

Reducing Radiation Dose to Ipsilateral Lung Volume by Using Surface-Guided Deep Inspiration Breath Hold (DIBH) Technique for Treating Patients with Right Breast Cancer

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Summative Statement

This comparative dosimetric study examines the difference in the lung dose volume histogram using free breathing (FB) and deep inspiration breath hold (DIBH) radiotherapy (RT) techniques for treating right breast/chest wall and lymph node target volume, and the potential clinical implications.

Background

DIBH is a well-established technique used to reduce heart dose when treating left breast cancer. However, there is limited utilization of DIBH technique for mitigating radiation exposure to lung volume, and it is not often used for treating right breast cancer. The primary aim of this study is to compare dosimetry of optimized photon plans for treating right breast/chest wall and regional lymph nodes using DIBH and FB techniques. The secondary aim is to evaluate right lung CTCAE toxicity at 1 year follow up after RT using DIBH technique.

Methods and materials

This is a retrospective study on 7 right breast cancer patients whom received breast/chest wall and regional nodal external beam radiation therapy.

Simulation

All patients underwent paired DIBH and FB CT scans.

Planning

- In all cases, 3-field mono-isocentric field arrangement consisting of a tangential pair plus a left anterior oblique field was used for DIBH and FB treatment plans. [Figure 1]
- Contouring of target volume and OARs on all simulation CT scans was provided by the same physician to offset inter-rater variability of volumes contoured.
- Treatment plans were optimized to deliver 95% of prescription dose to 95% of target volume. The commonly accepted ipsilateral lung dose constraint was placed on volume of right lung receiving 20Gy (V20Gy) <30%. [Figure 2]

Checks

All plans were subject to peer review, QA and second physics checks.

Treatment

All patients were treated using AlignRT system for surface guidance during DIBH. [Figure 3]

