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US SGRT ANNUAL MEETING

SGRT Begins at Simulation: Incorporating Surface Guidance Early in the Radiotherapy Workflow



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TWA

SGRT

Use of surface guidance to improve the safety, effectiveness and efficiency of the *entire* radiation therapy workflow.



SGRT COMMUNITY



SGRT Begins at Simulation: Incorporating Surface Guidance Early in the Radiotherapy Workflow

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Disclosure

- **Medical Physics resident at the University of Texas Southwestern Medical Center**
- **No conflicts of interest**

SGRT in Radiation Therapy Workflow



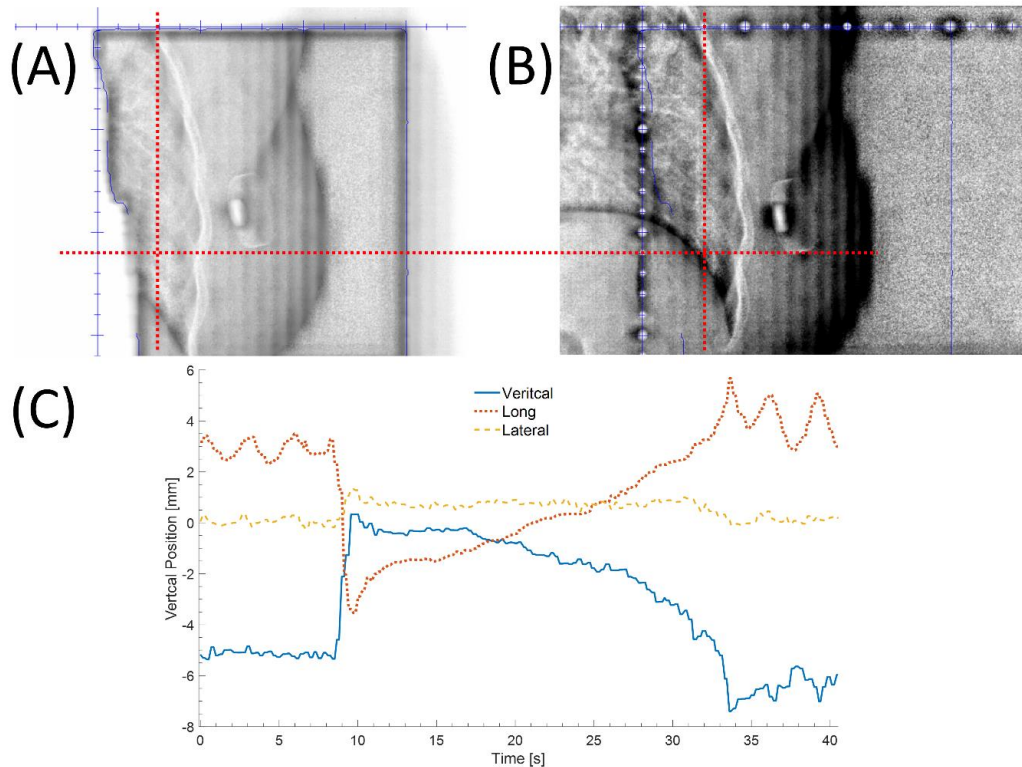
SGRT in treating breast patients

Breast Treatments at UTSW Before 2020

- Approx. 600 breast patients treated annually
- Simulation:
Breast board with marks/tattoos for simulation isocenter
- Daily Treatment:
Setup to marks/tattoos and shift to treatment isocenter
- Deep Inspiration Breath Hold (DIBH)
Using **Active Breathing Coordinator (ABC)**
- Initial plan verification and weekly 6 MV imaging/films
- All non-imaging days setup to **marks only**

