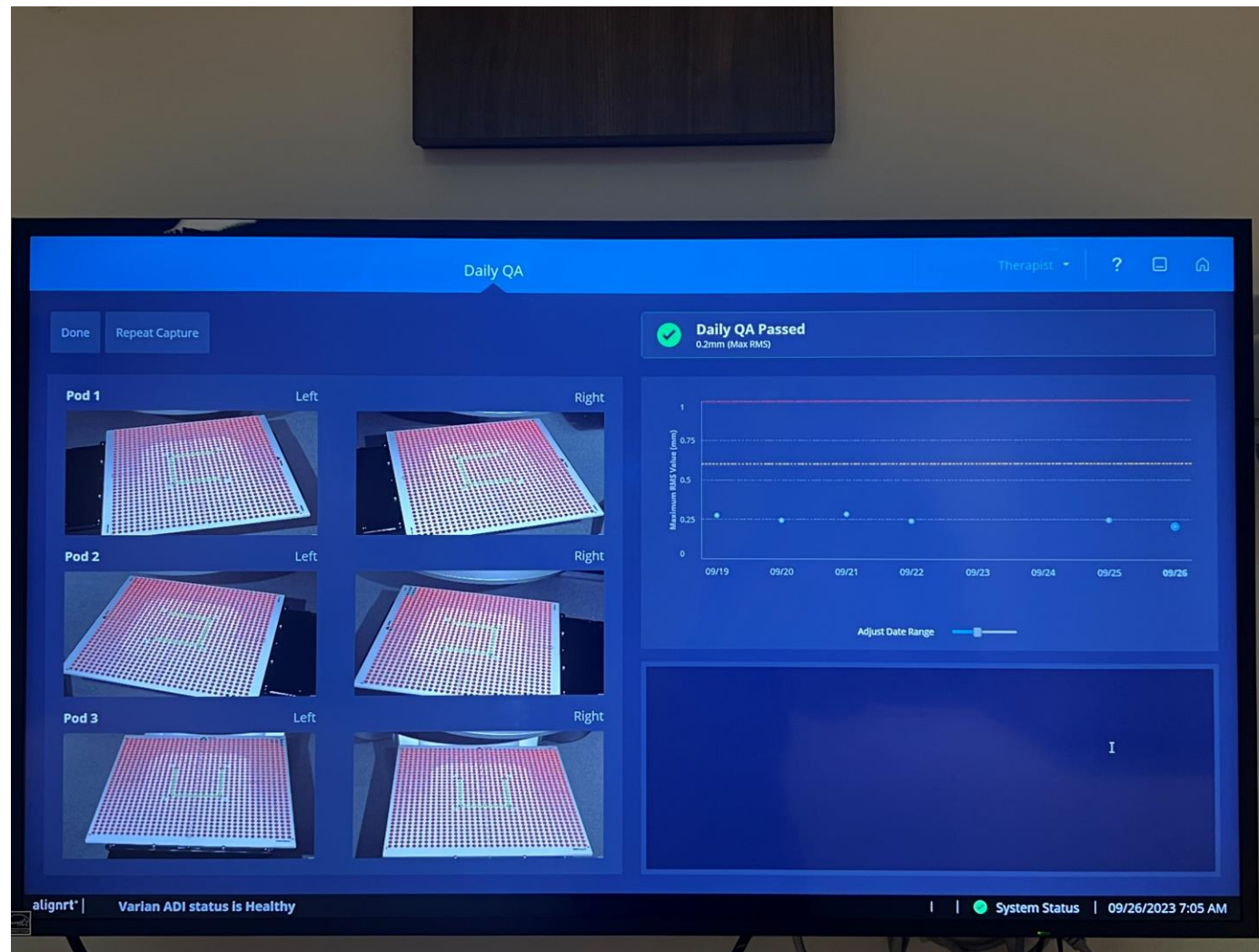


*Surface-Guided  
Radiation Therapy  
with TrueBeam's*

**By: Amber Nelsen**

# Daily Warm up – Vision Plate

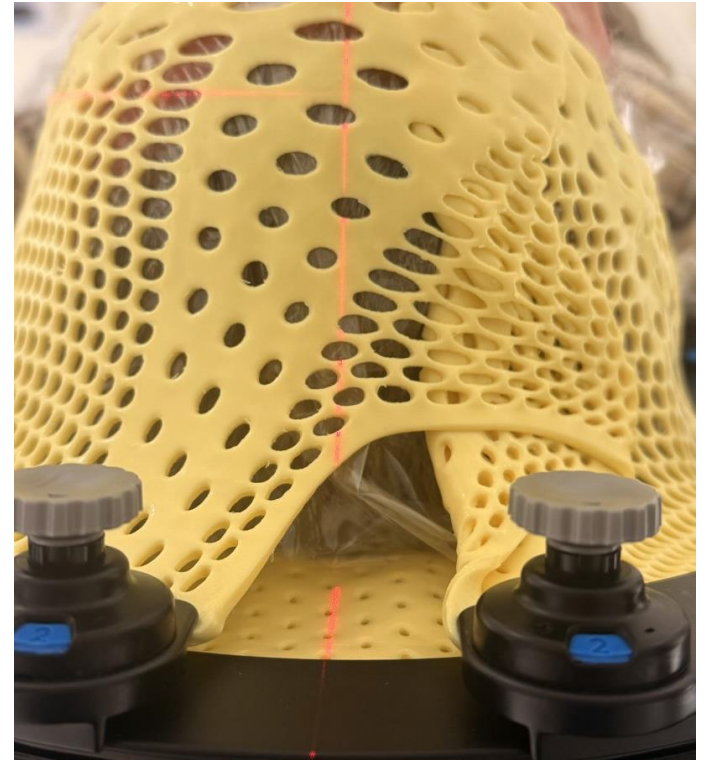
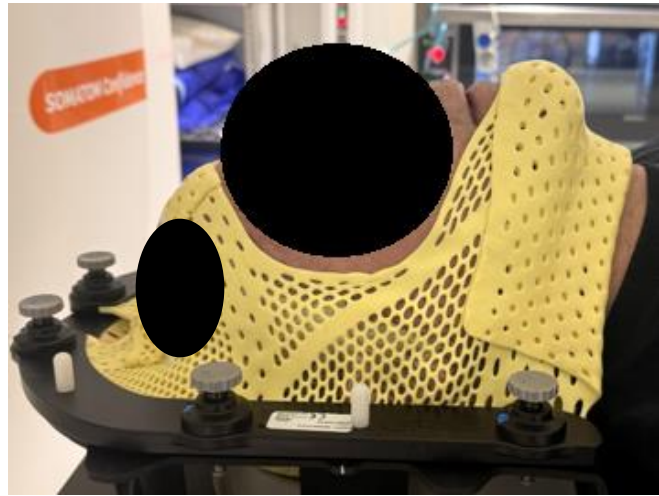


# CT SIMULATION

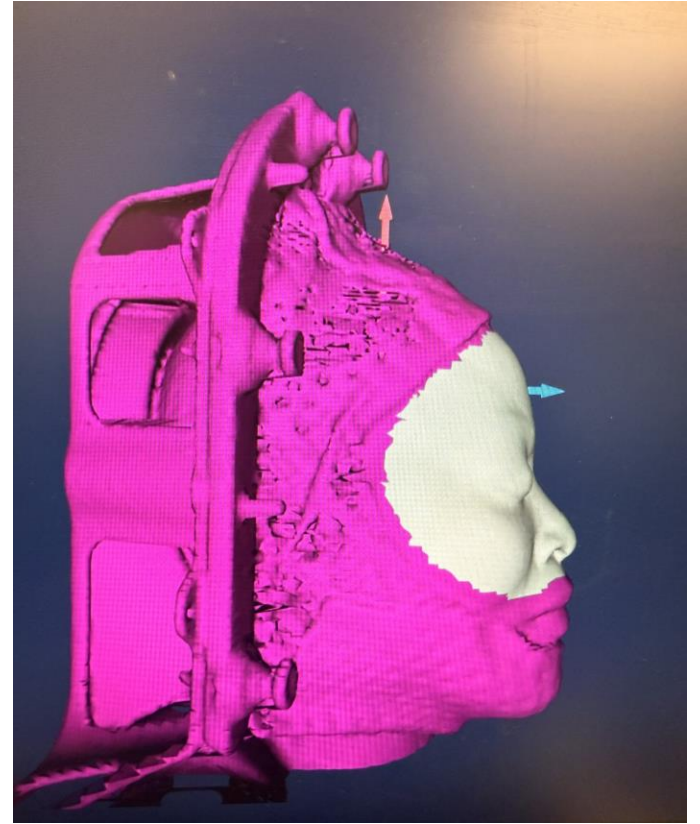
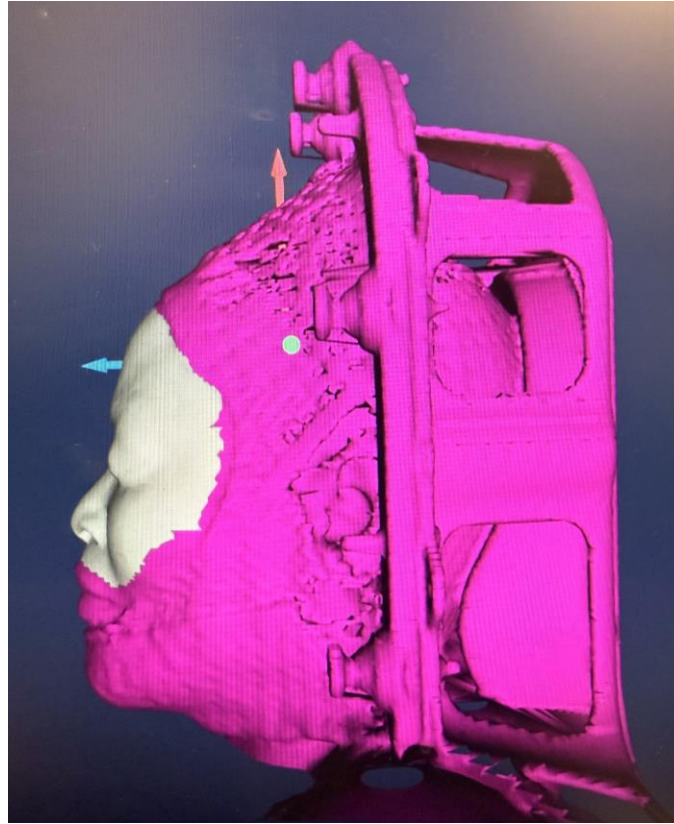
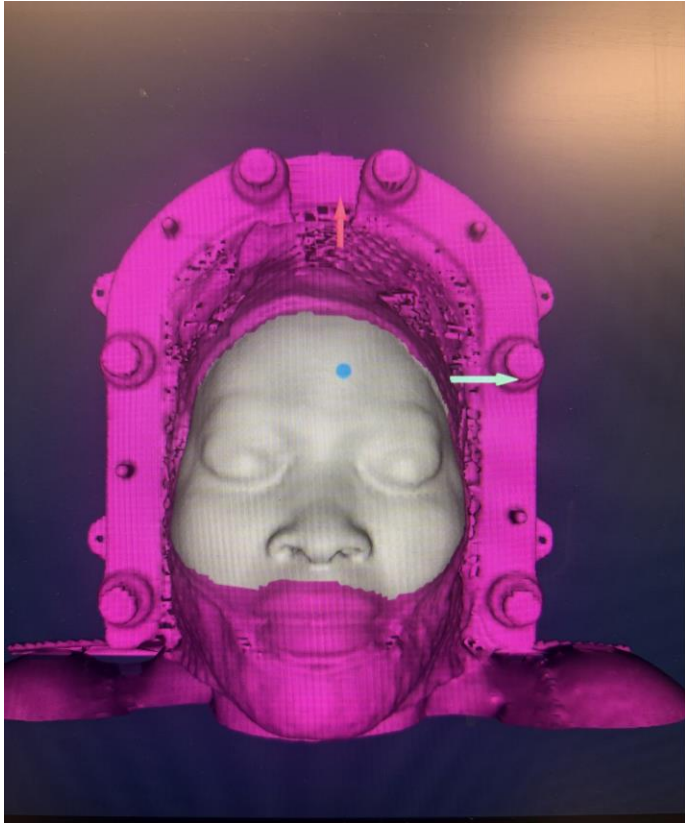
- CT sim is the first steps for SGRT to be successful for alignment during XRT treatments
- Patient will be uncovered for full length of scanning range
  - Genitalia area is covered if it is included within the scan range
- Scan ranges should extend beyond the immediate treatment volume to ensure adequate skin surface is captured for reliable setup and verification using the SGRT cameras
  - The only exception to this would be cases where immobilization masks are used

