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Theme: Physics **PTCOG-AO2025-ABS-0054**

Comparison of Plan Robustness Against Anatomical Changes Between SFUD and IMPT in Ultra-Hypofractionated Proton Therapy for Localized Prostate Cancer

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Background / Aims

- Photon-based UHF schedules have reported higher late toxicity (Tree AC, et al. 2022).
- In spot-scanning proton therapy
  - Single-field uniform dose (**SFUD**) : more robust but less conformal
  - Intensity-modulated proton therapy (**IMPT**) : reduces the dose to the organs at risk (OAR), but more sensitive to anatomy changes.
- The aim of this study is to compare plan robustness against anatomical changes for **SFUD** and **IMPT** plans used in the UHF schedule.

Methods

1. Treatment planning
   - Patients: Ten prostate cancer patients (Age: 73 (66-85) years, CTV: 44 (21-77) cc)
   - Plans: SFUD (bs-PTV) and IMPT (Robust optimization) using 3 mm setup and 3.5% range uncertainty consisted of bilateral 4 fields
   - Prescription: 36.25 GyE in 5 fractions (**Table 1**)
2. Accumulated dose simulation against anatomical changes
   - Summary of the entire dose simulation workflow (**Figure 1)**
3. Plan comparison between SFUD and IMPT
   - **Dose variations** (planned vs. accumulated) and **accumulated doses**
   - Wilcoxon signed-rank tests ($p < 0.05$)

Table1. Dose constrains

CTV	D99 > 36.25GyE
Rectum	V18.1 < 50%
	V29 < 20%
	V36 < 1cc
Bladder	V18.1 < 40%
	V37 < 10cc

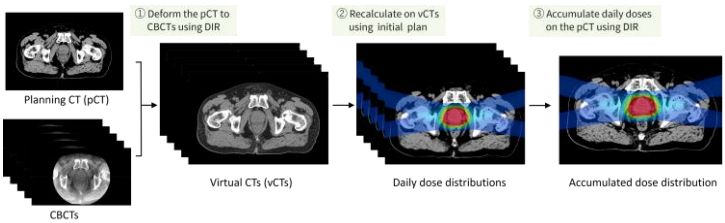

Figure 1. Workflow of the **accumulated dose simulation**

Results

- **Anatomical changes**
  - Mean volume changes between the pCT and vCT
    CTV: −0.03 (−7.04 to 4.13)%, Rectum: 8.93 (−16.05 to 85.16) %, Bladder: 0.27 (–40.27 to 37.27) %
- **Plan Robustness**
  - No statistically significant difference was observed between SFUD and IMPT in the mean **dose variations** (planned vs. accumulated) for CTV and OARs.
- **Accumulated dose**
  - IMPT significantly reduced OAR doses compared to SFUD (**Figure 2**), while maintaining comparable accumulated dose for CTV D 99 (36.05 GyE vs. 36.01 GyE).

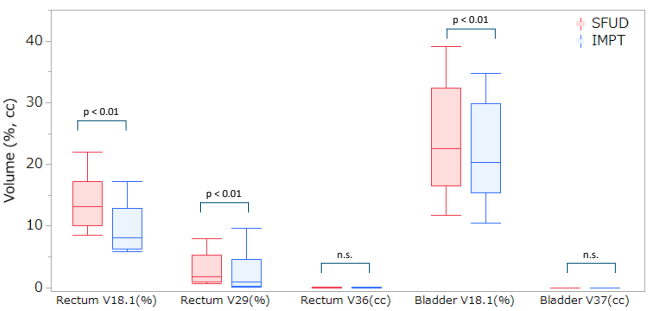

Figure 2. **Accumulated dose** metrics for OAR in the SFUD and IMPT

Conclusion

SFUD and IMPT plans showed similar robustness against anatomical changes.
IMPT significantly reduced rectum and bladder doses, suggesting it as a promising approach for prostate cancer treatment using UHF schedule.

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