



Pelvic Proton Radiotherapy for High Risk Prostate Cancer

Bhisham S. Chera, MD

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High Risk Prostate Cancer

- NCCN definition: T3a - T4 or GS 8 - 10 or PSA > 20 ng/ml
- Risk of Lymph Node Involvement: 11 to 50%
- Techniques: 4-field box or IMRT
- Pelvic radiotherapy increases gastrointestinal and genitourinary toxicities
- IMRT has less acute and late toxicity



Can Protons Improve the Therapeutic Ratio for Pelvic Radiotherapy?

❖ Purpose: We created IMRT, IMRT/Proton, and Proton plans and compared the dose to non-target tissues.

Pelvis	Prostate Boost
IMRT	IMRT
IMRT	Protons
Protons	Protons



Methods

- 5 patients with High Risk Prostate Cancer
- Target:
 - Pelvic Lymph Nodes (46 GE/Gy)
 - Prostate and Seminal Vesicles (78 GE/Gy)
- Non-target: Rectum, Bladder, Small Bowel, Femoral heads, and Pelvis
- Treatment Planning:
 - IMRT/IMRT (N = 5)
 - IMRT/Proton (N = 5)
 - Proton/Proton (N = 5)

Plan normalization:

100% of the dose
covered 95% of the PTV

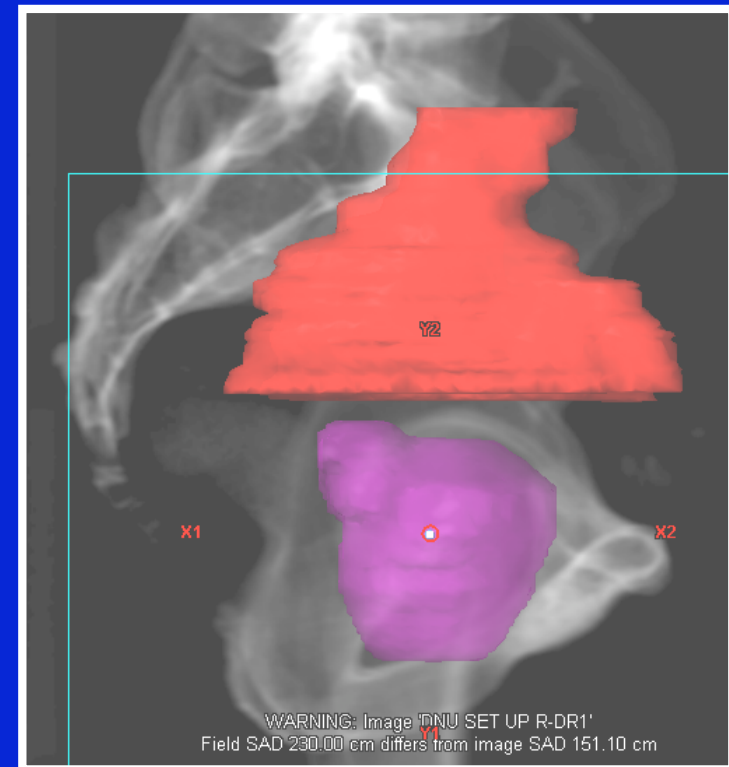
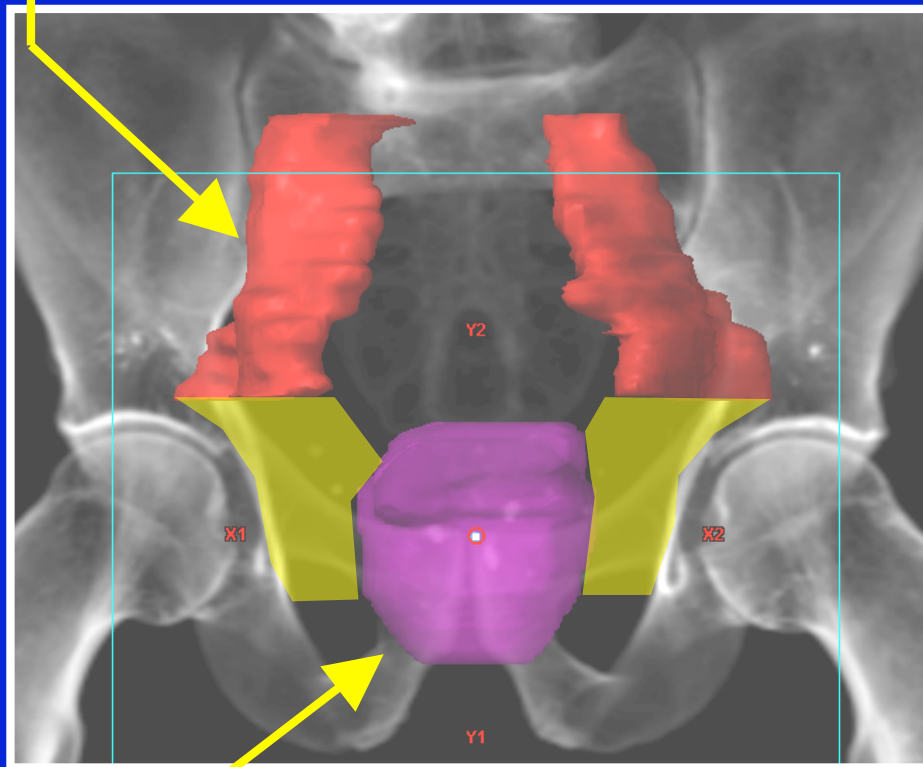
N = 15 plans



