

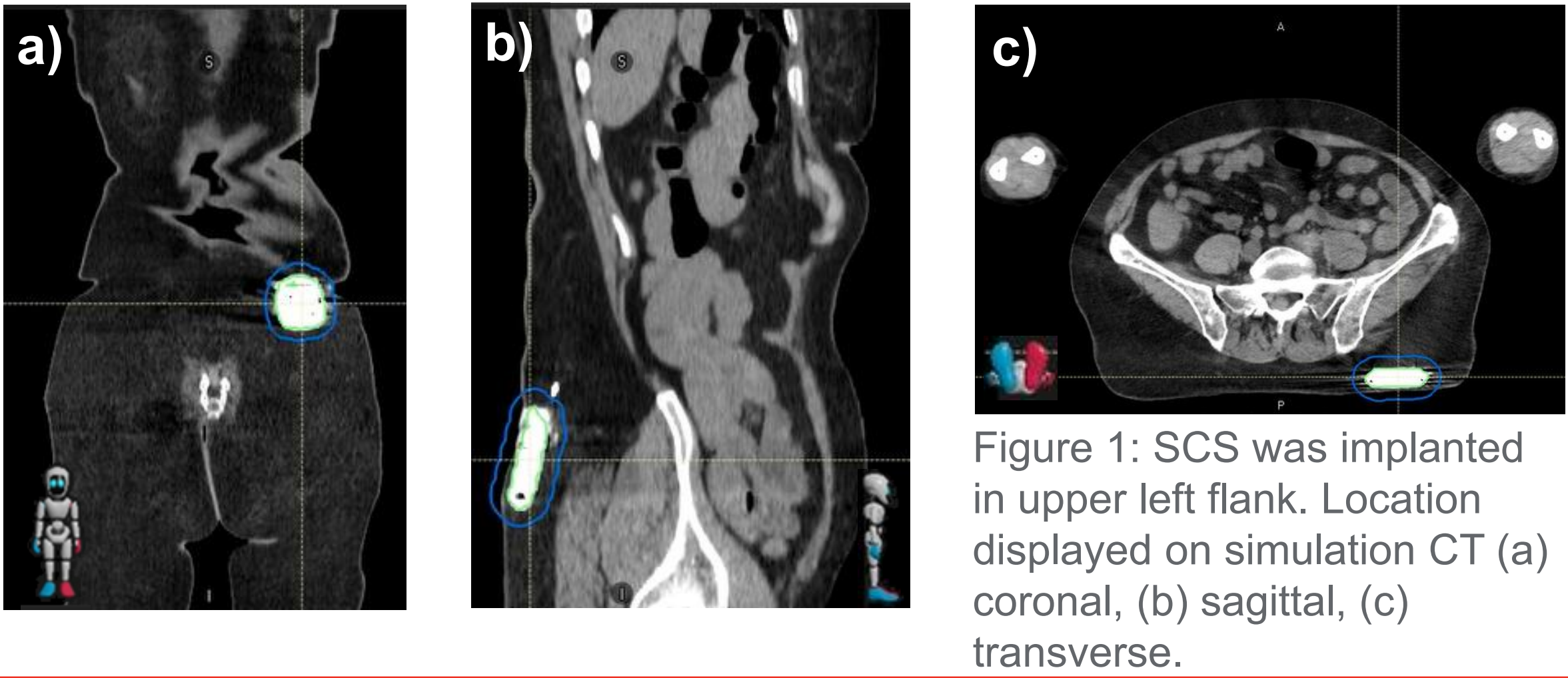
Modification of Total Body Irradiation to Reduce Risk of Damage to a Spinal Cord Stimulator

Angela Gearhardt^{1,2} and Tze Lim¹, Xin Wang¹, Bouthaina Dabaja¹, Angela Sobremonte¹, Shryll Turner¹, Stephen Kry¹

¹The University of Texas MD Anderson Cancer Center, ²The University of Texas MD Anderson Cancer Center UTHealth Houston Graduate School of Biomedical Sciences

