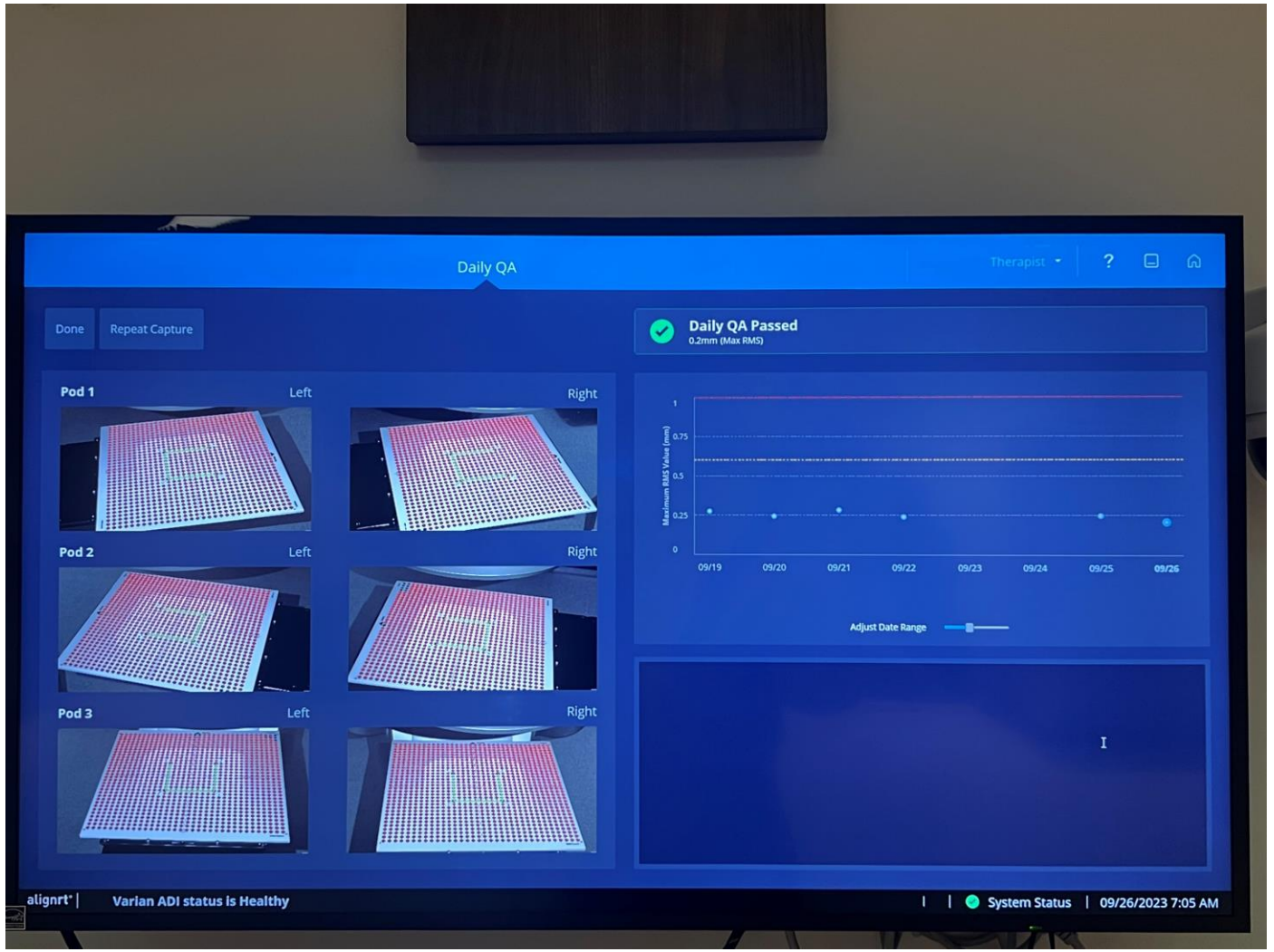
Surface-Guided Radiation Therapy with TrueBeam's