Planning Target Definition

Nodal PTV = Nodal CTV + 3mm superior and inferior

Nodal CTV^{1,2} = distal common & proximal internal/external iliacs + 7mm



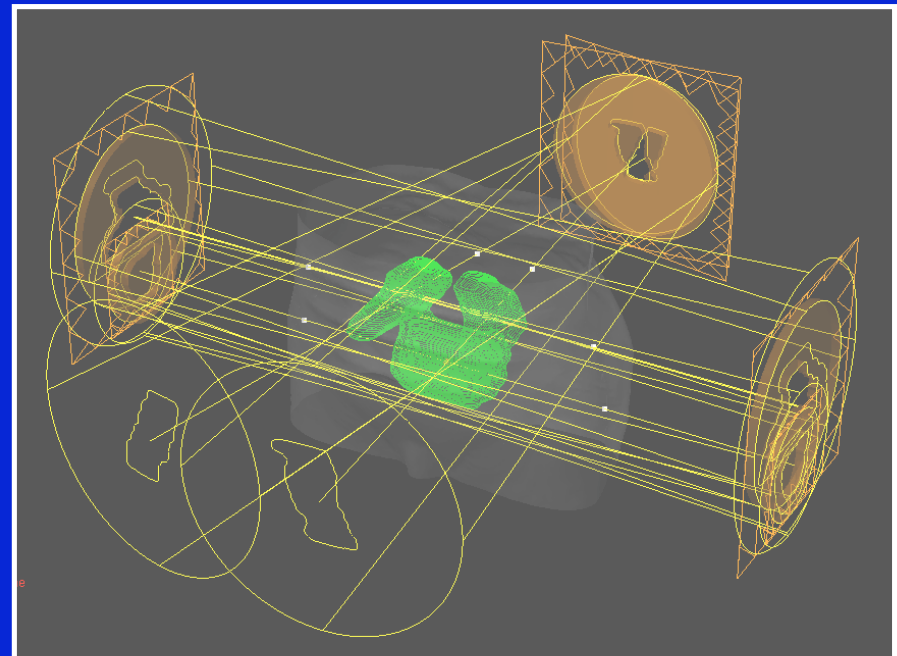
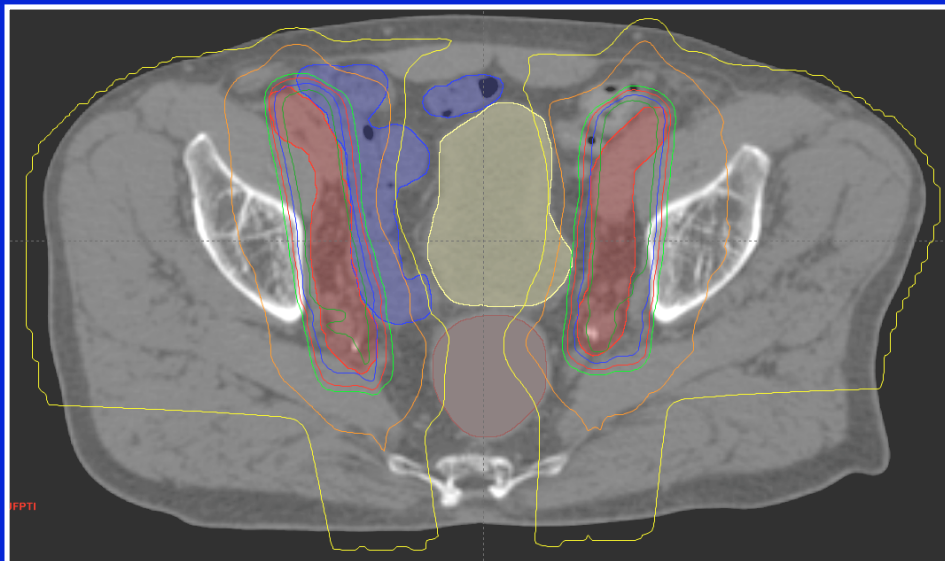
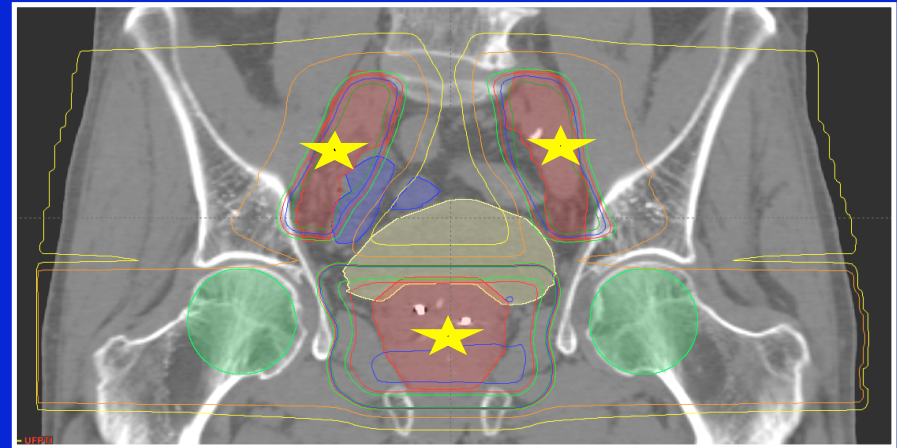
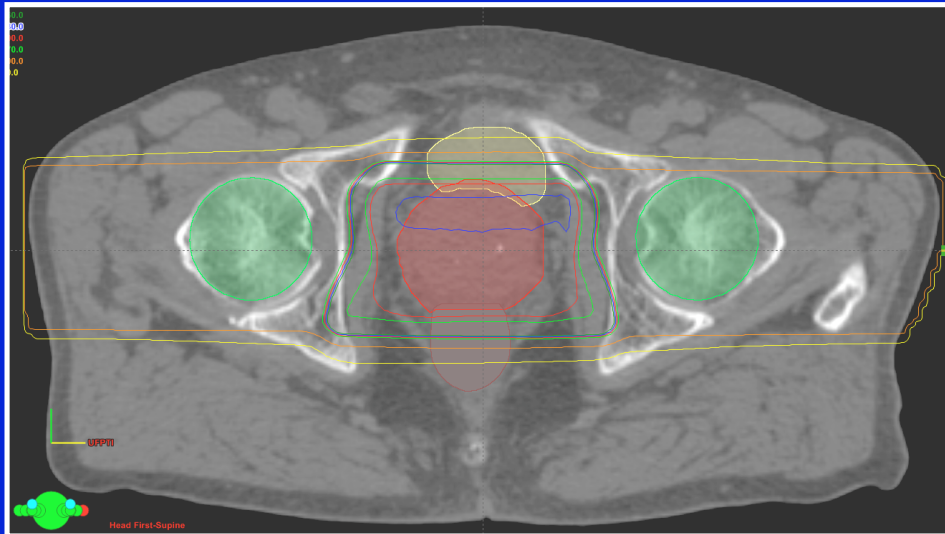
Prostate PTV = Prostate + SV + 3 mm