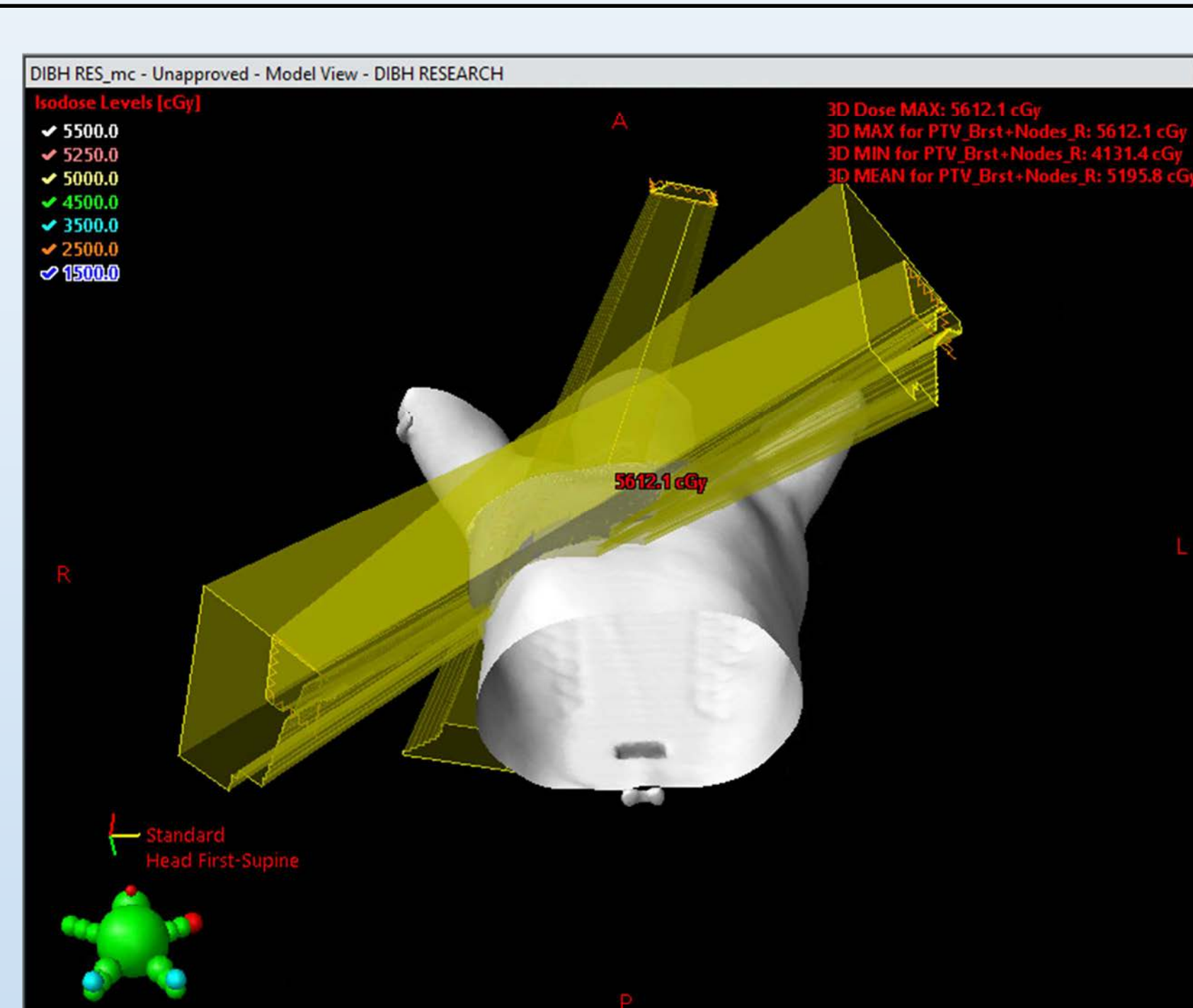


Figure 1. 3-field mono-isocentric setup utilizing a LAO, Right Medial, and Right Lateral fields for DIBH and FB techniques