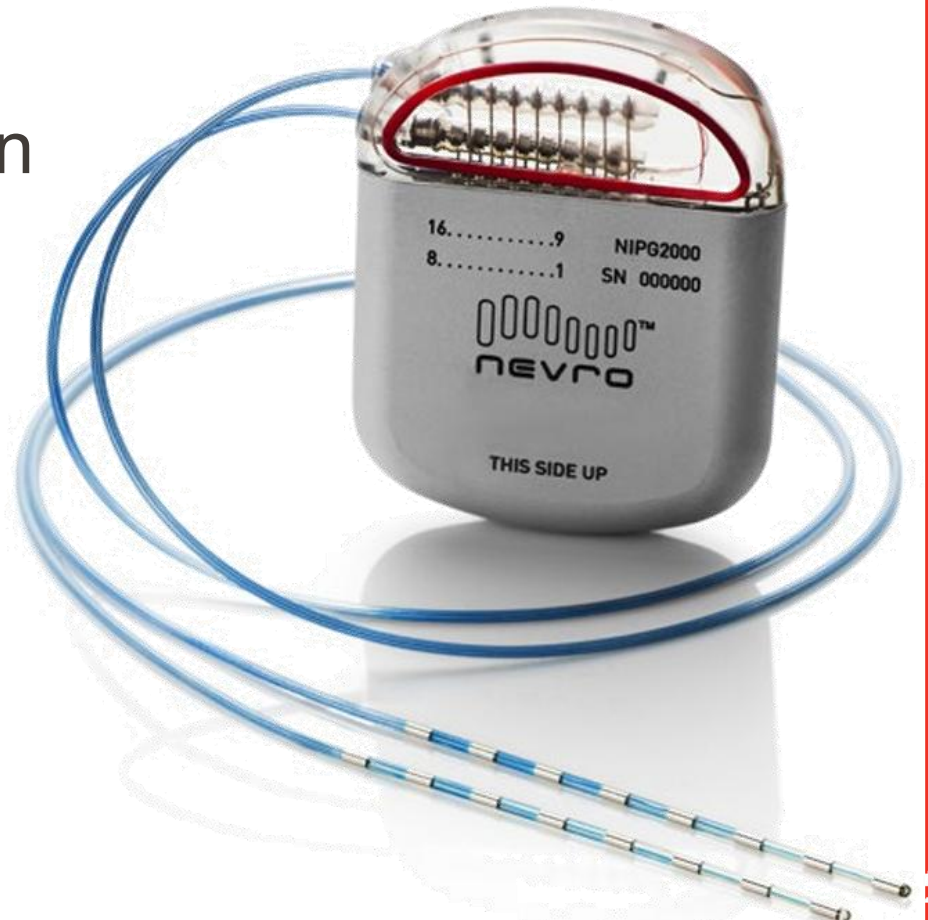
Patient Presentation

- 59 year old patient presenting with acute myeloid leukemia
- Nevro Senza spinal cord stimulator (SCS) implanted in upper left flank for chronic pain syndrome
- Prescribed 4 Gy in 2 fractions of total body irradiation (TBI)



SCS in RT

- Spinal cord stimulators (SCSs) consist of an implanted pulse generator (IPG), electrodes attaching to the dorsal column, and insulating extension wires
- No radiotherapy tolerance data for SCSs or community guidance for management
- 3 case reports have reported successful treatment of patients with SCS^{1,2,3}
- Recommendations from Senza Physician Implants Manual: minimize radiation exposure, shield device if radiation is necessary, turn off device during treatment
- Recommendation from Senza representative: extrapolating from CIED data, keep dose below 2 Gy
- Key management decisions: reduce photon dose as low as reasonably achievable, avoid neutron exposure**



Outcomes

- Treatment met all clinical goals
- No neutron exposure to IPG
- Dose to IPG reduced to less than half prescription dose
- No SCS malfunction observed**
 - Patient reported normal sensation on follow-up
 - No signs of malfunction present on remote

