Application of Small-Field Treatment: The Promises and Pitfalls of SBRT

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Disclosures

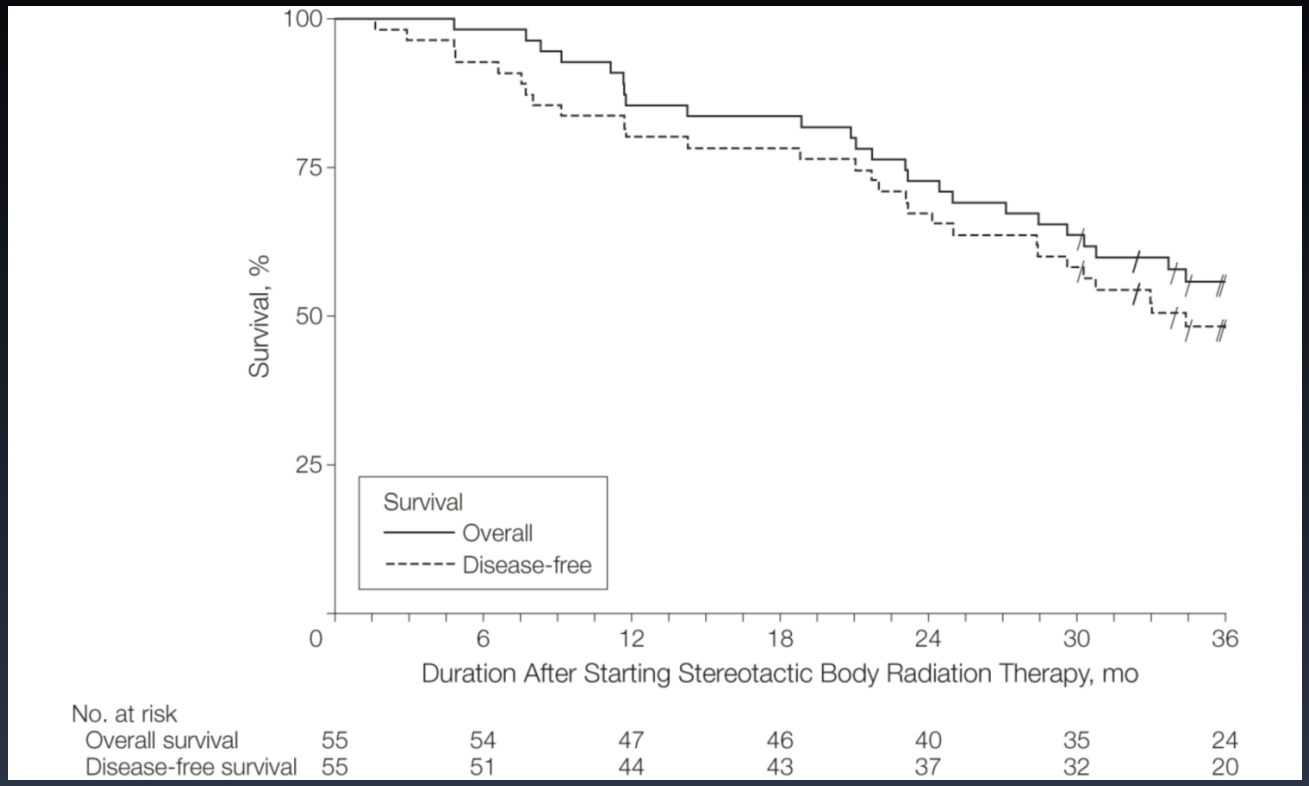
None

Learning Objectives

1. Learn special technical consideration in delivering SBRT treatments
2. Appreciate specific challenges of SBRT implementation