¹Taylor IJRBOP 2005;63:1604-1612

²Shih IJROBP 2005;63:1262-1269

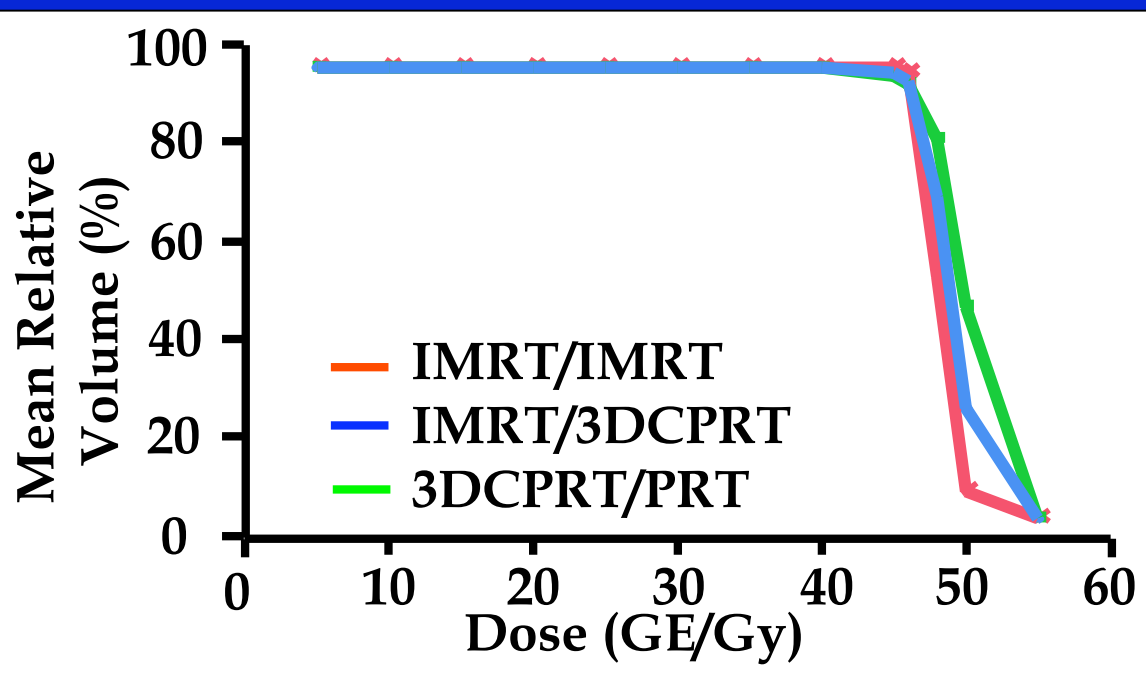


Proton/Proton Technique





Results: Dose to the Nodal PTV

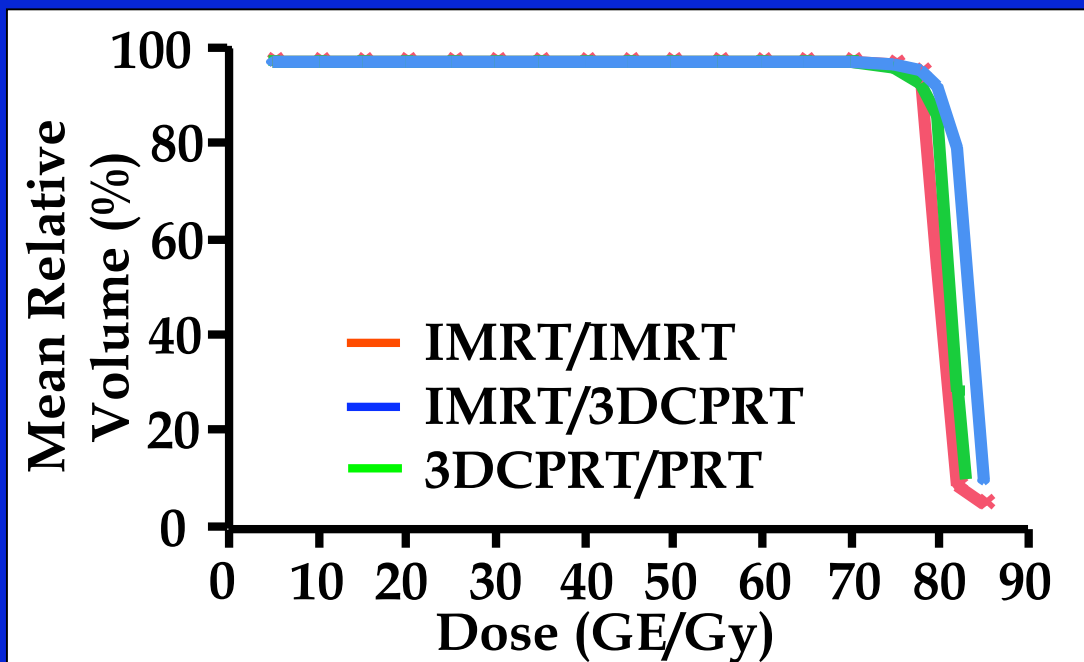


	Mean PTV V46 (%)
IMRT/IMRT	98.77
IMRT/3DCPRT	96.70
3DCPRT/PRT	96.20

	PTV mean dose (GE/Gy)	PTV maximum dose (GE/Gy)	PTV minimum dose (GE/Gy)
IMRT/IMRT	48.20	52.00	45.65
IMRT/3DCPRT	48.86	51.65	43.81
3DCPRT/PRT	49.92	53.07	42.96



Results: Dose to the Prostate PTV

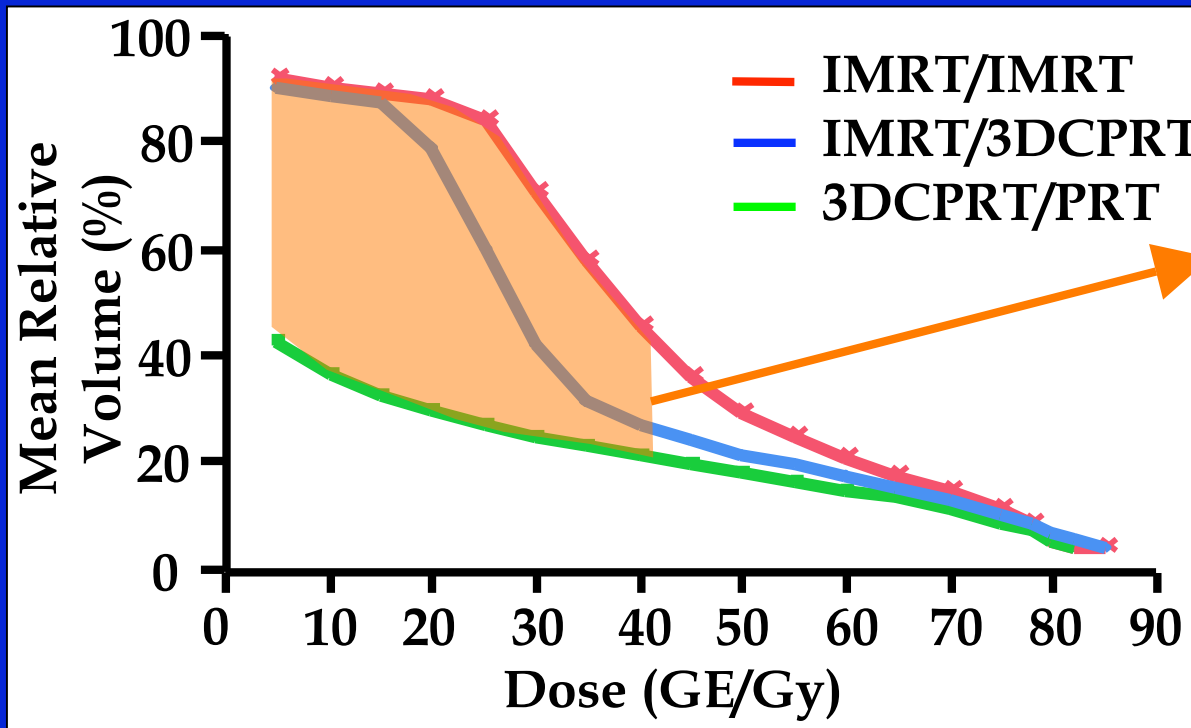


	Mean PTV V78 (%)
IMRT/IMRT	97.51
IMRT/3DCPRT	98.17
3DCPRT/PRT	95.26

	PTV mean dose (GE/Gy)	PTV maximum dose (GE/Gy)	PTV minimum dose (GE/Gy)
IMRT/IMRT	80.10	83.36	76.83
IMRT/3DCPRT	83.04	85.05	77.15
3DCPRT/PRT	81.21	82.90	74.51



Results: Dose to the Rectum



V5 to V40: ($p < 0.05$)

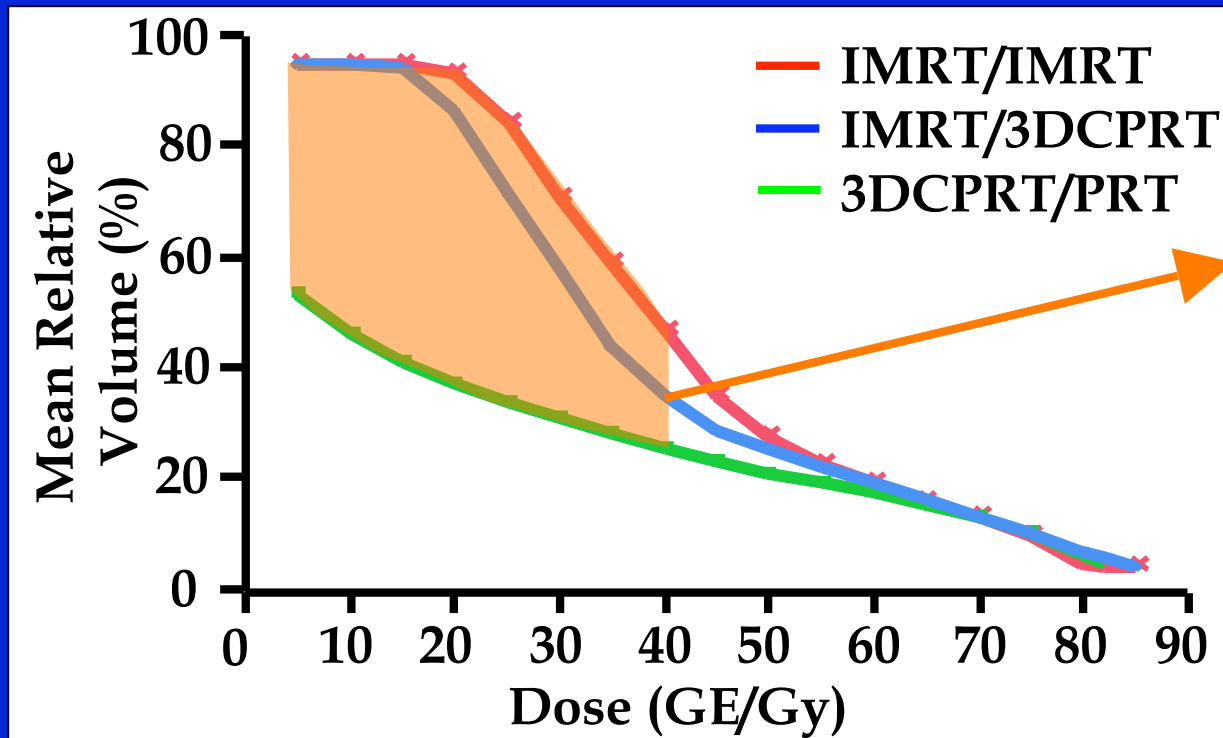
Relative: 35% to 53%

Absolute: 15% to 49%

	Mean Dose (GE/Gy)	
IMRT/IMRT	40.91	Relative: 60% Absolute: 24 GE/Gy
IMRT/3DCPRT	33.19	
3DCPRT/PRT	16.56	



Results: Dose to the Bladder



V5 to V40: (p<0.05)