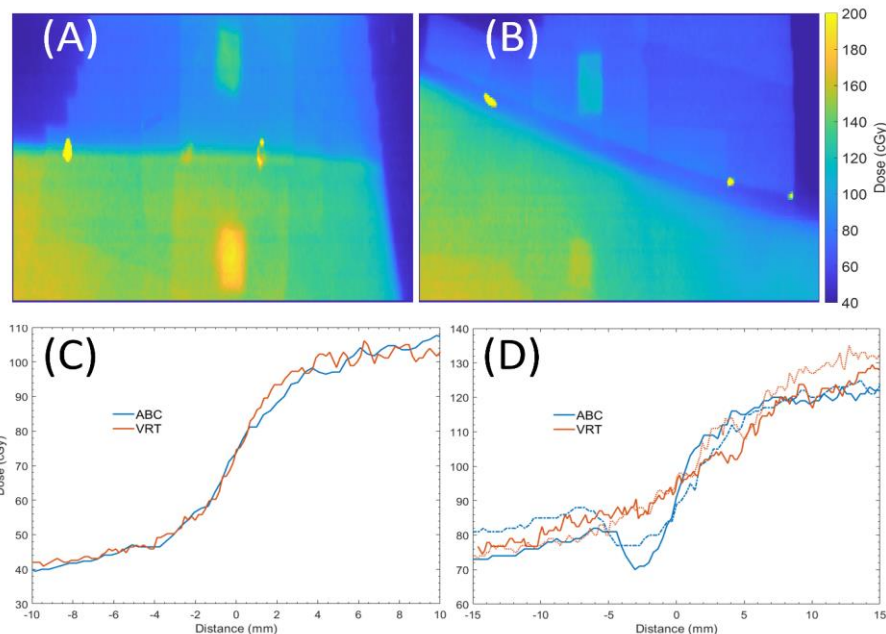
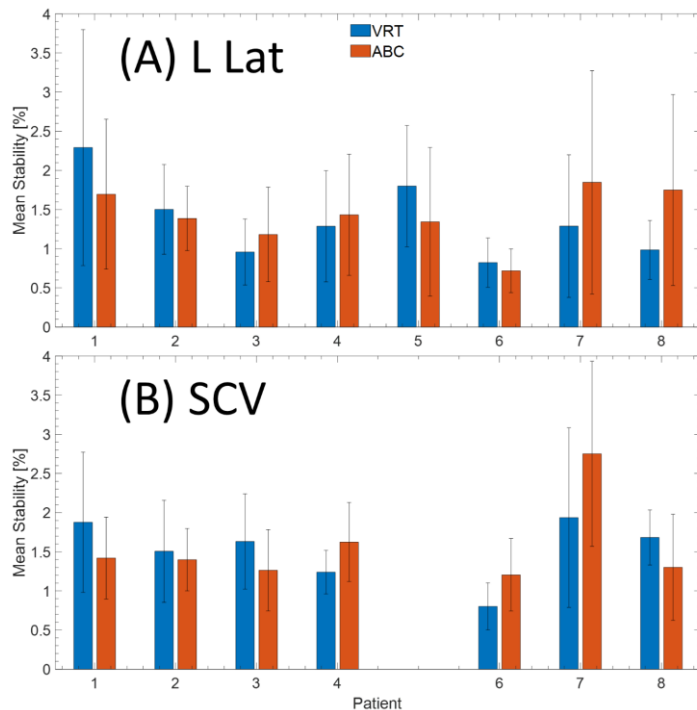
The Issue with ABC

- Double exposure images showing the change in diaphragm position during a single DIBH using ABC
- No indication on ABC
- But, readily observable on SGRT



Verification of SGRT vs. ABC Stability

- Area of lung in the treatment field
- Dose at junction between SCV and tangent fields



Trial: Stability Between ABC and SGRT

- 10 patients and 140 fractions trial **swapping between SGRT and ABC**

Session	ABC [min]	SGRT [min]	Difference [min]	p value
Plan Verify	40.0 ± 8.0	29.8 ± 11.4	10.2	0.182
Weekly Films	25.2 ± 11.0	20.0 ± 7.3	3.9	0.041
Daily Setup	9.2 ± 4.4	7.4 ± 2.9	1.8	0.007
Treatment Delivery	9.9 ± 3.7	9.7 ± 3.8	0.2	0.810

- On average, **SGRT shortens daily setup time between 15-25%** compared to ABC sessions.