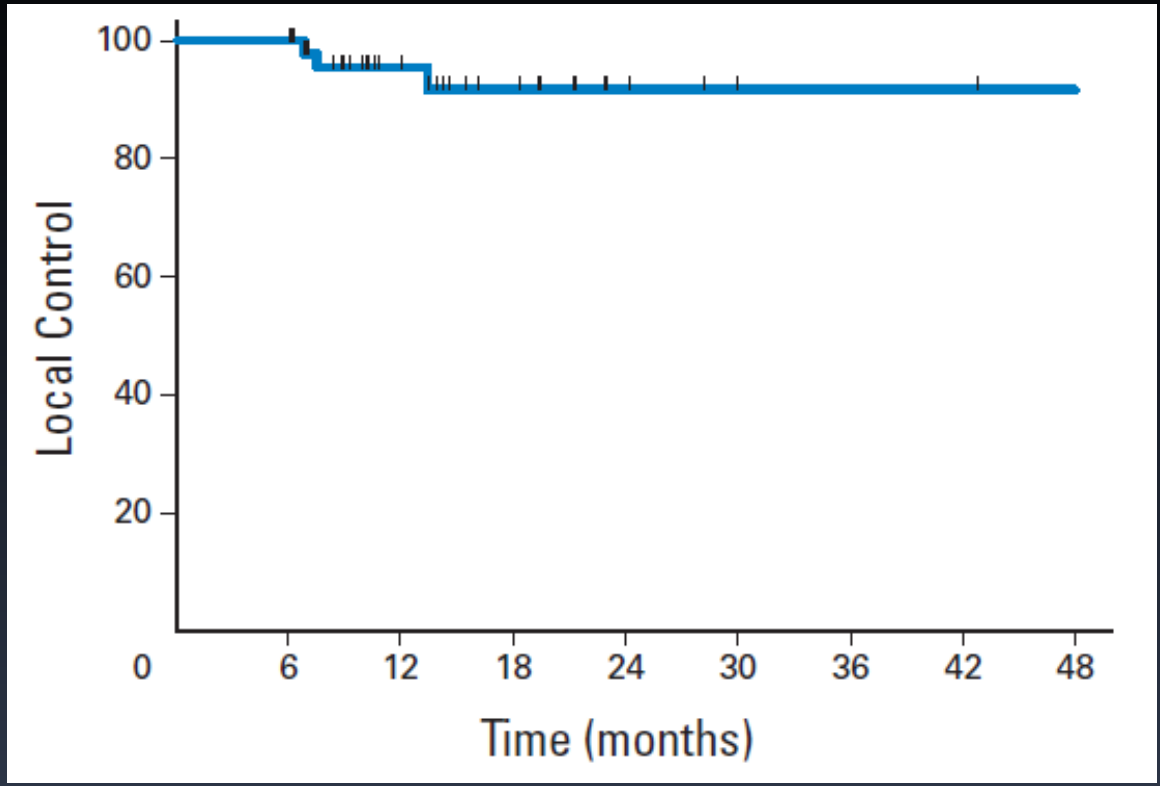
Promises

RTOG 0236: Lung SBRT



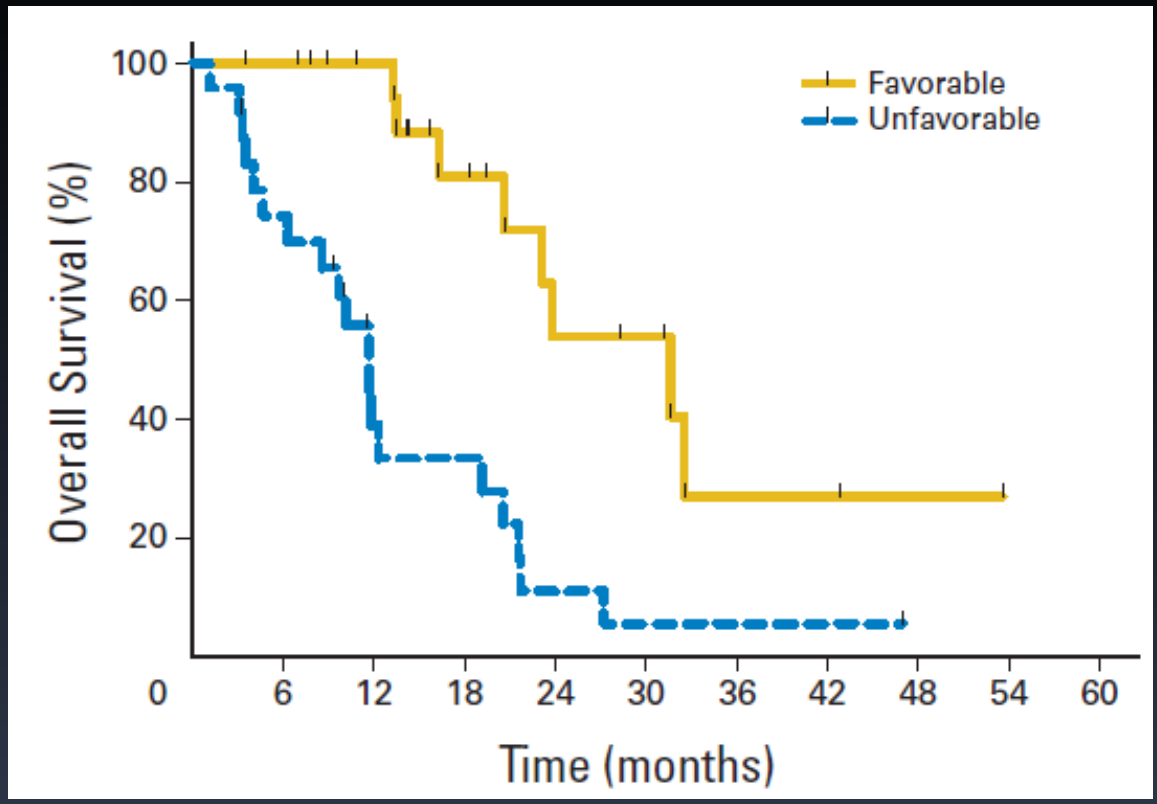
Timmerman et al. JAMA, 2010

Liver SBRT



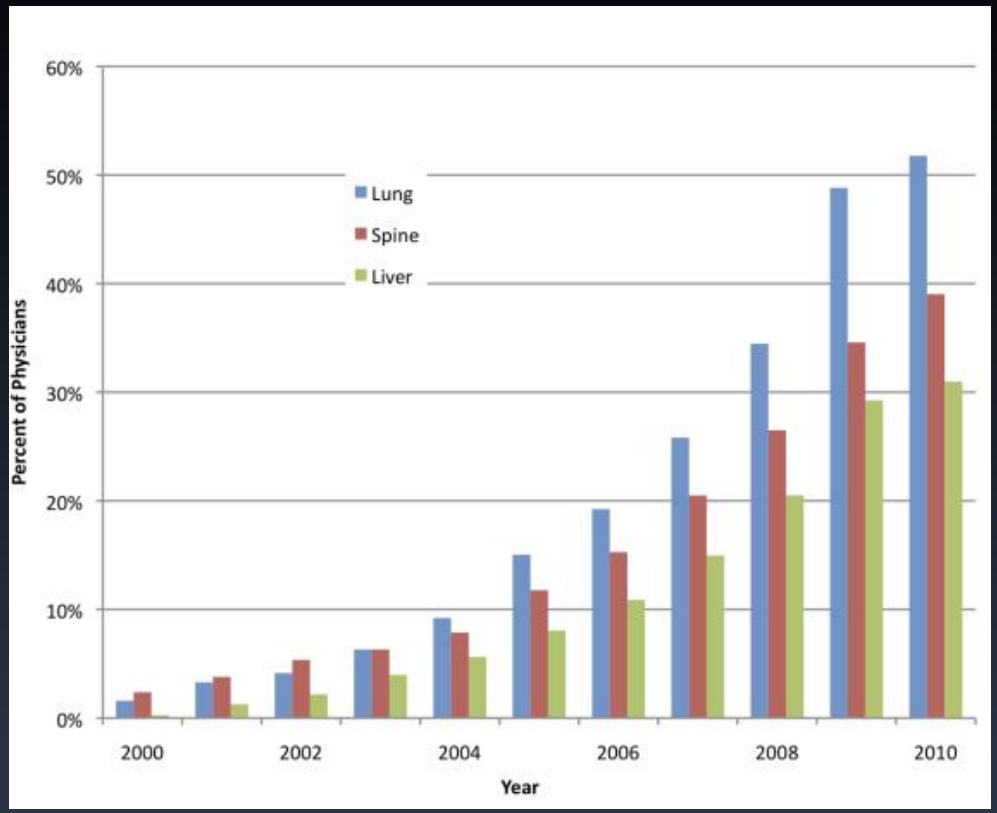
Rusthoven et al. JCO 2009

Liver SBRT



Rusthoven et al. JCO 2009

Availability of SBRT



Pan et al. Cancer, 117, 4566 (2011)

Availability of SBRT

AAPM COMMITTEE TREE

Task Group No. 275 Strategies for Effective Physics Plan and Chart Review in Radiation Therapy

