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DEBATE: Proton vs. Photon SBRT

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Disclosures

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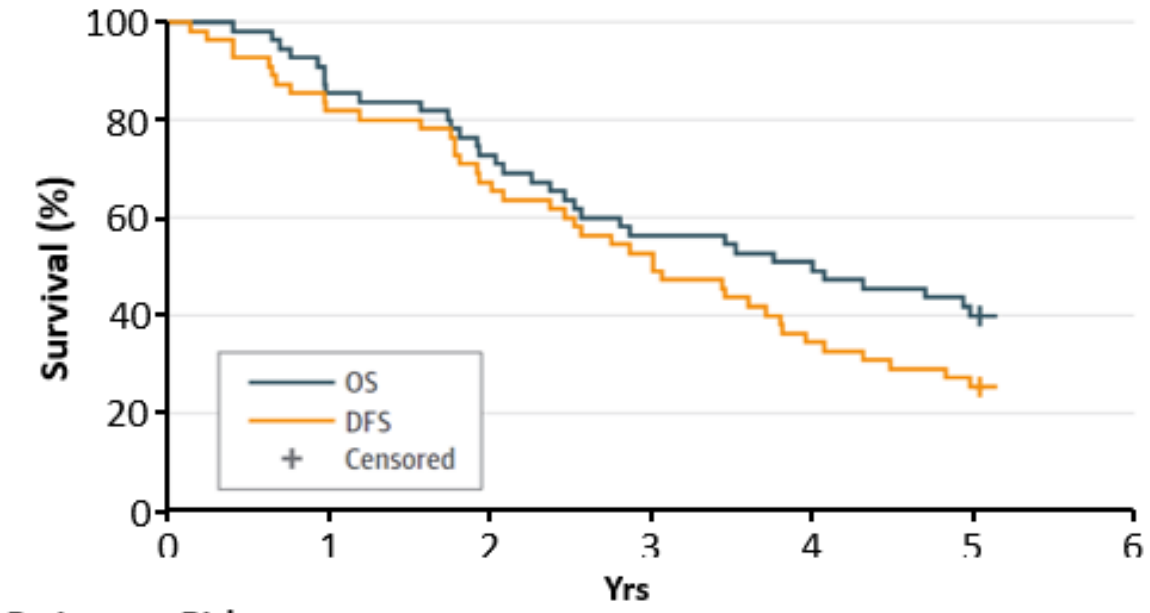
Phase II RTOG 0236: SBRT in Medically Inoperable, Early Stage NSCLC