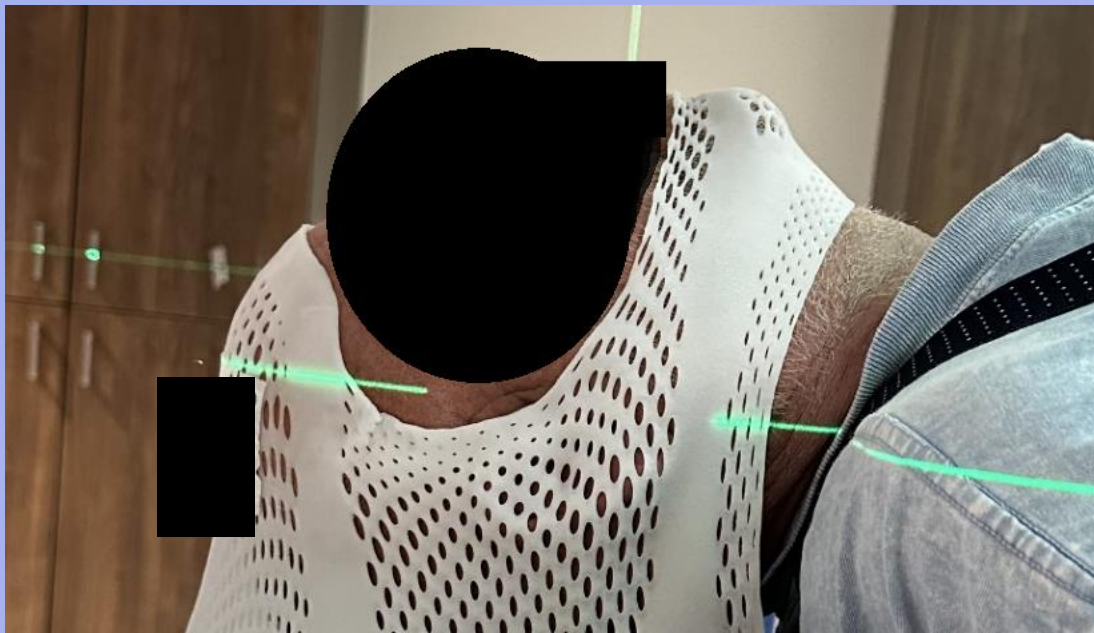
# Brain/H&N

- **Three different open face masks**
  - **SRS mask**
  - **Short S-frame mask**
  - **Long S-frame mask**
- **All masks made with emphasis on:**
  - **Sides – Opening stretched to anterior edges of patient's ears**
  - **Superior – Opening stretched to patient's hair line**
  - **Inferior – Opening stretched below patient's mouth**



# TREATMENT – Regions Of Interest (ROI)





The screenshot displays a medical software interface for patient alignment. The interface is divided into several sections:

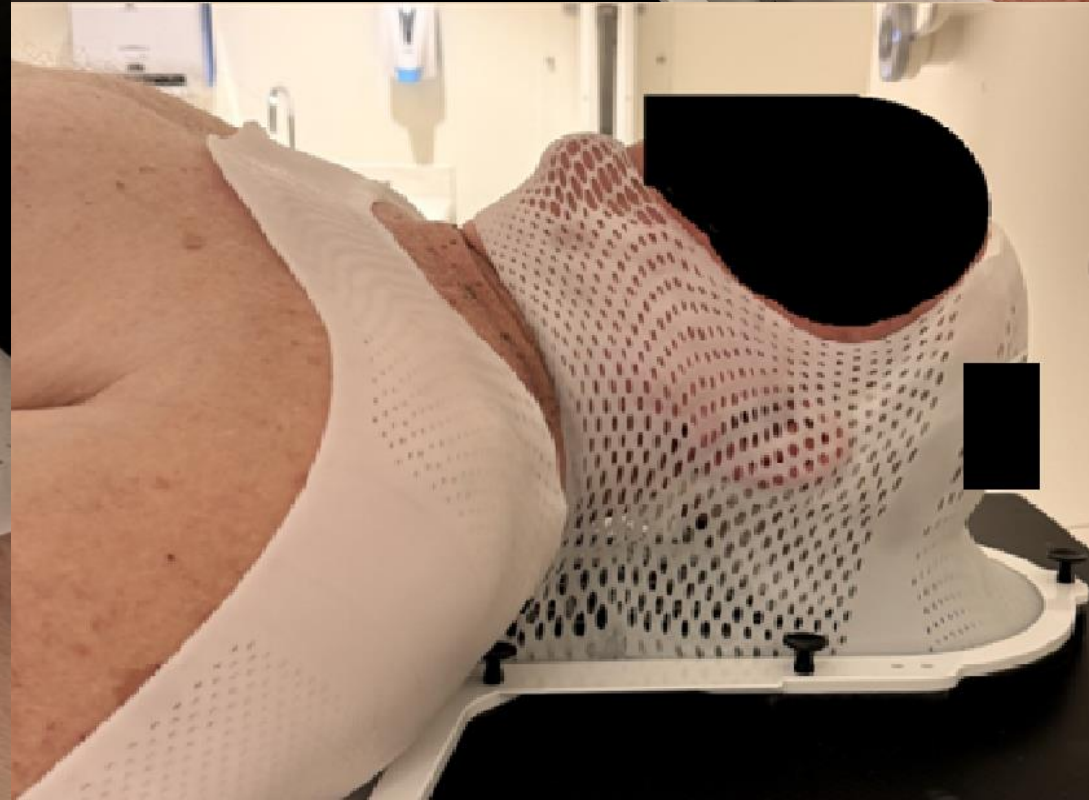
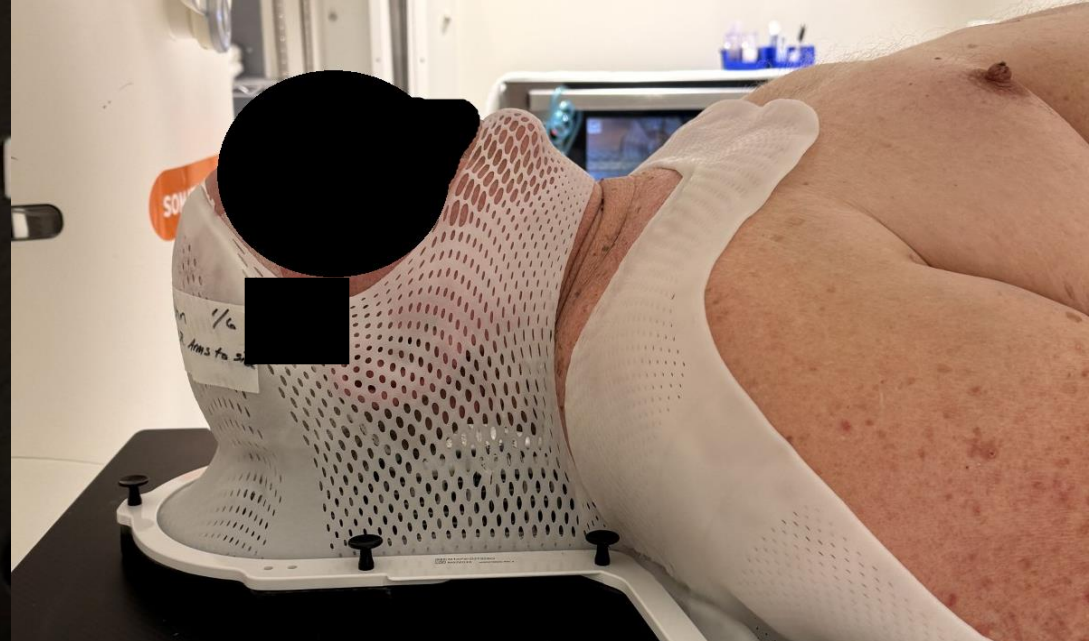
- Top Bar:** Shows 'Preparation' and 'Treatment' tabs, a 'Therapist' field, and a help icon.
- Patient Info:** 'R TempBrn ISO 1' and 'CT SIM External' are displayed.
- Target:** 'brain' is selected.
- Alignment Data:** A table lists various alignment parameters with their current values and visual indicators (vertical lines).
- Buttons:** 'Reference', 'Treatment', 'Couch 0.0°', 'Send to Couch', and 'Beam Control OFF' are available.
- 3D Model:** A 3D visualization of a head with a green and purple overlay, representing the target area.
- Bottom Bar:** Shows 'Coaching', 'Surface', 'Deformation', and 'Video' options, along with system status and date/time information.

Parameter	Value
VRT <sub>cm</sub>	0.00
LNG <sub>cm</sub>	0.02
LAT <sub>cm</sub>	-0.03
MAG <sub>cm</sub>	0.03
RTN <sup>°</sup>	0.1
ROLL <sup>°</sup>	0.4
PITCH <sup>°</sup>	-0.3

alignrt | 17.4 fps | Field Status | System Status | 01/08/2026 11:40

# ROI - H&N Long S-frame masks





# Lung/Breast/CW/T-L Spine/Ribs

**Mold around patient while leaving enough lateral skin surface for the cameras to detect**

**After ISO is set, lasers are shifted into position, mark the Rt & Lt laterals on the cradle**

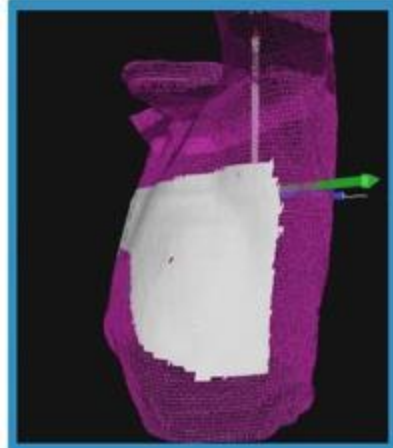
**Take pictures of where lasers fall on patient for AP, Rt lat, & Lt lat in addition to setup photos for XRT**

