Can We Use a Decay Plan for GammaPod APBI Treatments?

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INTRODUCTION

- The GammaPod is a novel radiation therapy device for prone stereotactic breast treatments. Key elements are:

  - vacuum-assisted breast cup for immobilization with radiographic wire

  - large number of non-coplanar beams from twenty-five Co-60 sources.

- A 5-fraction partial breast (APBI) schema, involves placement of the breast cup, daily CT, and re-plan for each fraction, posing a significant time burden for the patient and the staff.

Purpose: **This work investigates the possibility of using decay plans (original plan adjusted by radioactive decay of the sources) to treat APBI patients after the first fraction.**

METHODS

- We retrospectively reviewed ten previously treated GammaPod patients who were treated with a 5-fraction APBI approach.
- All CT images contours and the dose for each fraction were imported into a 3rd party TPS.
- CT images of days 2-5 were rigidly registered to the 1st day's CT image.
- We evaluated target contours overlap, PTV $D_{95\%}$ and CTV $D_{99\%}$ for each day as if the 1st day treatment had been used for all days as a decay plan. The registration was done using the breast cup as the main area of interest.

RESULTS

- PTV-PTV overlap between fractions averaged 82% (range 57.2%-95.2%).
- Target dosimetry showed a significant degradation for most patients.
- Of 28 decay plans analyzed, only 9 plans (32%) had clinically acceptable PTV $D_{95\%}$ and CTV $D_{99\%}$ (larger than 95% of prescription dose).
- Patients with lumpectomy cavities close to the chest wall showed the largest degradation in target dosimetry.

TABLES AND FIGURE

Fraction	PTV_D95(Gy) (Clinical Plan)	PTV_D95(%) (Decay Plan)	CTV D99 (%) (Decay Plan)
2	6	99.0%	100.5%
3	6	98.3%	100.7%
4	6	97.5%	100.5%
5	6	98.3%	100.5%
Average	6.0	98.3%	100.5%

Fraction	PTV D95(Gy) (Clinical Plan)	PTV D95(%) (Decay Plan)	CTV D99(%) (Decay Plan)
2	6	93.3%	95.0%
3	6	86.7%	103.3%
4	6	88.3%	88.3%
5	6	71.7%	68.3%
Average	6.0	85.0%	88.8%

Table 1: PTV D95% and CTV D99% of decay plans as percentages of prescription dose in fractions 2-5 for two patients**. Left Panel:** Patient 2 is a best -case scenario (PTV D95% and CTV D99% both equal or larger than 95% of prescribed dose) for all fractions. **Right Panel:** Patient 4 is a worst-case scenario where none of the fractions show acceptable dosimetry for both PTV and CTV.

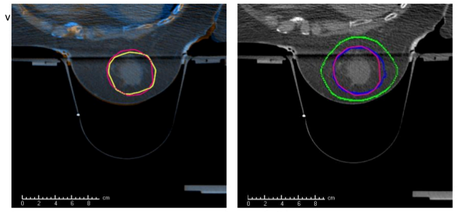

Fig. 1. Patient 2 CT1-CT3 registration based on external cup and radiographic markers. **Left Panel:** PTV1(yellow) and PTV3(pink) have a large overlap. **Right panel:** the 95% isodose(blue) from the decay plan covers PTV3(pink). The 50% isodose is shown in green for reference.

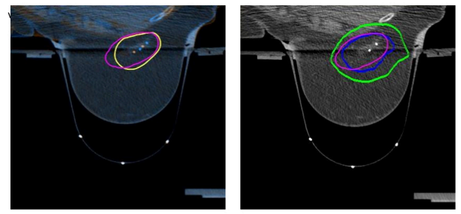

Fig. 2. Patient 6 CT1-CT5 registration based on external cup and radiographic markers. **Left panel:** PTV1(yellow) and PTV5(pink) have a significant area without overlap and there is a clear shift in the surgical clips. **Right panel:** the 95% isodose(blue) from the decay plan does not properly cover PTV5(pink).

CONCLUSIONS

In most cases it's not possible to use a decay plan for APBI treatments due to unacceptable dosimetry. A subset of patients based on target location and size may be identified that can benefit from the use for decay plans.