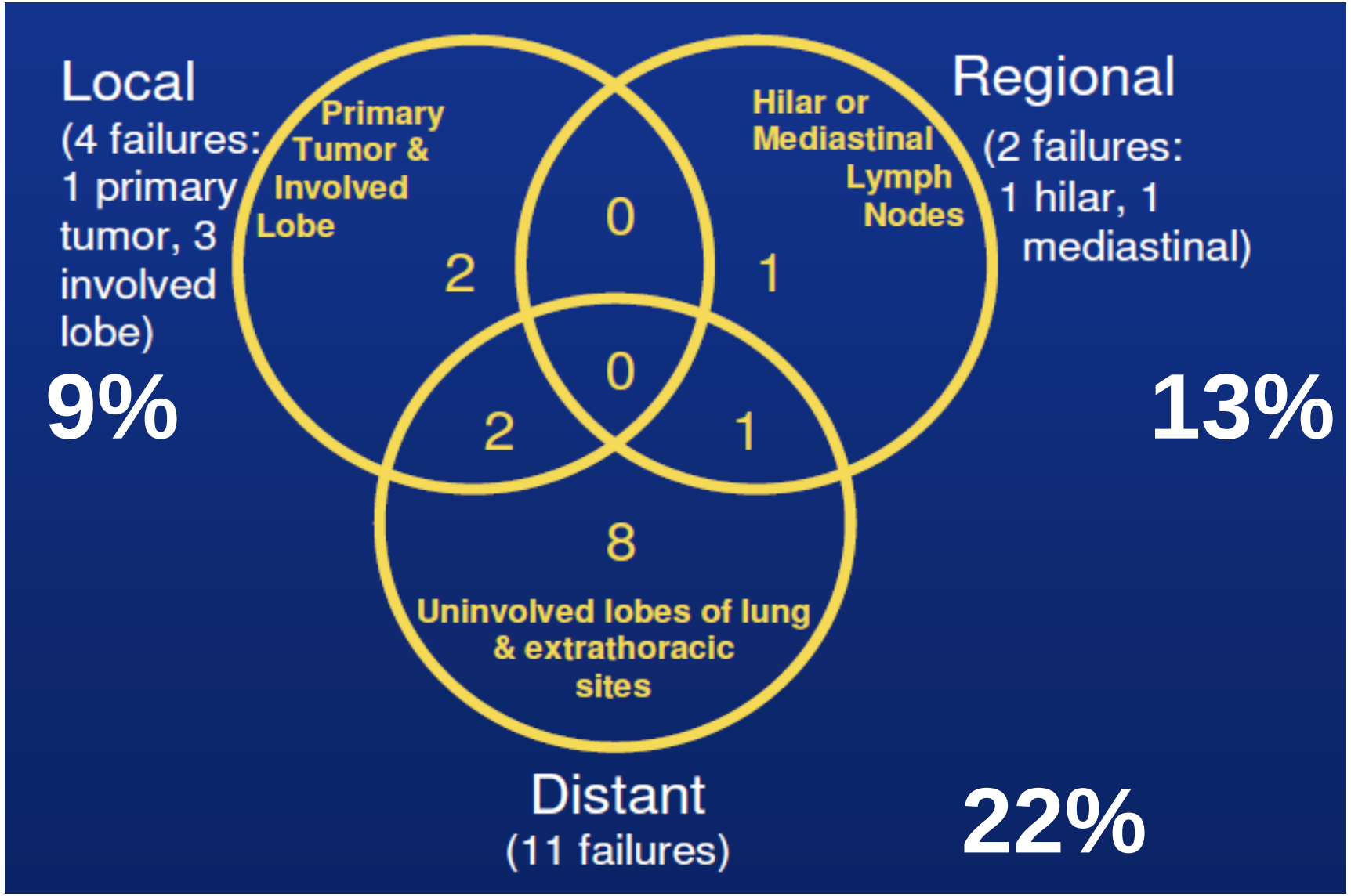
- SBRT: standard of care for medically inoperable, early stage NSCLC[1,2]
- Distant metastasis remains the dominant pattern of failure
  - **RTOG 0236** long-term follow up, 5-year distant progression was 31%[2]



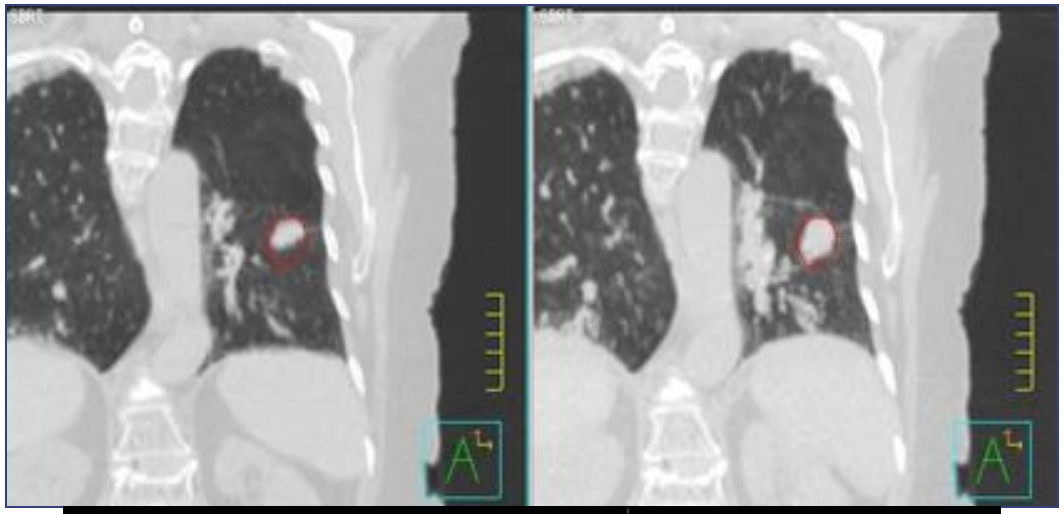
Patients at Risk, n						
OS	55	47	40	31	28	22
DFS	55	45	37	29	19	14