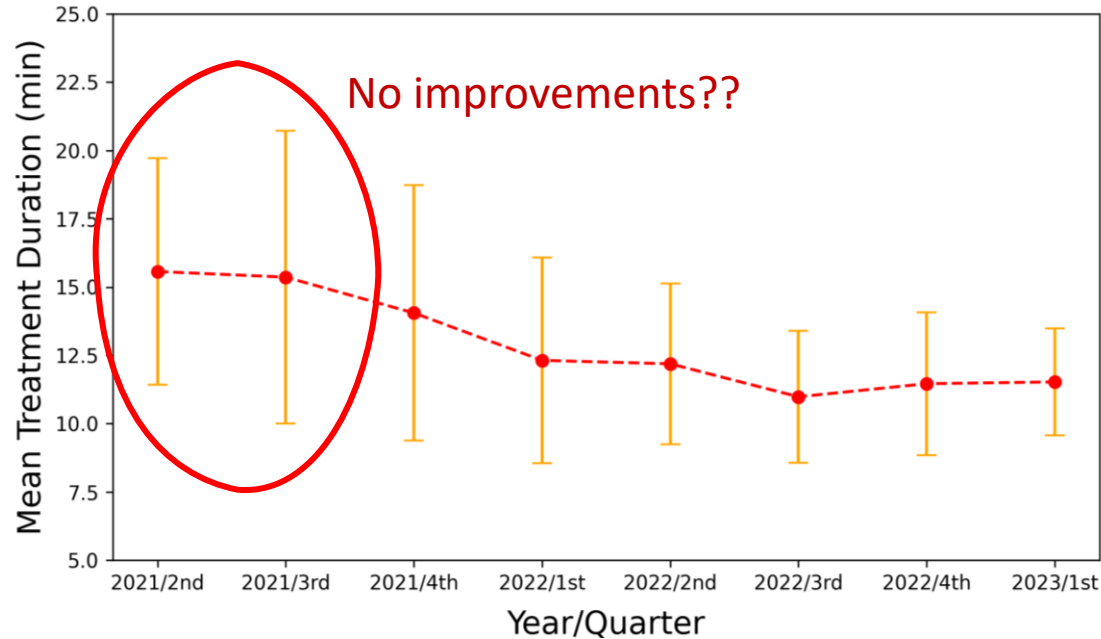
Breast Treatments at UTSW After 2020



- **Simulation:**
Breast board with marks/tattoos for sim iso
- **Daily Treatment:**
Setup to **free breathing CT surface** using **SGRT**
DIBH using **breath hold CT surface** using **SGRT**
- If differences in surface noticed, kV or 2.5 MV images are taken, and MD and physicist paged to machine
- X-ray imaging on plan verify and weekly
- Quarterly review of setup with staff

Breast Treatment Duration from 2021-Present

- Real-Time Location Service (RTLS) tracking Patient In-Vault Time



Breath-hold at Simulation

- **Good simulation = foundation of any successful treatment**
- **So why aren't we starting SGRT at sim?**

Breath-hold Sim Workflow w/ SGRT

- Evaluate breath hold candidacy
- Assess breathing pattern
 - Determine breath hold time
 - Find optimal tracking ROI
- Coach breathing
 - Exercises to confirm breath hold stability using SGRT
 - Potentially Real-Time Coaching (RTC)



simRT at CT Simulation

One centrally positioned 3D camera



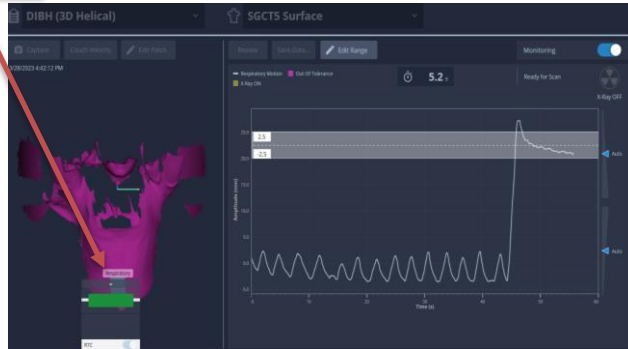
Optimized for respiratory tracking



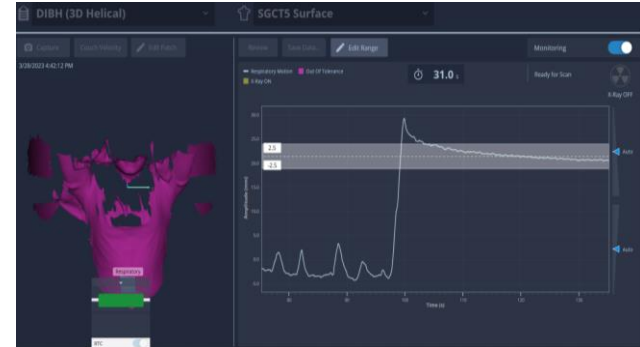
1. One-click selection of tracking ROI
2. Real-Time Coaching display
3. Breath hold timer