By: Amber Nelsen

Daily Warm up – Vision Plate

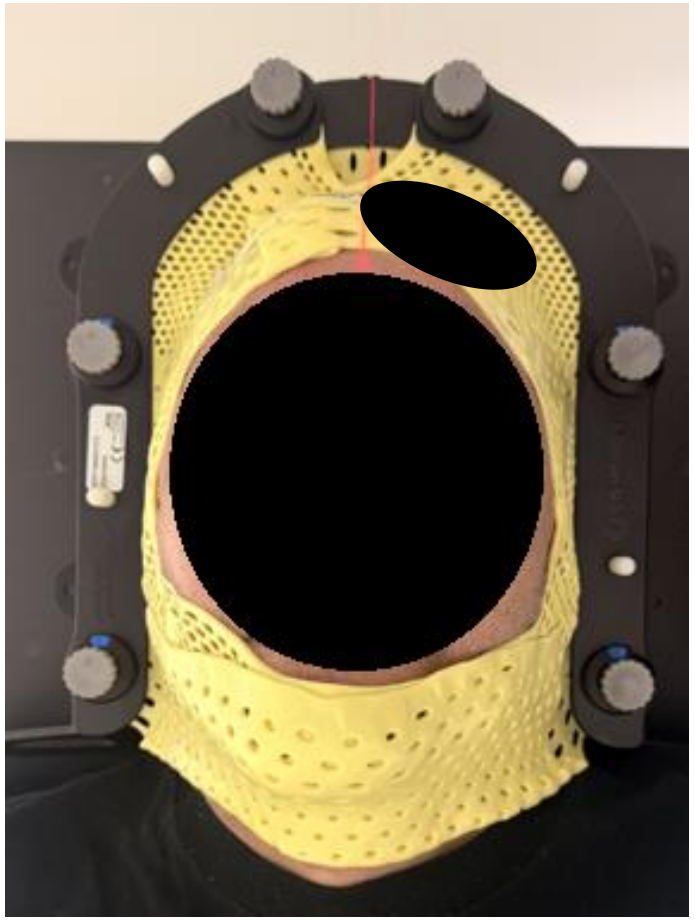


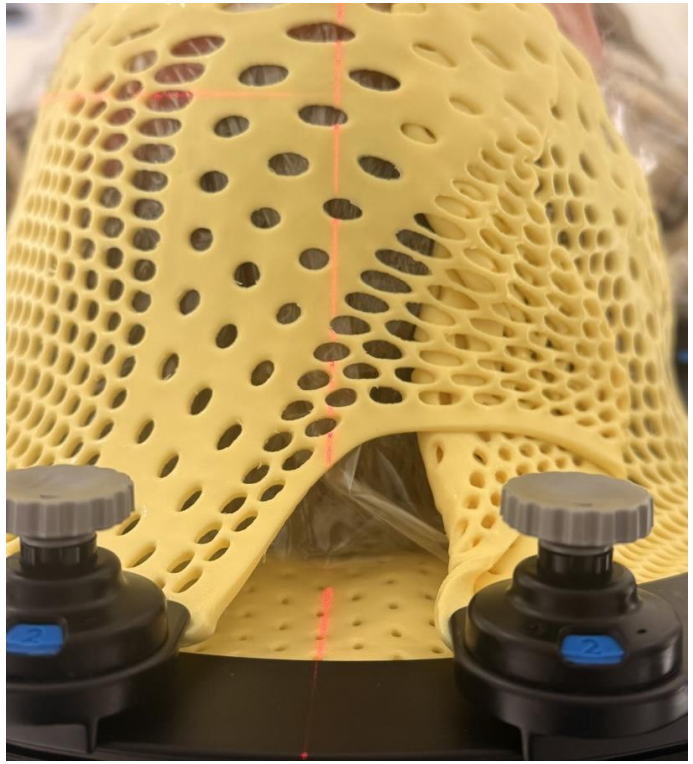
CT SIMULATION

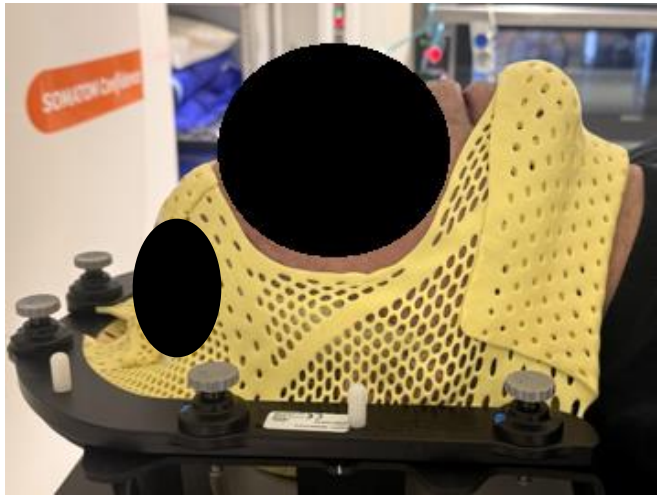
- CT sim is the first steps for SGRT to be successful for alignment during XRT treatments
- Patient will be uncovered for full length of scanning range
  - Genitalia area is covered if it is included within the scan range