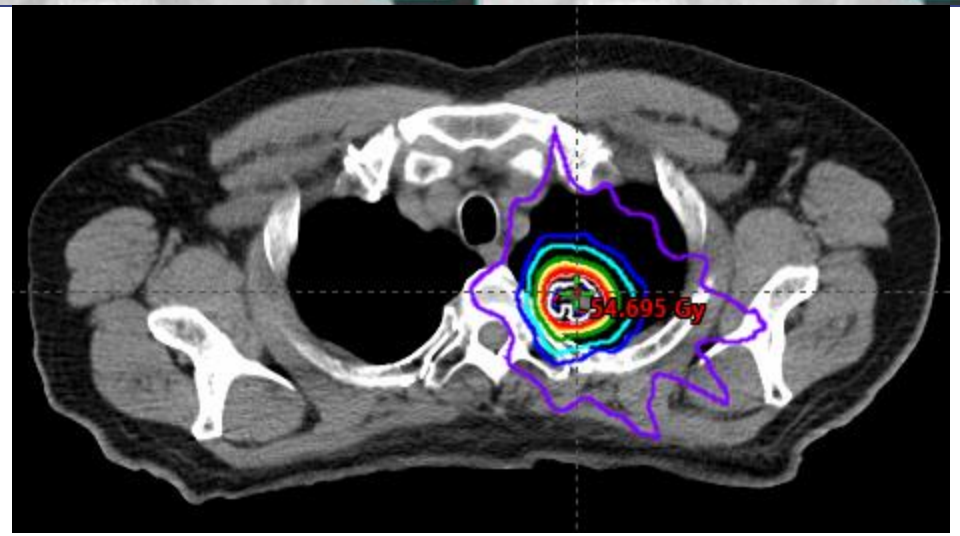
Timmerman. JAMA. 2010;303:1070. Timmerman. Int J Radiat Oncol Biol Phys. 2014;90:S30.

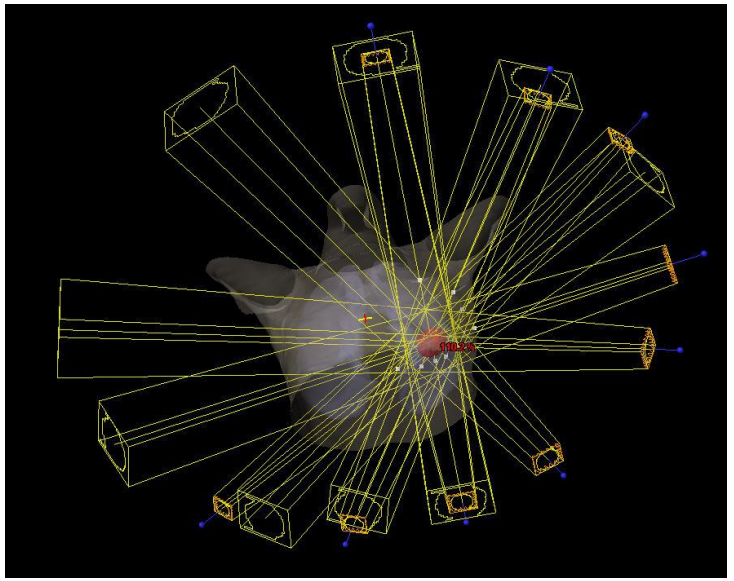
RTOG 0236


Local
(4 failures: 1 primary tumor, 3 involved lobe)
9%
Primary Tumor & Involved Lobe
2
0
Hilar or Mediastinal Lymph Nodes
1
Regional
(2 failures: 1 hilar, 1 mediastinal)
13%
0
2
1
8
Uninvolved lobes of lung & extrathoracic sites
Distant
(11 failures)
22%

SBRT for Medically Inoperable, Early Stage NSCLC







Slide credit: clinicaloptions.com

SBRT Summary: Current State

- High dose, ablative radiation treatment using robust immobilization, motion management, and real-time tumor localization
  - 3-5 fractions typically
- Curative treatment for patients ineligible or not wanting to pursue surgery
- Standard option for T1-T3, N0 tumors 7 cm or less
  - Most clinical trials use 5 cm or less
  - Not used for node + disease
- Dose per fraction depends upon tumor location
  - Caution with ultra-central tumors