Breath-hold Sim Workflow w/ SGRT

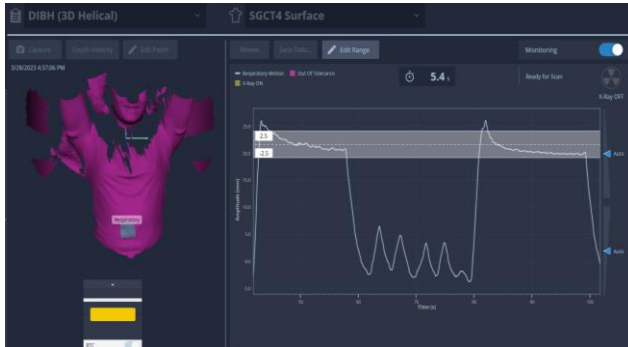
1. Select ROI and test breath-hold to find the amplitude range



3. One long 30-second practice breath-hold



2. Two practice 5-second breath-holds to test reproducibility

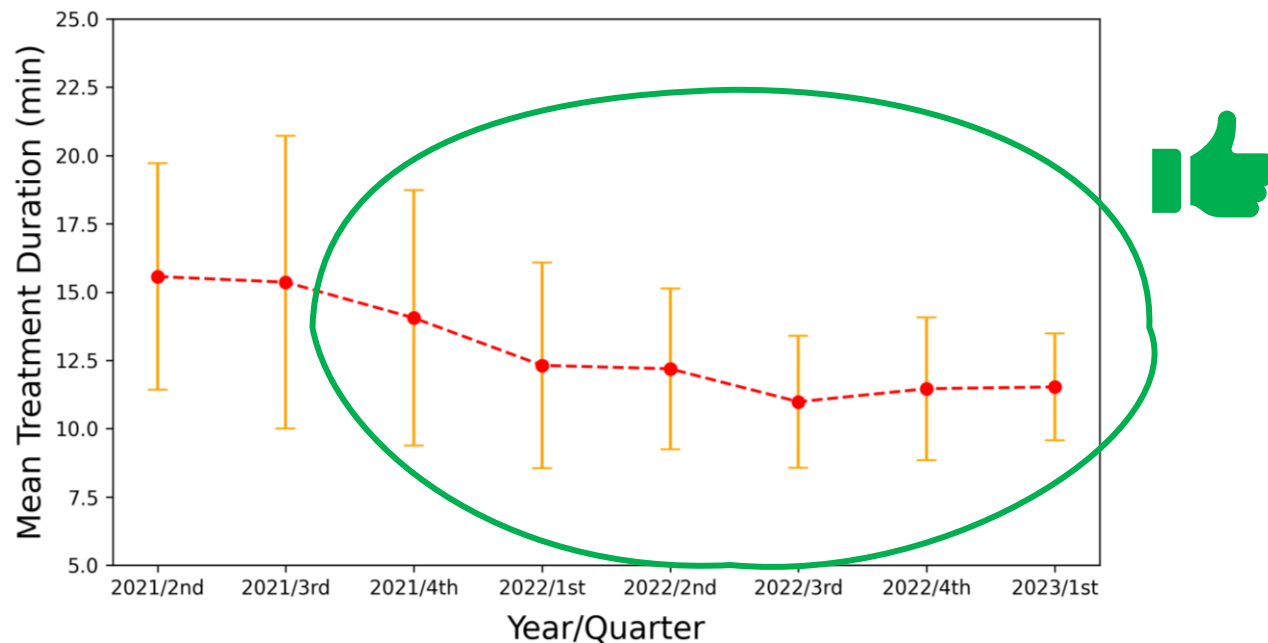


4. Acquire CT images with SGRT monitoring



Breast Treatment Duration from 2021-Present

- Reduction from 15.6 ± 4.2 min to 11.5 ± 2.0 min
- Potentially a more robust setup workflow



Marker-less Breast Simulation and Treatment

- Currently, **simulation center** is marked by tattoos or skin marks
 - Tattoos are invasive
 - Skin marks may fade or stain clothing
 - Patients report negative feelings associated with markers
- What if we can **replace the markers with SGRT?**