# ROI's - Lung/CW/T-L Spine/Ribs



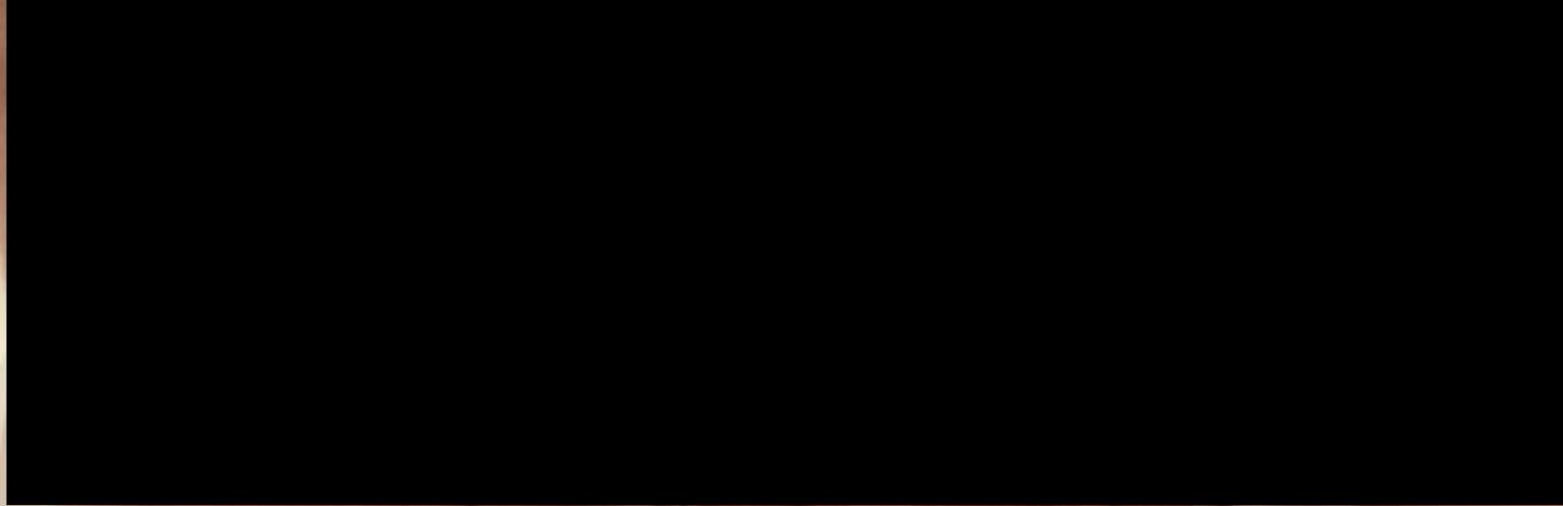
# ROI's - Continued

## Thorax/CW/T-L Spine/Ribs



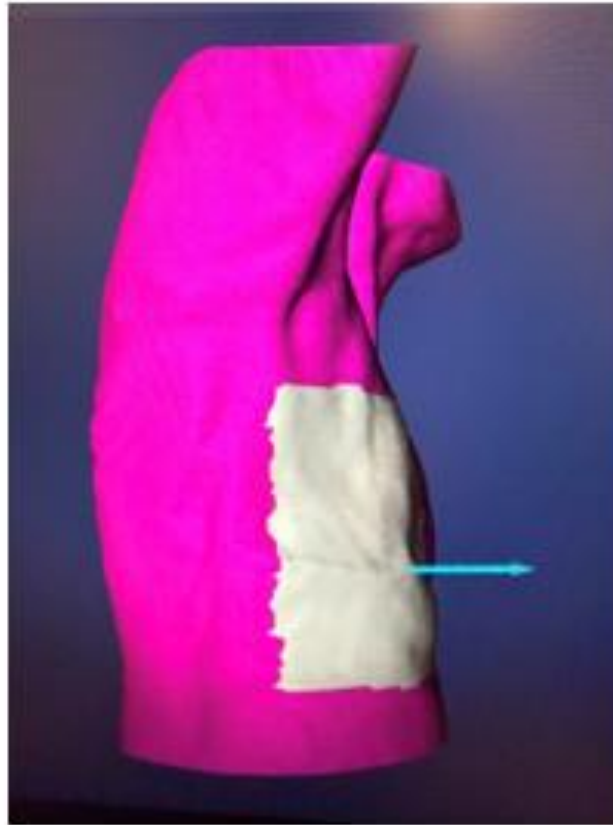
# ROI - SBRT Lung

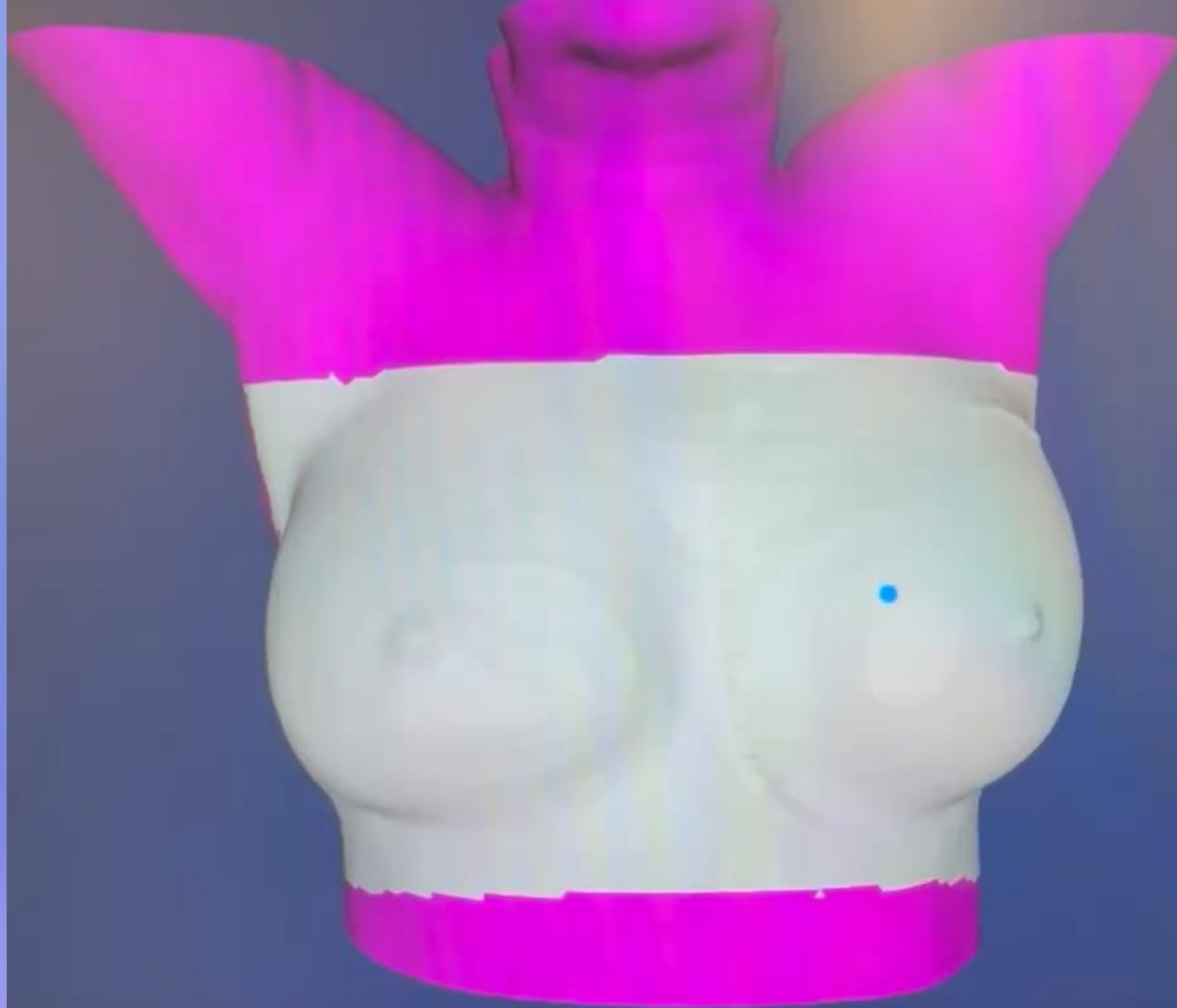




Parameter	Value
VRT <sub>cm</sub>	-0.04
LNG <sub>cm</sub>	0.05
LAT <sub>cm</sub>	0.15
MAG <sub>cm</sub>	0.17
RTN <sup>°</sup>	-0.9
ROLL <sup>°</sup>	-0.6
PITCH <sup>°</sup>	-0.7


# ROI – Breast or CW





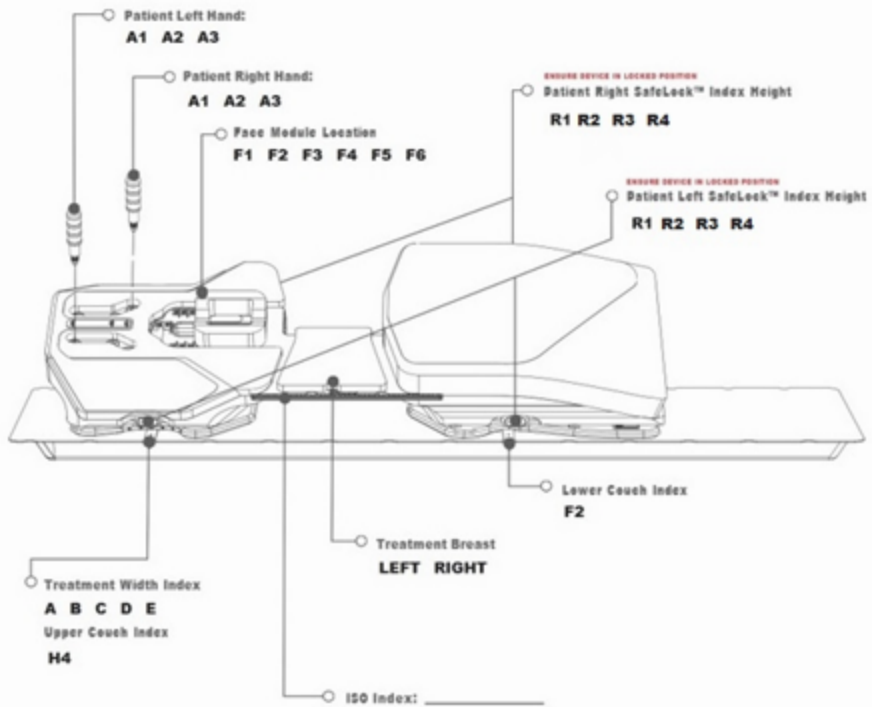
# Prone Breasts

- Patient is prone on CDR procline breast board
- Dr. places wires to outline breast borders
- Patient positioned
- Fill out form

**CDR PROCLINE™ SETUP SHEET** 

Patient Name: \_\_\_\_\_

Patient ID: \_\_\_\_\_ Date: \_\_\_\_\_



The diagram shows a top-down view of the CDR Procline breast board. It features two breast support modules. Labels include: 'Patient Left Hand: A1 A2 A3', 'Patient Right Hand: A1 A2 A3', 'Face Module Location: F1 F2 F3 F4 F5 F6', 'Treatment Breast LEFT RIGHT', 'ISO Index: \_\_\_\_\_', 'Treatment Width Index: A B C D E', 'Upper Couch Index: H4', 'Lower Couch Index: F2', 'Patient Right SafeLock™ Index Height: R1 R2 R3 R4', and 'Patient Left SafeLock™ Index Height: R1 R2 R3 R4'. Red text above the R1-R4 labels reads 'ENSURE DEVICE IS LOCKED POSITION'.