Proton SBRT

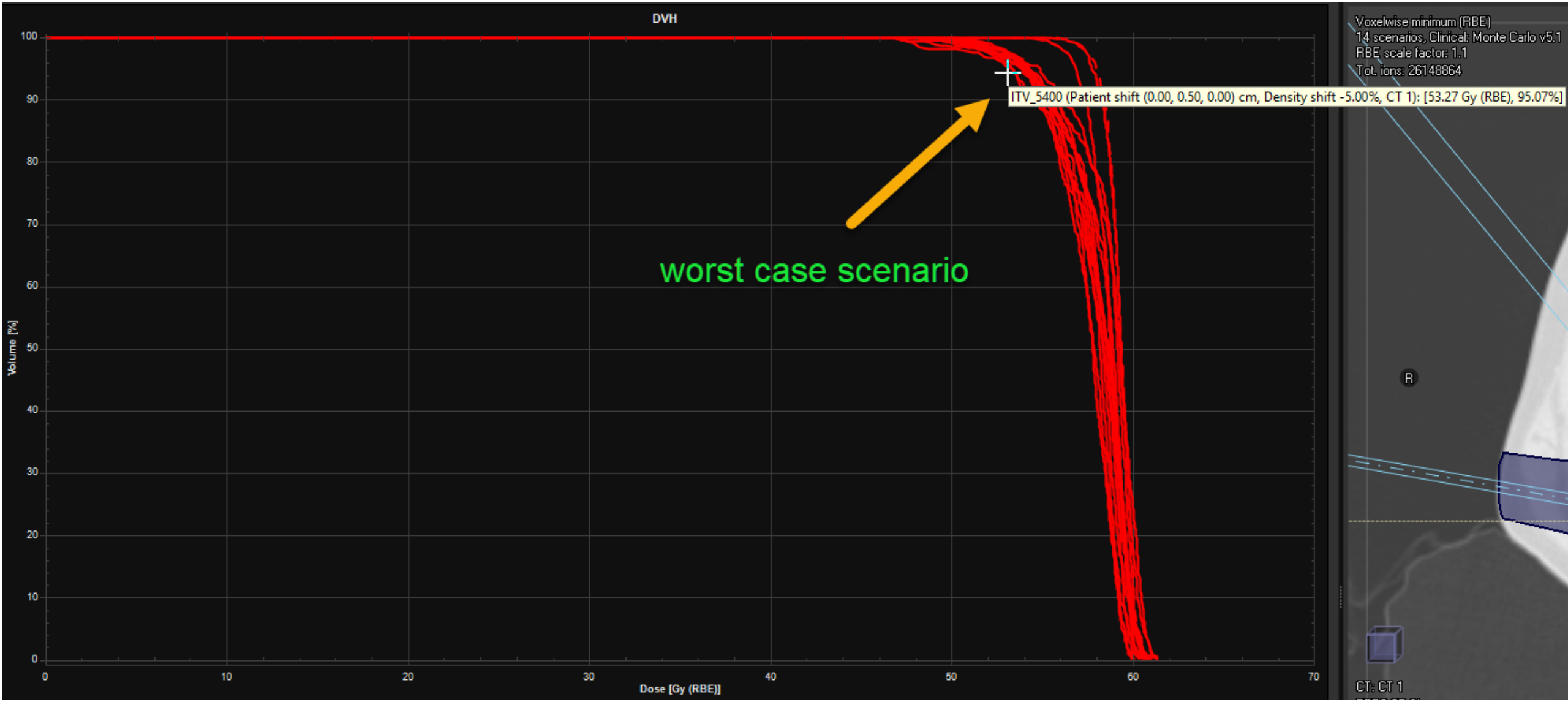
- Proton SBRT is feasible
  - Logistically more challenging
  - Could outcomes possibly be worse than SOC?

- Just because we can, should we use this technology when standard and less expensive techniques perform very well?

