOGY



*National
Alliance for
Medical Image
Computing*



DBP: Head and Neck Cancer

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Department of Radiation Oncology
Massachusetts General Hospital

NA-MIC AHM January 10, 2013

Head & neck cancer: Statistics

- Between 4-6% of all new cancer cases
- About 60,000 new cases per year
- 60% present with advanced disease
- 5 year survival: 57%
- Multimodal treatment

Head & neck cancer sites

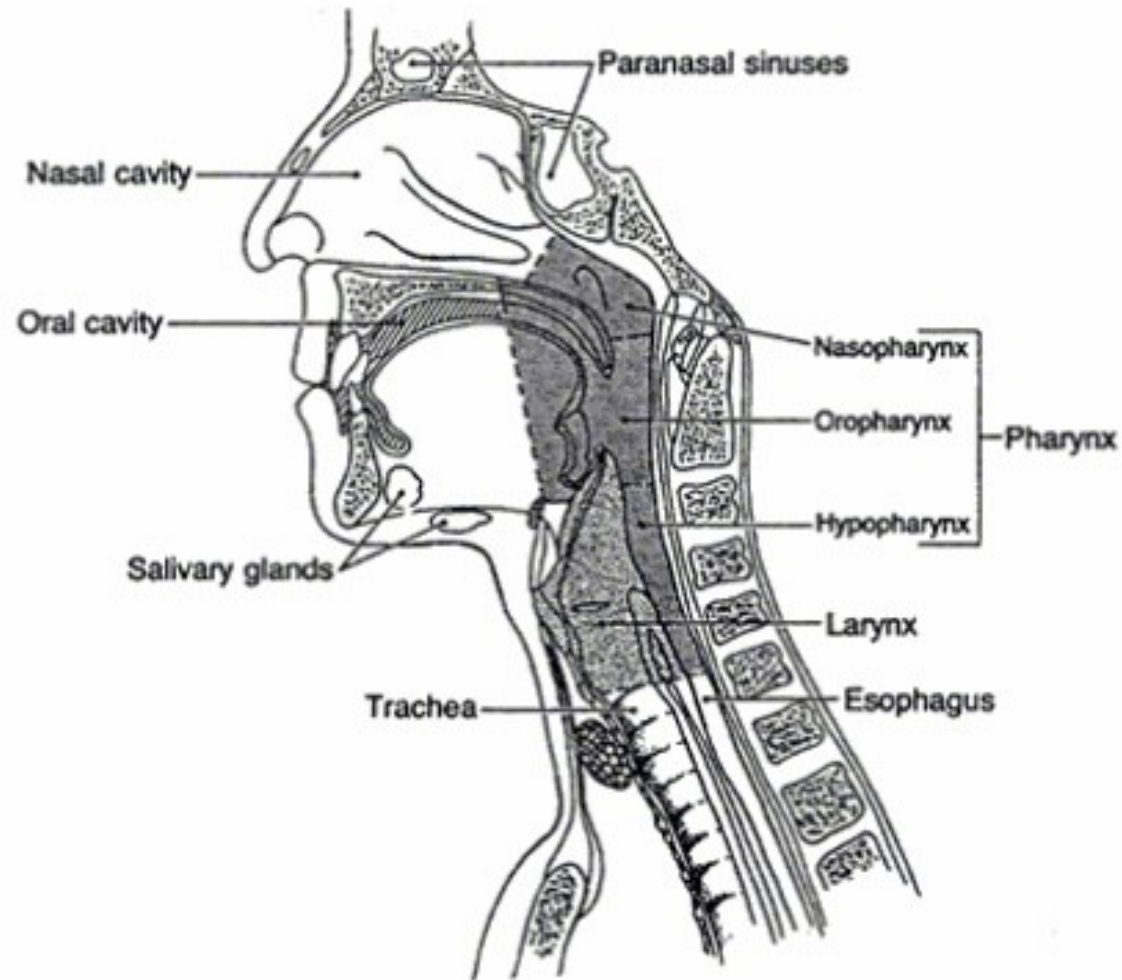
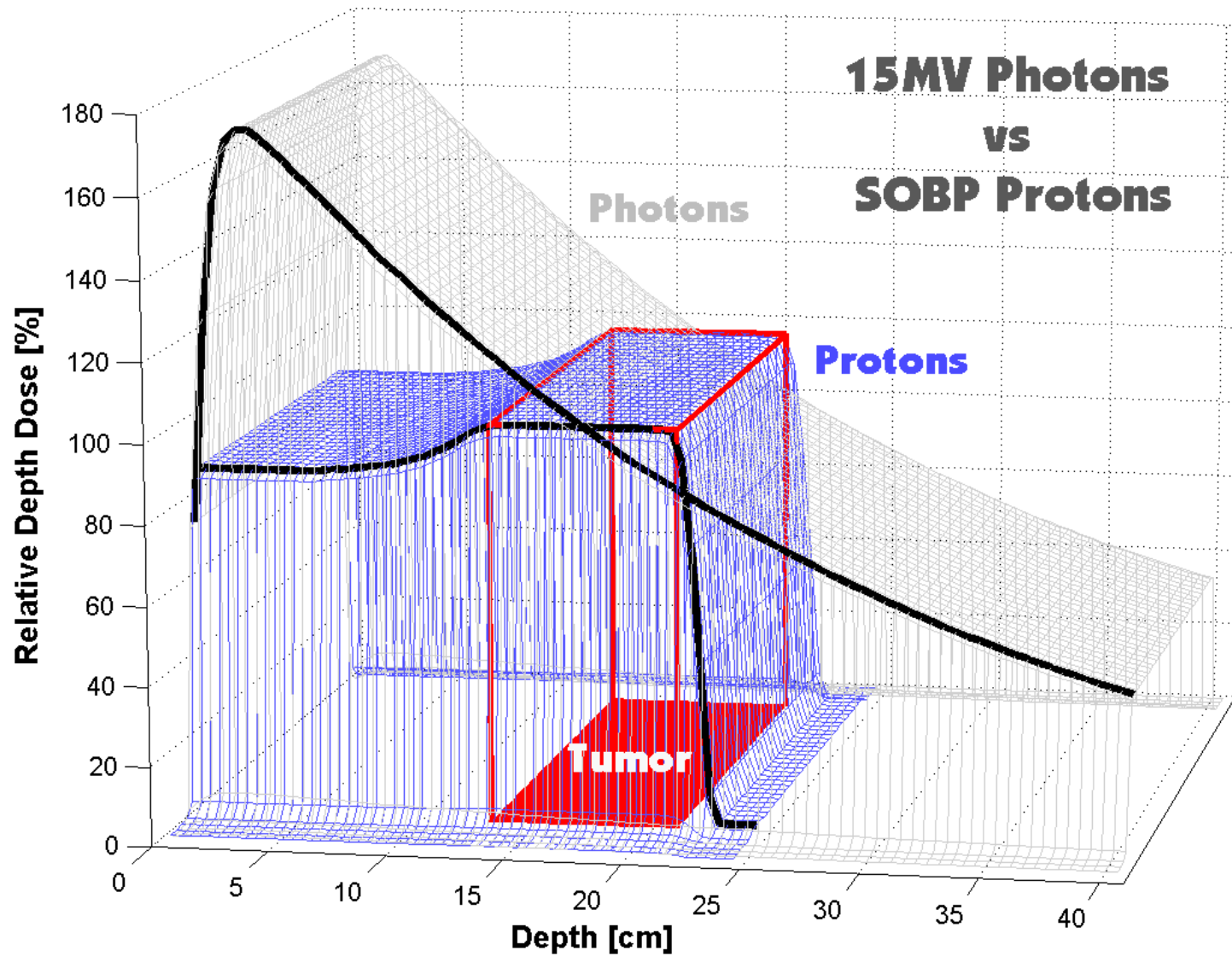


Image credit: American Cancer Society (www.cancer.org)

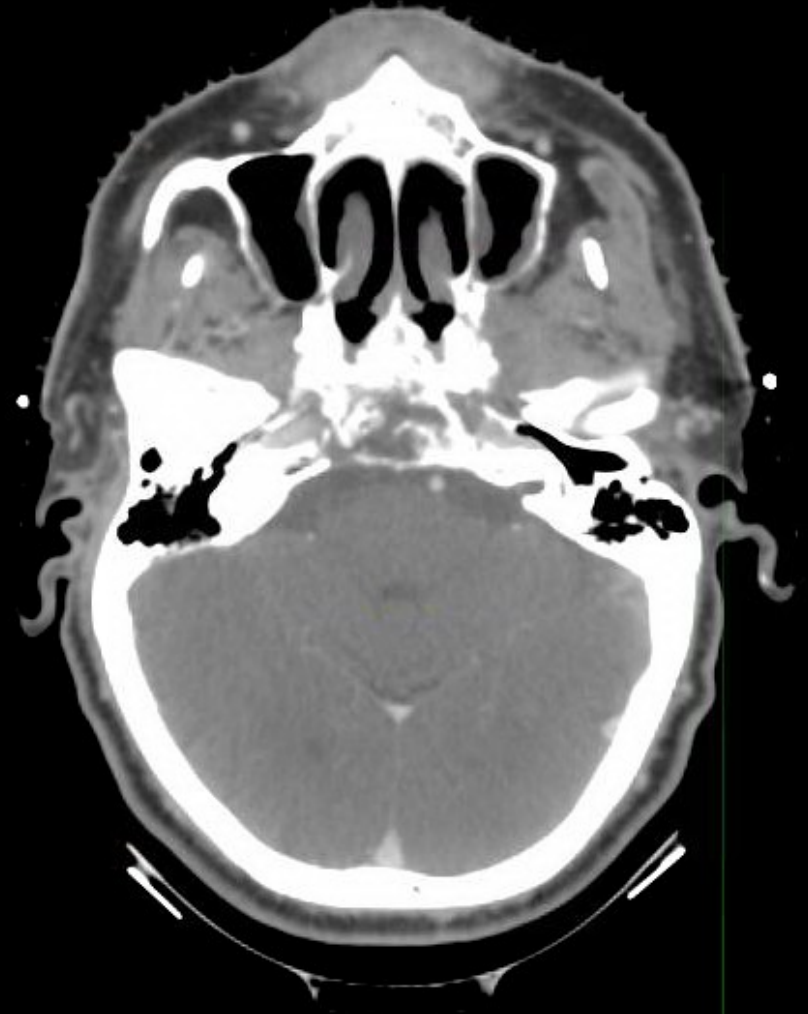
Proton therapy



Rationale for adaptive radiotherapy



L R



Proton therapy in the news...