- Scan ranges should extend beyond the immediate treatment volume to ensure adequate 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

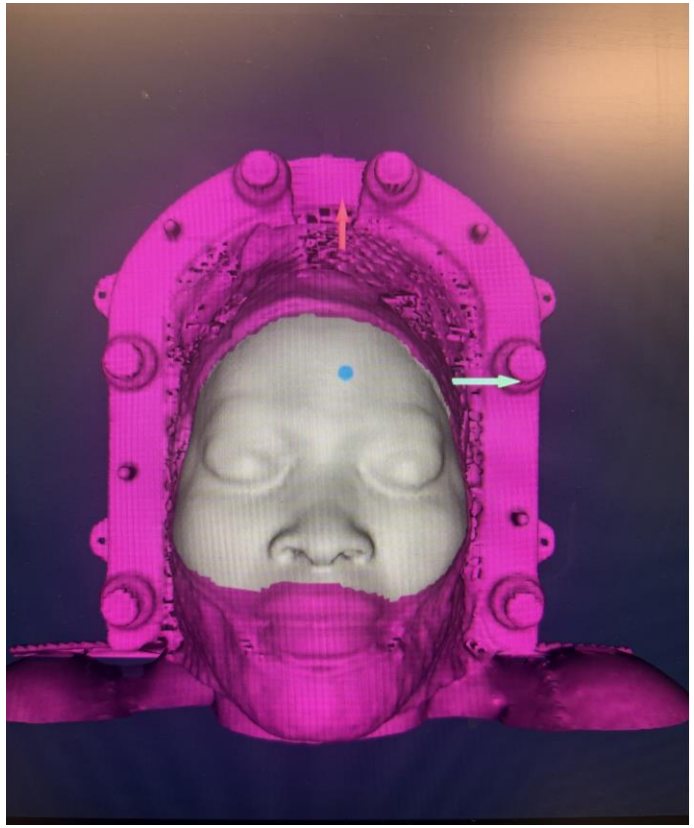
- Three different open face masks
  - SRS mask
  - Short S-frame mask
  - Long S-frame mask
- All masks made with emphasis on:
  - Sides – Opening stretched to anterior edges of patient's ears
  - Superior – Opening stretched to patient's hair line
  - Inferior – Opening stretched below patient's mouth