**SUP** \_\_\_\_\_

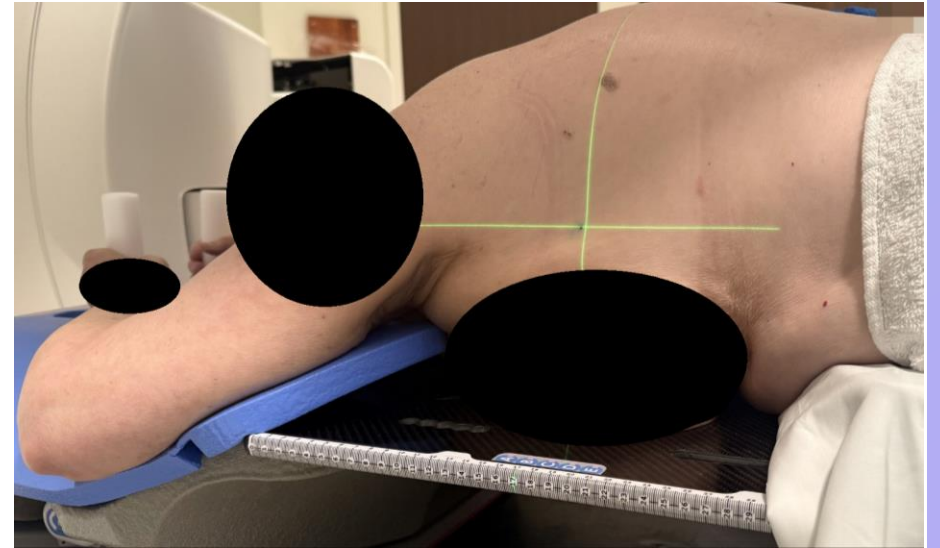
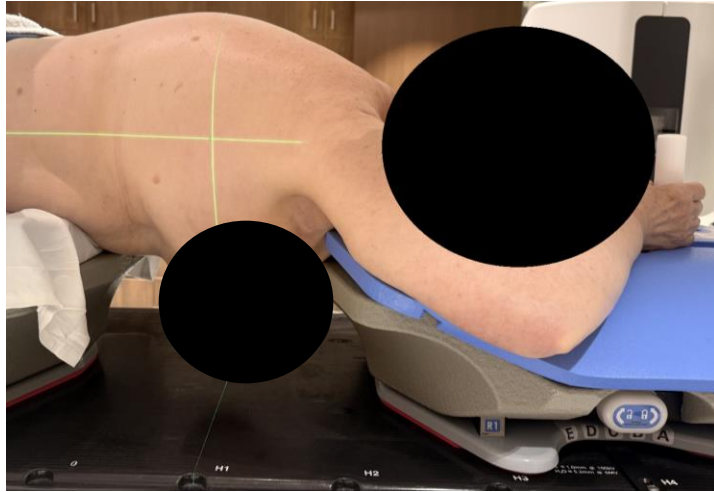
**INF** \_\_\_\_\_

**MED** \_\_\_\_\_

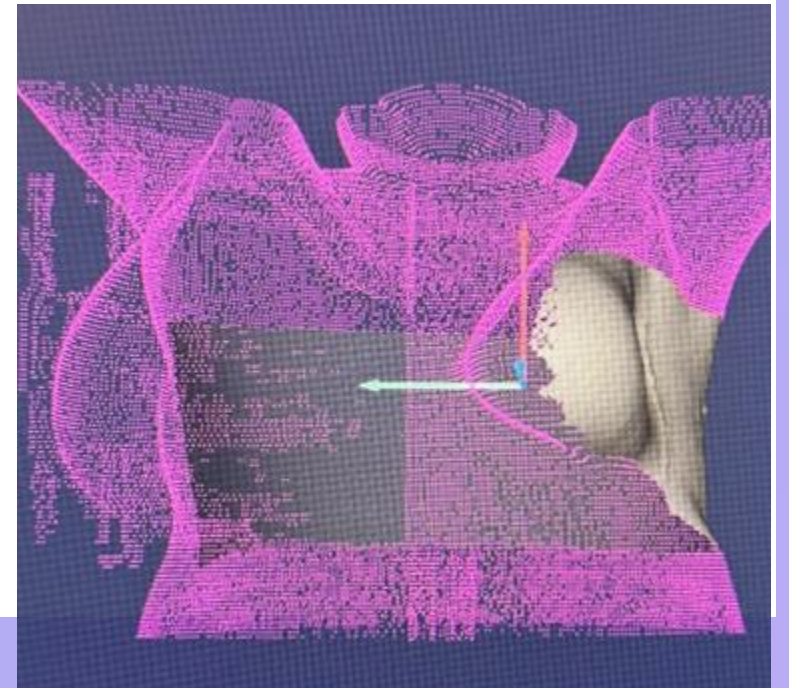
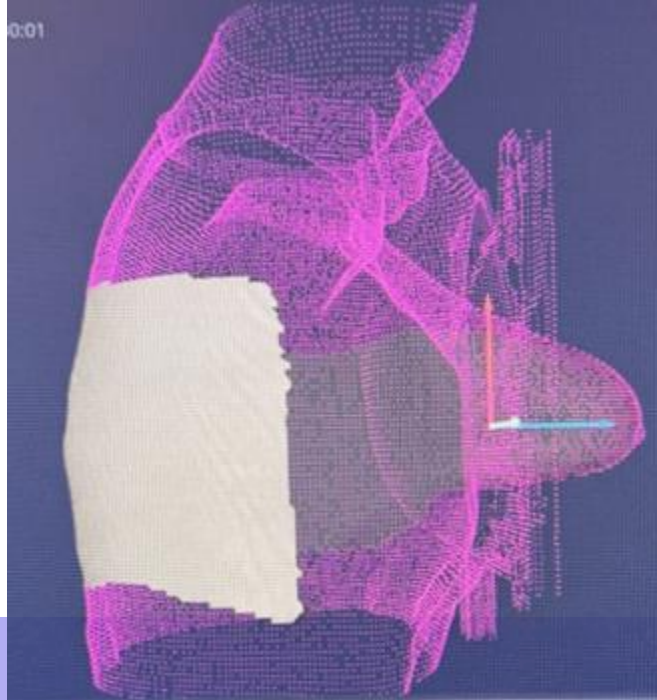
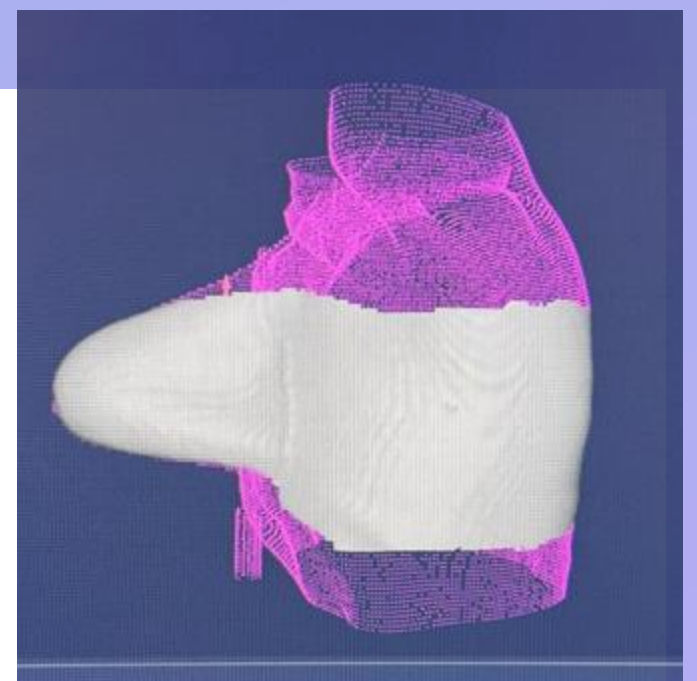
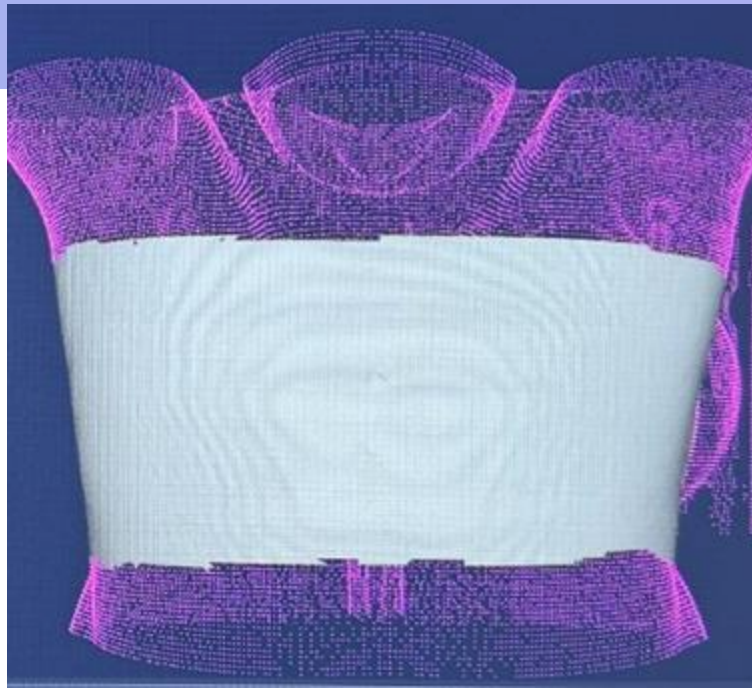
**Notes:** \_\_\_\_\_