THE WALL STREET JOURNAL.

Costly Cancer Therapy Dinged

Proton-Beam Treatment for Prostate Tumors No Better Than Radiation, Study Says

CBSNEWS

IMRT is best radiation for early prostate cancer, study finds

npr

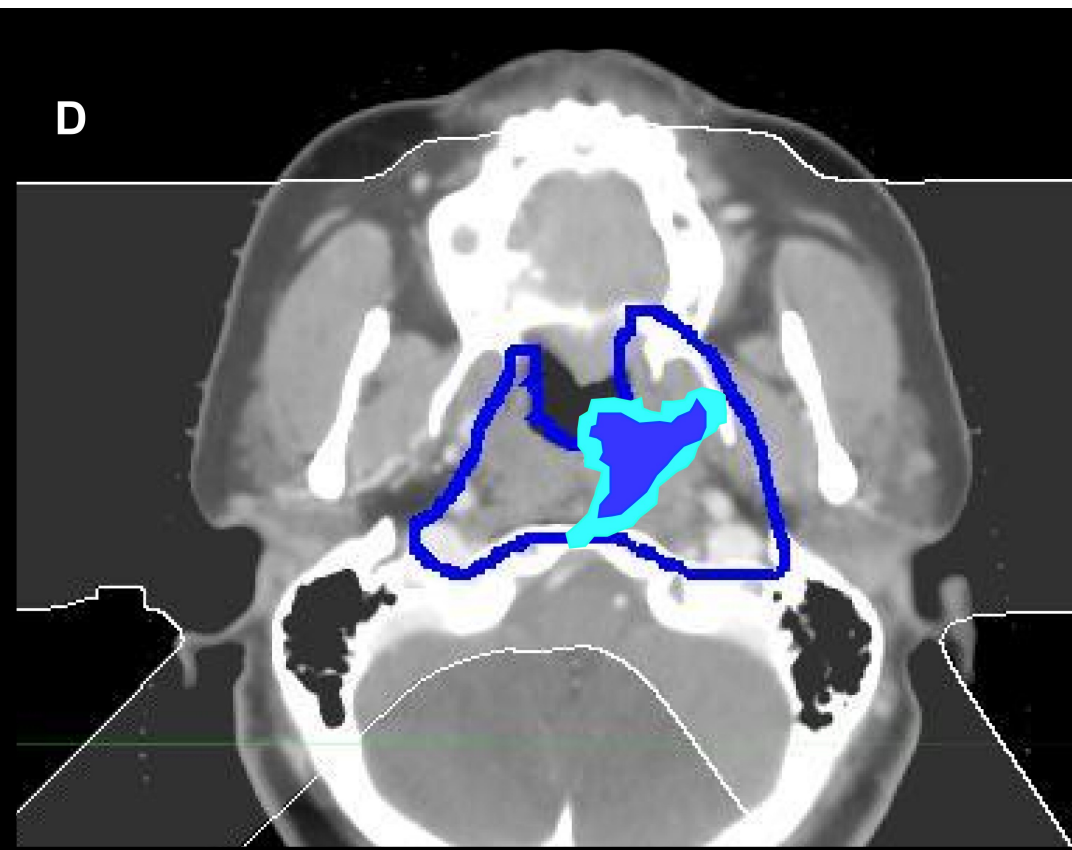
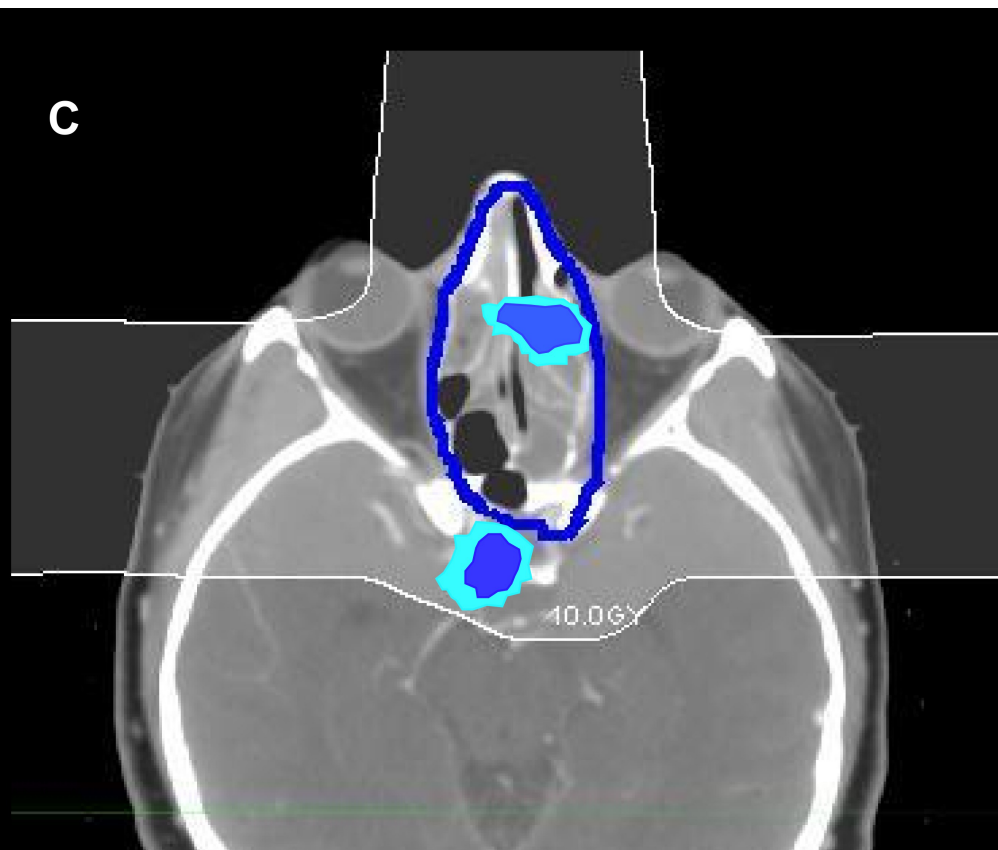
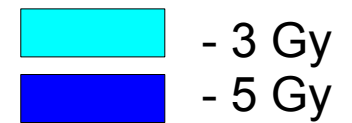
Pricey Prostate Cancer Therapy Raises Questions About Safety, Cost

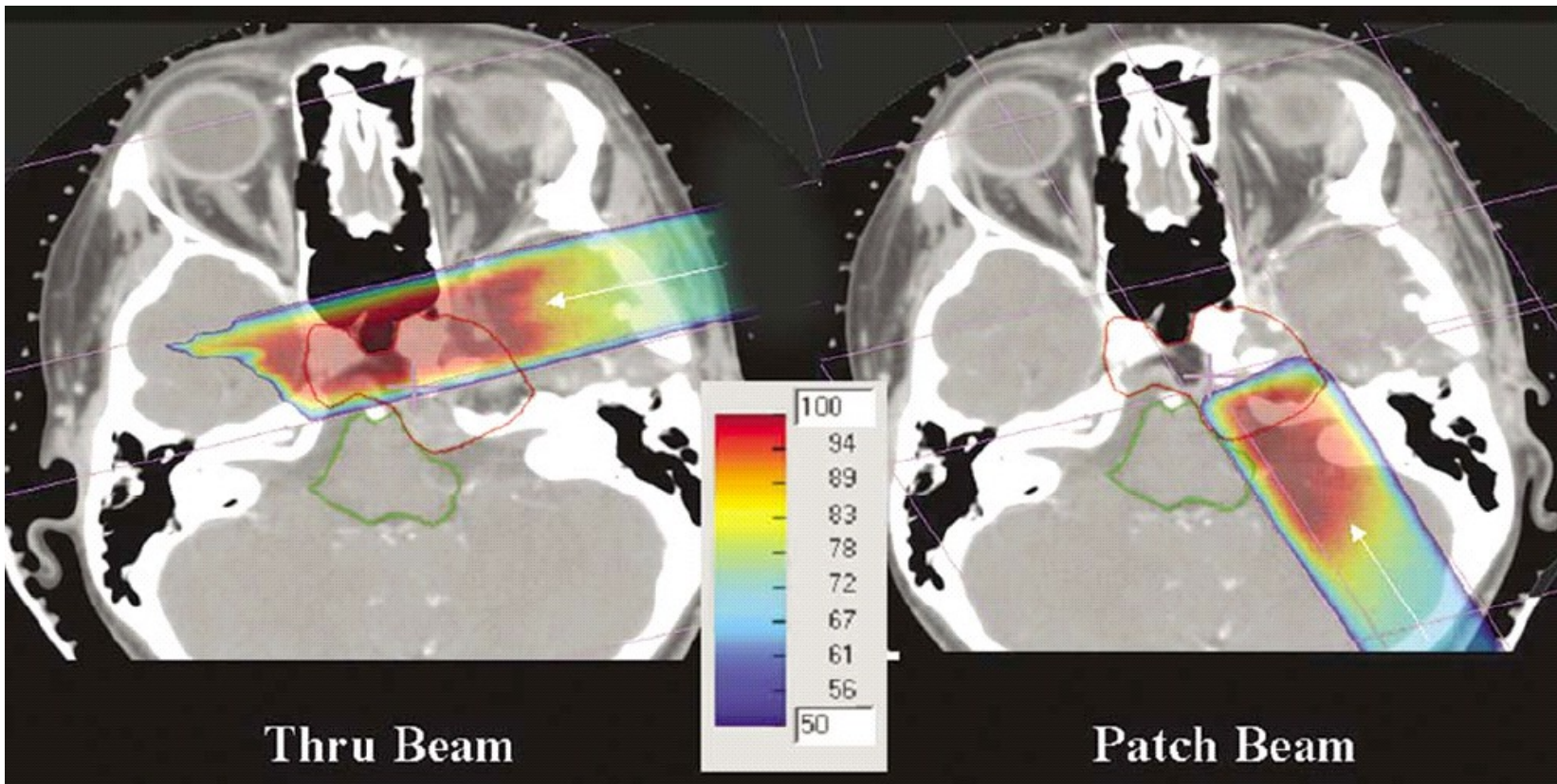
Protons for sinonasal cancers

3D Protons	71.6 Gy, 88 % local control @ 6.6 yrs (Chan 2004) 65 Gy, 77 % local control @ 1 yr (Zenda 2011)
IMRT	63 Gy, 62 % local control @ 5 yrs (Hoppe 2006) 66 Gy, 64 % local control @ 2 yrs (Wiegner 2012)