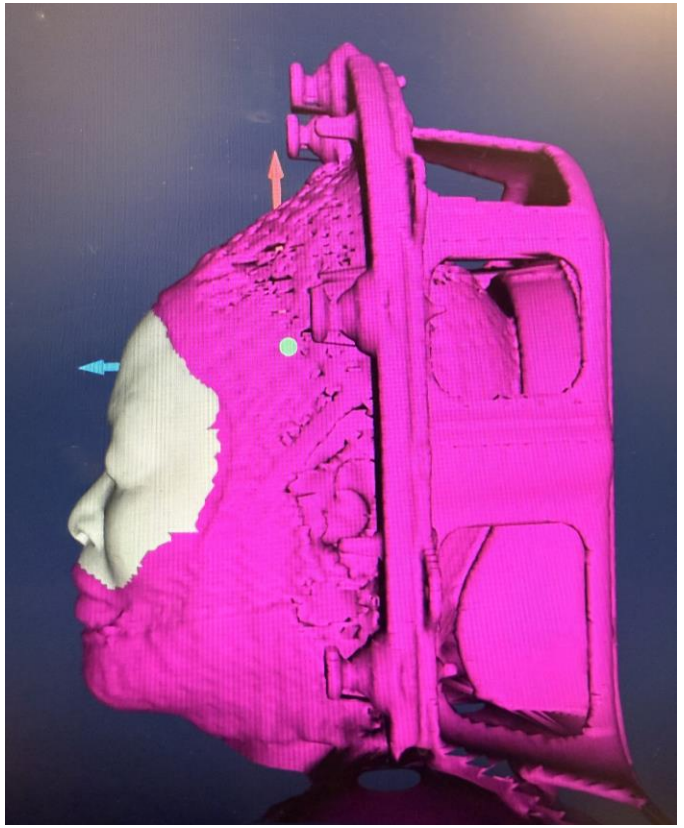


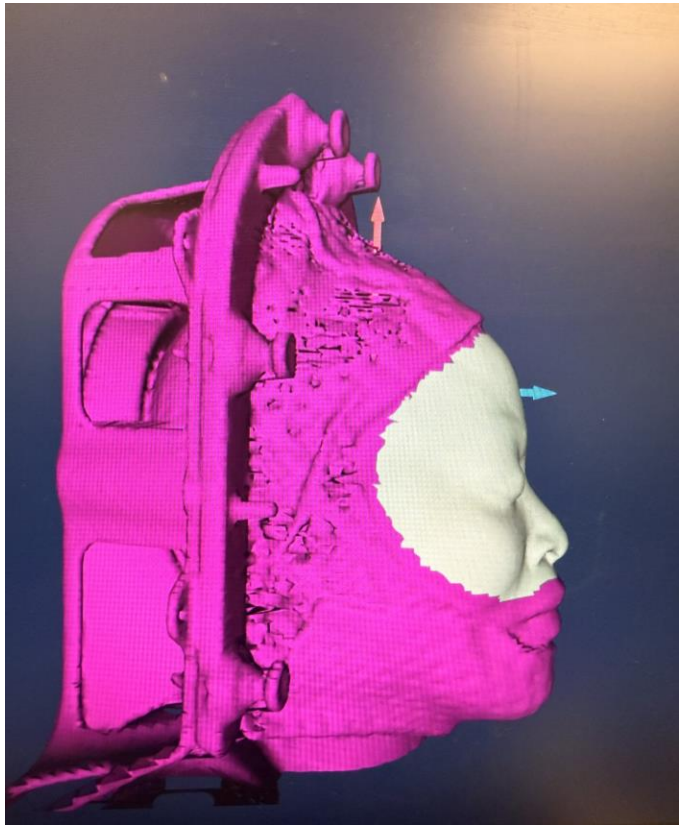