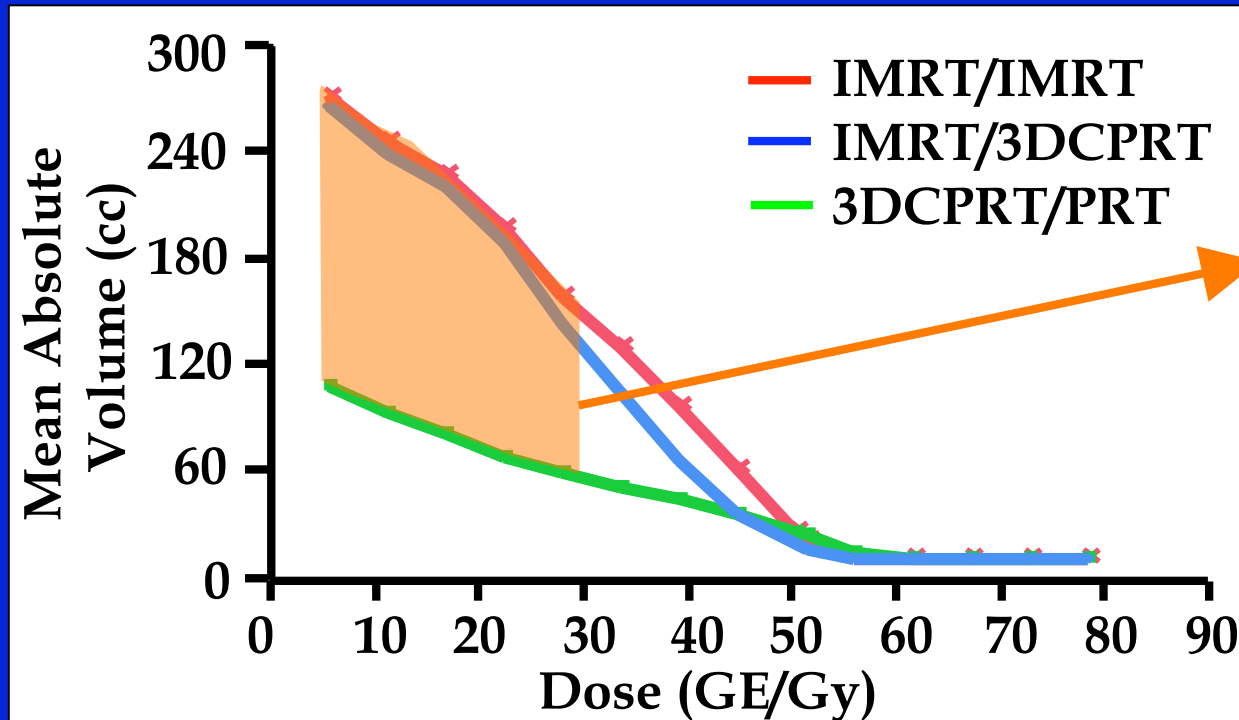
Relative: 46% to 50%

Absolute: 23% to 46%

	Mean Dose (GE/Gy)	
IMRT/IMRT	42.12	Relative: 50% Absolute: 21 GE/Gy
IMRT/3DCPRT	38.45	
3DCPRT/PRT	21.22	



Results: Dose to the Small Bowel



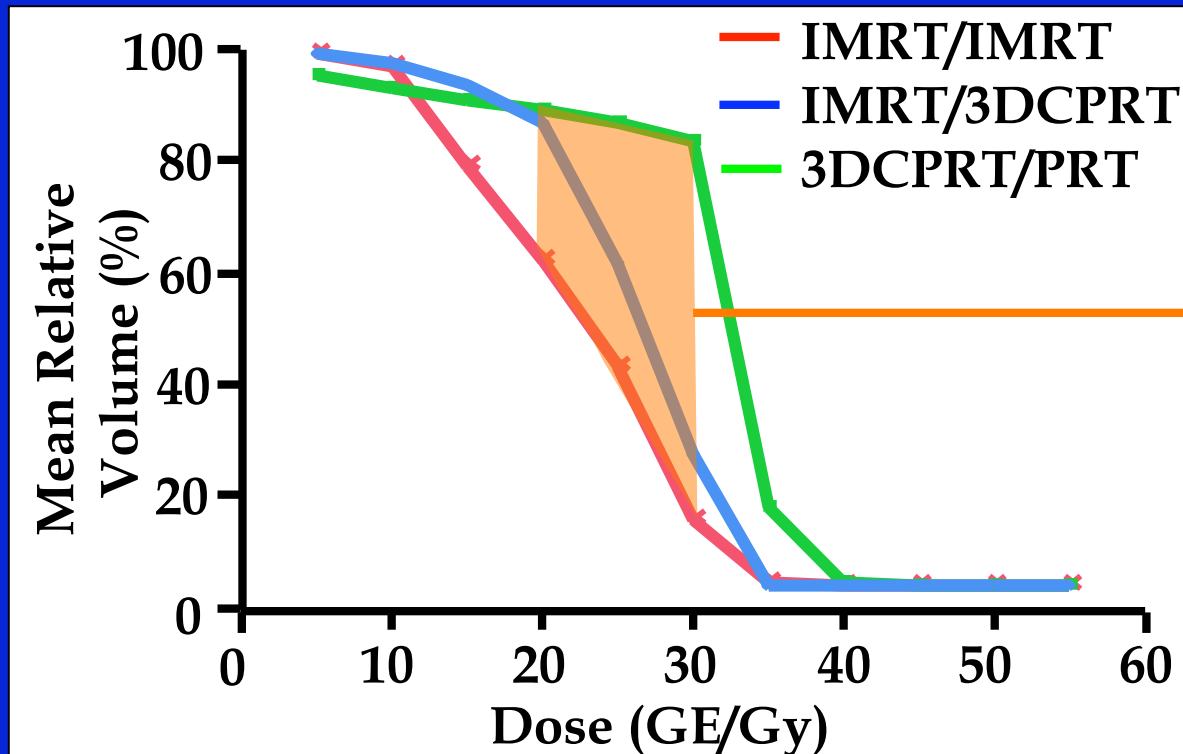
V5 to V30: ($p < 0.05$)

Relative: 62% to 65%

	Mean Dose (GE/Gy)	
IMRT/IMRT	27.28	Relative: 62% Absolute: 17 GE/Gy
IMRT/3DCPRT	25.22	
3DCPRT/PRT	10.36	



Results: Dose to the Femurs



IMRT/IMRT

IMRT/3DCPRT

3DCPRT/PRT

Mean Dose (GE/Gy)