Findings during 2012

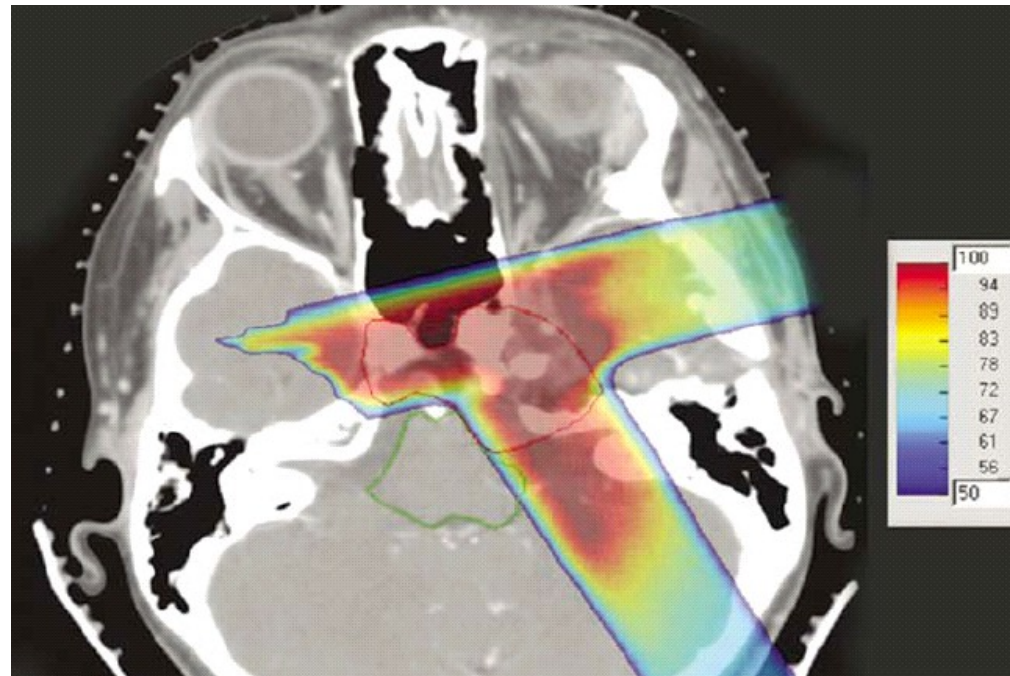
- Hot & cold spots in tumor



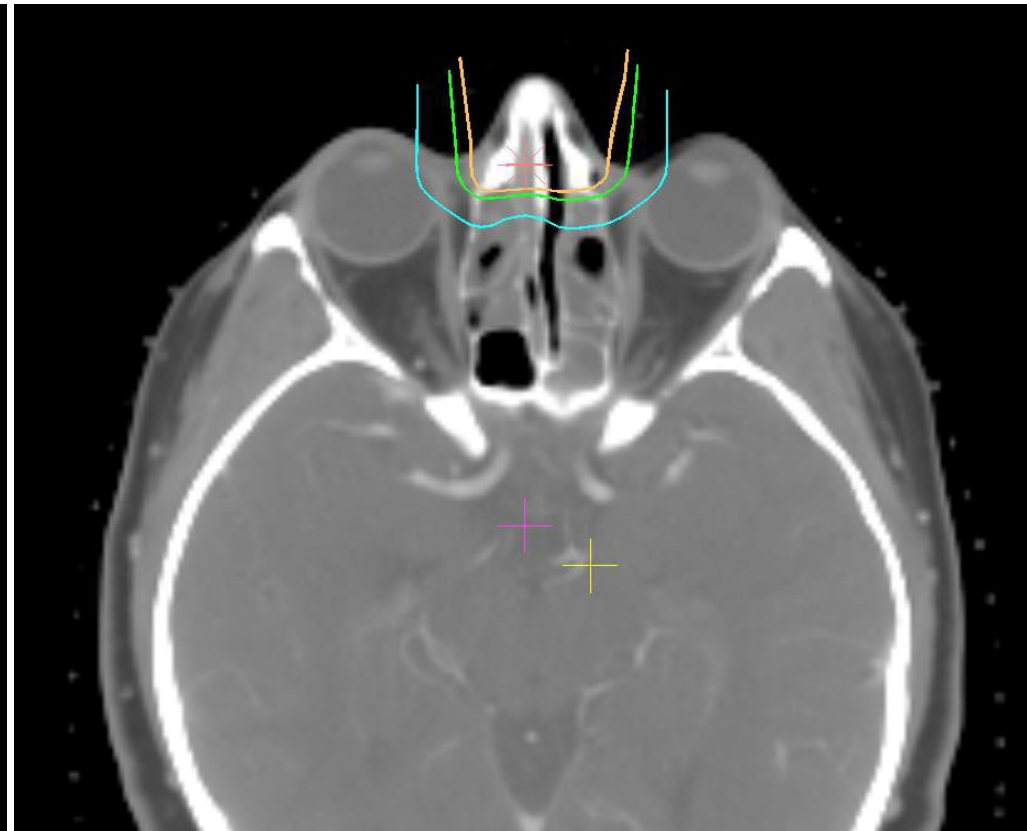
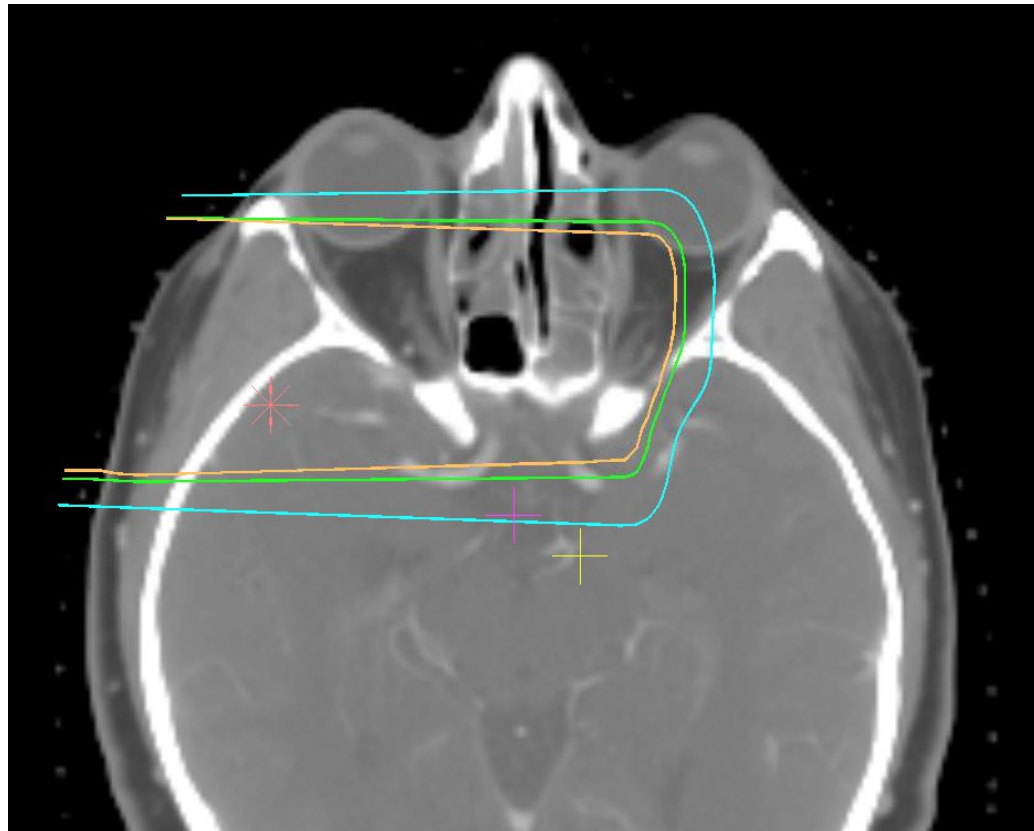