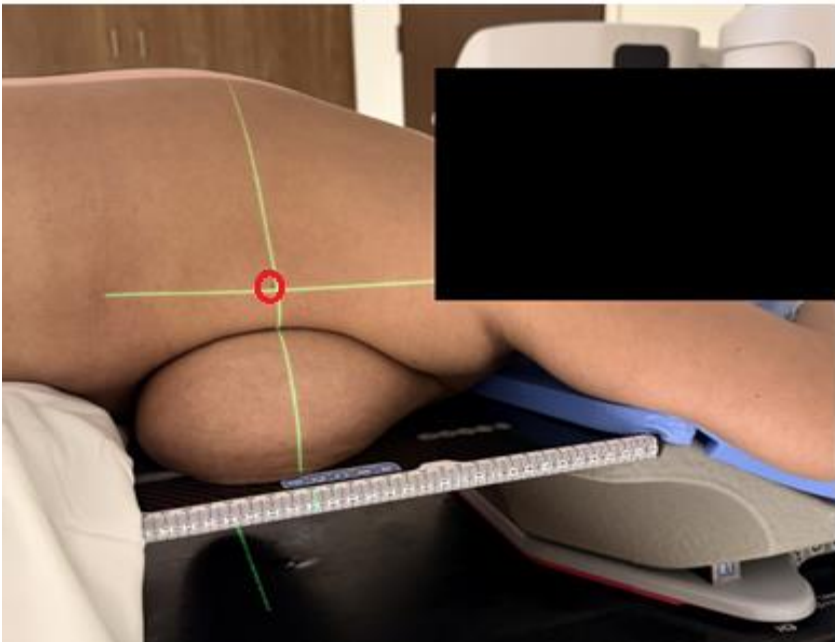
\_\_\_\_\_

\_\_\_\_\_

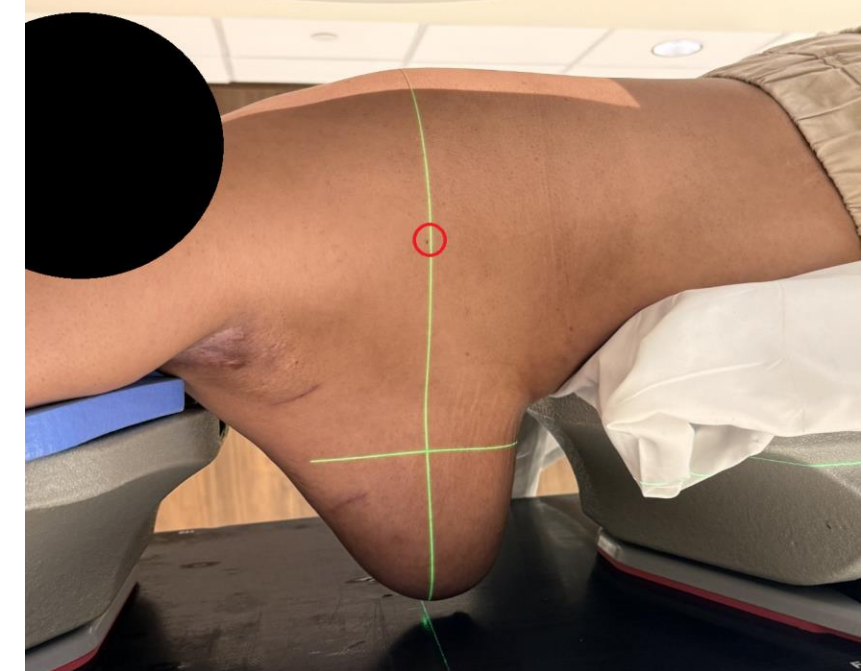
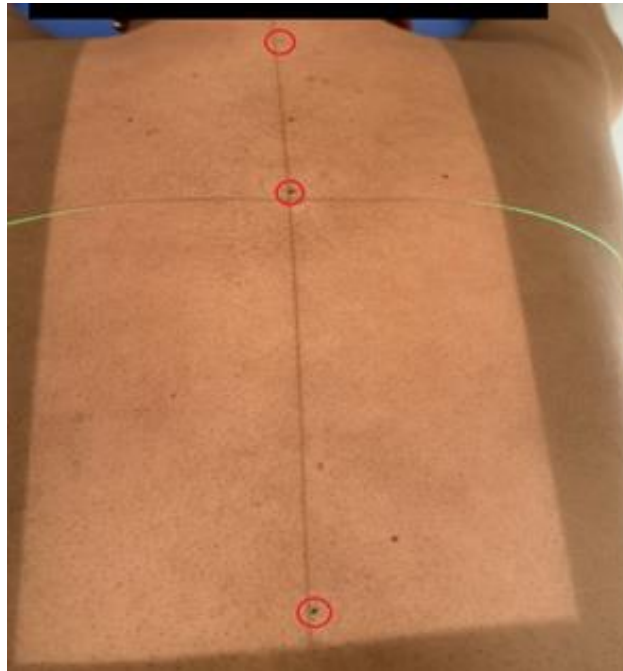
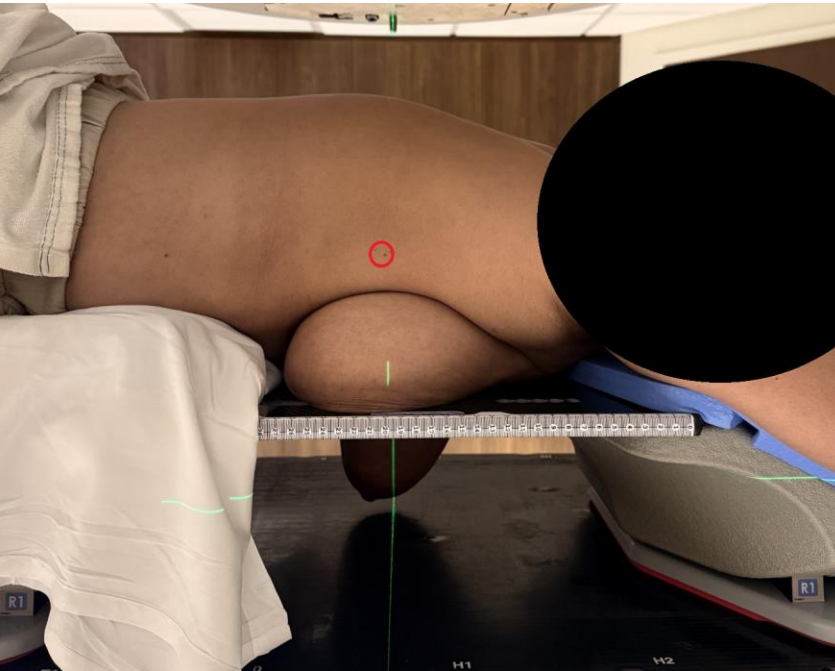
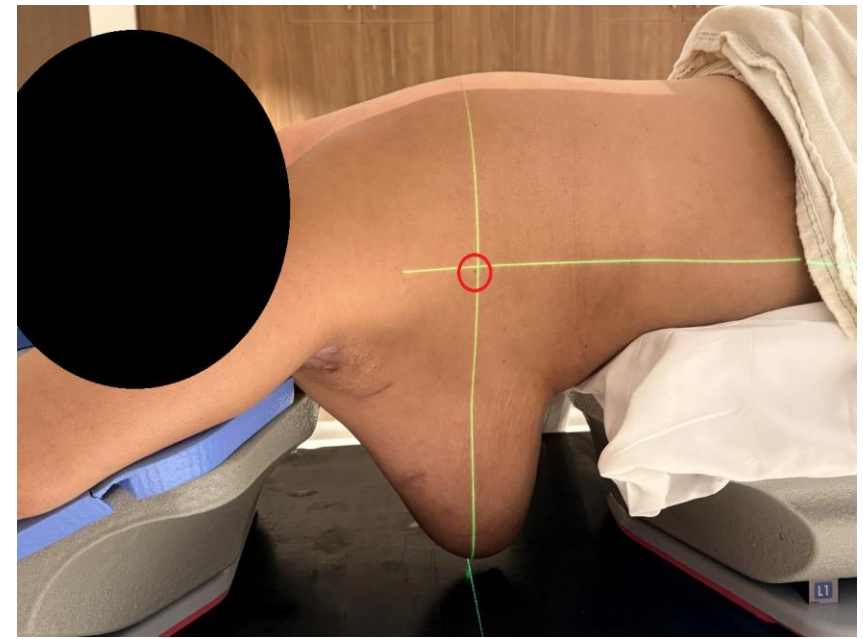


# ROI – Prone Breast





# Prone Breast Continued...



Preparation Treatment Therapist ?

Left Breast ISO 1 SGRT External Lt Prone Breast

VRT<sub>cm</sub> **-0.14**

LNG<sub>cm</sub> **-0.01**

LAT<sub>cm</sub> **-0.01**

MAG<sub>cm</sub> **0.16**

RTN° **1.4**

ROLL° **-1.3**

PITCH° **-3.5**

Reference Treatment Couch 0.0° Send to Couch Beam Control OFF

Preparation Treatment Therapist ?

Left Breast ISO 1 SGRT External Lt Prone Breast

VRT<sub>cm</sub> **0.05**

LNG<sub>cm</sub> **0.09**

LAT<sub>cm</sub> **0.06**

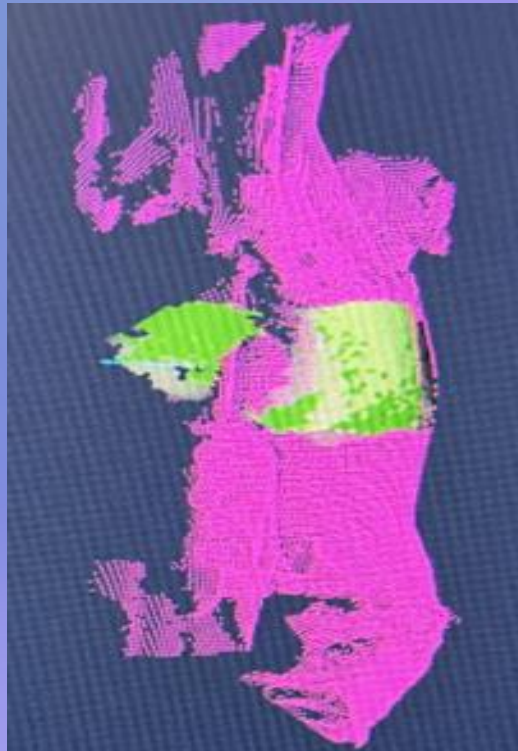
MAG<sub>cm</sub> **0.12**

RTN° **0.0**

ROLL° **-0.2**

PITCH° **-0.8**

Reference Treatment Couch 0.0° Send to Couch Beam Control OFF



Preparation Treatment Therapist ?

Left Breast ISO 1 SGRT External Lt Prone Breast

VRT<sub>cm</sub> **0.00**

LNG<sub>cm</sub> **0.05**

LAT<sub>cm</sub> **0.00**

MAG<sub>cm</sub> **0.05**

RTN° **0.0**

ROLL° **0.0**

PITCH° **0.1**

Reference Treatment Couch 0.0° Send to Couch Beam Control OFF

01/30/2026 14:53:59

Coaching Surface Deformation Video

# ROI - Pelvis







Preparation Treatment Therapist ?

Pros60\_edge ISO 1 CT SIM External Pros60

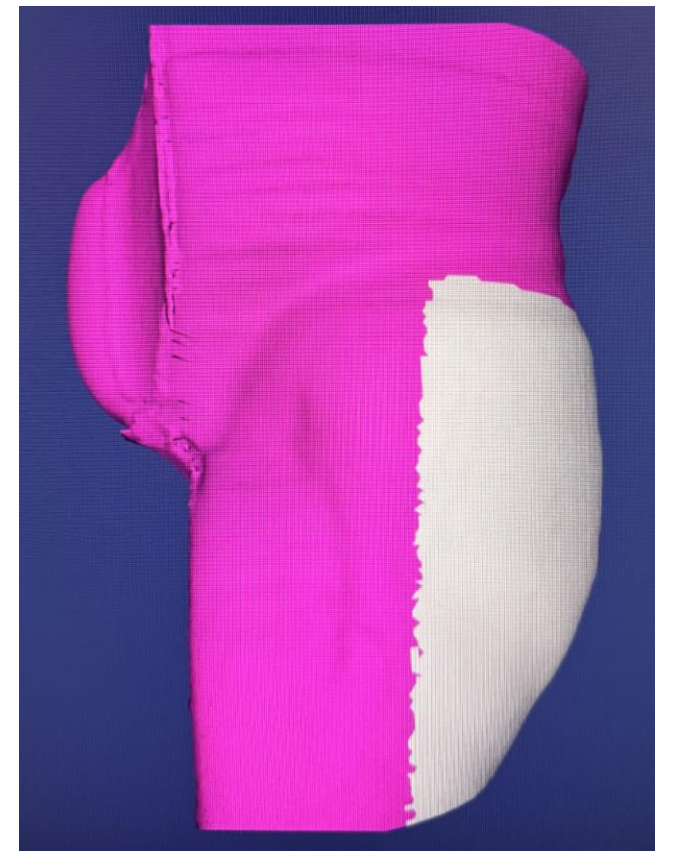
VRT <sub>cm</sub>	-0.02	
LNG <sub>cm</sub>	-0.10	
LAT <sub>cm</sub>	0.04	
MAG <sub>cm</sub>	0.11	
RTN <sup>°</sup>	0.3	
ROLL <sup>°</sup>	-0.2	
PITCH <sup>°</sup>	-0.8	