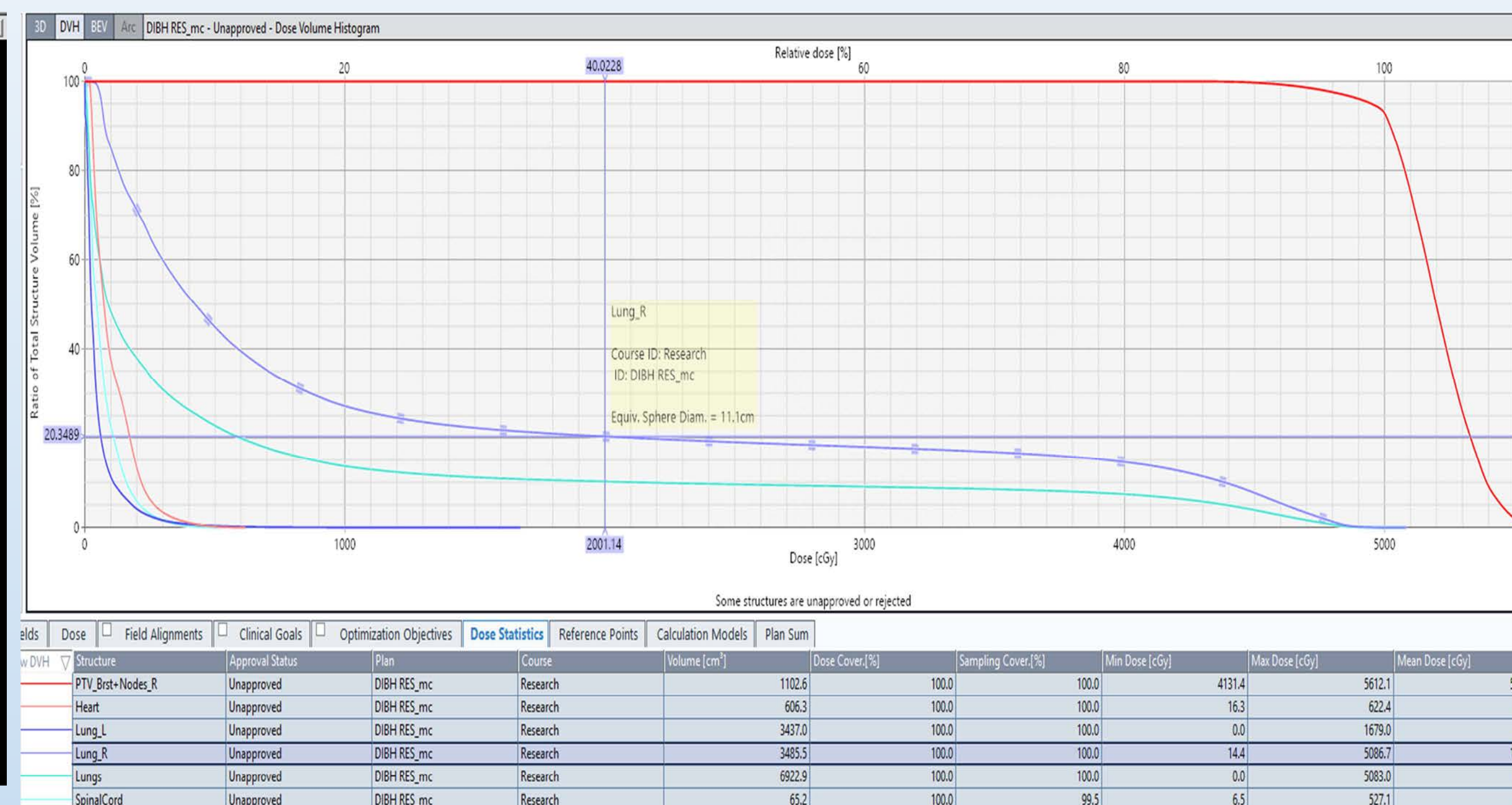


Figure 2. Dose Volume Histogram

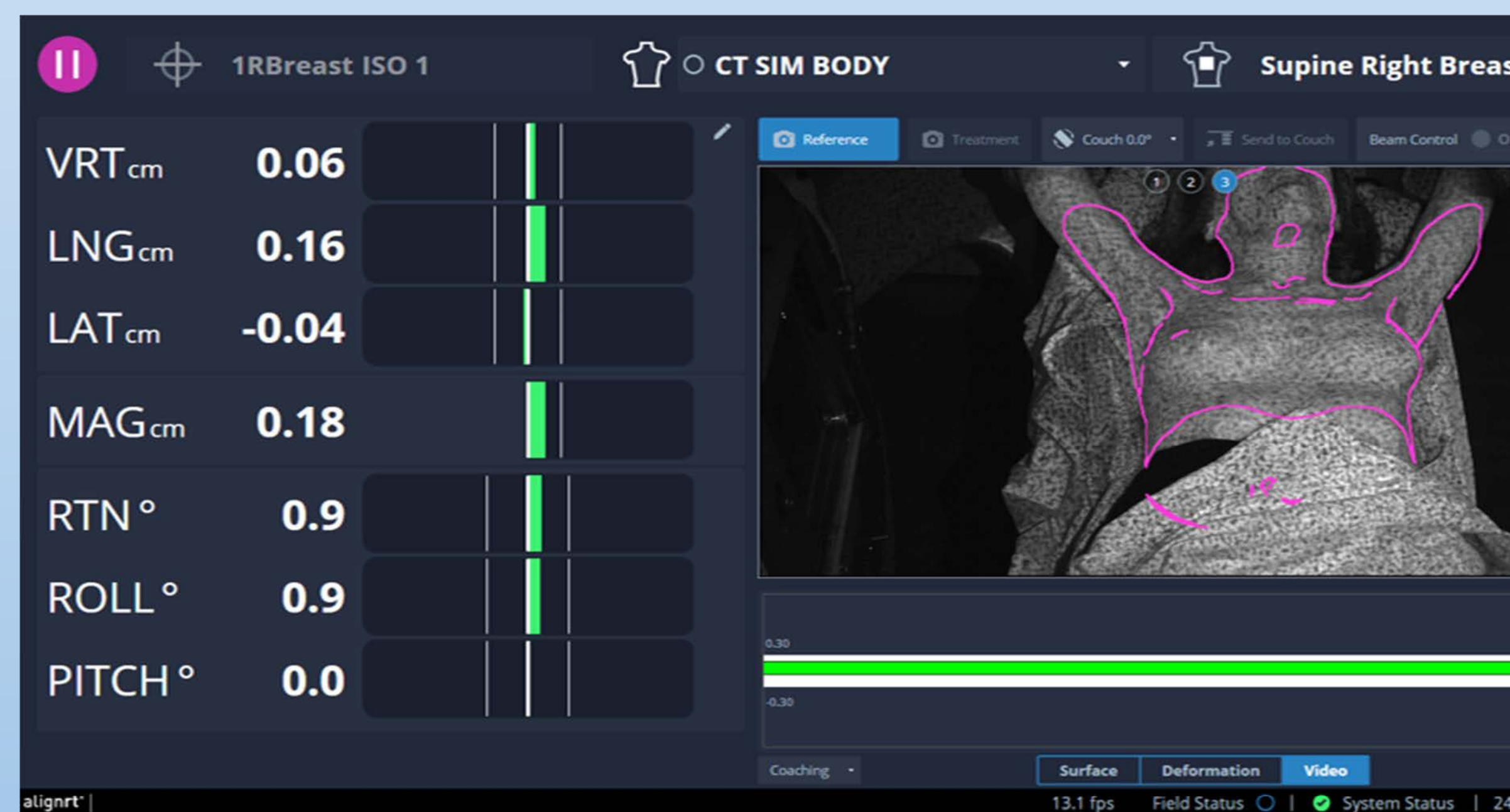


Figure 3. Surface guidance during DIBH using AlignRT system. DIBH treatment delivery will beam on when detected surface is within preset limits to reference CT data (magenta outline) and beam off if detected surface variation is outside tolerances.



Figure 4. Patient's right lung volume (cc) as measured in DIBH and FB CT scans.



Figure 5. Patient's right lung V20Gy DVH results from generated 3 field mono-isocentric plans.

| | Total Lung Volume (cc) | V20Gy cc (%) | V5Gy cc (%) |
|---------|------------------------|---------------|----------------|
| FB | 1302.7 | 448.6 (35.2%) | 764.4 (59.6%) |
| DIBH | 2156.1 | 574.3 (27.5%) | 1141.4 (53.8%) |
| p-value | | p<0.05 | p<0.05 |

Table 1. Mean right lung volumes (cc) and dosimetric values from all patients in both DIBH and FB.

Analysis and Results

Wilcoxon signed-ranked test was used to compare paired V20Gy values between DIBH and FB dosimetry. Post RT treatment, patients were followed by the multi-disciplinary team at regularly scheduled intervals.

- The median dose delivered to the right breast/chest wall and regional nodes was 50Gy in 25 fractions.
- We observed that the right lung volume on DIBH plans was 30% to 50% (average 700 cc) more than in FB plans. [Figure 4]
- V20Gy were reduced in DIBH plans. [Figure 5]
- The mean V20Gy to right lung using DIBH was 27.49% and FB was 35.36% (p<0.05). Improvement was also observed in V5Gy values. [Table 1]
- Follow up to evaluate right lung CTCAE toxicity at 1 year after RT is ongoing. As of this writing, the median follow up after RT is 10 months (range 3 months to 15 months). In early follow up, no patient developed acute CTCAE ≥ grade 3 pulmonary toxicity. One patient reported self-limiting cough and normal pulmonary function tests at follow up 7 months after RT.

Conclusion

3-D conformal external beam therapy and DIBH technique used for treating right breast and regional nodes is associated with significantly reduced right lung mean V20Gy dose when compared to FB plans, achieving optimal target coverage, and more likely to meet the common standard dosimetric lung dose constraints. Our observations suggest a benefit to using DIBH for treatment of locally advanced right breast cancers.

Reference

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