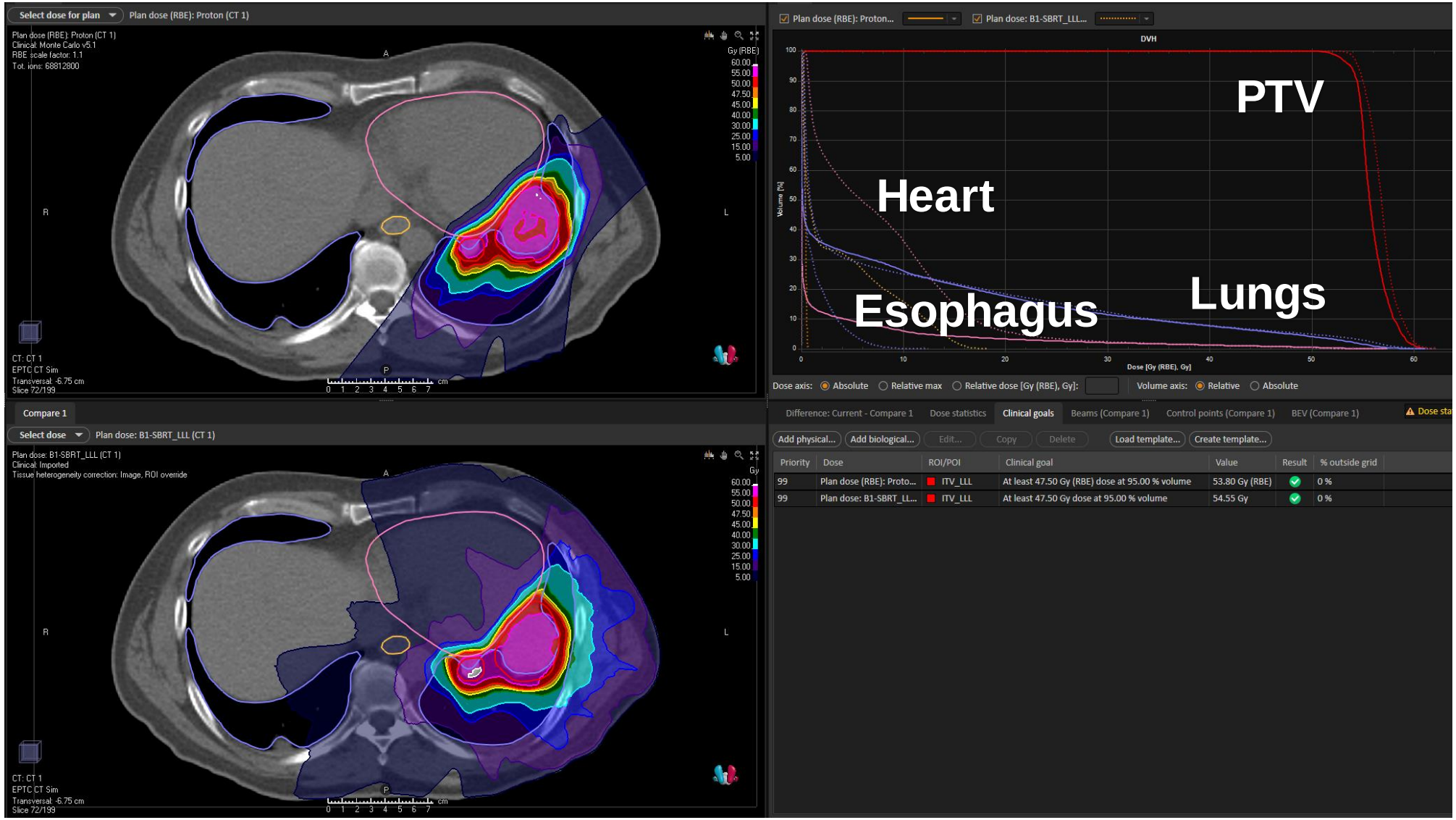
- Are there certain disease sites where proton SBRT makes more sense?
  - i.e. Liver vs. Lung?