Marker-less Breast Simulation and Treatment

- 5 **breath hold** patients and 4 **free breathing** patients
- Whole breast tangents
- Positioned w/ markers **2 days** of the week (65 fractions)
- Positioned w/ SGRT **3 days** of the week (89 fractions)
- RTLS records patient in-vault time
- Weekly films reviewed by physicians

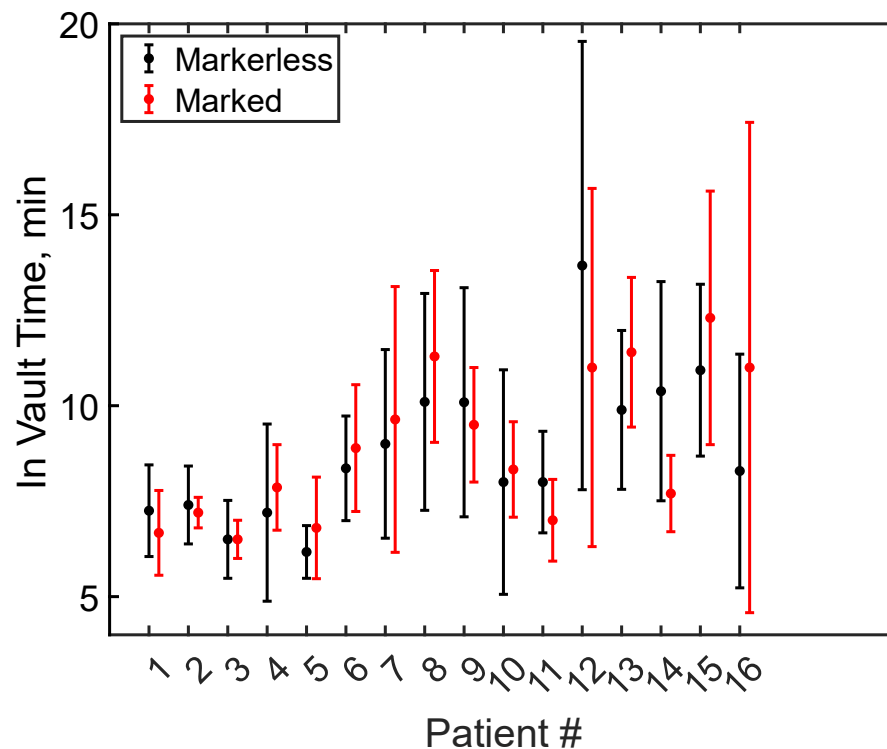
Marker-less Breast Simulation and Treatment

- Treatment In-Vault Time:

SGRT: 8.3 ± 2.5 min

Marker: 8.5 ± 1.1 min

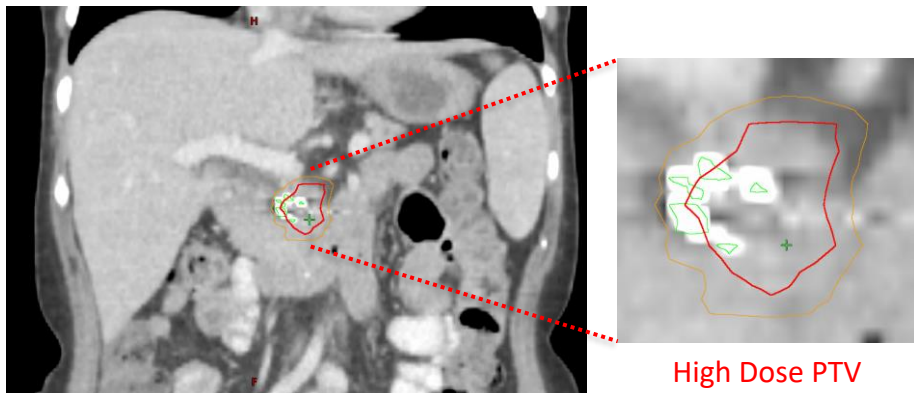
- All weekly films were approved regardless of setup methods