Thru Beam

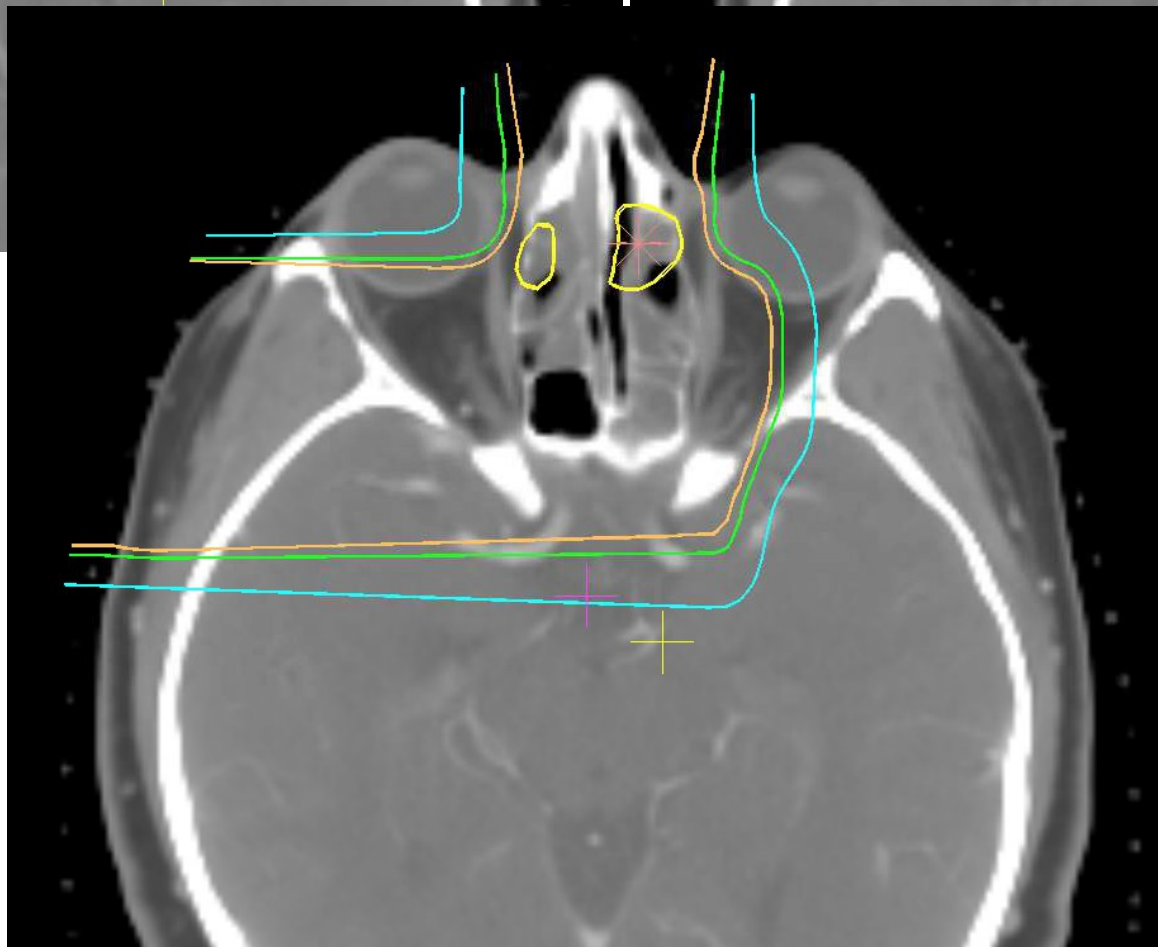
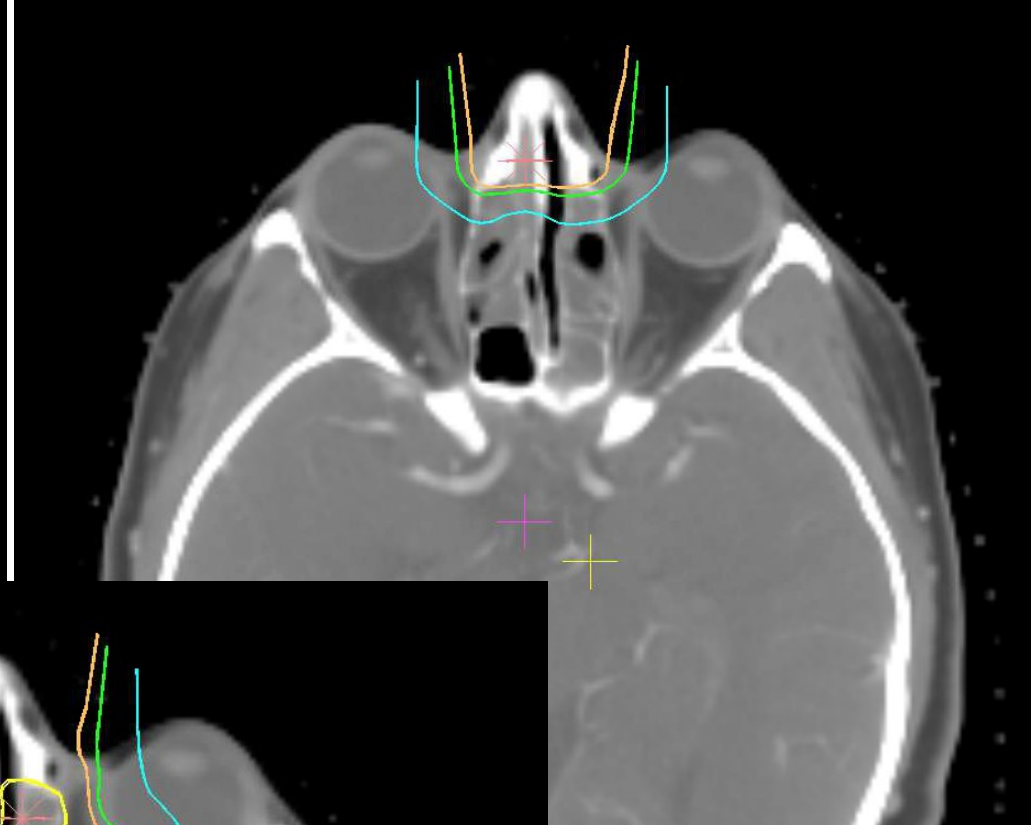
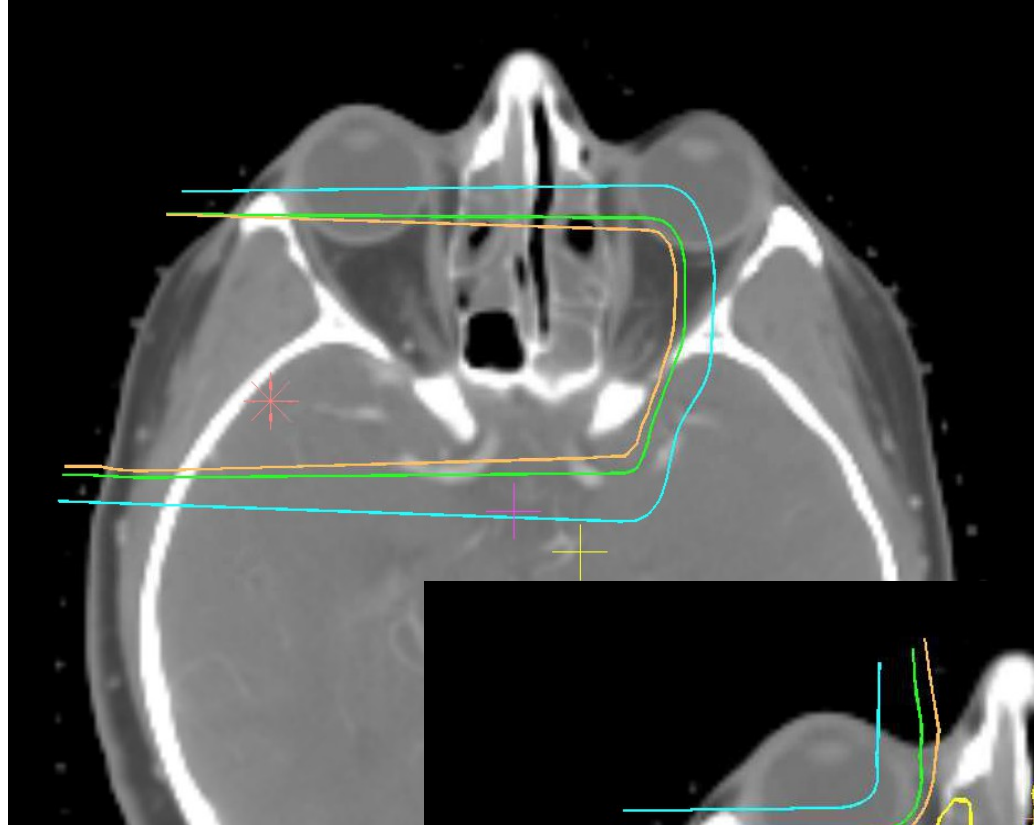
Patch Beam