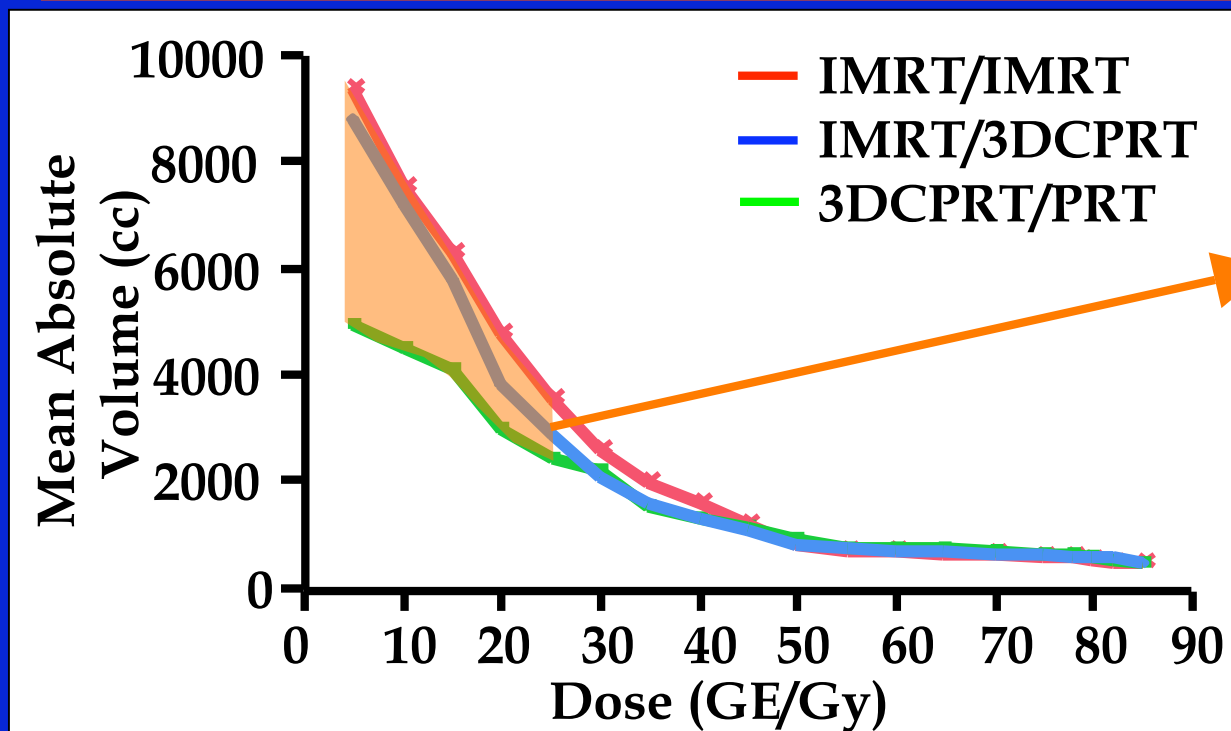
22.13

25.78

30.61



Results: Dose to the Non-target Pelvis



V5 to V25: ($p < 0.05$)

Relative: 38% to 50%

	Mean Dose (GE/Gy)	
IMRT/IMRT	14.17	Relative: 40%
IMRT/3DCPRT	12.75	
3DCPRT/PRT	8.47	Absolute: 6 GE/Gy



Conclusions

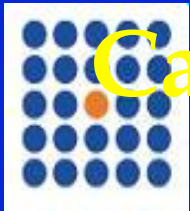
- Proton Therapy reduced the dose to non-target tissues

Non-Target Tissue	Relative Reduction
Rectum	35% to 53%
Bladder	46% to 50%
Small Bowel	62% to 65%
Pelvis	38% to 50%

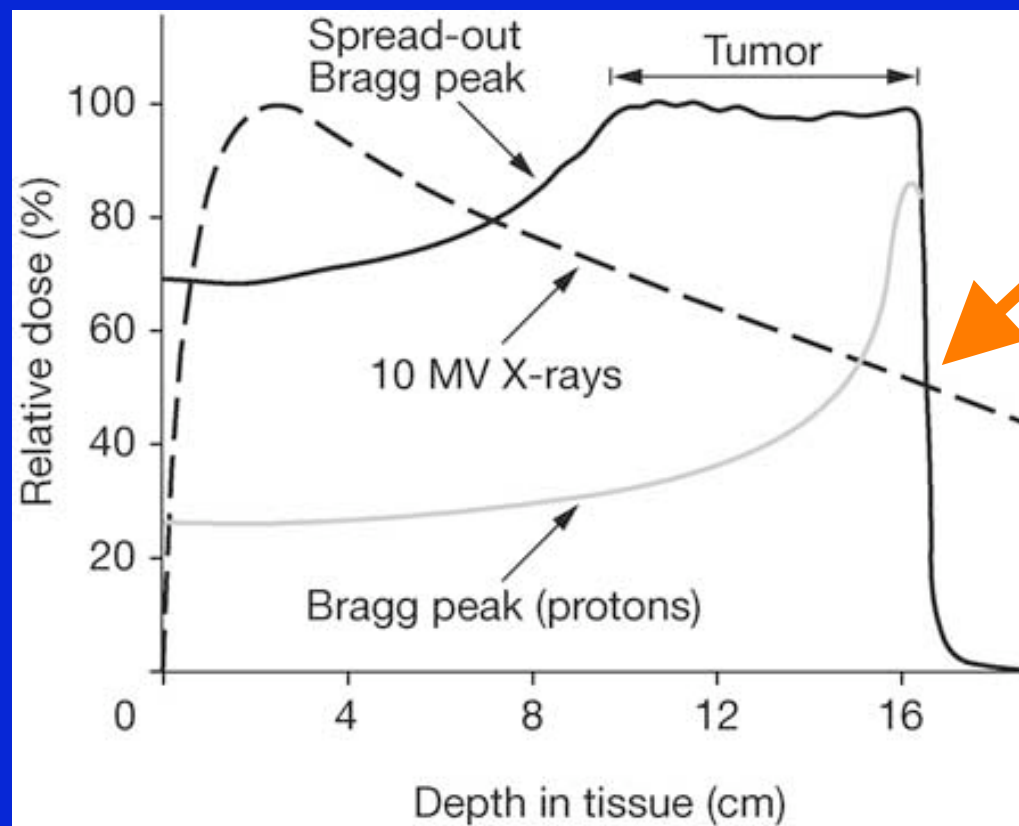
- Proton Therapy may improve the Therapeutic Ratio
- Field size limitations with double scattering limit the practicality of treating pelvic lymph nodes with protons