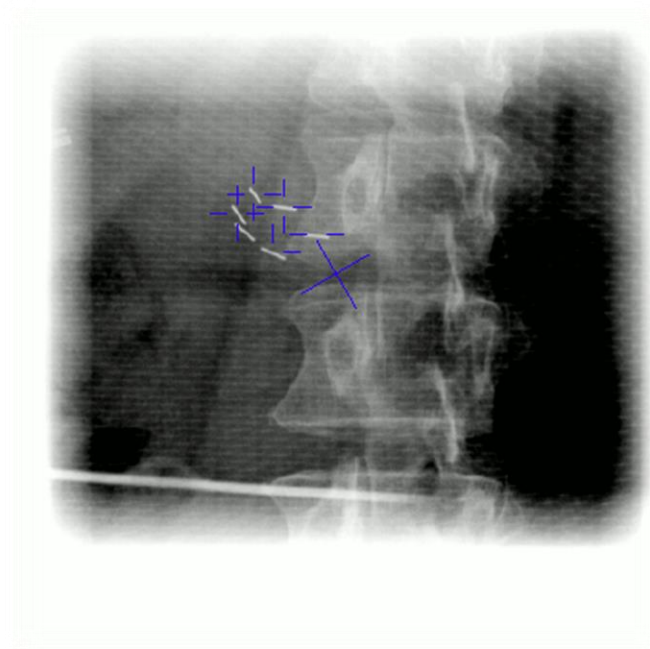
SGRT in treating GI SBRT patients

Trigger + SGRT for GI SBRT

- Pancreas SIB 50Gy/30Gy in 5 fractions
- Triggered Imaging
 - Arc delivery
 - kV imaging per 30-degree gantry rotation



High Dose PTV
Low Dose PTV
Fiducials



Trigger + SGRT for GI SBRT

- **Motion Management: Breath Hold**

- **Conventionally:** Real-time Position Management (RPM) for respiratory monitoring + ABC for breath hold
- Can **SGRT** substitute the conventional breath hold method?

- **To investigate:**

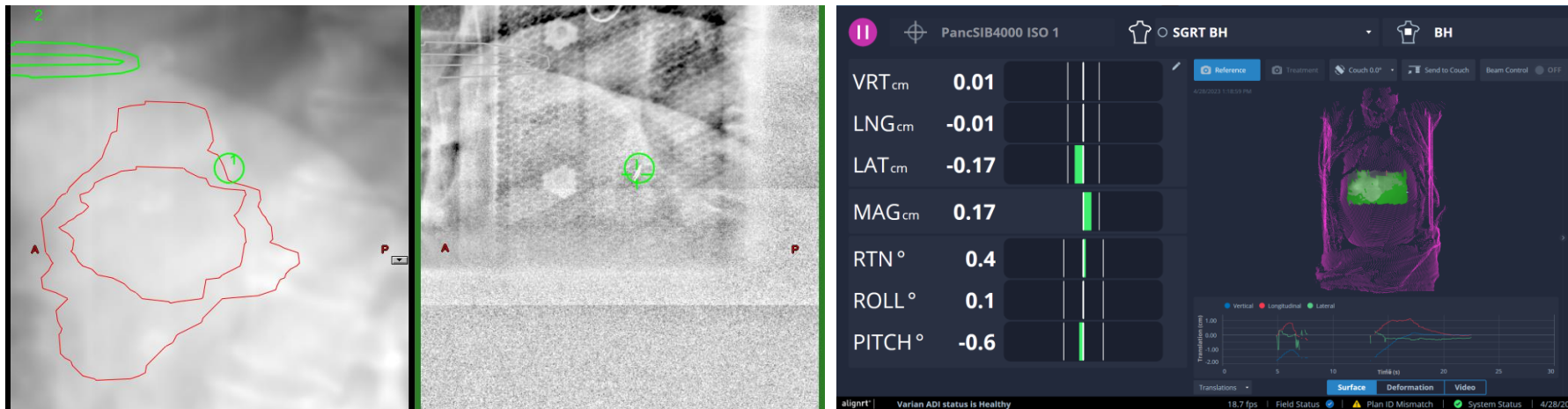
- **Trigger (ground truth) + SGRT + RPM + ABC**

Trigger + SGRT for GI SBRT

- Simulation with SGRT and ABC
- Scans taken:
 1. Free Breathing
 2. Non-Contrast BH using SGRT
 - ABC not activated
 3. Post-Contrast 35/70s BH using ABC
 4. Post-Contrast 3min/5min BH using SGRT