Charge	1. To review existing data and recommendations that support the use of physics plan and chart review; and to review the current recommendations on the qualifications for performing these. 2. To provide survey information on current practices in the community with respect to physics plan and chart review.

Survey of physics practices

Availability of SBRT

What treatment modalities and techniques does your practice provide?

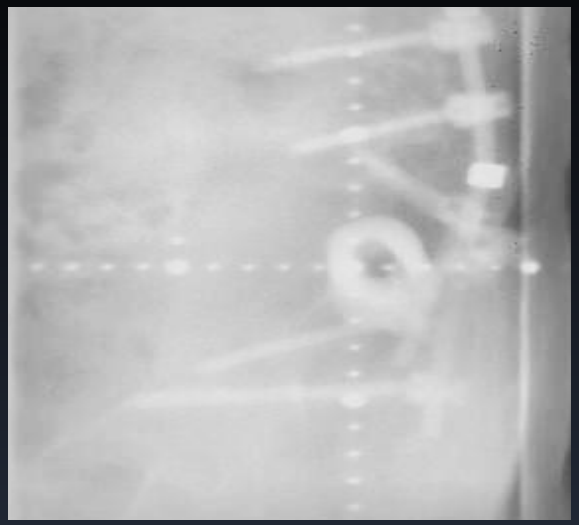
Type	% respondents
Photon	96%
IMRT	96%
VMAT	79%
SRS	67%
SBRT	81%
Brachytherapy	65%
IORT	15%