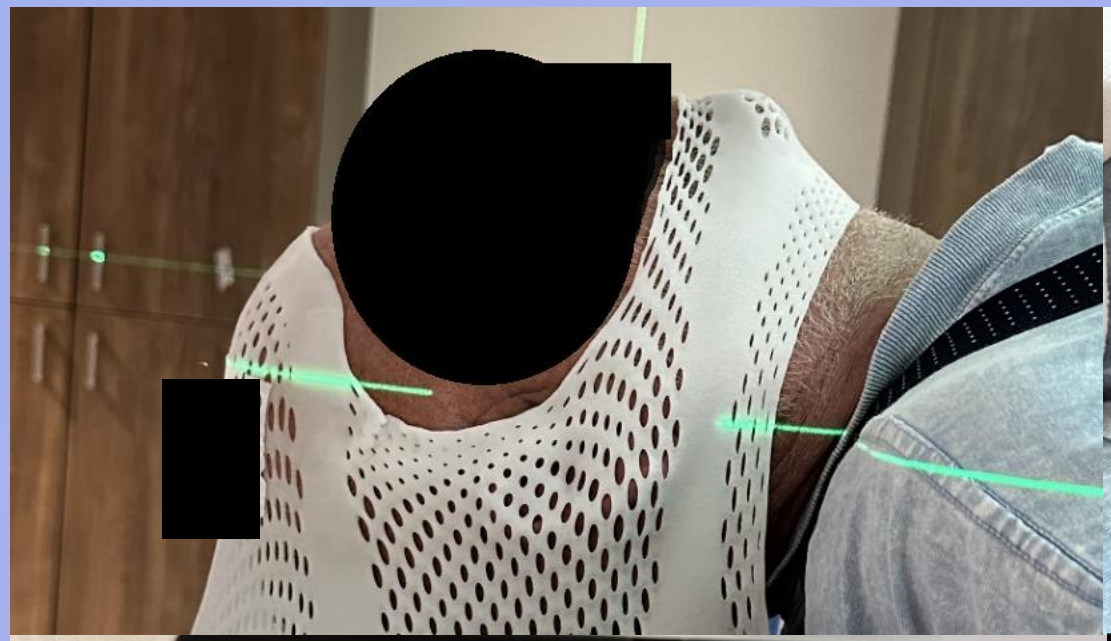


TREATMENT – *R*egions *O*f *I*nterest (ROI)