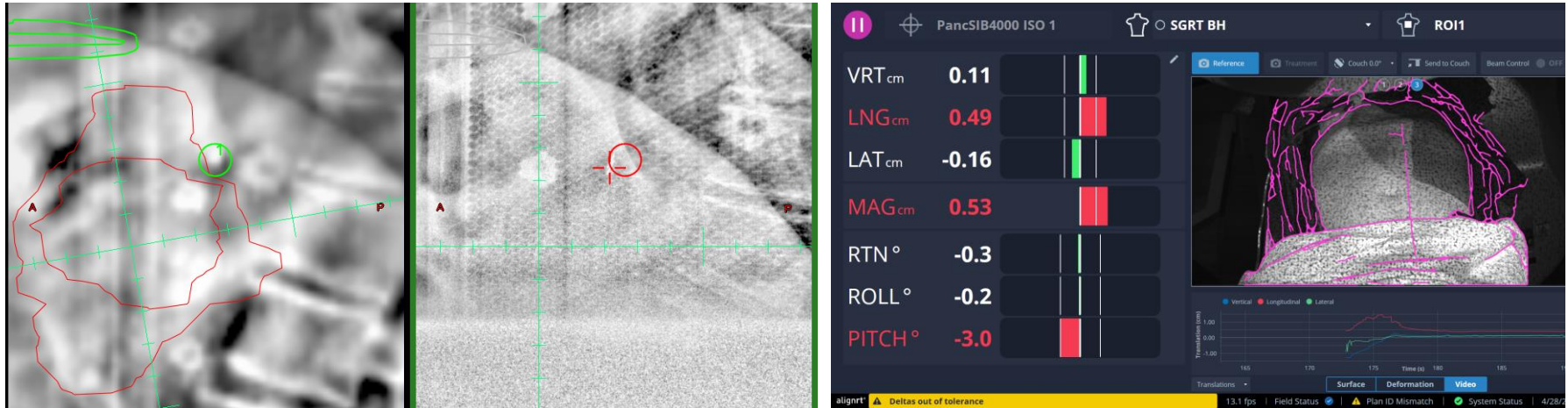
Trigger + SGRT for GI SBRT

- SGRT correlating with triggered kV image
- Fiducial within tolerance:



Trigger + SGRT for GI SBRT

- SGRT correlating with triggered kV image
- Fiducial drifted out:



Trigger + SGRT for GI SBRT

■ Motion Management: Breath Hold

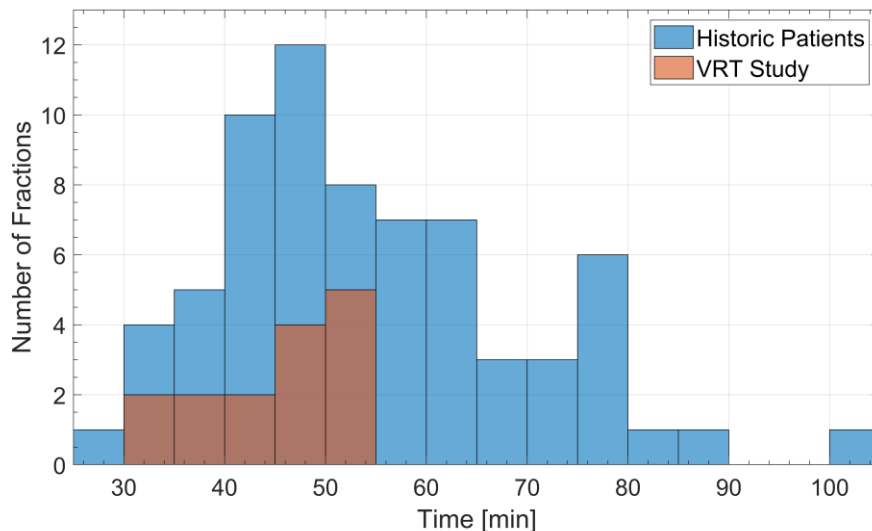
- **Conventionally:** Real-time Position Management (RPM) for respiratory monitoring + ABC for breath hold
- Can **SGRT** substitute the conventional breath hold method?

■ To investigate:

- Trigger (ground truth) + SGRT + ~~RPM~~ + ~~ABC~~
- 6 patients treated or on treat
 - 3 without ABC, and 2 with only SGRT

Trigger + SGRT for GI SBRT

- Ongoing study...
- 6 patients and 25 fractions treated
- 183 breath holds
 - Initial analysis: **86.2%** SGRT matched with fiducials (3-mm tolerance on shifts)
 - Drifting of breath hold consistent in SGRT vs. fiducials



Significant reduction in treatment time
compared with historic patients

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