

I. Floros¹ · K. Silivridou¹ · M. Spyrakos¹ · S. Makarona¹ · G. Kritselis^{1,2}
¹Athens Medical Center, Medical Physics Dept, Marousi, Greece · ²Oncocare, Marousi, Greece

PURPOSE

Is a 3mm CTV→PTV margin safe for ultra-hypofractionated prostate SBRT (N=3 fractions)?

With N=3 fractions, random errors cannot average out as in conventional fractionation — Van Herk coefficients underestimate margins, empirical validation is required

- **Characterise inter/intrafraction errors** - justify CBCT + real-time tracking strategy
- **Validate 3mm CTV-PTV margin using an empirical method.** Real-time transmitter tracking (RayPilot)
- **Identify anatomical predictors** - rectal gas, rectal & bladder volumes

THE PRECISION STUDY

3-fraction prostate SBRT with intrafraction monitoring using Raypilot system

METHODS

15	Patients
3	Fractions per patient
10.5 Gy	Dose/Fraction
2 mm	Action threshold – Intrafraction motion - beam hold trigger

WORKFLOW

- 1 Daily CBCT** - Interfraction error quantification (couch shifts)
- 2 RayPilot tracking** - Intrafraction motion tracking - treatment interruption and patient position correction when motion >2mm

PROCESSING

- 1 Margin adequacy** - % of time geometrical displacement remained <3mm (all directions)
- 2 Anatomical analysis** Welch's t-test — Rectal gas Pearson correlations — Rectal & bladder volumes

RayPilot/HypoCath electromagnetic transmitter anchored in prostatic urethra. Combined CBCT + real-time tracking.

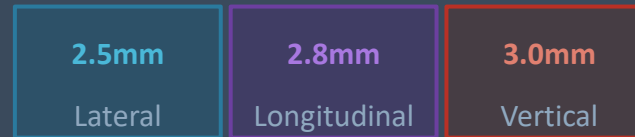
RESULTS

A. MARGIN VALIDATION

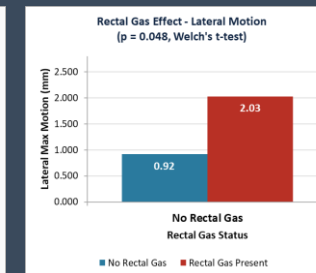
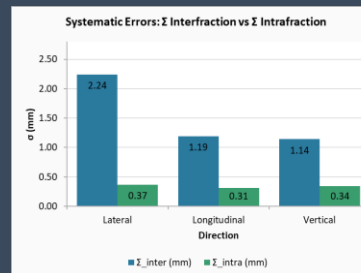
3mm MARGIN CONFIRMED:

- 95th percentile displacement ≤ 3.0mm (per direction) with 2mm action threshold active
- 90% geometric coverage (all directions simultaneously)

Σ_inter (1.1–2.2mm) significantly exceeded Σ_intra (0.3–0.4mm) — setup error is the dominant source



B. ANATOMICAL PREDICTORS



Increased Rectum Volume → increased Lateral motion Statistically significant: $r = 0.64$ $p < 0.001$
 Bladder volume and motion: no significant correlation (all $p > 0.05$)

CONCLUSIONS

- 1** 3mm margin validated: adequate geometric coverage, all 95th percentiles ≤3mm with 2mm gating threshold
- 2** Rectal gas and increased rectal volume drive lateral intrafraction excursions - effectively compensated by real-time tracking
- 3** Intrafractional motion Tracking is crucial for reduced PTV margins
- 4** Results validate implementation of the PRECISION Trial protocol in our department

CLINICAL IMPLICATIONS

- ▶ **Dose escalation & OAR sparing:** smaller PTV margins enable higher doses
- ▶ **Mandatory bowel preparation:** rectal volume assessed at simulation as motion predictor