Early stage lung cancer SBRT

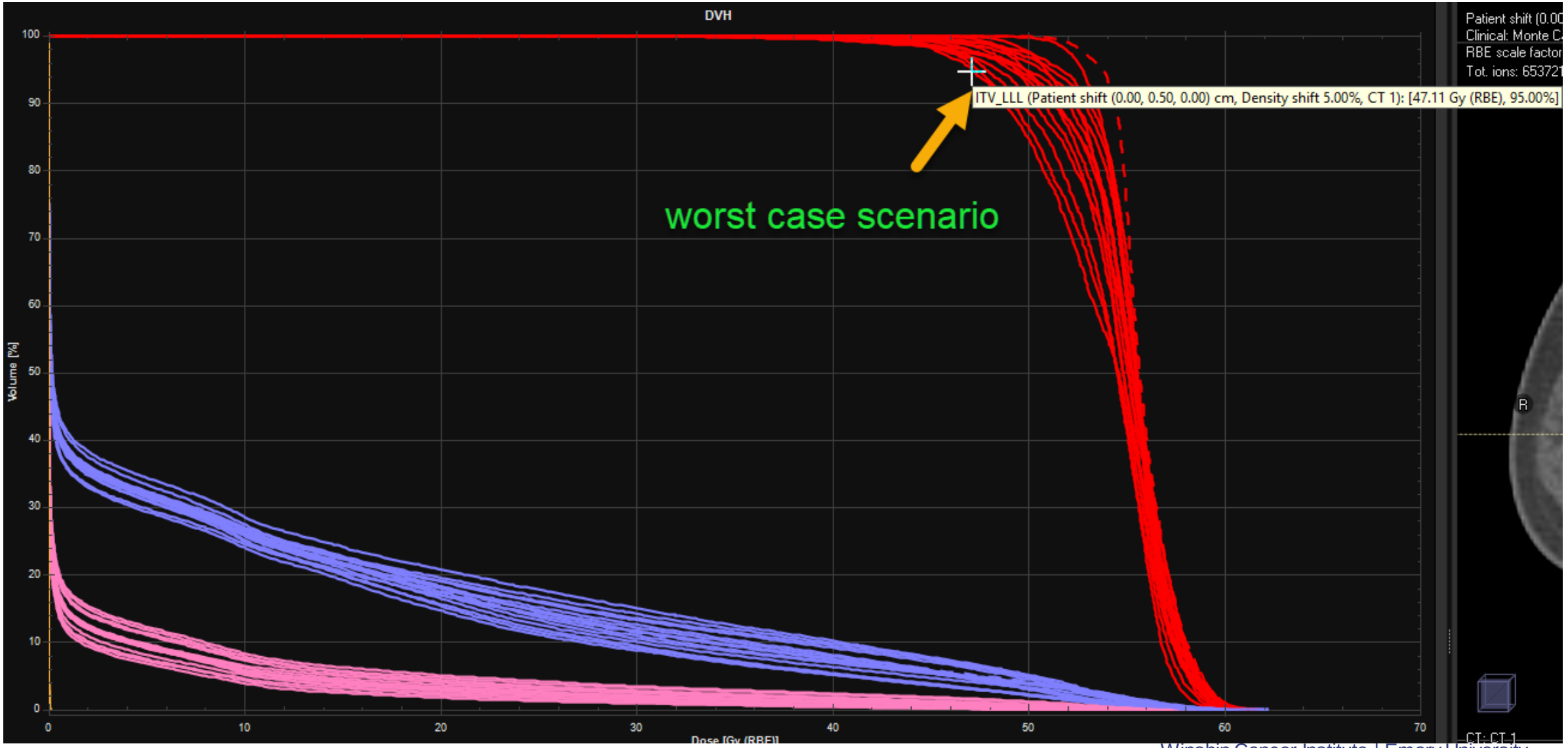
Robust Evaluation



Lung metastasis located near the heart



Robust Evaluation



Lung SBRT: Photon Standards

Plan Evaluation	Institution A	Institution B	Institution C
Primary Target Coverage Goal	PTV $D_{95\%} \geq$ 100% Rx	PTV $D_{95\%} \geq$ 100% Rx GTV $D_{100\%} \geq$ 110-120% Rx	PTV $D_{95\%} \geq$ 100% Rx
Maximum Dose No Greater Than	0.03cc $\leq$ 150% Rx	No specific requirement	D_{max} < 115%
Maximum Dose No Less Than	0.03cc $\geq$ 115% Rx	No specific requirement	Not utilized
CI‡ Goal	$\leq$ 1.5	No specific requirement	Not utilized
$R_{50\%}$‡‡ Goal	Varies, depends on PTV volume (ref RTOG 0915)	No specific requirement	Not utilized

De Leo et al, PRO 2022 Feb 24;S1879-8500(22)00067-4

Proton vs. Photon SBRT Dosimetry

- Proton plans have less dose heterogeneity, lower max point dose
- Protons demonstrate low-dose sparing for total lung OAR, i.e. V5 and V10 but equivalent V20
- Protons provide better cardiac and great vessel sparing for tumors located near the heart
- Proton plans could result in slight under-coverage of PTV when range uncertainty is considered

Proton vs. Photon Logistical Considerations

- Motion management challenges
  - No phase gating which can be challenging when lower lobe tumors are moving > 1cm with abdominal compression
  - Not every patient is suitable for SDX (pts that wear oxygen) or breathhold

- Longer treatment times
  - May be difficulty for frail patient population for which SBRT was originally developed for

- High Cost – though billed the same as photon SBRT- is it worth the human capital in rad onc departments to produce proton SBRT plans?