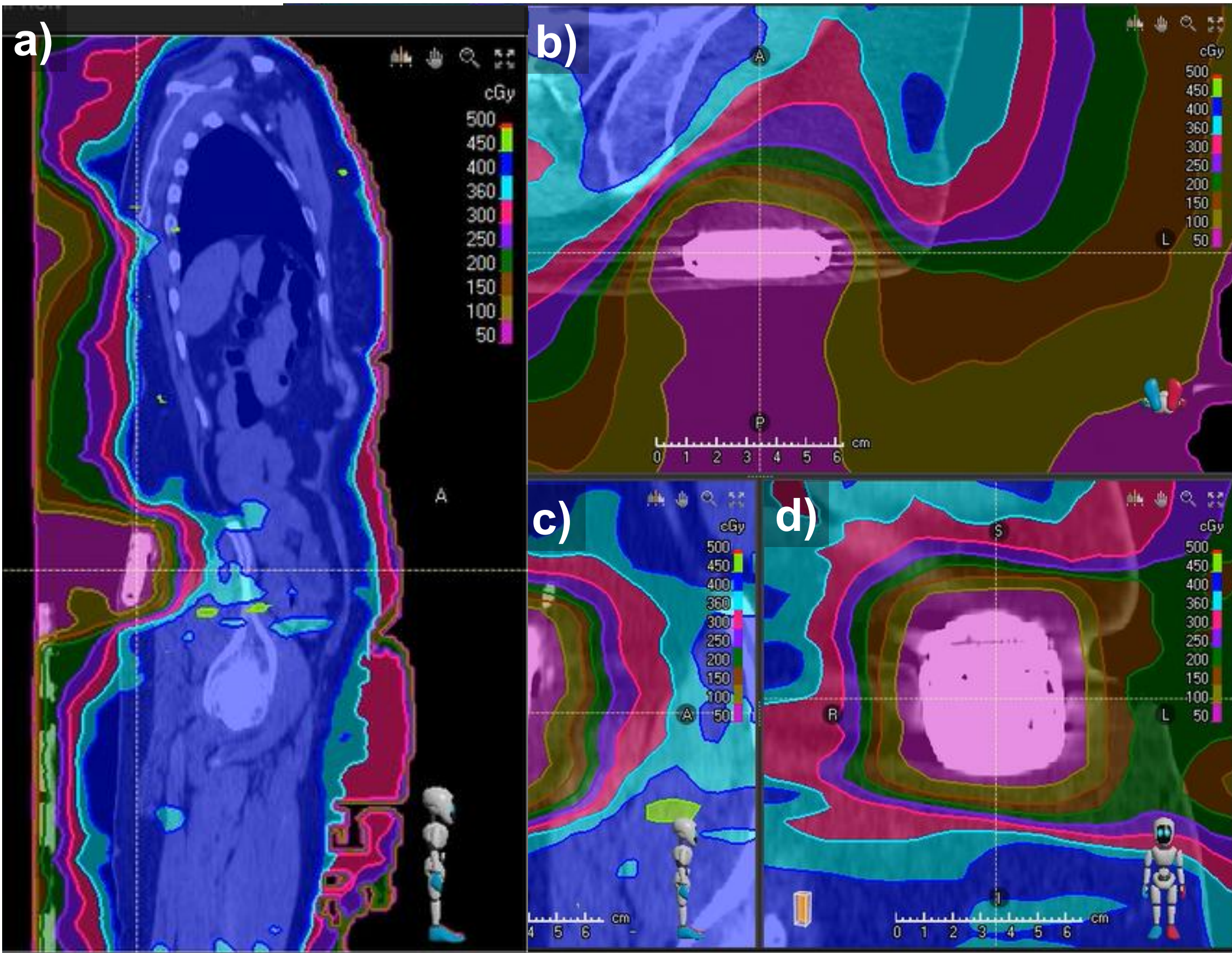


Recommendations

- Avoid neutron producing energies**
- Avoidance volume around IPG for treatment planning should include a large margin, as displacement up to 2.2 cm was observed**

Treatment Approach

- Challenges:
 - Neutrons pose specific risk of electronic device malfunction⁴
 - Traditional TBI utilizes neutron-producing energy
 - High MU increases neutron production
 - As the target is the whole body, IPG is in the primary field
- Solution: Utilize VMAT TBI technique
 - Challenge 1: Use 6 MV to **avoid neutrons**
 - Challenge 2: Use MLC blocking to **reduce photon exposure**
- Planning
 - 3 VMAT head-first supine isos
 - 2 AP/PA feet-first supine isos
 - Limited planned dose to IPG: 0.7 Gy mean dose and 0.91 Gy max dose**



Treatment Delivery

- IPG location during treatment delivery was not the same as in planning geometry (**up to 2.2 cm displacement**) due to soft tissue displacement
 - First Fraction: 2.2 cm inferior, 0.8 cm right, and 0.4 cm anterior
 - Second Fraction: 1.4 cm superior, 0.7 cm right, and 1 cm anterior
- Maximum dose to the IPG as measured by TLD was 1.88 Gy; greater than planned max dose of 0.91 Gy.