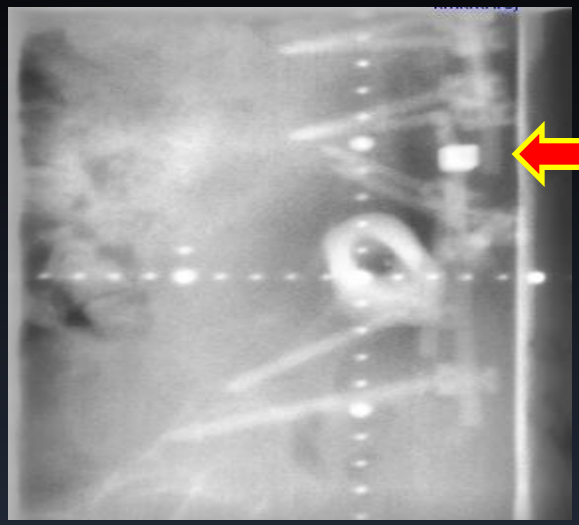
TG275 survey

Pitfalls

Pitfalls
Case Studies

Case Study #1



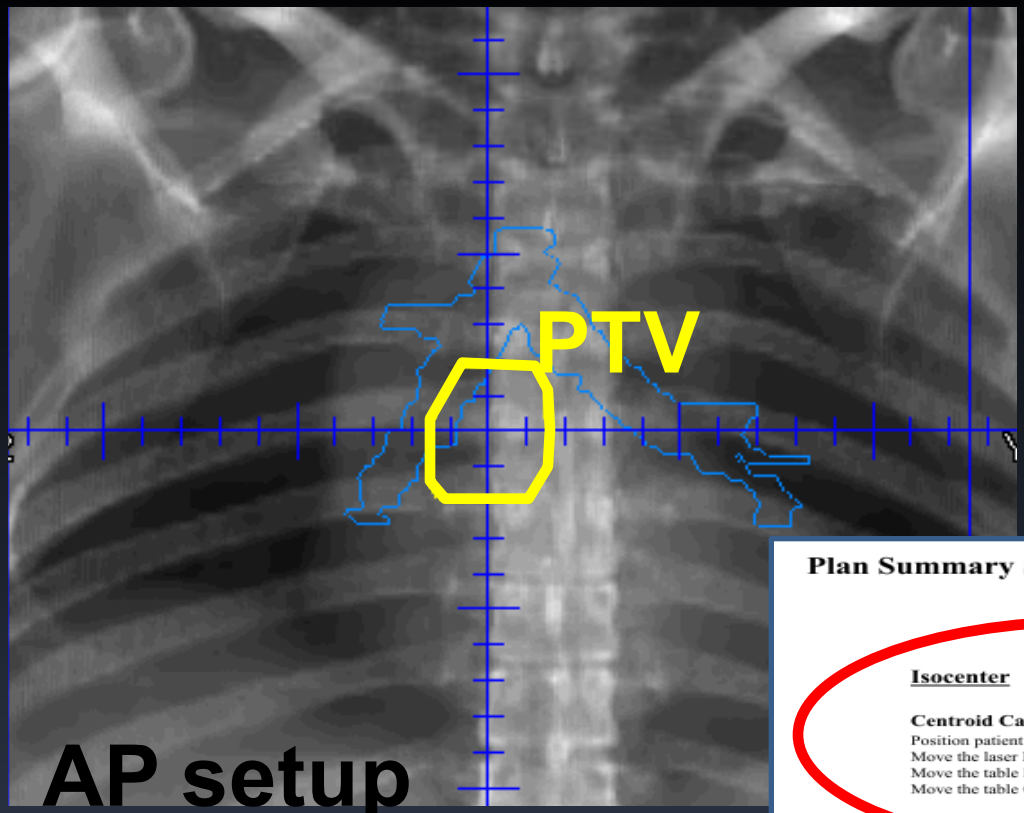


Simulation Treatment

S-spine Hardware

Case Study #2: Wrong Tx Location

- Patient with metastatic melanoma undergoing Tx to R hilar mass
- 600 cGy x 5
- Physicist notes wrong isocenter on plan check