Conclusions

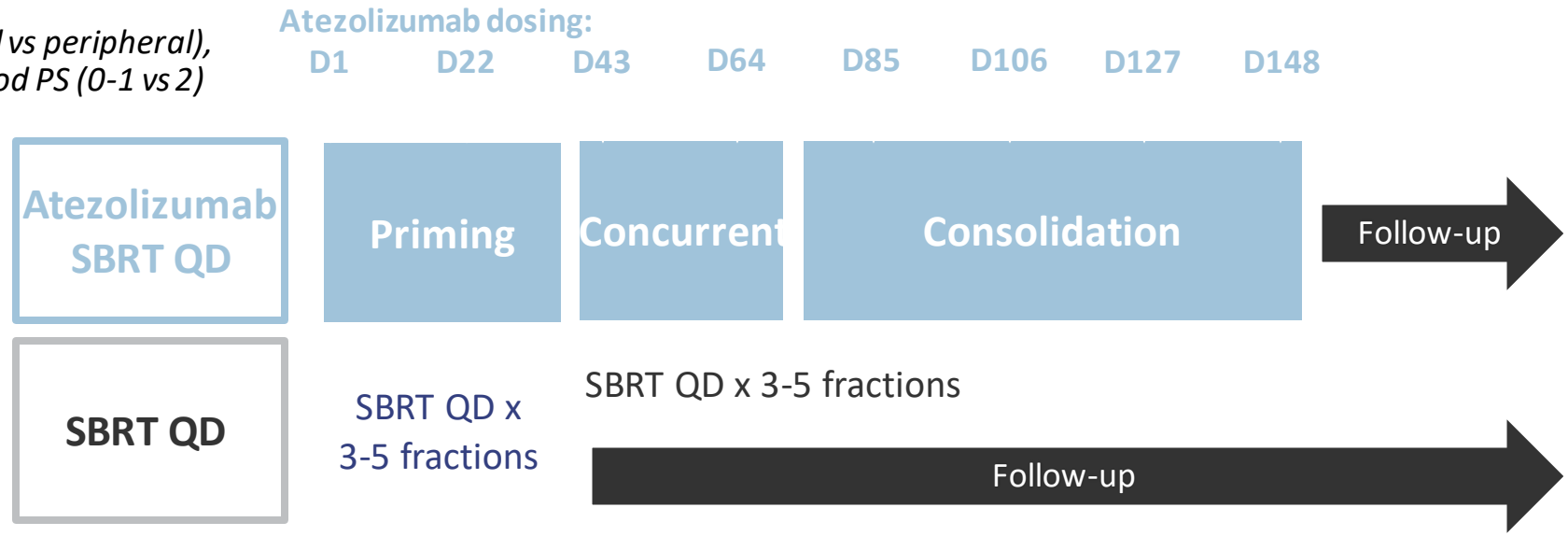
- Proton lung SBRT provides little benefit over standard photon lung SBRT
  - May perform worse for some metrics including heterogeneity and PTV coverage
  - Caveat is for tumors located adjacent to heart- cardiac sparing is improved
- Complicating logistical issues further the case against proton SBRT
- There are always exceptions
  - Multiple prior courses of RT, critical location of target, etc.

Ongoing Trials of SBRT + Immunotherapy: SWOG/NRG S1914 (Atezolizumab Plus SBRT vs SBRT)

- Open-label, randomized phase III study

Stratified by location (central vs peripheral), size (< 4 cm vs ≥ 4 cm), Zubrod PS (0-1 vs 2)

Patients with early stage (stage I-IIA or limited T3N0M0), high-risk, previously untreated NSCLC; Zubrod PS 0-2 (Estimated N = 432)



- Primary endpoint: OS
- Secondary endpoints: PFS, toxicity, QoL, failure rates (local, regional, distant)

ClinicalTrials.gov. NCT04214262.

Go Photons!!!