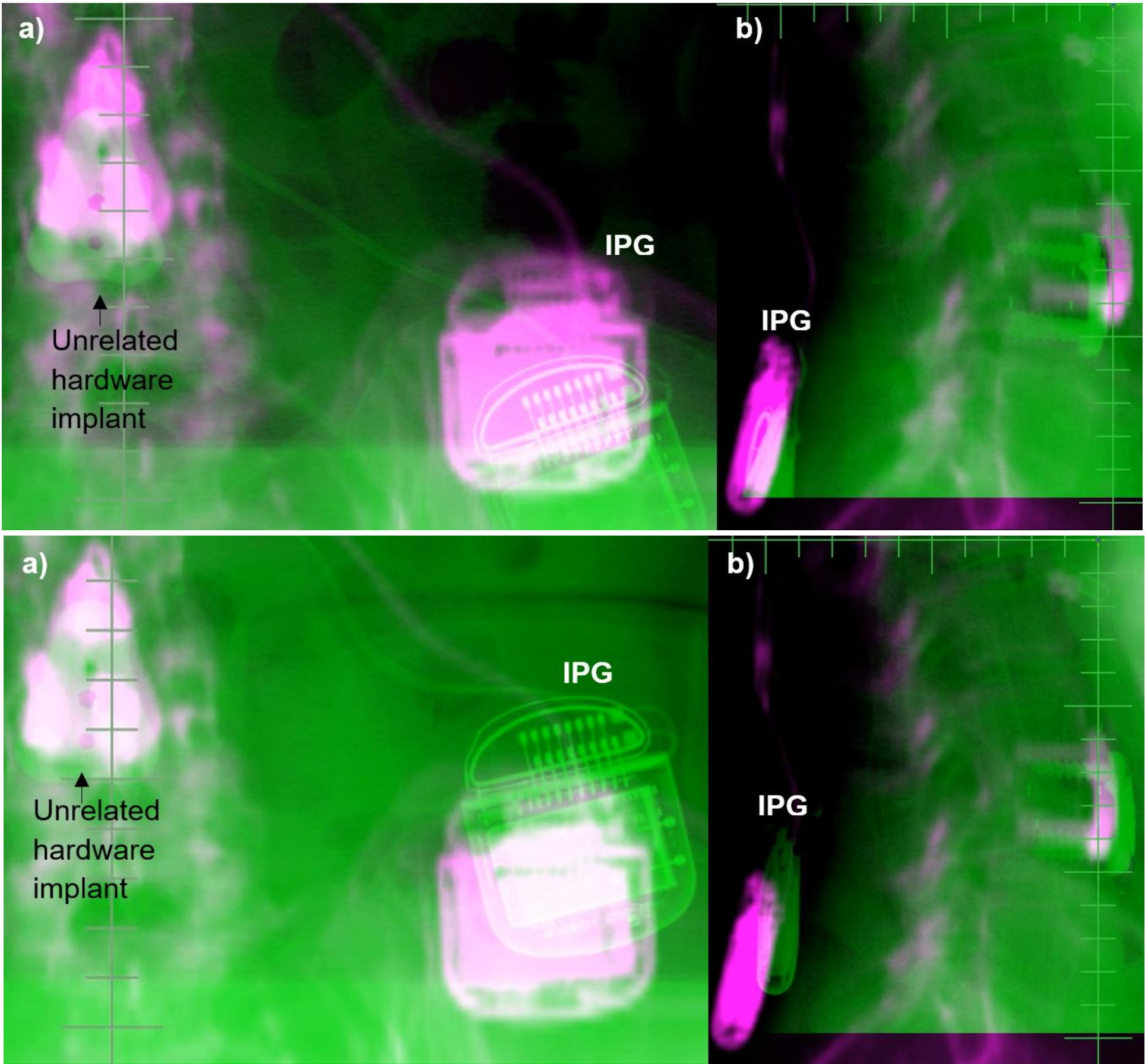


Figure 5: KV setup images for second fraction: (a) AP (b) lat. Magenta is planned geometry, green is delivered.

TLD Position	First Fraction (Gy)	Second Fraction (Gy)	Total Dose (Gy)
<i>Superior</i>	0.49	1.39	1.88
<i>Inferior</i>	0.97	0.47	1.44
<i>Left</i>	0.45	0.67	1.12
<i>Right</i>	0.57	0.51	1.08
<i>Center</i>	0.45	0.50	0.95

Table 1: Dose to IPG was measured by TLD for each fraction. TLD were placed at the center of the IPG and superior, inferior, left, and right extents.

Resources

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Contact Info

Angela Gearhardt, MS
aggearhardt@mdanderson.org



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