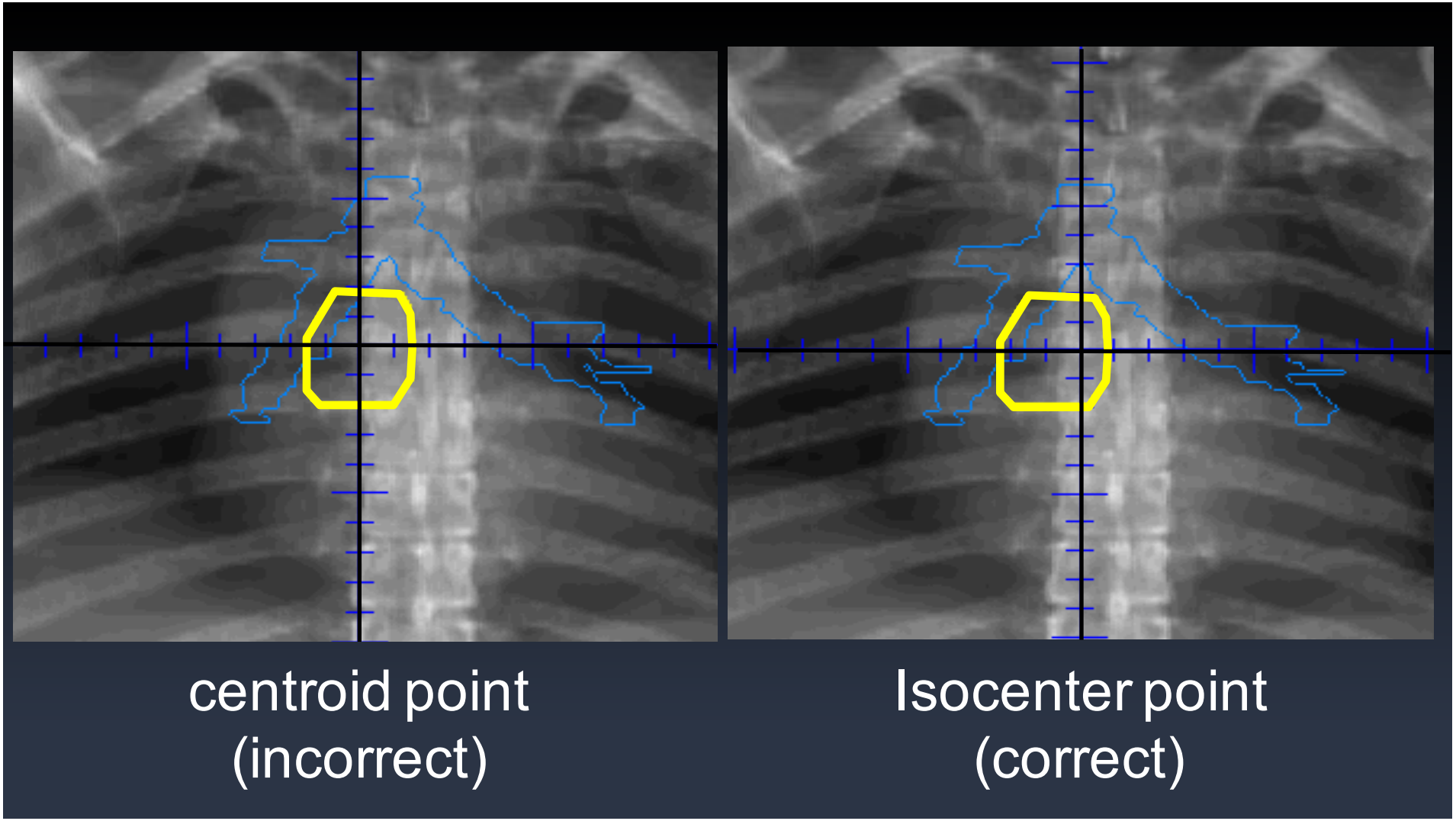


AP setup

Plan Summary Sheet

Isocenter

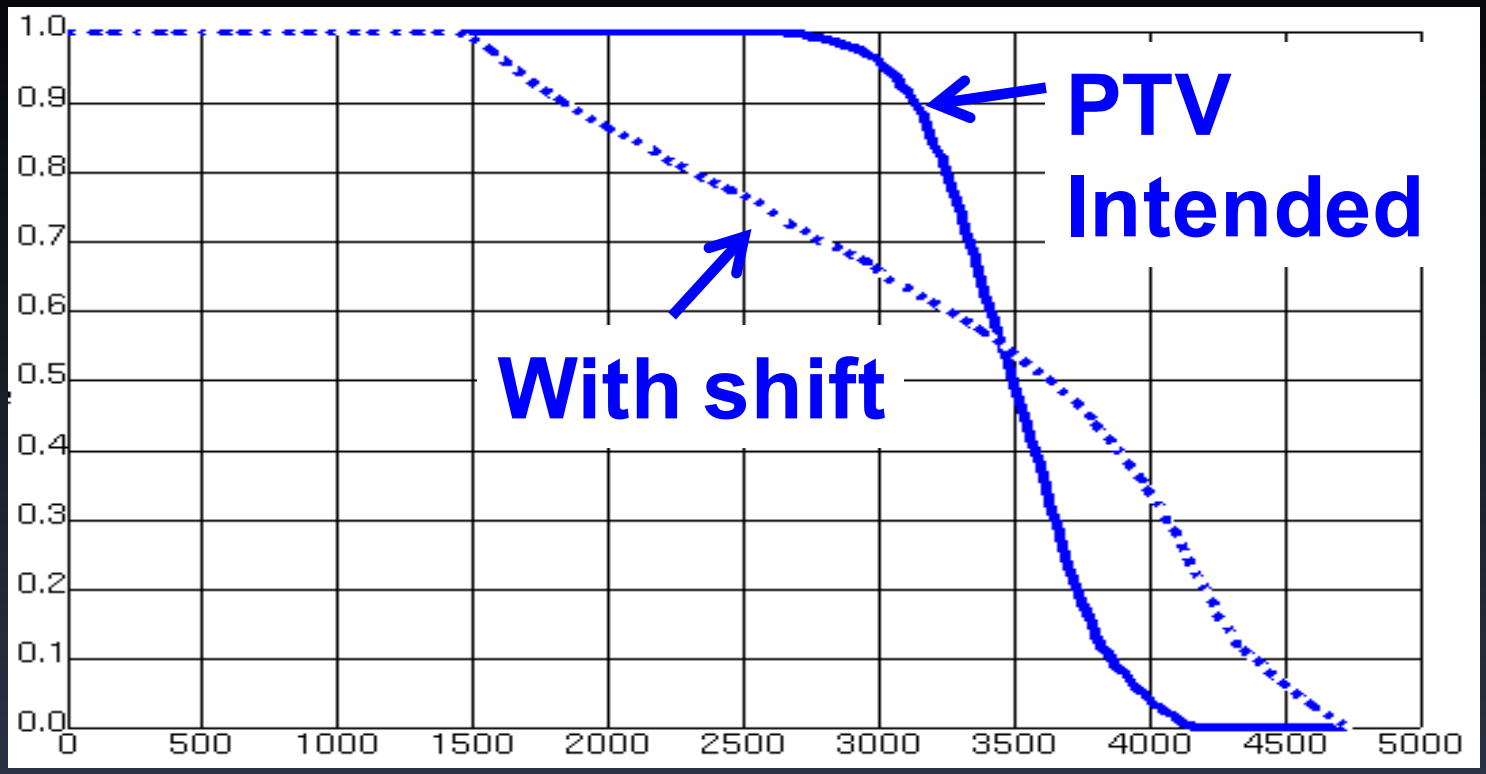
Centroid Calc Pt
Position patient such that lasers line up with patient marks.
Move the laser LEFT 0.75 cm (looking from foot of table.)
Move the table DOWN 0.73 cm.
Move the table OUT (away from the gantry) 0.06 cm.



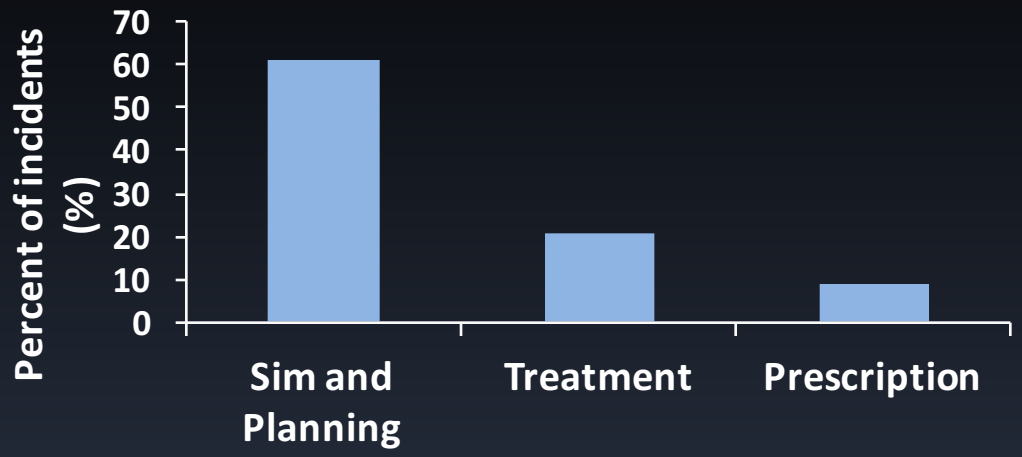
centroid point
(incorrect)

Isocenter point
(correct)

Big effect (SBRT/small fields)



Where Do Errors Originate?