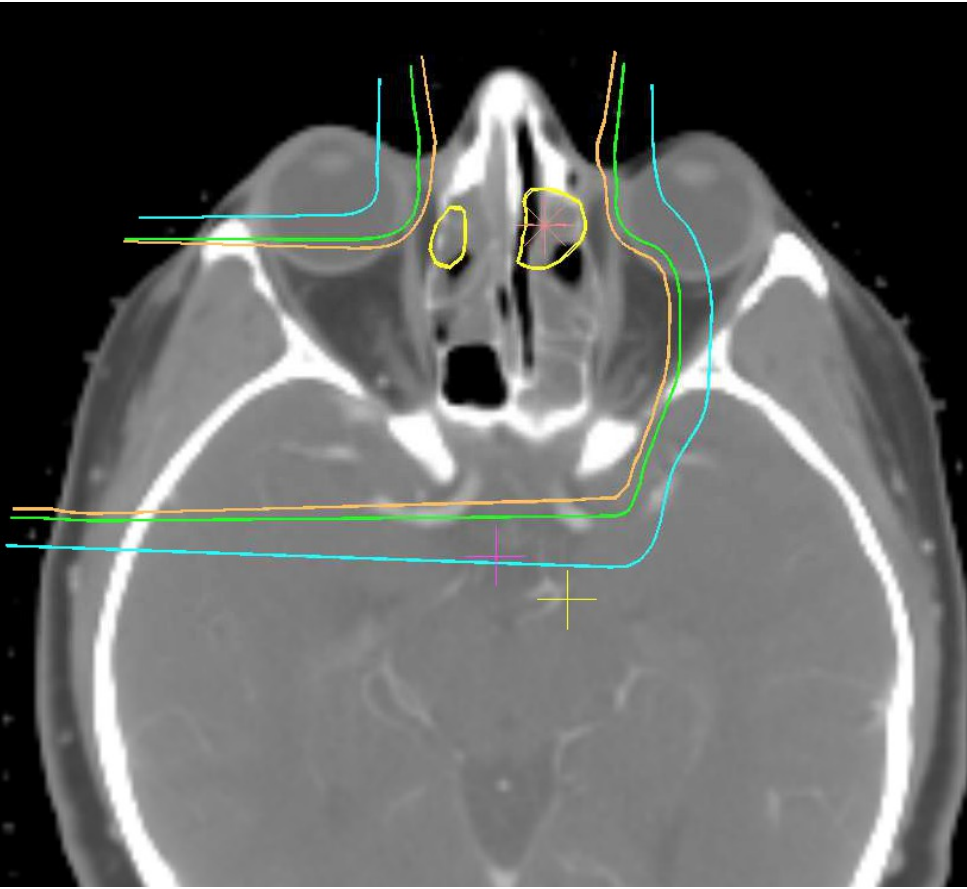
Patching



- 50%
- 90%
- 100%



Patching

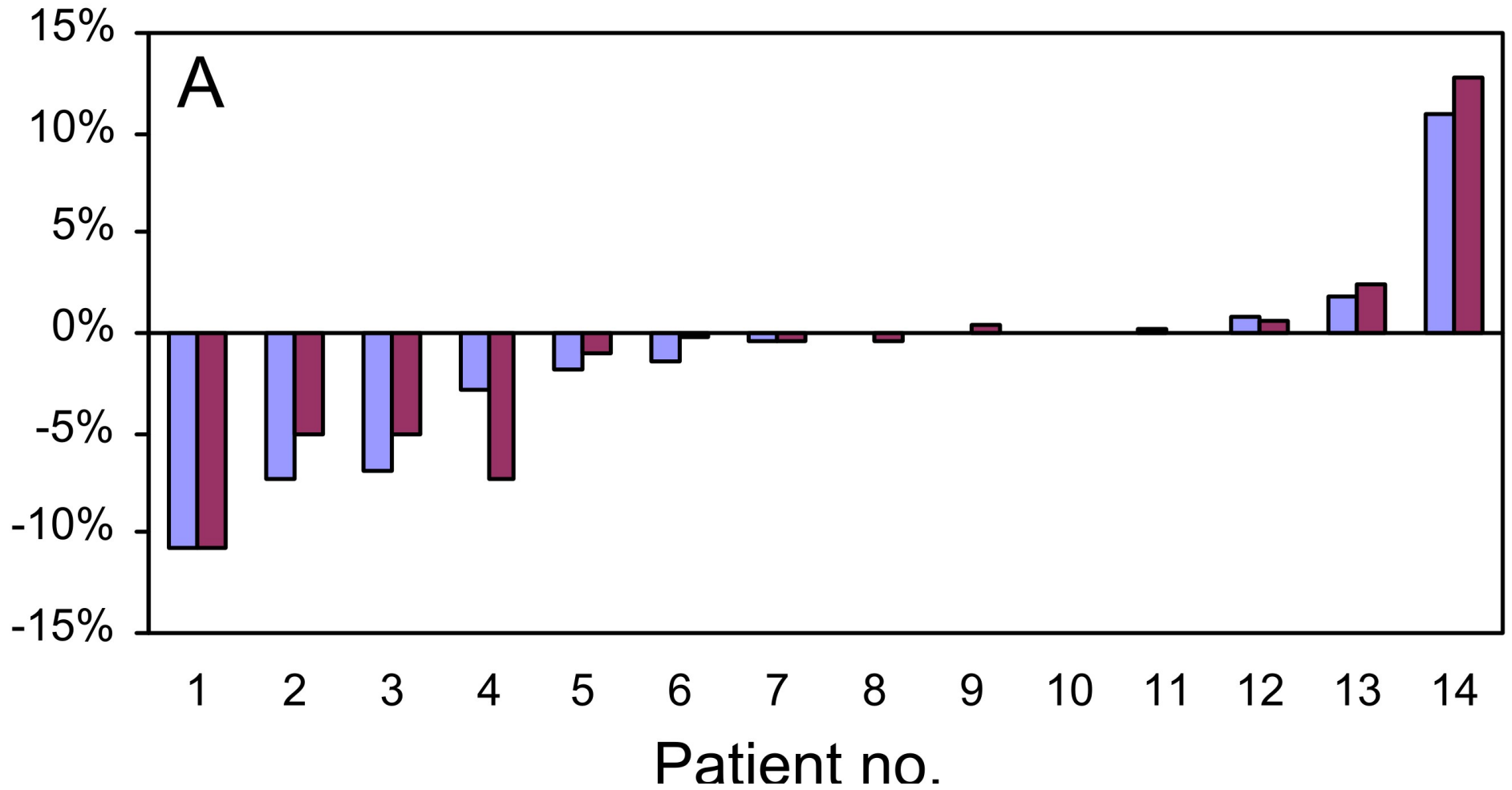


Pre-treatment

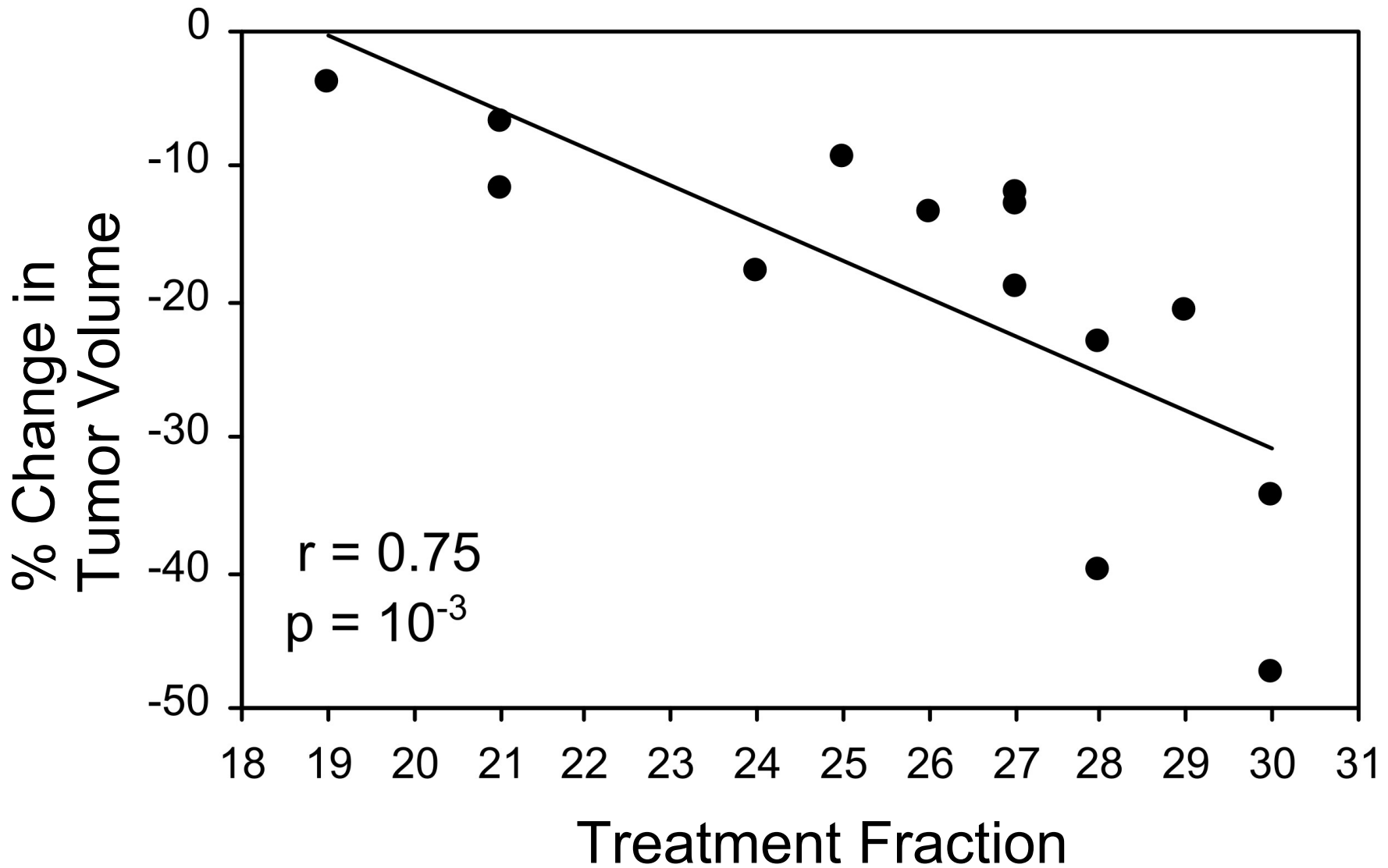


Mid-treatment

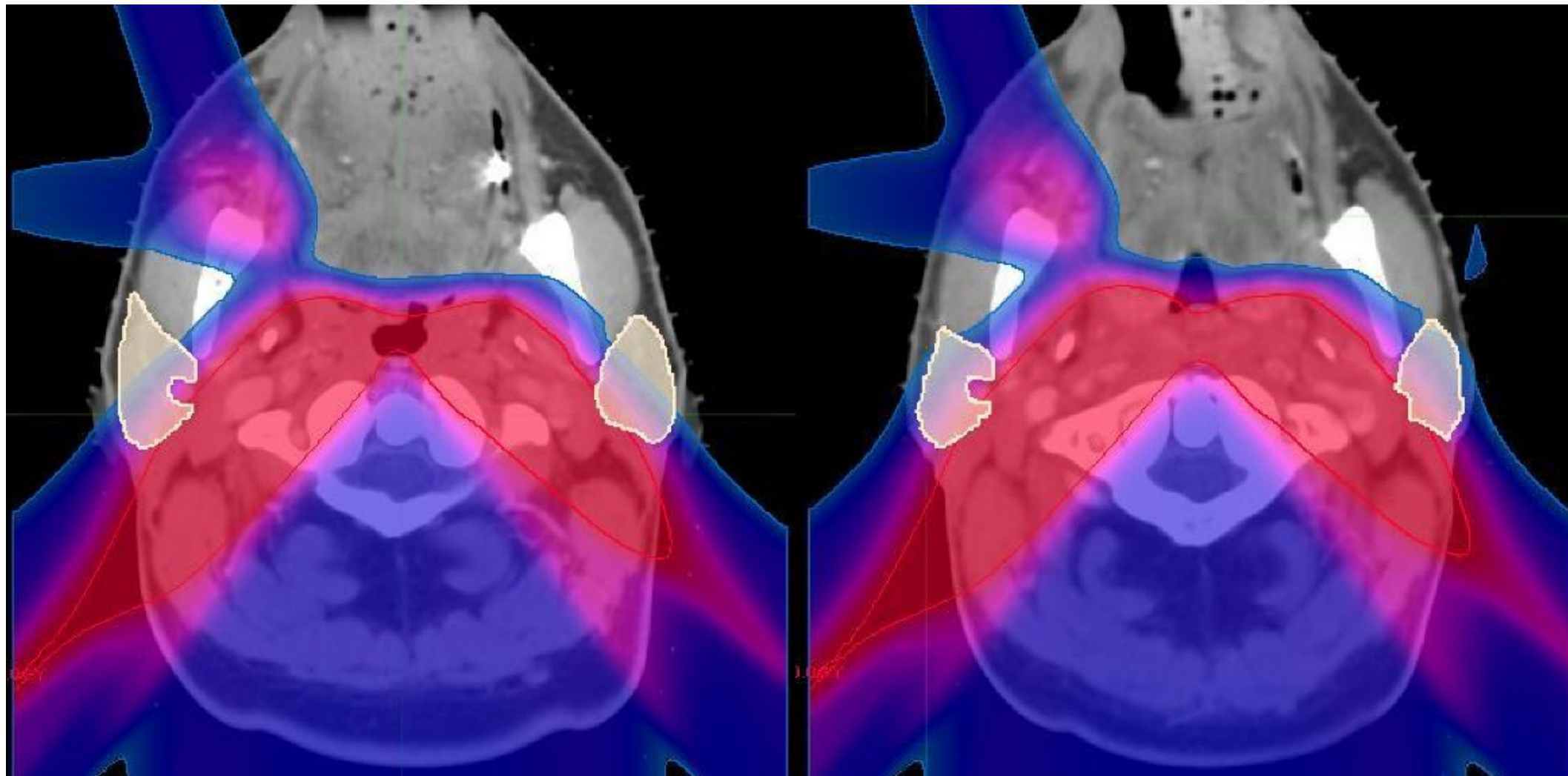
Change of mean dose to CTV and GTV



Progressive change



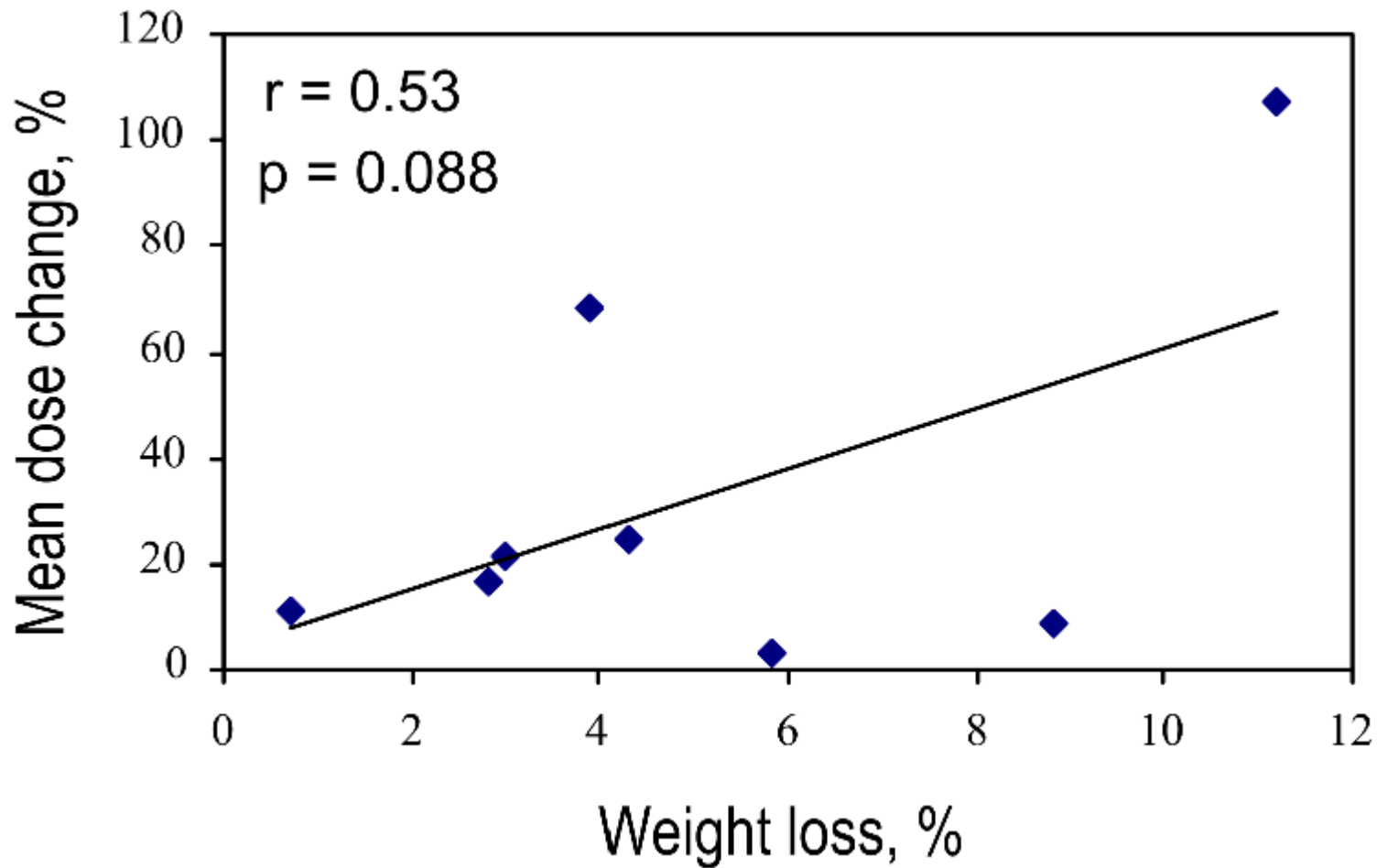
Change in parotids



Pre-treatment

Mid-treatment

Progressive change



Plan for year 4

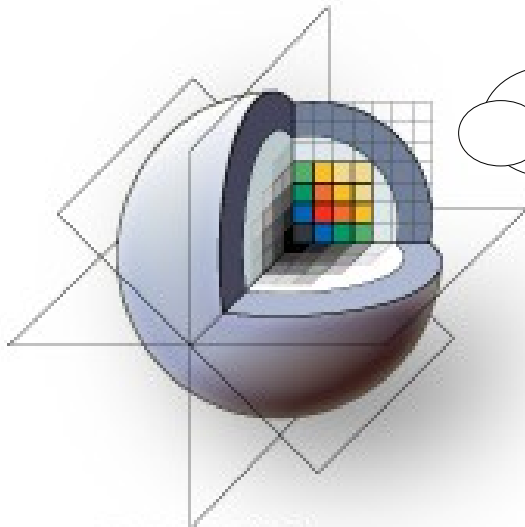
- Hybrid registration
- Atlas-based segmentation
- DICOM-RT improvements