Slides not used

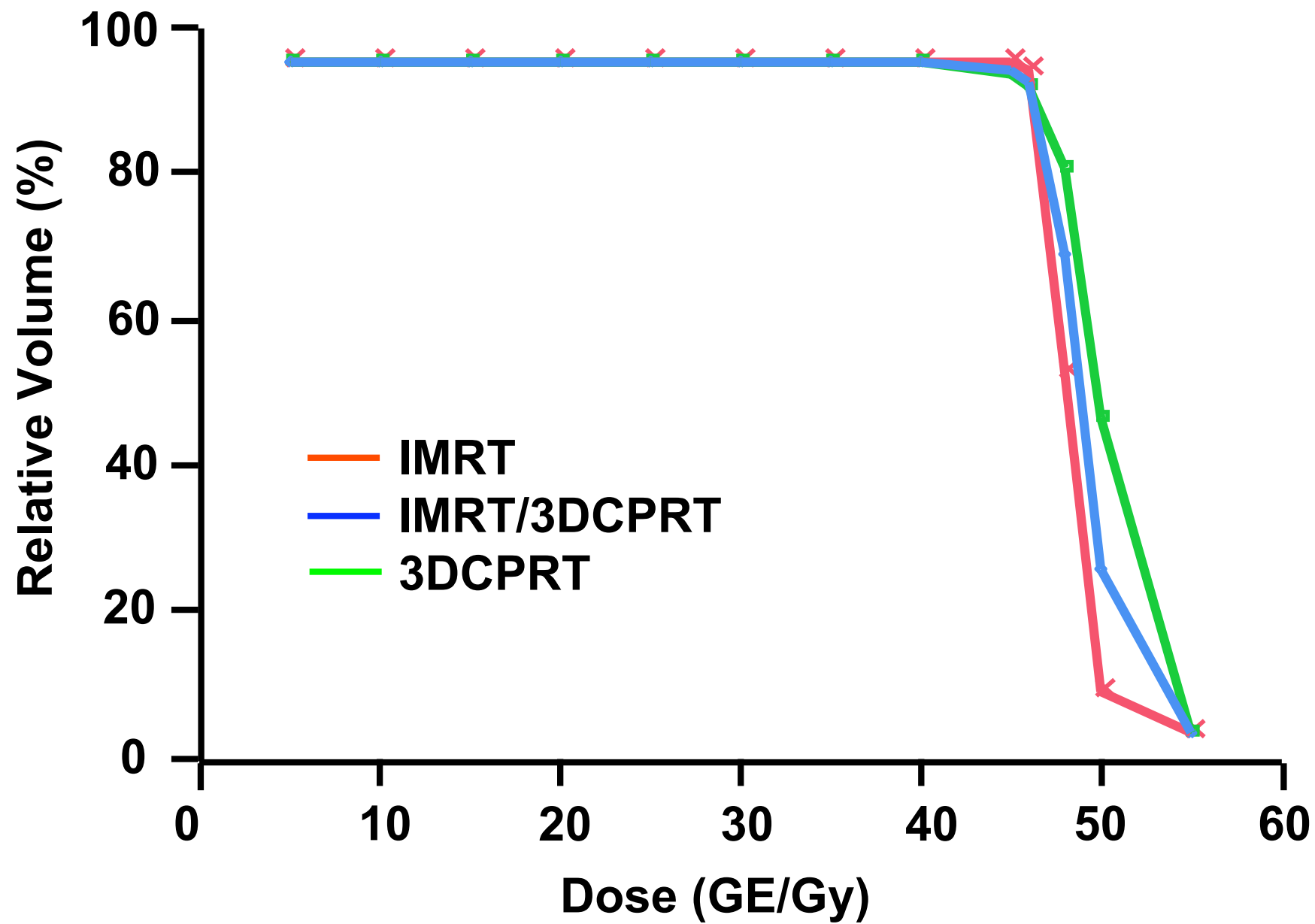


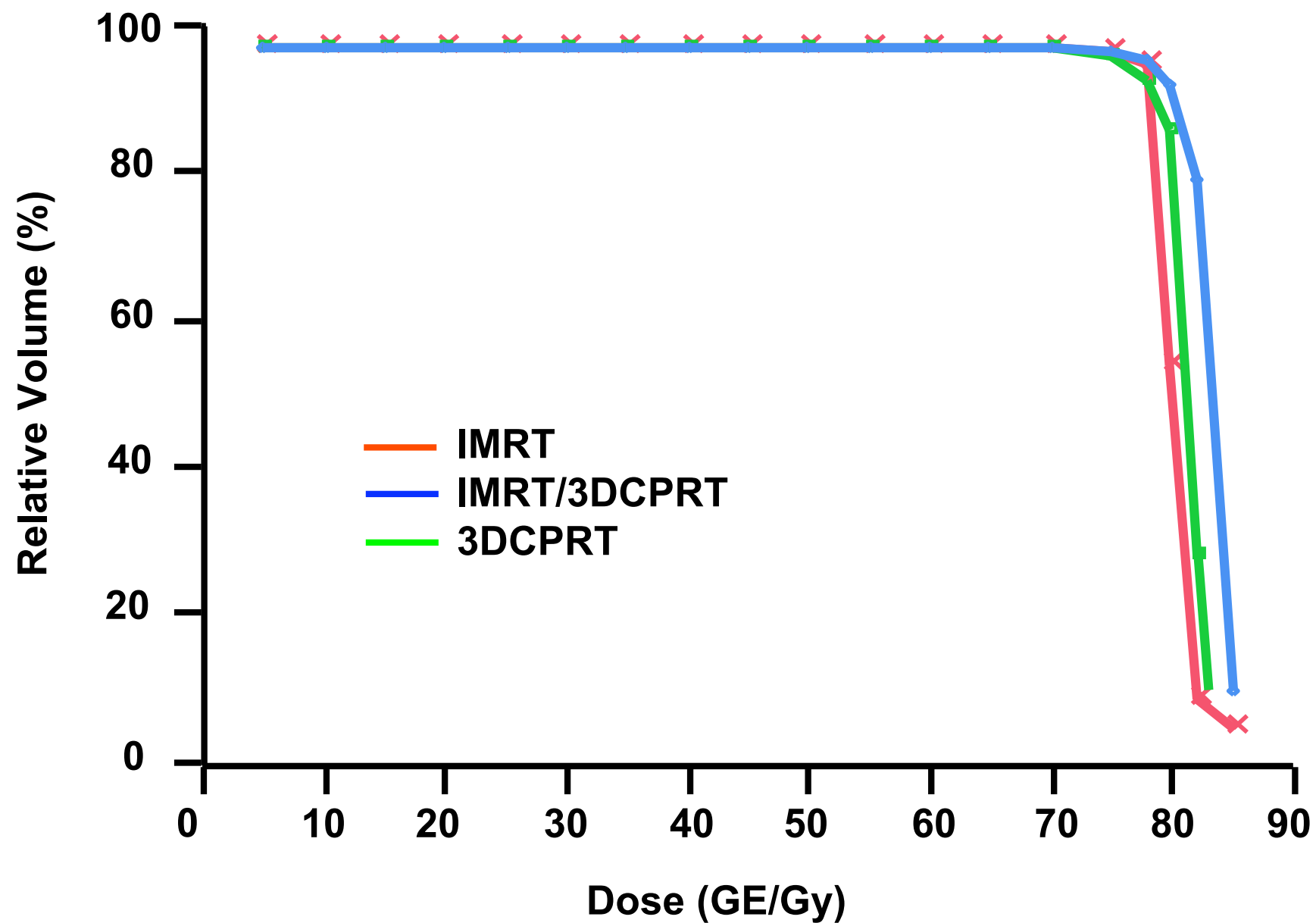
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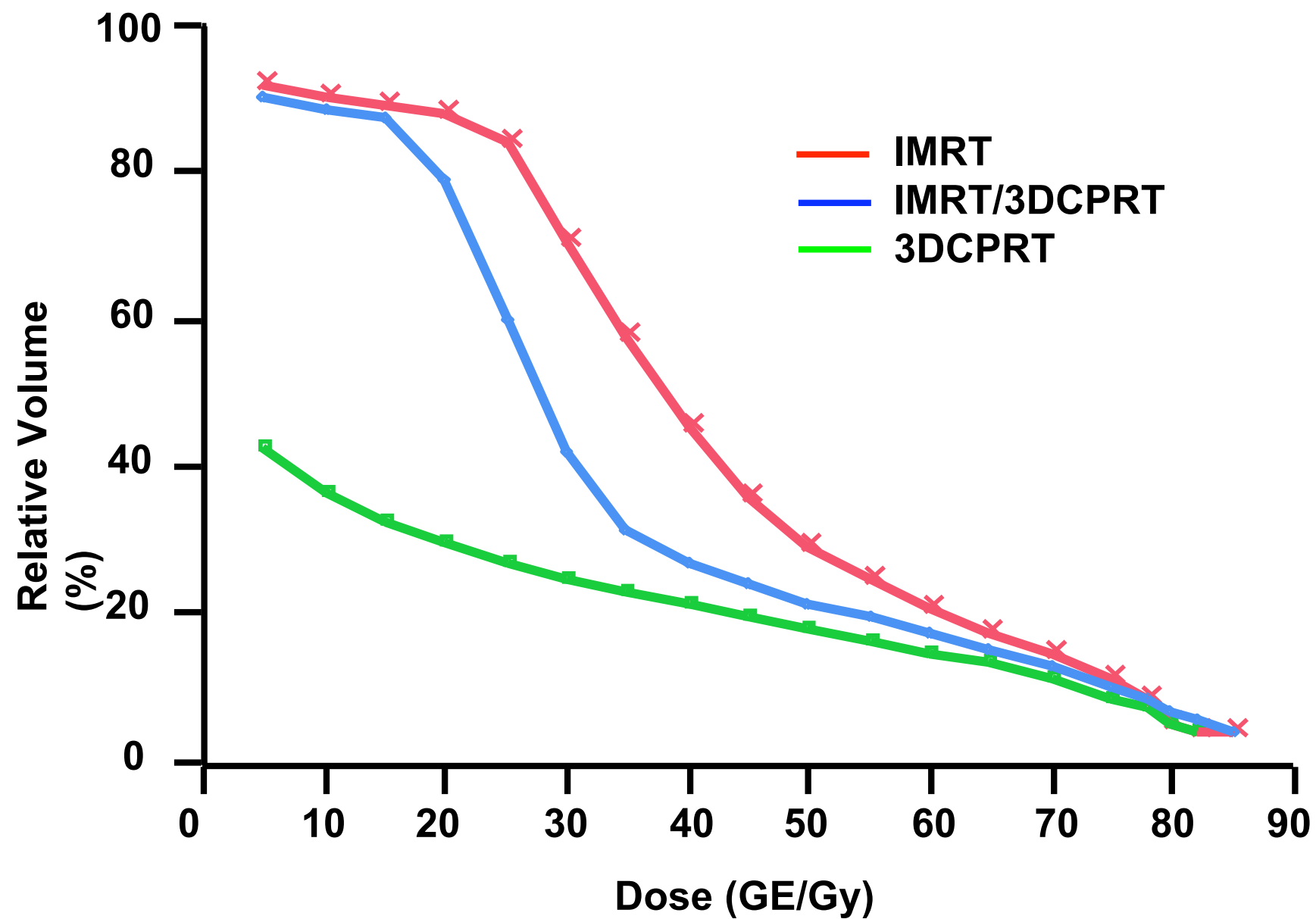