Clark et al. Prac Rad Onc, 3, 157-163, 2013

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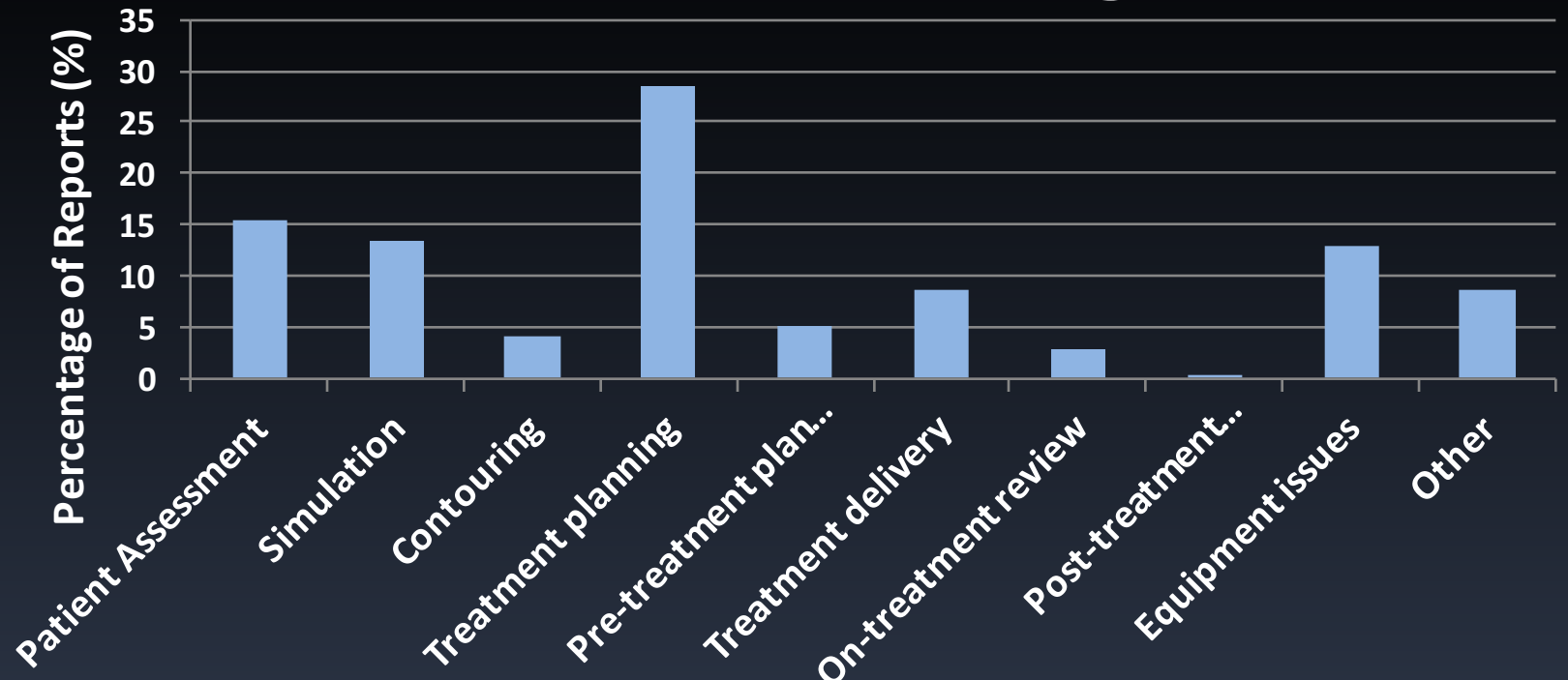

Avrey Novak, Jing Zeng, et al. 2015

What do you need to do SBRT safely?

ASTRO White Paper on SBRT Safety

Practical Radiation Oncology (2012) **2**, 2–9

practical radiation oncology
pro
www.practicalradonc.org

Special Article

Quality and safety considerations in stereotactic radiosurgery and stereotactic body radiation therapy: Executive summary

Timothy D. Solberg PhD [a,*], James M. Balter PhD [b], Stanley H. Benedict PhD [c], Benedick A. Fraass PhD [d], Brian Kavanagh MD [e], Curtis Miyamoto MD [f], Todd Pawlicki PhD [g], Louis Potters MD [h], Yoshiya Yamada MD [i]

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Received 4 May 2011; revised 14 June 2011; accepted 16 June 2011

What you need to do SBRT Safely

IGRT

- 3D
- Direct tumor visualization @ fraction
- Markers acceptable
- Respiratory management