- DIR validation suite
- Dissemination and training

Hybrid registration

Problem Type	3D Slicer Module	Algorithm
Fully Automatic	BRAINS, plastimatch, HAMMER, ...	B-Spline, demons, etc.
Hybrid	?	?
Fully Manual	LANDWARP	Thin-plate spline, Wendland spline, Gaussian spline

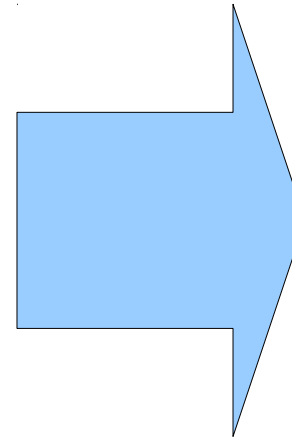
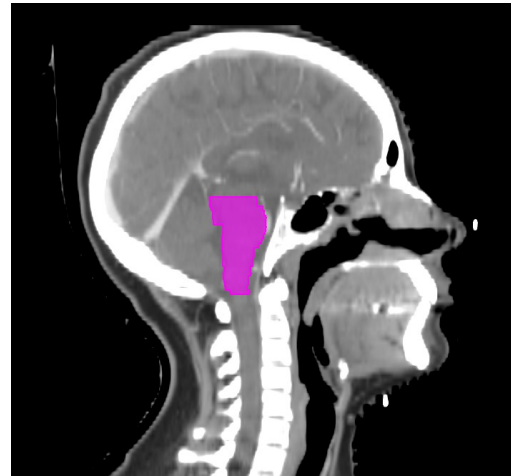
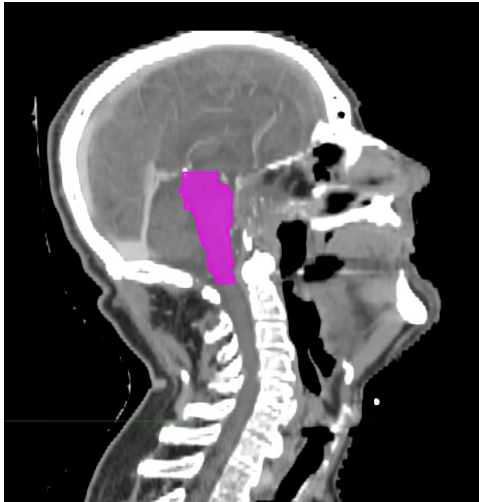
Hybrid registration

Cost = image metric
+ λ landmark metric
+ ρ regularization metric



3DSlicer

Atlas-based segmentation



???

