Spirometer guided breath-hold breast VMAT on Halcyon verified with portal images and surface tracking

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Purpose

Spirometer devices use lung volume as a surrogate for the breast position for DIBH treatments. We verified the applicability of the SDX spirometer (Dyn'R) for breast VMAT using **portal images** and **external surface monitoring** on the Varian Halcyon linac.

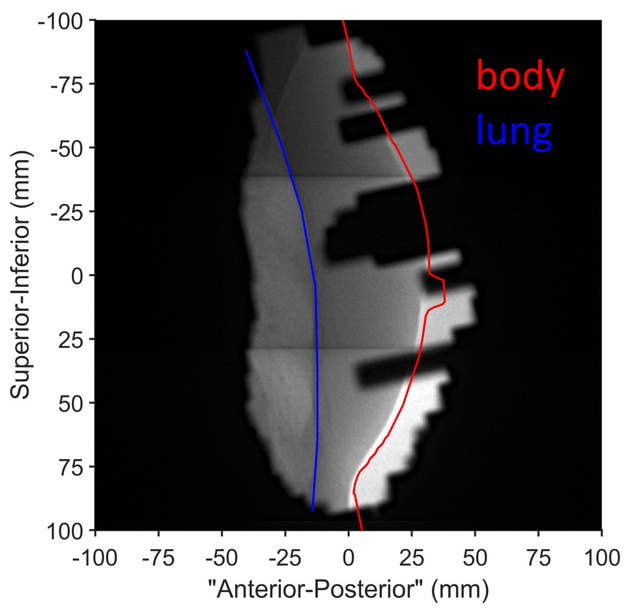
1. Patients and VMAT planning

7 left-sided breast cancer patients (ages 68 to 74)
2.66 Gy to the tumor bed, 2.17 Gy whole breast (for 21 fx)
3 partial arc VMAT-SIB on Halcyon (6FFF)

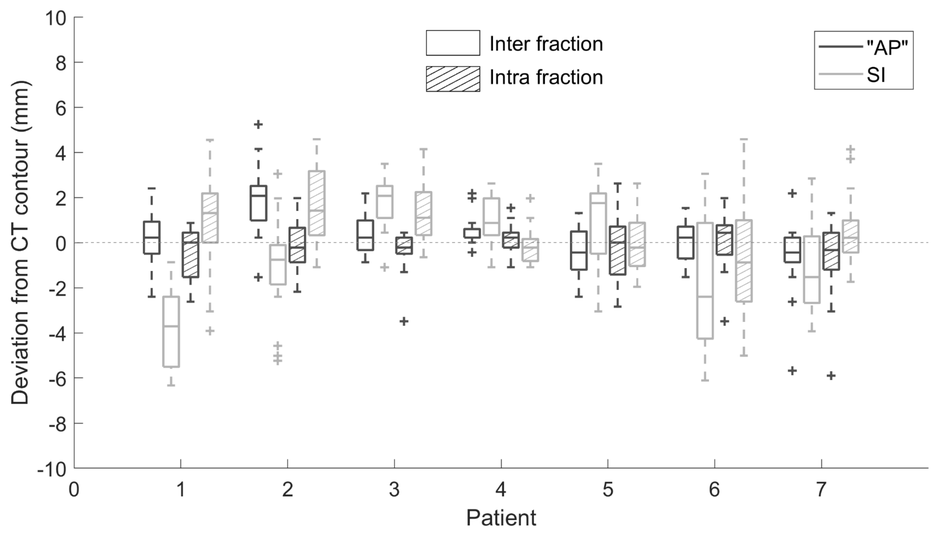
2. EPID frame analysis

- EPID frame at 301° gantry angle used for analysis
→ 3 images/fx

- Manual registration to lung and breast contour from pCT



- Inter and intra fraction deviations:

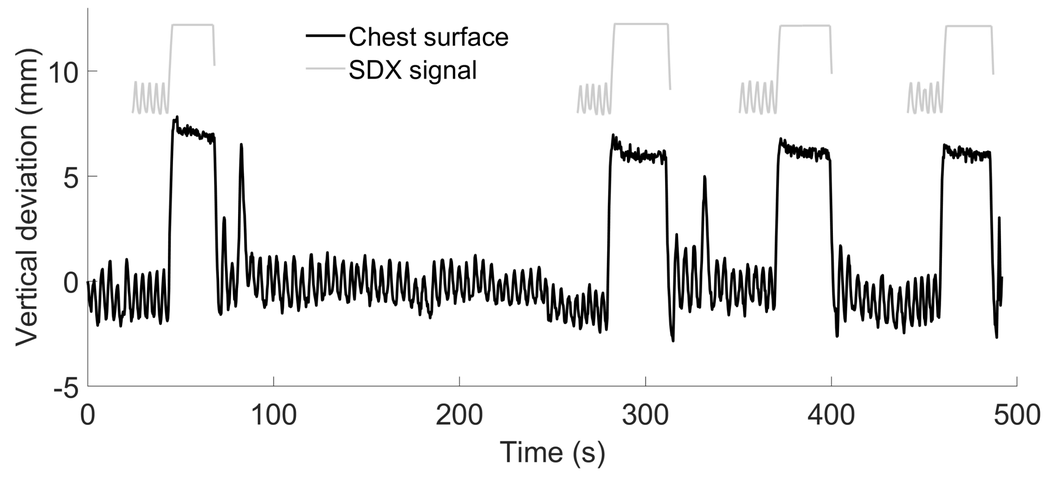


- Systematic and random errors:

	"AP" (mm)	SI (mm)
Σ	0.8	2.1
σ	1.2	1.9

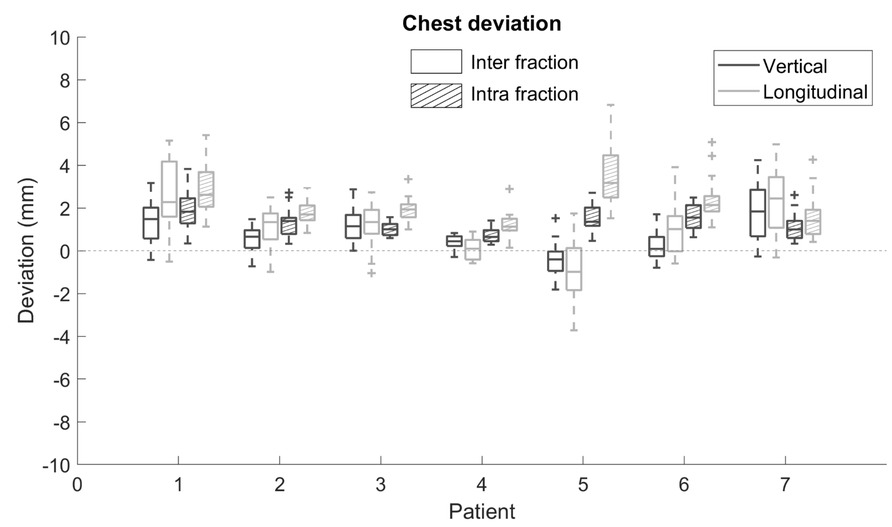
3. Surface scanning analysis

Continuous monitoring of chest surface from completion of setup to end of radiation delivery



- Extract breath-hold amplitudes for all breath-holds

- Median time on couch was 7 min 36 sec.
- 84% of fractions were completed in < 10 min.
- Inter and intra fraction deviations:

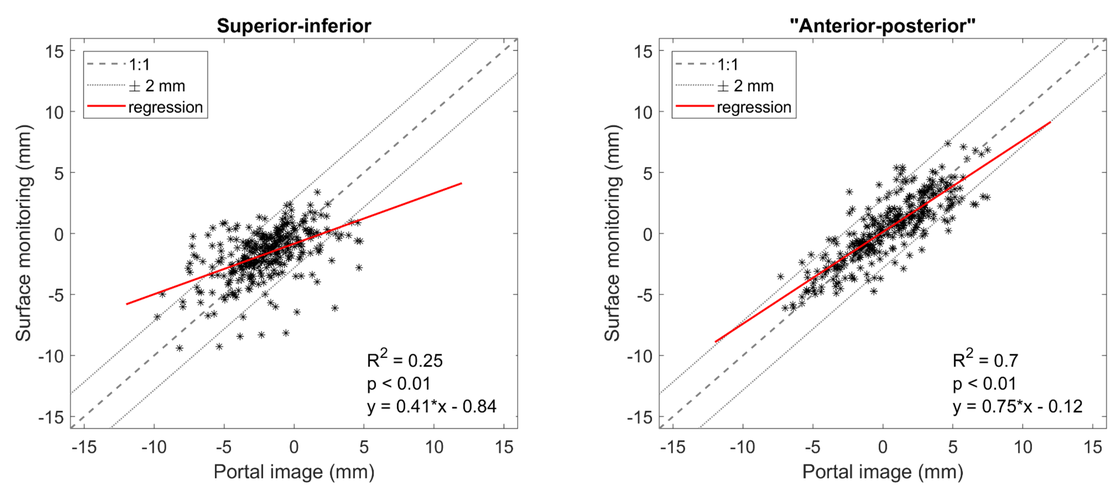


- Systematic and random errors:

	AP (mm)	SI (mm)
Σ	0.7	1.2
σ	0.8	1.2

4. EPID vs. Surface scanning

- The correlation between the portal image registration and the surface scanning result was determined:
- A strong correlation for the "AP" direction was found: $R^2 = 0.7$ ($p < 0.01$) and a weak correlation for the SI direction: $R^2 = 0.25$ ($p < 0.01$).



Conclusion

Using a spirometer, fast and accurate breath-hold treatments for breast cancer patients can be performed on the Halcyon linac. Even in an older population a majority of fractions were completed within 10 min with systematic and random errors below 2 mm. The correlation between portal image and surface imaging results warrants further study.

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