QA program

- Formalized
- Periodically updated

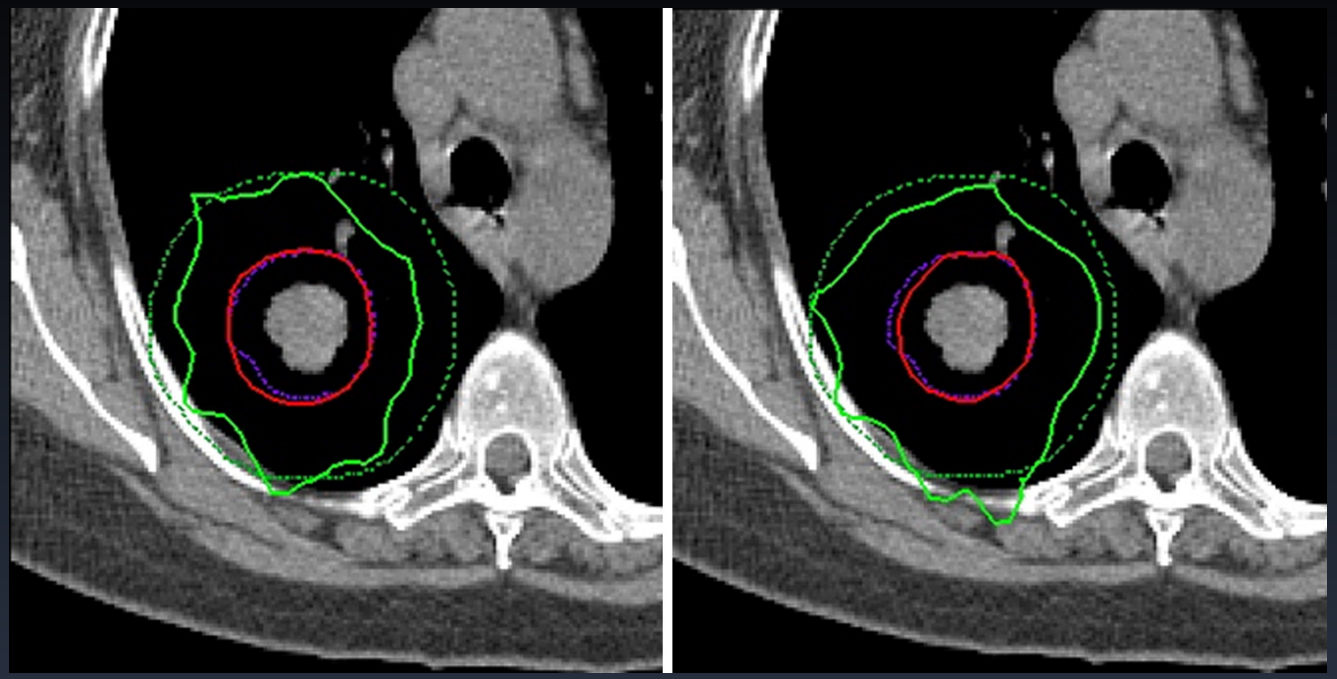
What you need to do SBRT Safely

Personnel

- Special staffing needs
- SRS/SBRT-specific training per disease site
- SRS/SBRT-specific CME

Commissioning

Effects of Heterogeneity

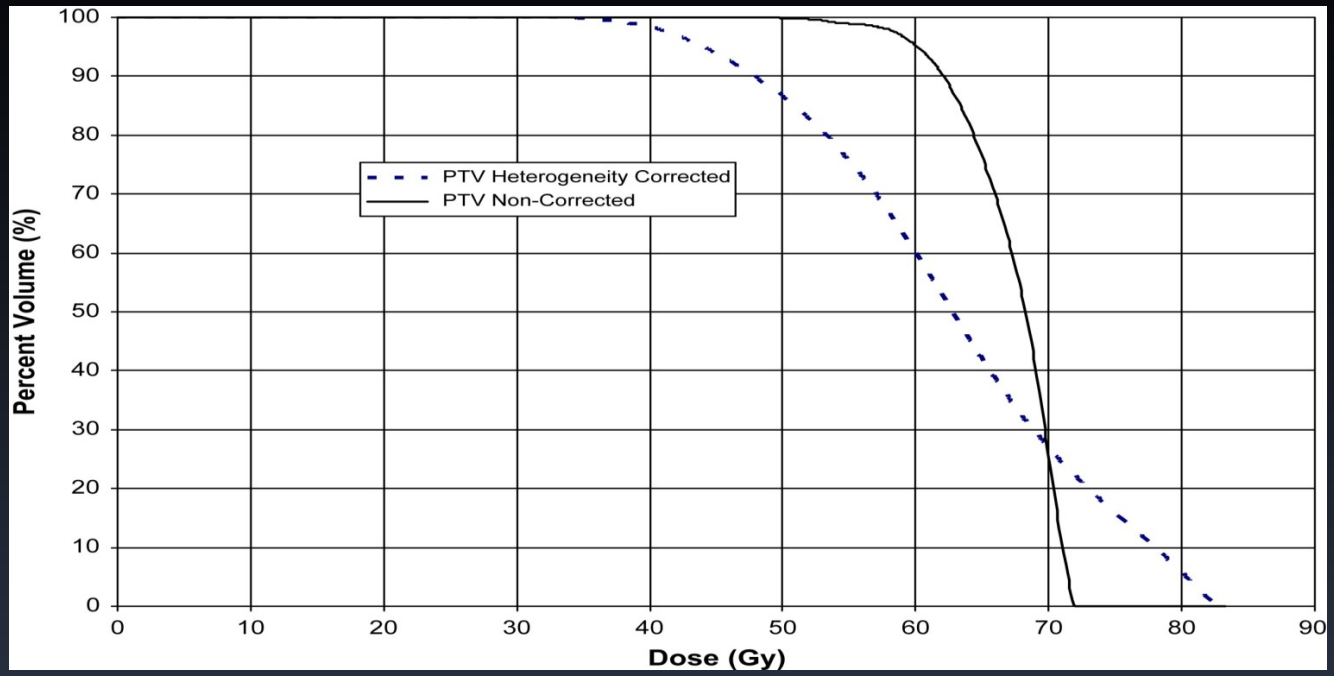


homogeneous heterogeneous

Xiao et al. 2009

International Journal of Radiation Oncology • Biology • Physics 2009 73, 1235-1242DOI: (10.1016/j.ijrobp.2008.11.019)