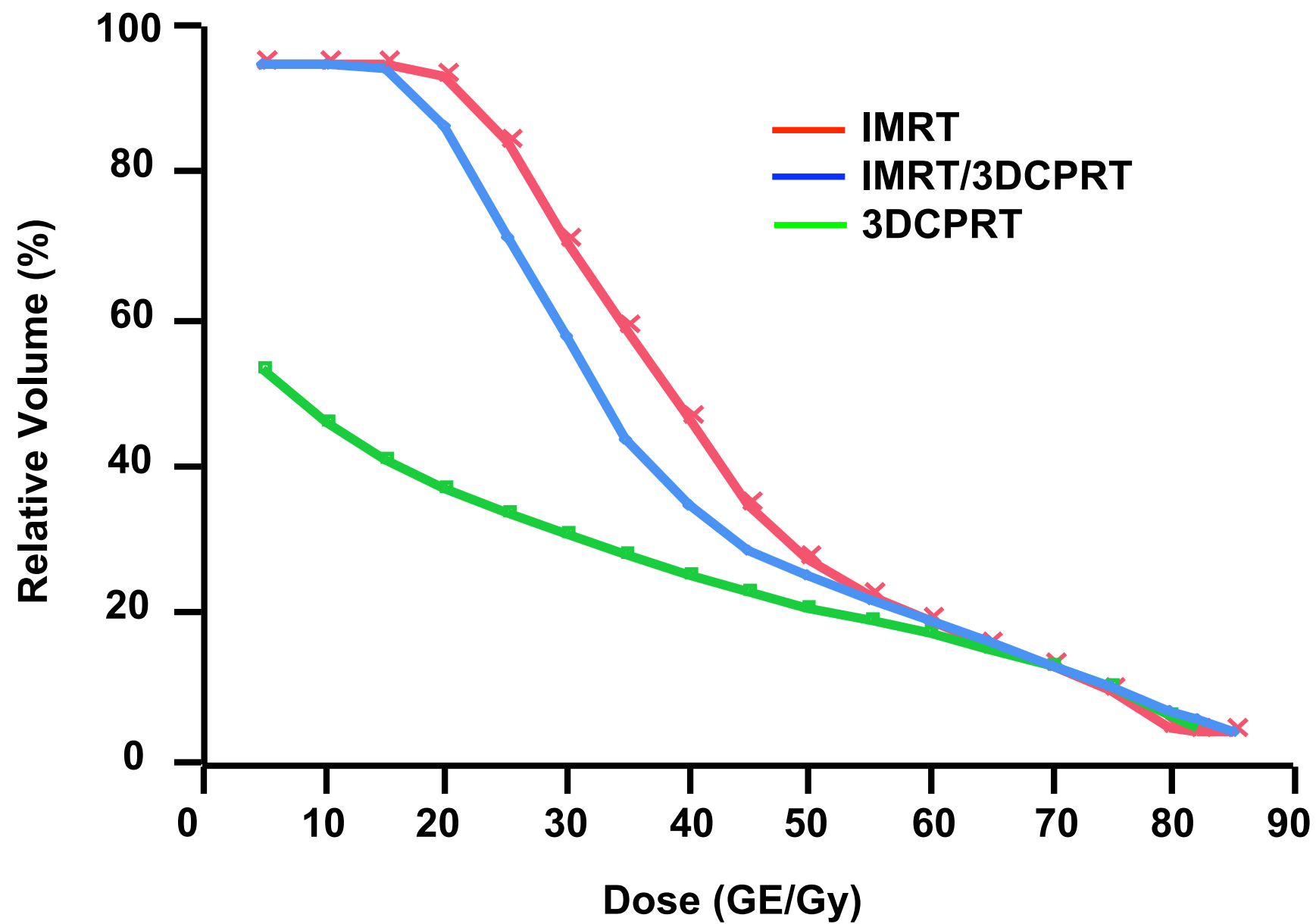
“No Exit Dose”

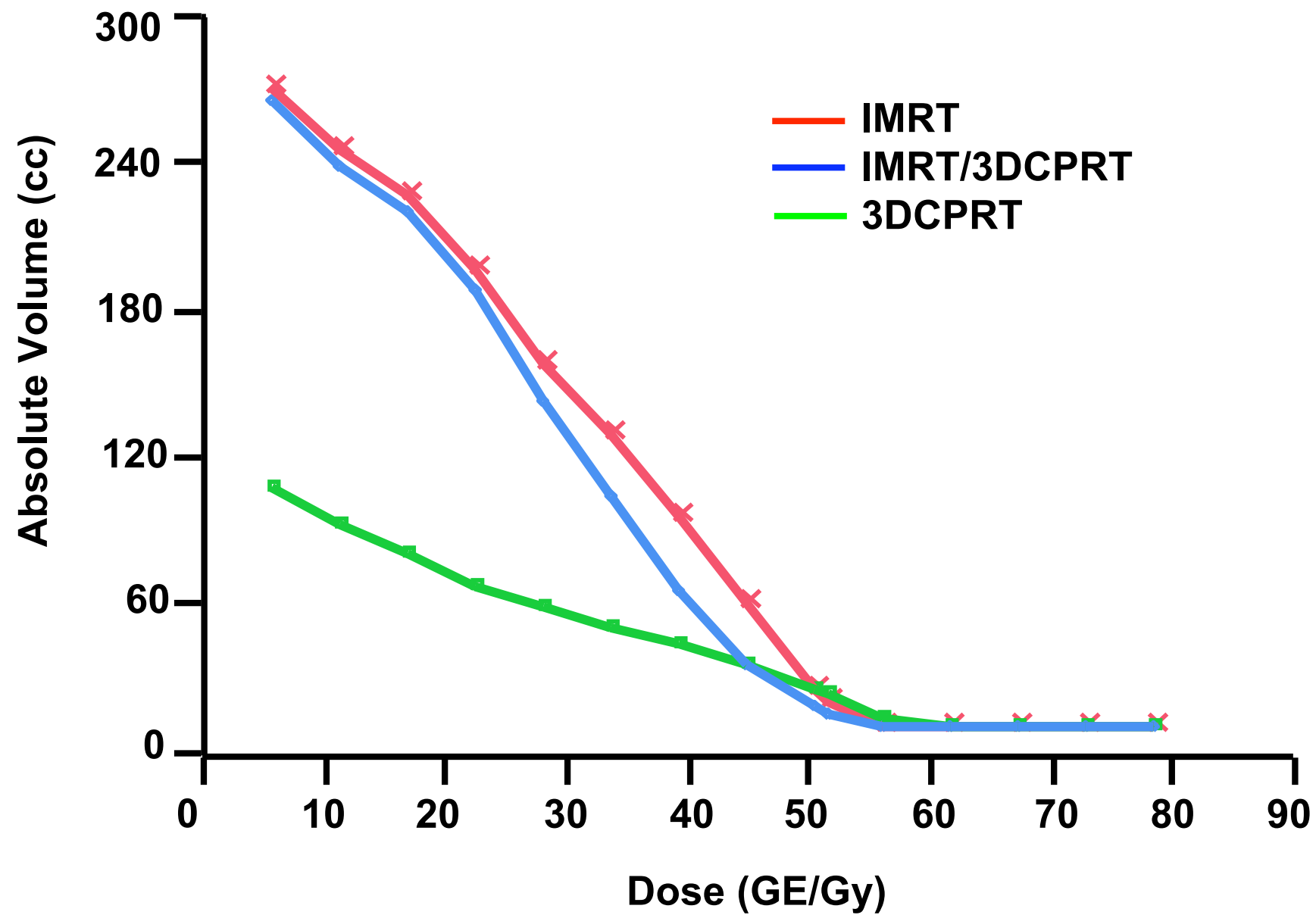
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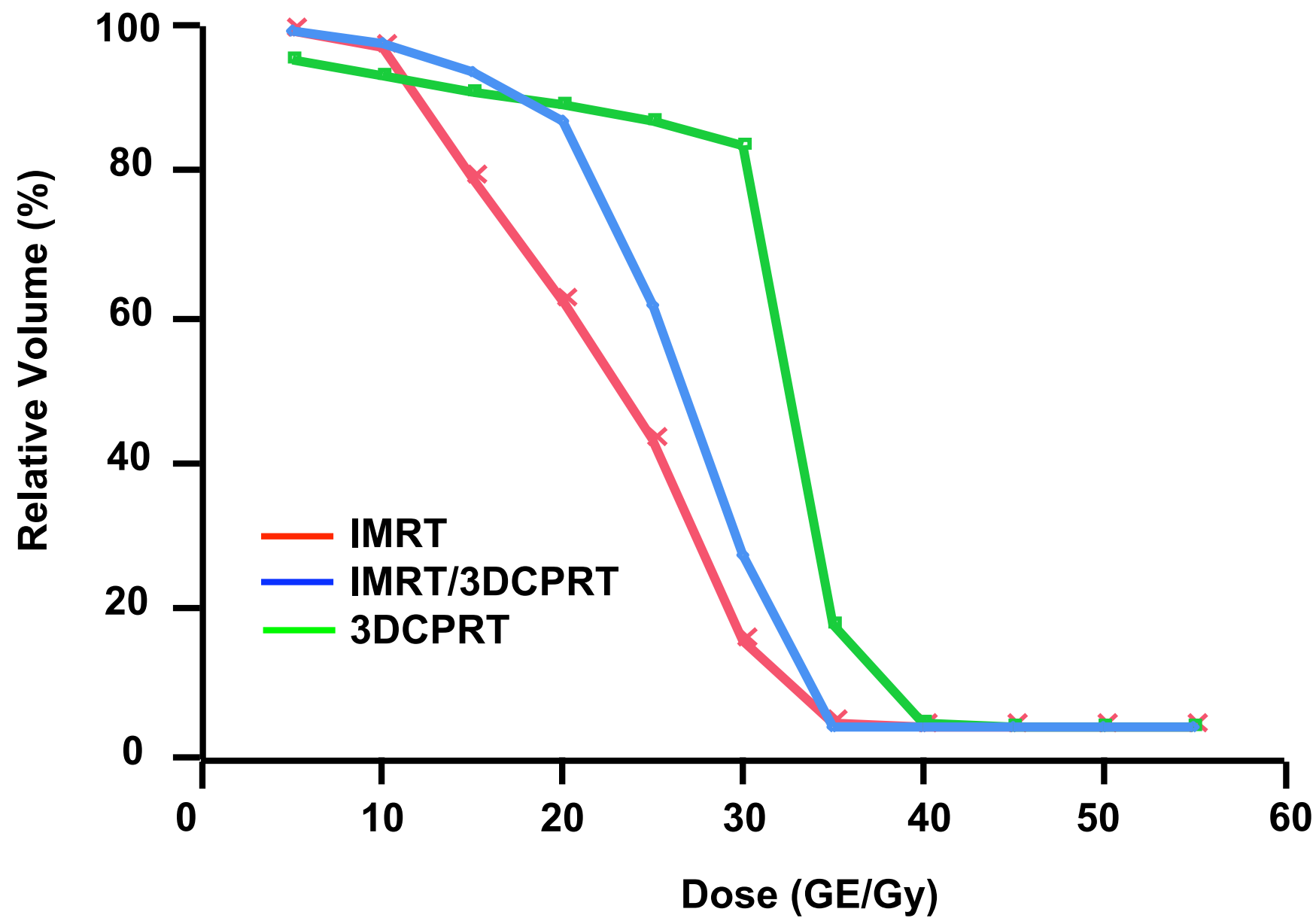