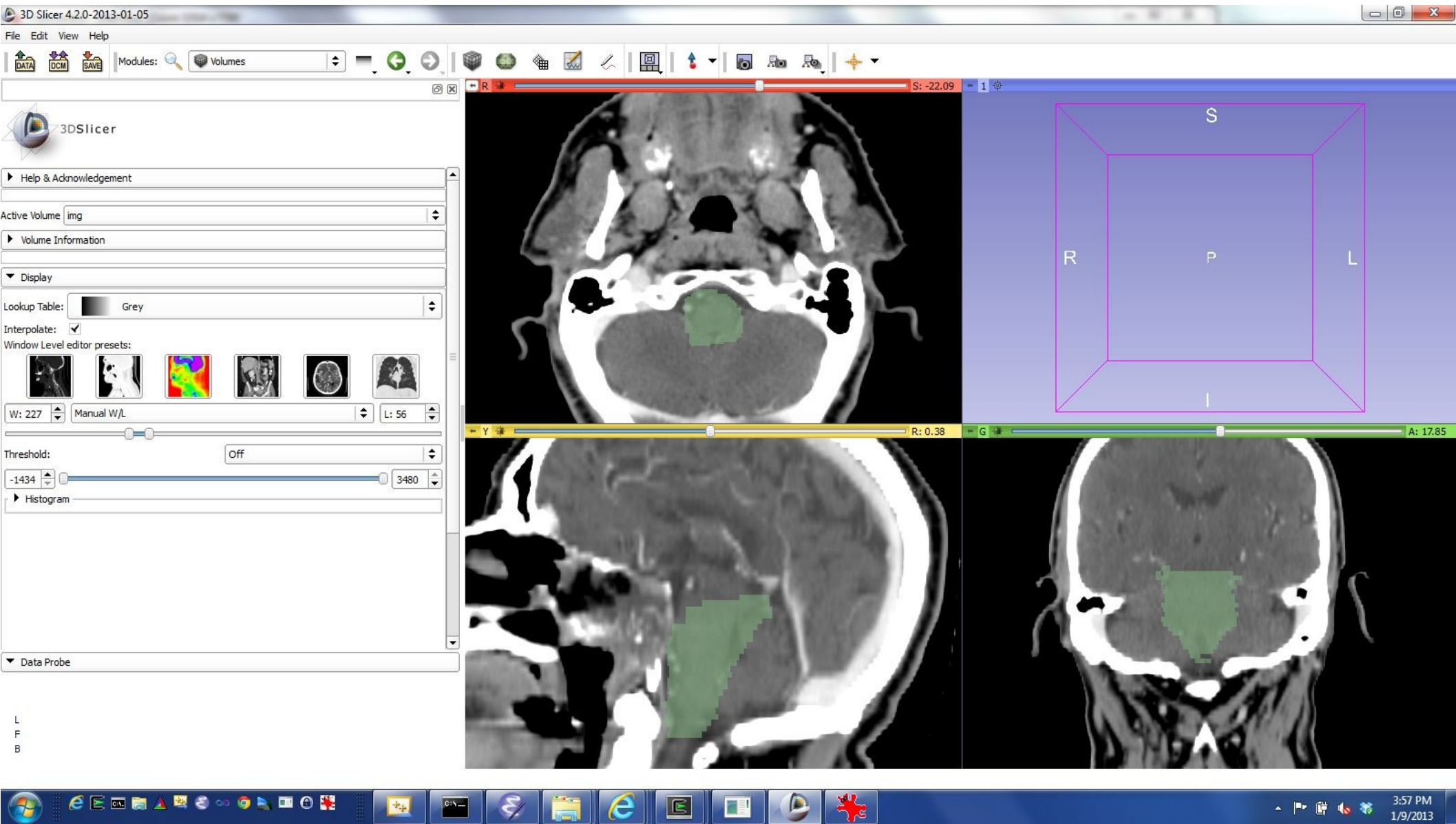


Peroni, Politecnico di Milano, 2012
Arbisser, MIT, 2012

Atlas-based segmentation

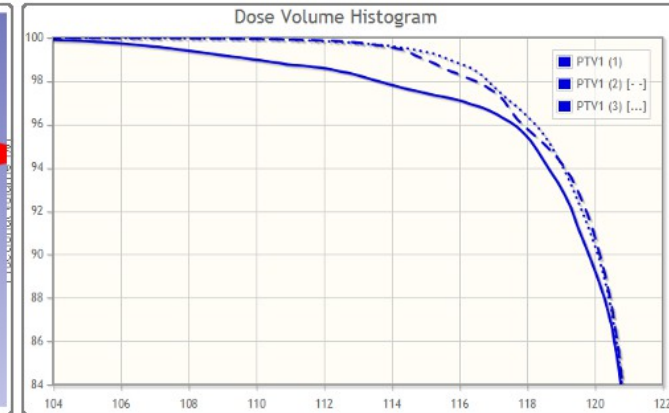
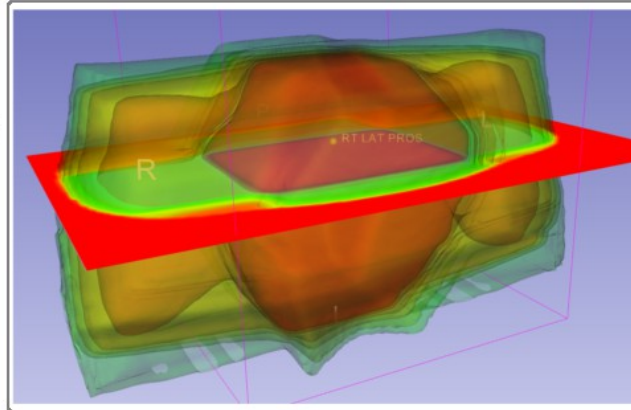
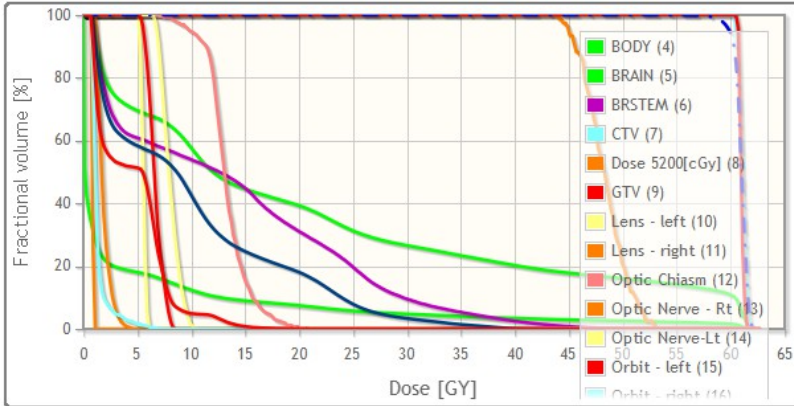
Structure	Overlap %	Overlap % (from literature)
Mandible	86 (± 4)	85-90 [X. Han et al., 2008] 78 \pm 6 [R. Sims et al., 2009]
Spinal cord	81 (± 10)	70-80 [X. Han et al., 2008]
Left optical nerve	52 (± 11)	50 \pm 17 [M. A. Deeley et al., 2011]
Left Eye	80 (± 6)	83 \pm 9 [M. A. Deeley et al., 2011]
Left Parotid	70 (± 14)	85 \pm 2 [Faggiano et al., 2011] 69 \pm 9 [R. Sims et al., 2009]
Brainstem	77 (± 11)	83 \pm 10 [M. A. Deeley et al., 2011] 58 \pm 20 [R. Sims et al., 2009]

Atlas-based segmentation

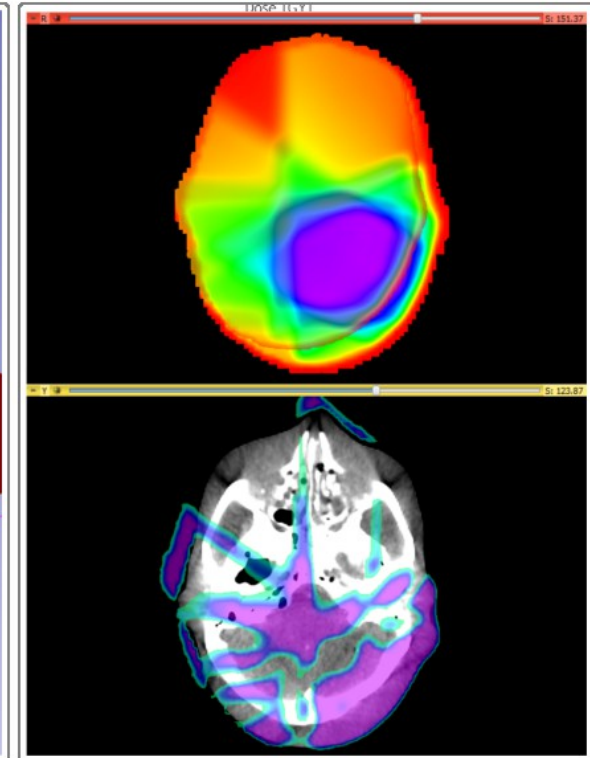
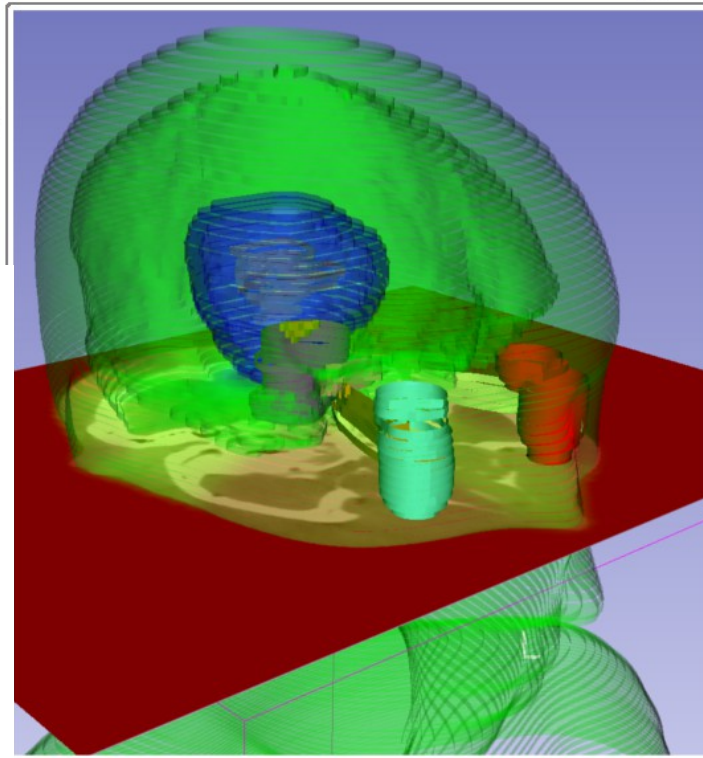