Reference Treatment Couch 0.0° Send to Couch Beam Control OFF

0.30  
-0.30

Coaching Surface Deformation Video

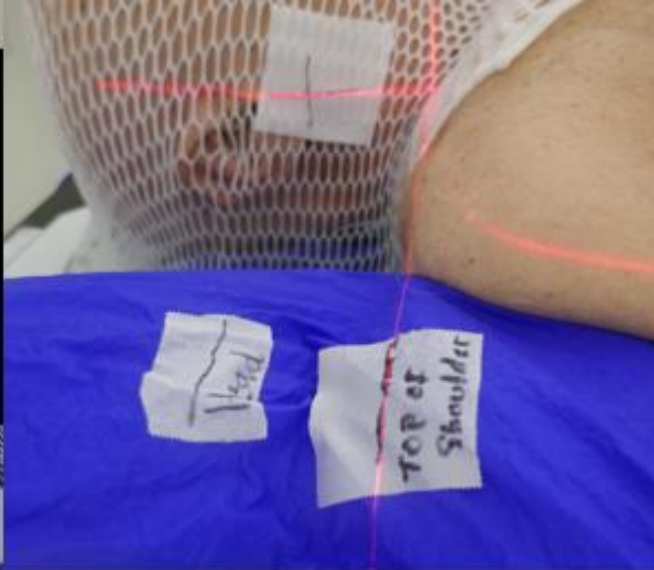
# ROI - Prone Pelvis



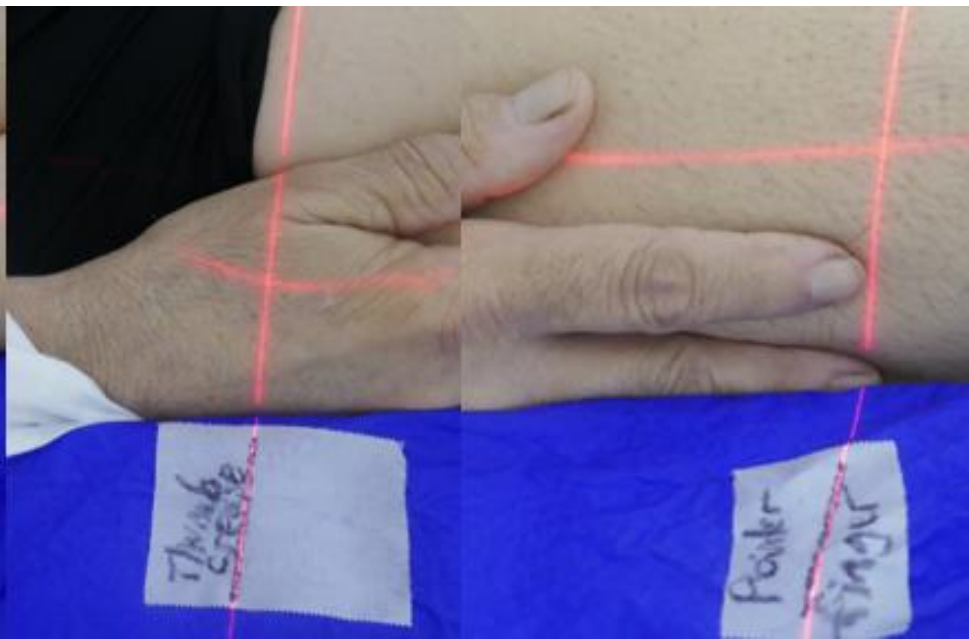


# CT SIM – CSI

- ❖ Long body fix/Uframe holder/Short closed mask w/extended neck
- ❖ Arms down - hands at sides with palms against thighs – no footwear
- ❖ Depth is set midplane for the brain
- ❖ A measurement of approximately 16-18cm inferiorly from the top of the patient's head is taken to estimate the brain ISO which is typically around the C1 level.
- ❖ The AP, Lt & Rt lat are marked & BB'd
  - Dosimetry provides SFP shifts from the brain ISO for the Upper & Lower Spine ISO's
- ❖ Keeping the same depth from the brain ISO, inferior level marks are placed on cradle/pt
  - Tattoo's still at level marks since we've only had a handful of cases we've treated
- ❖ Cradle marks:
  - Top of shoulders, thumb creases, and tip of middle fingers (can be different on each side)
- ❖ Photos



# CSI XRT



# Extremities

Make custom vac-loc  
cradle

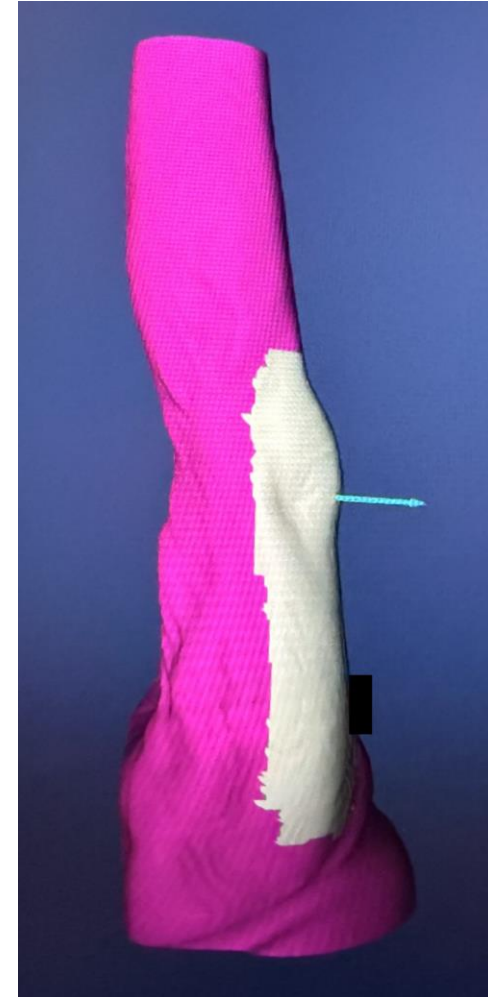
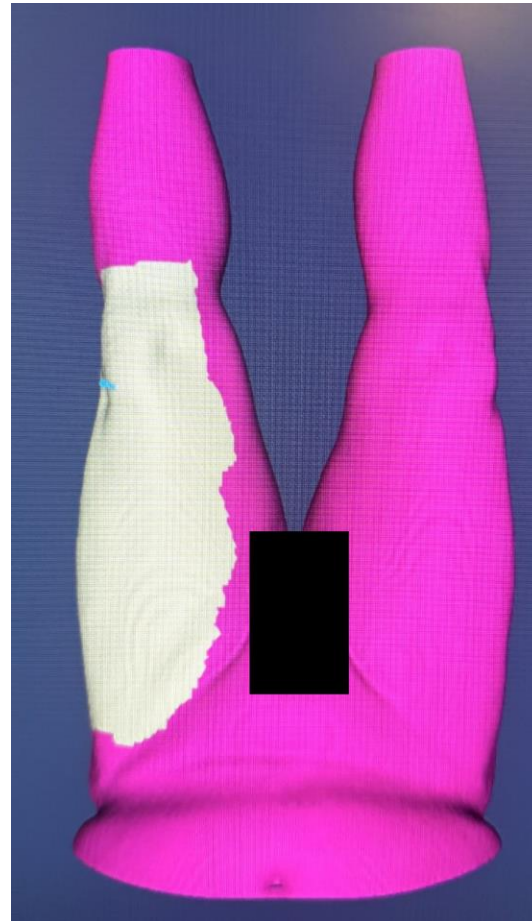


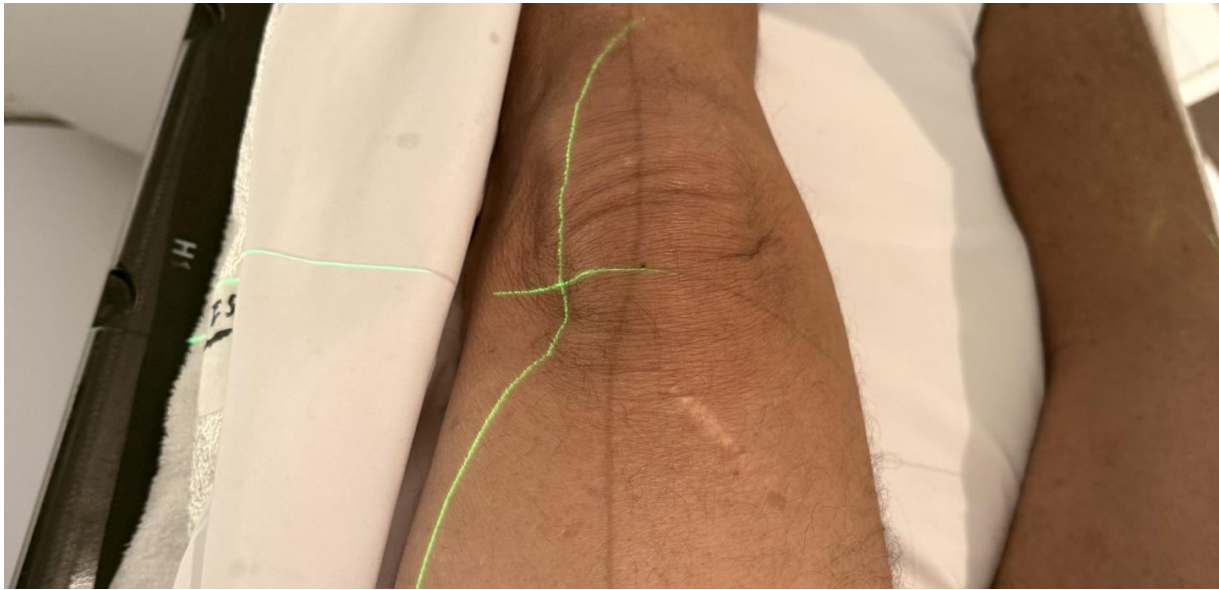
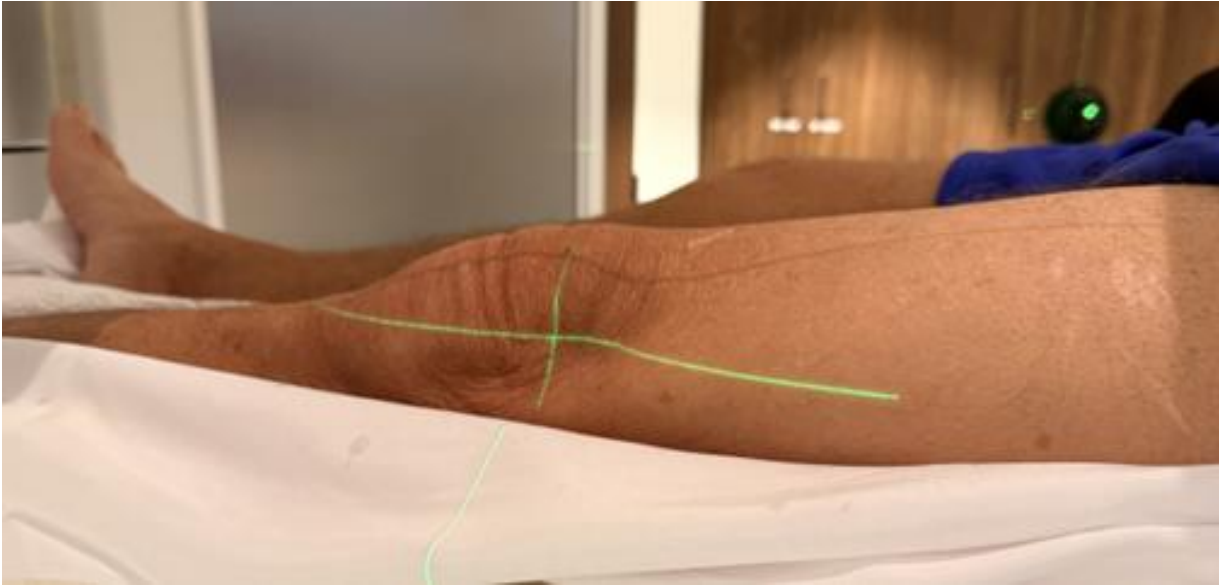
Verify enough lateral  
side view of XRT site  
can be visualized by  
Align RT cameras