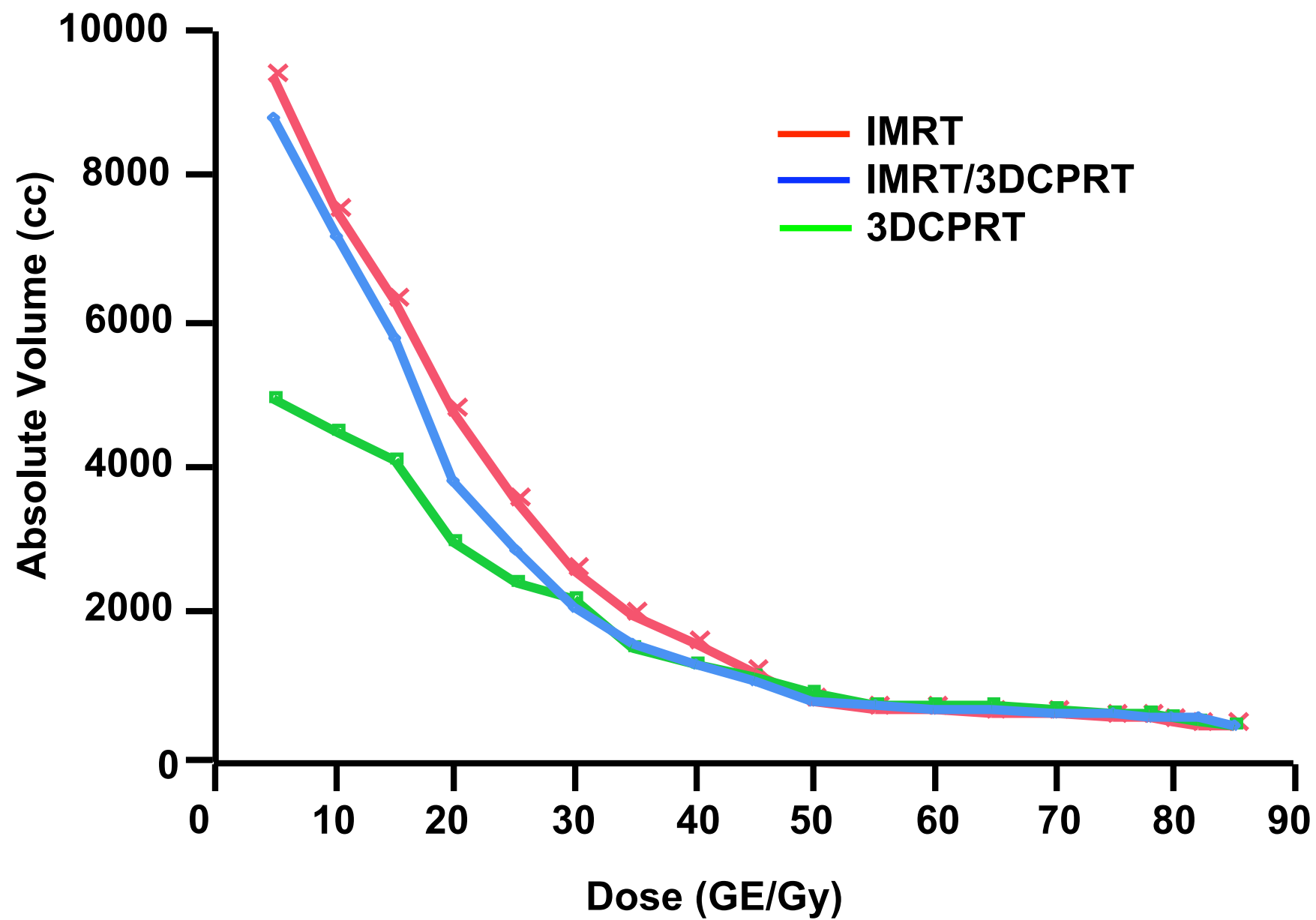














UFPTI 0703 - PR05



UNIVERSITY OF FLORIDA

PROTON THERAPY

INSTITUTE

**Eligibility
(at least one)**

≥ T2c
GS 8-10
PSA > 20 ng/ml
Radiographic
positive
pelvic LN



< 20% risk of + LN

Proton
Prostate + SV
46 CGE/23 fx
↓
Proton boost to
prostate +/- S.V.
28-36 CGE/14-16 fx

≥ 20% risk of + LN

Conformal X-ray
Prostate + SV + LN
46 Gy/23 fx
↓
Proton boost to
prostate
28-36 CGE/14-16 fx

Positive pelvic LN

Conformal X-ray
Prostate + SV + LN
46 Gy/23 fx
↓
Proton boost to
prostate
28-36 CGE/16 fx
and
**Proton boost to
nodes**
20-26 CGE/12 fx

All patients:

Concurrent **Docetaxel** 20 mg/m²/week

Adjuvant **androgen deprivation therapy** x 6 months