DICOM-RT improvements

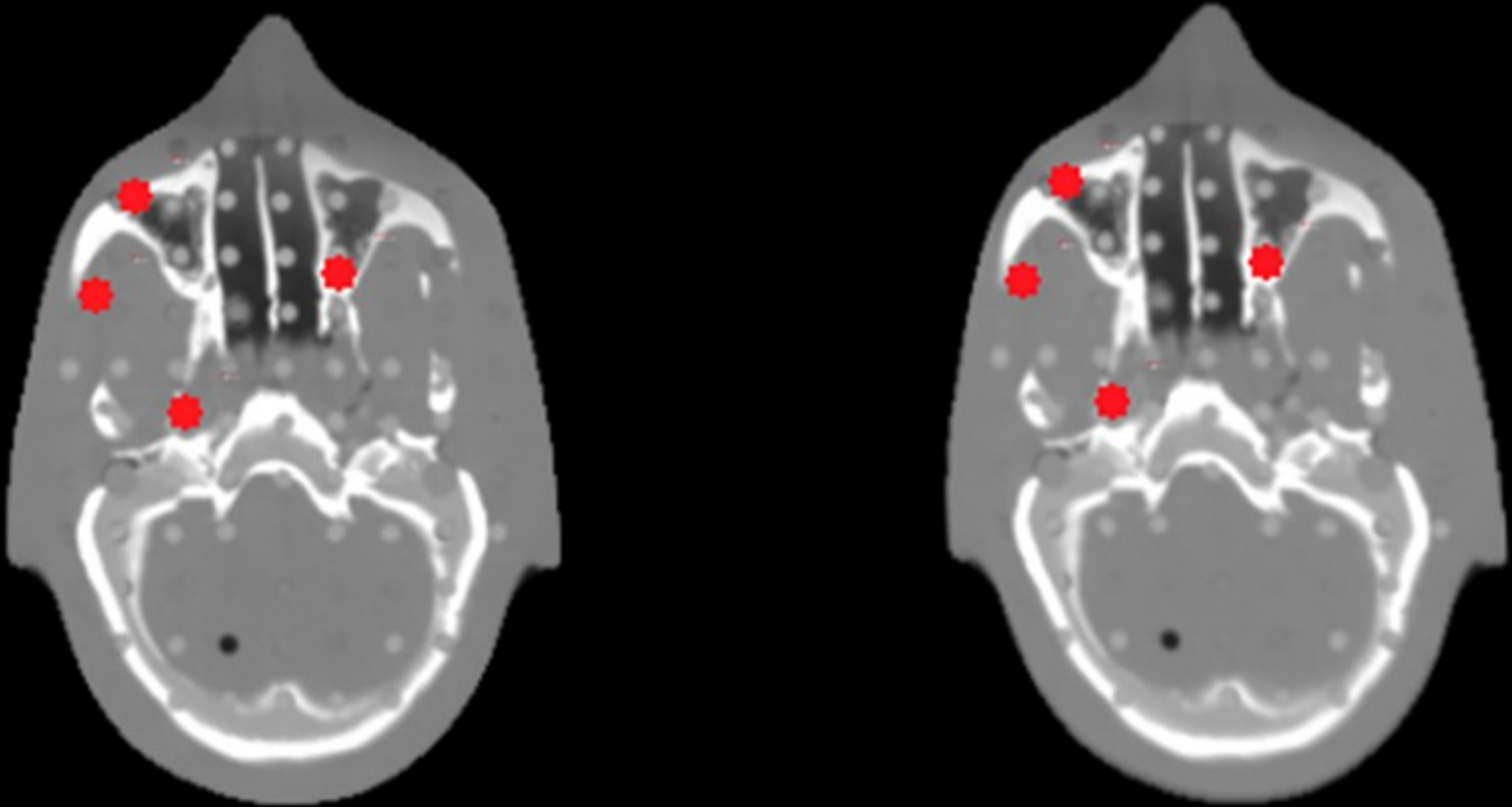
Structure	Volume name	Total volume (cc)	Mean dose (Gy)	Min dose (Gy)	Max dose (Gy)	V40 (%)	V50 (%)	V60 (%)	D90% (Gy)	D99% (Gy)	
1	PTV1	5: RTDOSE 1	126.957	60.9408	51.1546	62.6127	100.00	100.00	94.01	1.98	3.63
2	PTV1	5: RTDOSE 2	126.957	60.8105	49.3361	62.3971	100.00	99.99	90.55	2.15	5.21
3	PTV1	5: RTDOSE 3	126.957	59.6941	29.9264	62.3628	99.44	95.51	80.90	5.78	20.03



Name	Age	Scan	Date	Subject ID	Number	Institution	Referrer
TEST				TEST			
RANDO~PROSTATE				TEST PHYS PROS...			
RANDO~ENT				TEST PHYS ENT			
No description		CT	2011-09-20		1		
ENT IMRT			2011-09-20		0		
No description		RTSTRUCT					

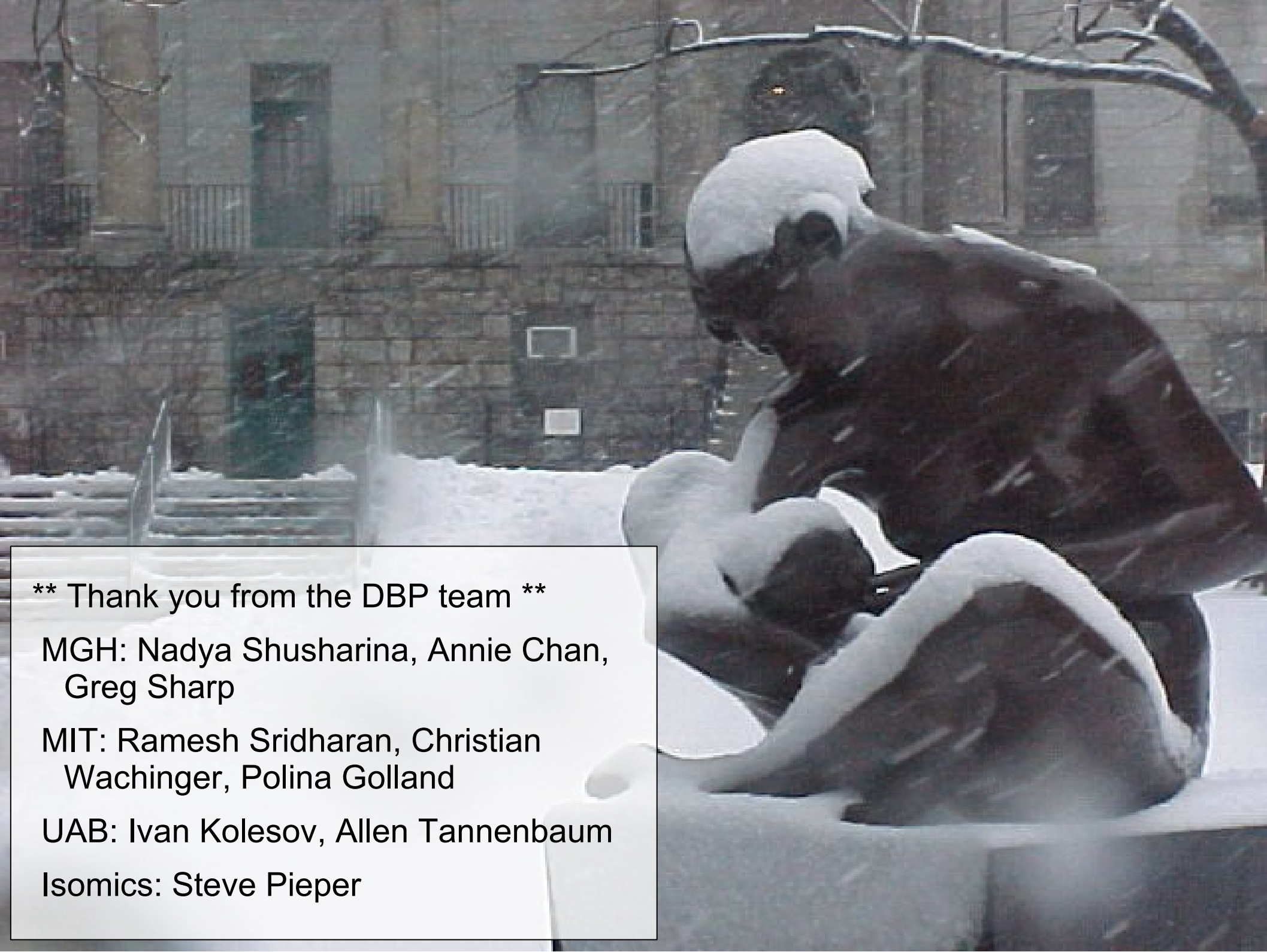


DIR validation suite



Dissemination and Training

- Documentation and tutorials!
- 3D Slicer user group at AAPM annual meeting
 - 2011, 2012, (2013, 2014)
- Module development training



**** Thank you from the DBP team ****

**MGH: Nadya Shusharina, Annie Chan,
Greg Sharp**

**MIT: Ramesh Sridharan, Christian
Wachinger, Polina Golland**

UAB: Ivan Kolesov, Allen Tannenbaum

Isomics: Steve Pieper