Effects of Heterogeneity



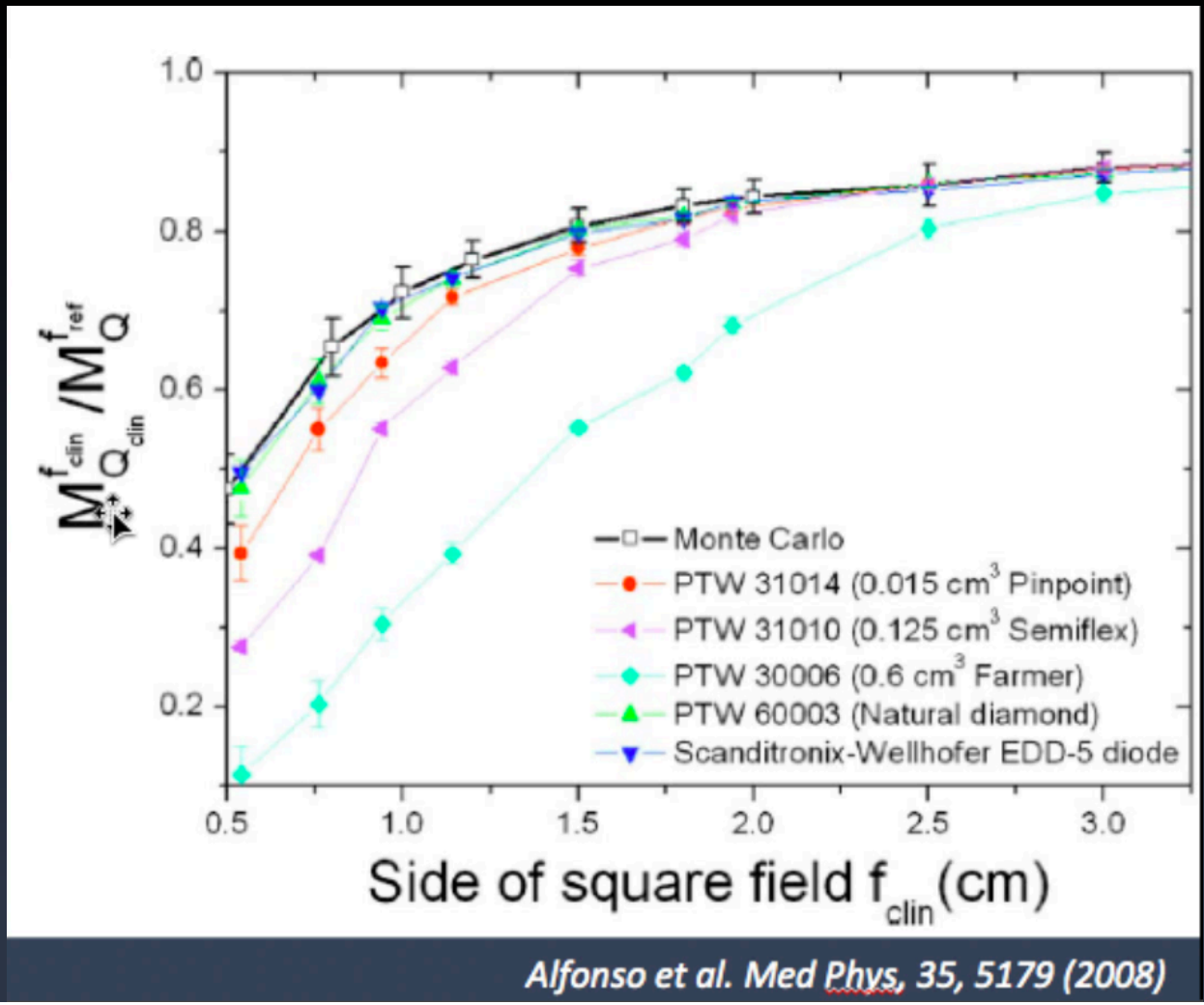
Xiao et al. 2009

International Journal of Radiation Oncology • Biology • Physics 2009 73, 1235-1242DOI: (10.1016/j.ijrobp.2008.11.019)

What you need to do SBRT Safely

Commissioning

- Independent check of small field measurements
- End-to-end tests
- Independent check of TPS dose calc (IROC-H)



Alfonso et al. Med Phys, 35, 5179 (2008)

The New York Times

HEALTH | THE RADIATION BOOM

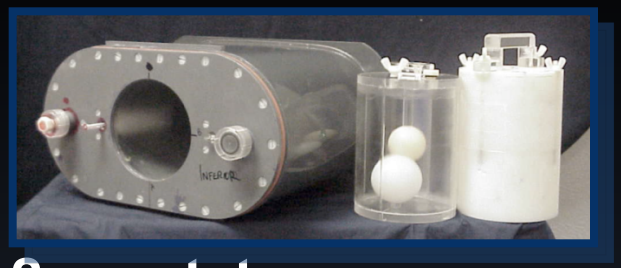
A Pinpoint Beam Strays Invisibly, Harming Instead of Healing

By **WALT BOGDANICH** and **KRISTINA REBELO** DEC. 28, 2010

- Overdoses due to wrong output factor
- Factor of ~2
- 75 patients

Terri Anderson was given too much radiation last year while being treated for a benign tumor. She now suffers facial spasms. "I started having 12 to 14 of those a day," she said.

IROC-H Phantom Family

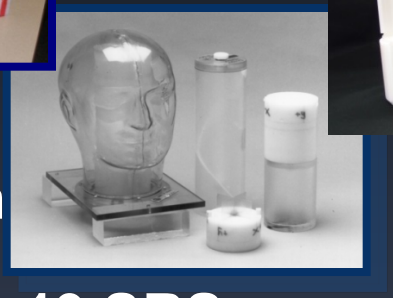


2 prostate phantoms

33 lung phantoms

24 H&N phantoms

8 Spine phantoms



19 SRS phantoms

10 liver inserts

Courtesy: Dave Followill

Phantom Results

Comparison between institution's plan and delivered dose.

Phantom	H&N	Liver insert	Lung	Prostate	Spine
Irradiations	1880	143	950	556	308
Pass	1595 (85%)	105 (73%)	784 (82%)	474 (85%)	237 (77%)
Fail	285	38	166	82	71
Criteria	7%/4mm	7%/4mm	5%/5mm	7%/4mm	5%/3mm

Courtesy: Dave Followill

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Courtesy: Dave Followill

On-Site Dosimetry Review Audit

Discrepancies Discovered (Jan. '05 – April '13)

Discrepancies Regarding:	Number of Institutions Receiving rec. (n = 206)
Review QA Program	152 (74%)
Photon Field Size Dependence	**138 (67%)**
Wedge Factor (WF)	66 (32%)
Off-axis Factors (OAF)/Beam symmetry	60 (29%)
Electron Calibration	35 (17%)
Photon Depth Dose	33 (16%)
Electron Depth Dose	25 (12%)
Photon Calibration	16 (8%)

This is a beam measurement issue and TPS beam modeling challenge.

IROC IMAGING AND RADIATION ONCOLOGY CORE

Global Leaders in Clinical Trial Quality Assurance

Courtesy: Dave Followill

Conclusions

- Minor deviations – big effect
- Quality gap
- Commissioning and independent audit

Acknowledgments

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Olga Gopan, PhD
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Gabrielle Kane, MD

UW RAD ONC QUALITY TEAM