ISO set & lasers shifted  
to position. Pictures of  
AP, Rt lat, & Lt lat are  
taken where lasers fall  
and any additional  
setup photos

# ROI - Extremity





**Masks: Use Align Rt to adjust patient prior to placing mask on patient, then place mask to make final adjustments (This helps reduce pitch/yaw/roll)**

**Cradle/Body fix: Align to level marks & adjust patient superiorly/inferiorly with Align RT to help any pitch issues. Continue with Align RT for remaining adjustments**

**No immobilization devices: Visually make patient straight with lasers, not rolled, then adjust patient with Align RT**

# Example of Brain XRT



# Example of Brain XRT Continued...

HA Brain ISO 1      CT SIM External      HA Brain

VRT<sub>cm</sub>    **-0.11**    [Green bar]

LNG<sub>cm</sub>    **-0.06**    [Green bar]

LAT<sub>cm</sub>    **0.42**    [Red bar]

MAG<sub>cm</sub>    **0.44**    [Red bar]

RTN<sup>°</sup>    **-0.8**    [Green bar]

ROLL<sup>°</sup>    **1.8**    [Red bar]

PITCH<sup>°</sup>    **1.6**    [Red bar]

Reference    Treatment    Couch 0.0°    Send to Couch    Beam Control OFF

Deltas    Select

VRT<sub>cm</sub>    **-0.11**   

LNG<sub>cm</sub>    **-0.07**   

LAT<sub>cm</sub>    **0.43**   

3 DoF     4 DoF     6 DoF

Cancel    Send

alignrt\* ⚠ Deltas out of tolerance

Coaching    Surface    Deformation    Video

# SSD'S

ISO 1 CT SIM External HA Brain

VRT<sub>cm</sub> -0.02  
LNG<sub>cm</sub> -0.01  
LAT<sub>cm</sub> -0.02  
MAG<sub>cm</sub> 0.03  
RTN° -1.0  
ROLL° 1.9  
PITCH° 1.7

Reference Treatment Couch 0.0° Send to Couch Beam Control OFF

0.20  
0.20

Coaching Surface Deformation Video

A yellow arrow points to the ISO 1 button, and another yellow arrow points to the video button.

### SSD Measurements

Field	Gantry	Couch	Plan	Current
R	179.0°	0.0°	79.50cm	Fail
S	181.0°	0.0°	79.50cm	Fail
T	179.0°	0.0°	79.50cm	Fail
U	181.0°	0.0°	79.50cm	Fail
REF13	0.0°	0.0°	91.28cm	90.67cm
REF14	90.0°	0.0°	79.34cm	73.27cm

Save to Report

SSD

Report Screenshot

ROI Tools

Surface Display

Reset Surface

A 3D surface model of a patient's head is visible at the bottom of the panel.

# Example of Brain XRT Continued...

- After imaging and application of shifts, move gantry to 0, 180, or 180.1 (if not already there) to avoid camera blockage.
- “Reference capture” the patient’s position
- Select “This session only”
  - If shifts  $> 5\text{mm}$ , select “This and future sessions”



# Example of Brain XRT Continued...

The screenshot displays a medical treatment planning software interface for Brain XRT. The top navigation bar includes a pause icon, a target icon, and the text "HA Brain ISO 1". Below this, there are icons for "SGRT External" and "HA Brain".

The left panel shows patient position parameters:

VRT <sub>cm</sub>	-0.01
LNG <sub>cm</sub>	-0.01
LAT <sub>cm</sub>	-0.01
MAG <sub>cm</sub>	0.02
RTN <sup>°</sup>	0.1
ROLL <sup>°</sup>	-0.1
PITCH <sup>°</sup>	0.4

The right panel features a 3D model of a patient in a treatment couch, with a red brain region highlighted. Below the model is a graph showing a red line representing a parameter over time, with a scale from -0.20 to 0.20. The graph shows a slight downward trend.

At the top right, there are buttons for "Reference", "Treatment", "Couch 0.0°", "Send to Couch", and "Beam Control OFF". A timestamp "09/29/2023 1:06:26 PM" is displayed below the buttons.

# Example of C Spine XRT



Reference

Treatment

Couch 0.0°

Send to Couch

09/25/2023 09:26:46

Reference capture in progress

Please wait



0.20

-0.20

## Reference Capture

- This session only
- This and future sessions

Save

Cancel

**!** You are going to replace the reference surface. Please make sure your patient is in the correct position or patient mistreatment may occur.

09/26/2023 13:08:50



C4 ISO 1



SGRT External



C4

VRT<sub>cm</sub> -0.02

LNG<sub>cm</sub> -0.03

LAT<sub>cm</sub> 0.03

MAG<sub>cm</sub> 0.04

RTN° -0.2

ROLL° 0.0

PITCH° 0.3

Reference

Treatment

Couch 0.0°

Send to Couch

09/26/2023 13:08:50



0.20

-0.20

# Example of Lung XRT (SBRT/Gating Reference)

Right post Pleur ISO 1 | CT SIM External | Right post pleura

VRT<sub>cm</sub> - | LNG<sub>cm</sub> - | LAT<sub>cm</sub> - | MAG<sub>cm</sub> - | RTN° - | ROLL° - | PITCH° -

09/22/2023 9:15:52 AM

0.30  
-0.30

Coaching | Surface | Deformation | Video

Field Status | System Status | 09/29/2023 2:23 PM

Right post Pleur ISO 1 | CT SIM External | Right post pleura

VRT<sub>cm</sub> **-0.06** | LNG<sub>cm</sub> **0.77** | LAT<sub>cm</sub> **-0.32** | MAG<sub>cm</sub> **0.82** | RTN° **-1.7** | ROLL° **-0.6** | PITCH° **0.5**

0.30  
-0.30

Coaching | Surface | Deformation | Video

Reference | Treatment | Couch 0.0° | Send to Couch | Beam Control OFF

Deltas | Select

VRT<sub>cm</sub> **-0.23**

LNG<sub>cm</sub> **0.73**

LAT<sub>cm</sub> **-0.33**

3 DoF  4 DoF  6 DoF

Cancel | Send

Right post Pleur ISO 1 | CT SIM External | Right post pleura

VRT<sub>cm</sub> **0.01** | LNG<sub>cm</sub> **0.11** | LAT<sub>cm</sub> **-0.08** | MAG<sub>cm</sub> **0.14** | RTN° **-0.2** | ROLL° **0.7** | PITCH° **-0.7**

0.30  
-0.30

# Example of Lung XRT (SBRT/Gating Reference)

Right post Pleur ISO 1

SGRT External

Right post pleura

VRT<sub>cm</sub> 0.03

LNG<sub>cm</sub> -0.19

LAT<sub>cm</sub> -0.05

MAG<sub>cm</sub> 0.19

RTN° -0.1

ROLL° 0.0

PITCH° 0.0

Reference Capture

This session only

This and future sessions

Gated Capture  OFF

Capture

**!** You are going to replace the reference surface. Please make sure your patient is in the correct position or patient mistreatment may occur.

Coaching

Surface Deformation Video



Right post Pleur ISO 1



SGRT External



Right post pleura

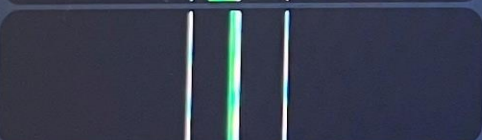
VRT<sub>cm</sub> 0.03



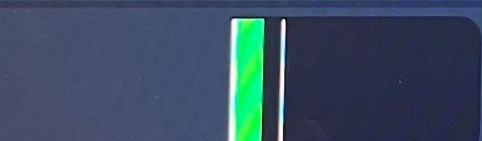
LNG<sub>cm</sub> -0.19



LAT<sub>cm</sub> -0.05



MAG<sub>cm</sub> 0.19



RTN<sup>°</sup> -0.1



ROLL<sup>°</sup> 0.0



PITCH<sup>°</sup> 0.0



Reference

Treatment

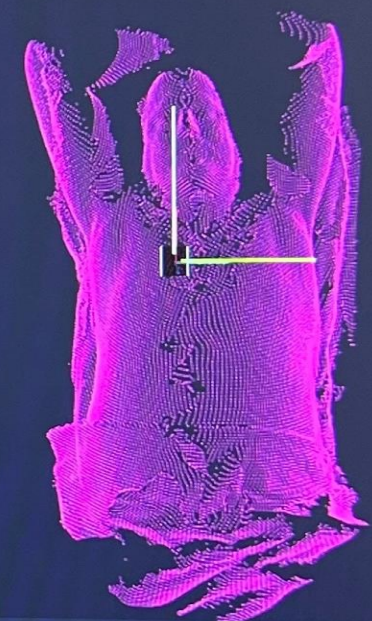
Couch 0.0°

Send to Couch

Beam Control OFF

09/29/2023 2:33:02 PM

Gated Capture



Gated Capture Review

To select a new reference surface, click on a dot in the graph below:



Accept

Recapture

Surface Deformation Video

Field Status

Plan ID Mismatch

System Status

09/29/2023 2:33 PM

# Example of Lung XRT (SBRT/Gating Reference)

The screenshot displays a medical device interface for lung XRT. The top bar includes a pause button, a target icon, and the text "Right post Pleur ISO 1". The center bar shows a shirt icon, "SGRT External", another shirt icon, and "Right post pleura".

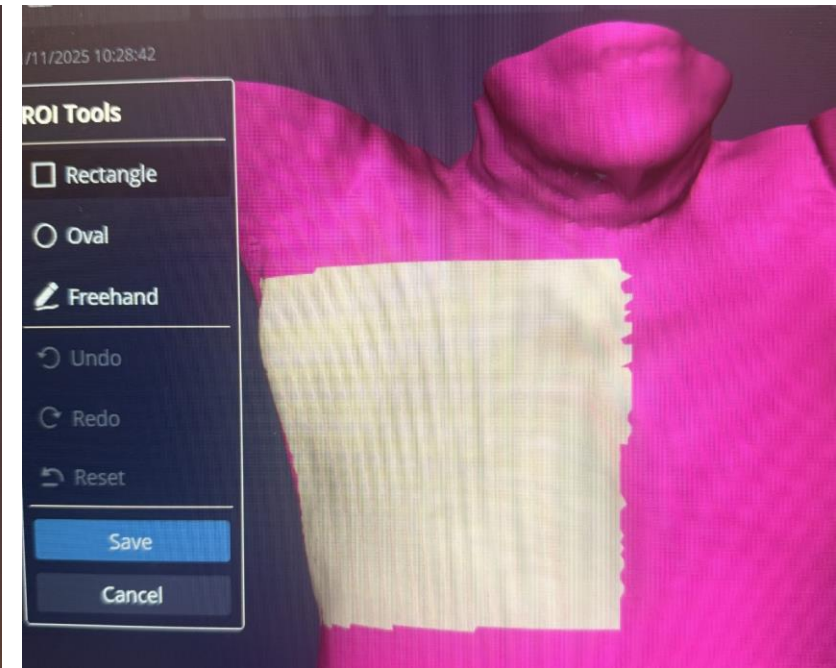
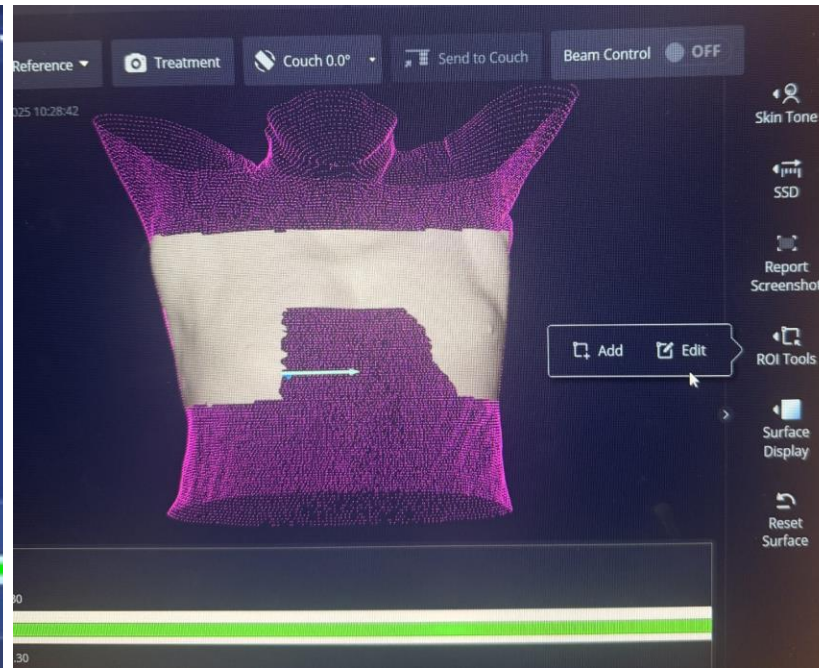
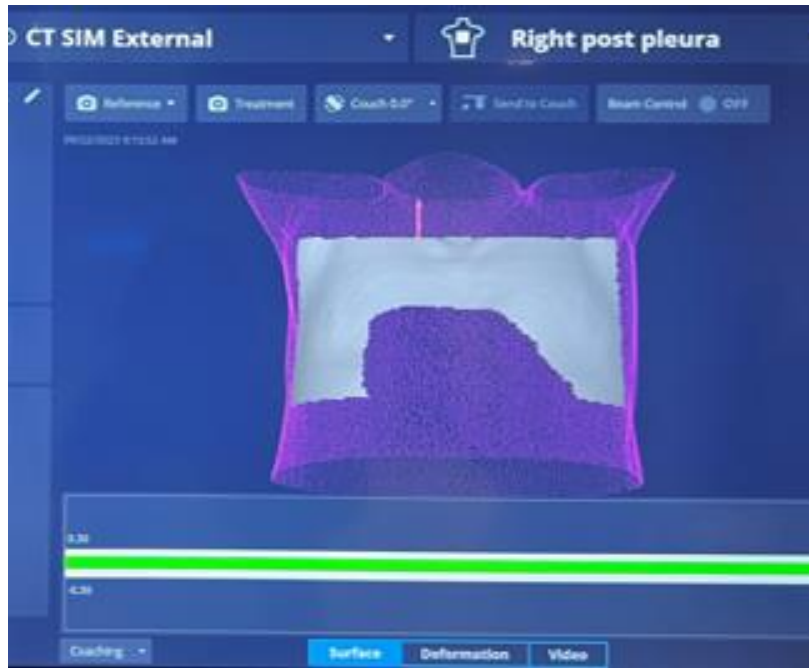
On the left, a list of position parameters is shown with corresponding green bars in a grid:

VRT <sub>cm</sub>	0.04
LNG <sub>cm</sub>	-0.18
LAT <sub>cm</sub>	-0.04
MAG <sub>cm</sub>	0.19
RTN <sup>°</sup>	0.0
ROLL <sup>°</sup>	0.1
PITCH <sup>°</sup>	0.0

The main area features a 3D visualization of a patient's torso with a green target area. Above the visualization are buttons for "Reference", "Treatment", "Couch 0.0°", and "Send to Couch". A "Beam Control" toggle is set to "ON", and a "BEAM: ENABLED" warning is visible. The date and time "09/29/2023 2:31:37 PM" are displayed.

At the bottom, there is a "Coaching" dropdown, a "Surface" button, and tabs for "Deformation" and "Video". The status bar shows "17.5 fps | Field Status".

# Example of Lung XRT (SBRT/Gating Reference)





Right post Pleur ISO 1



SGRT External



Right Post Pleur

VRT<sub>cm</sub> **-0.08**

LNG<sub>cm</sub> **-0.05**

LAT<sub>cm</sub> **0.04**

MAG<sub>cm</sub> **0.10**

RTN<sup>°</sup> **0.1**

ROLL<sup>°</sup> **-0.1**

PITCH<sup>°</sup> **-0.1**



Reference

Treatment

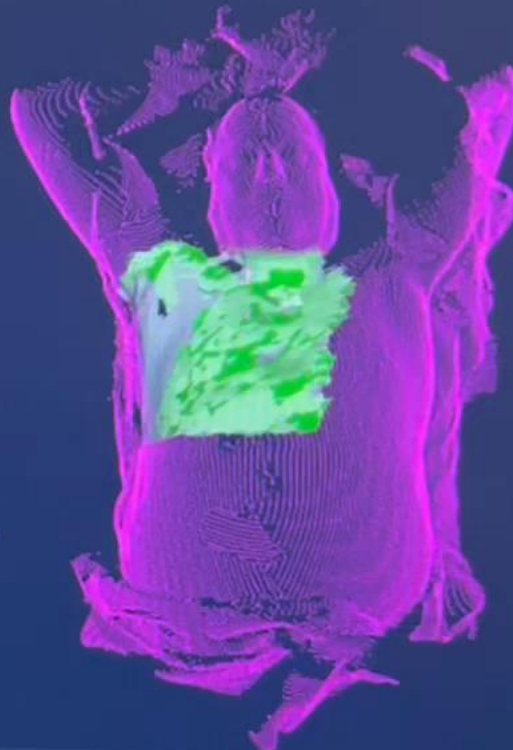
Couch 0.0°

Send to Couch

Beam Control **ON**

BEAM: **ENABLED**

09/27/2023 1:53:36 PM



Coaching

Surface

Deformation

Video

10.2 fps

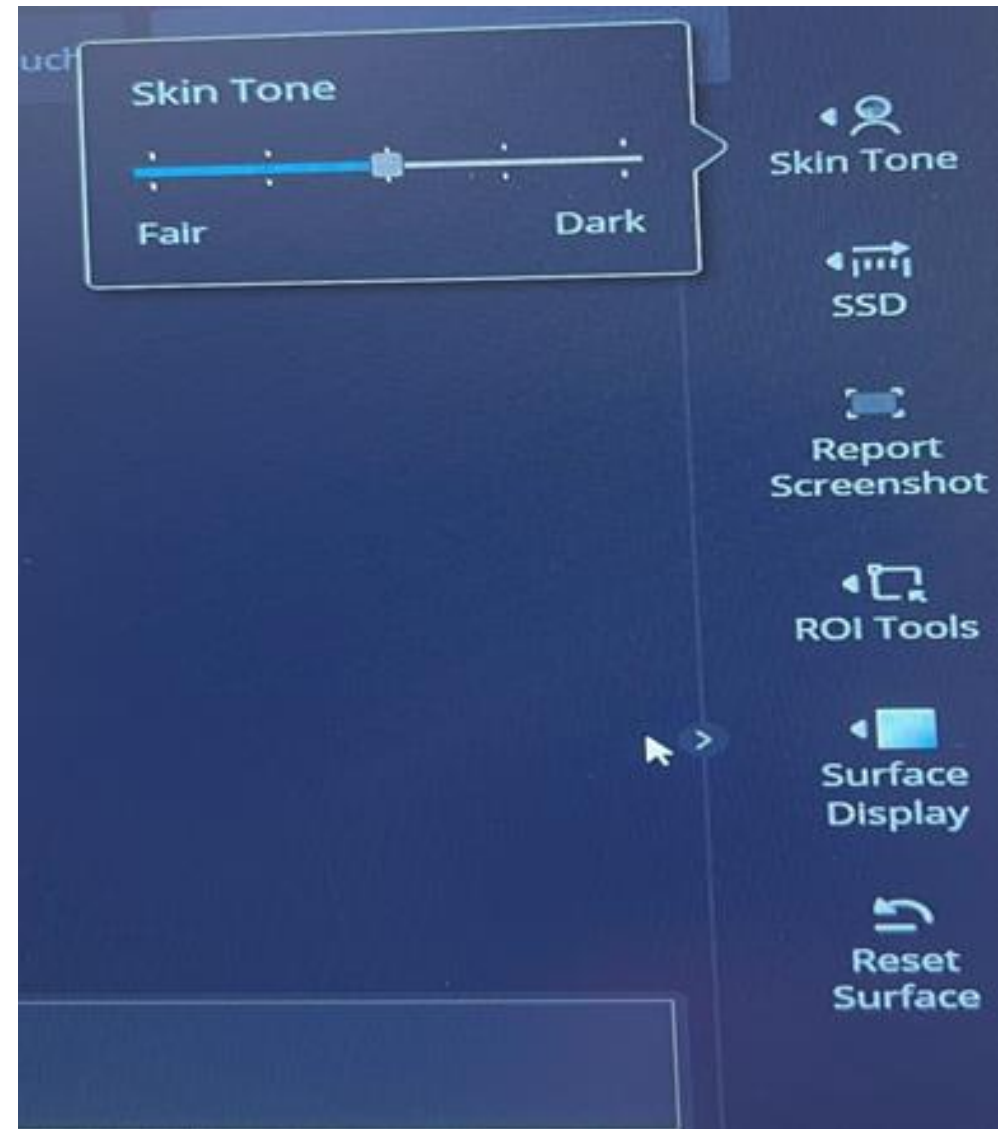
Field Status

Plan ID Mismatch

System Status

# Skin Tone

- If Align is having difficulty seeing darker or fairer skin tones, you can adjust from fair to dark to enable better detection from the cameras for the patient's skin surface



# Conclusion – Disadvantages

- Gantry interference of cameras which causes a pause in treatment to edit ROI's if patient is beam controlled.
- Align may fail to recognize the ROI placement after shifts are applied and a reference capture is taken. Mostly only happens with extremity sites. If this happens, redraw your ROI & recapture the reference position.
- Technical problems that requires full restart of all programs to reconnect properly.
- On occasion, patient setup in room showing all green for being in tolerance, however several cm's off once imaging is performed (SG possibly not recognizing sup/inf for example on a spine).

# Conclusion – Advantages

- Improves patient comfort by eliminating the need for tattoos and restrictive mask's
- Enhances safety and efficiency through real-time surface tracking during treatment delivery
- Identifies setup variables prior to imaging (Ex: Arm positioning, head/chin tilts/rotations)
- Streamlines patient setups and positioning, reducing overall time on the treatment table
- Improves respiratory management for DIBH/gating treatments with visual monitoring of BH's and breathing patterns. It also eliminates variability from daily placement of external marker boxes
- Increases therapist confidence by providing continuous motion monitoring rather than relying on assumptions during treatment (e.g., coughing or sneezing in the middle of treatment)
- Enables automatic surface-guided SFP shifts
- Supports accurate bolus placement verification
- Applicable across a wide range of treatment sites

THANK YOU!