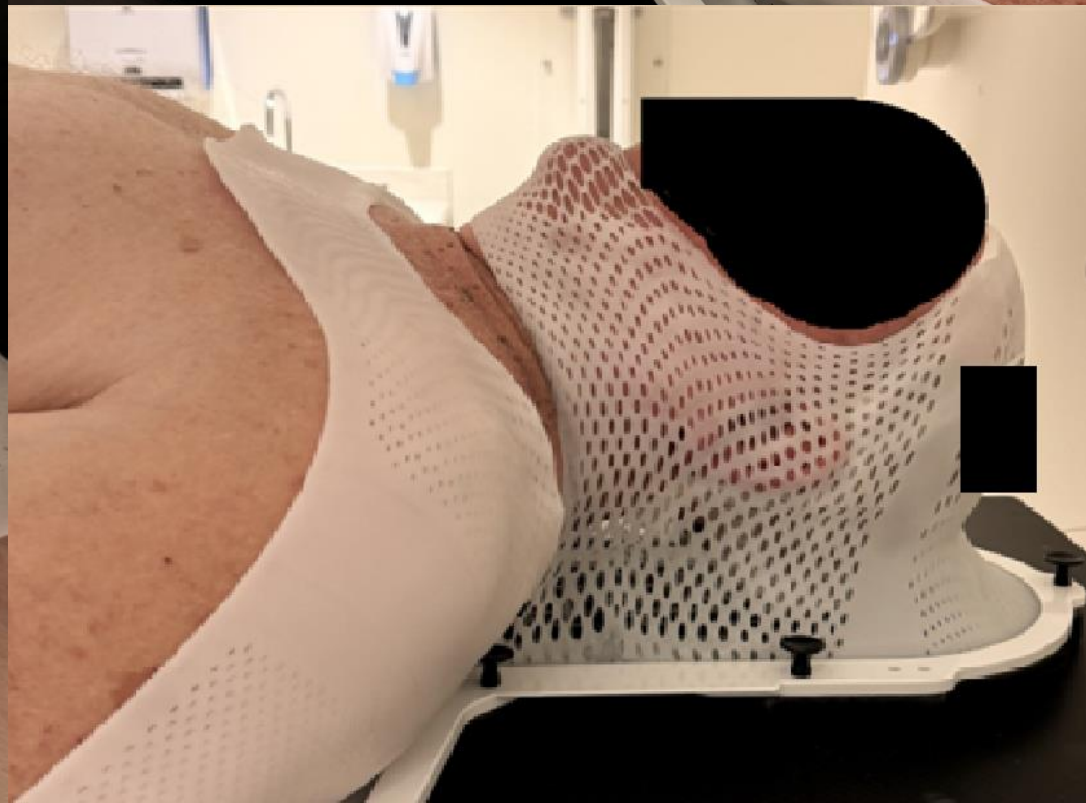







Preparation
Treatment
Therapist
R TempBrn ISO 1
CT SIM External
brain
VRT cm 0.00
LNG cm 0.02
LAT cm -0.03
MAG cm 0.03
RTN ° 0.1
ROLL ° 0.4
PITCH ° -0.3
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control OFF
11/20/2025 15:12:52
0.20
-0.20
Coaching
Surface
Deformation
Video
17.4 fps | Field Status | System Status | 01/08/2026 11:40
alignrt

ROI - H&N Long S-frame masks



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

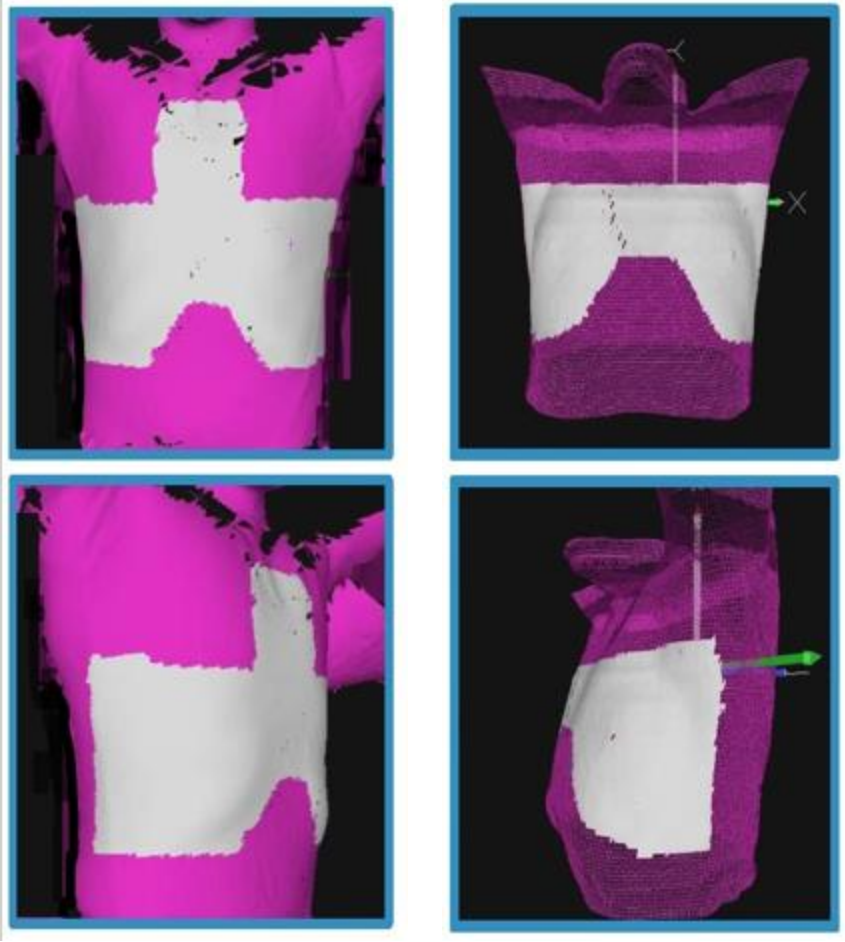
Mold around patient while leaving enough lateral skin surface for the cameras to detect

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

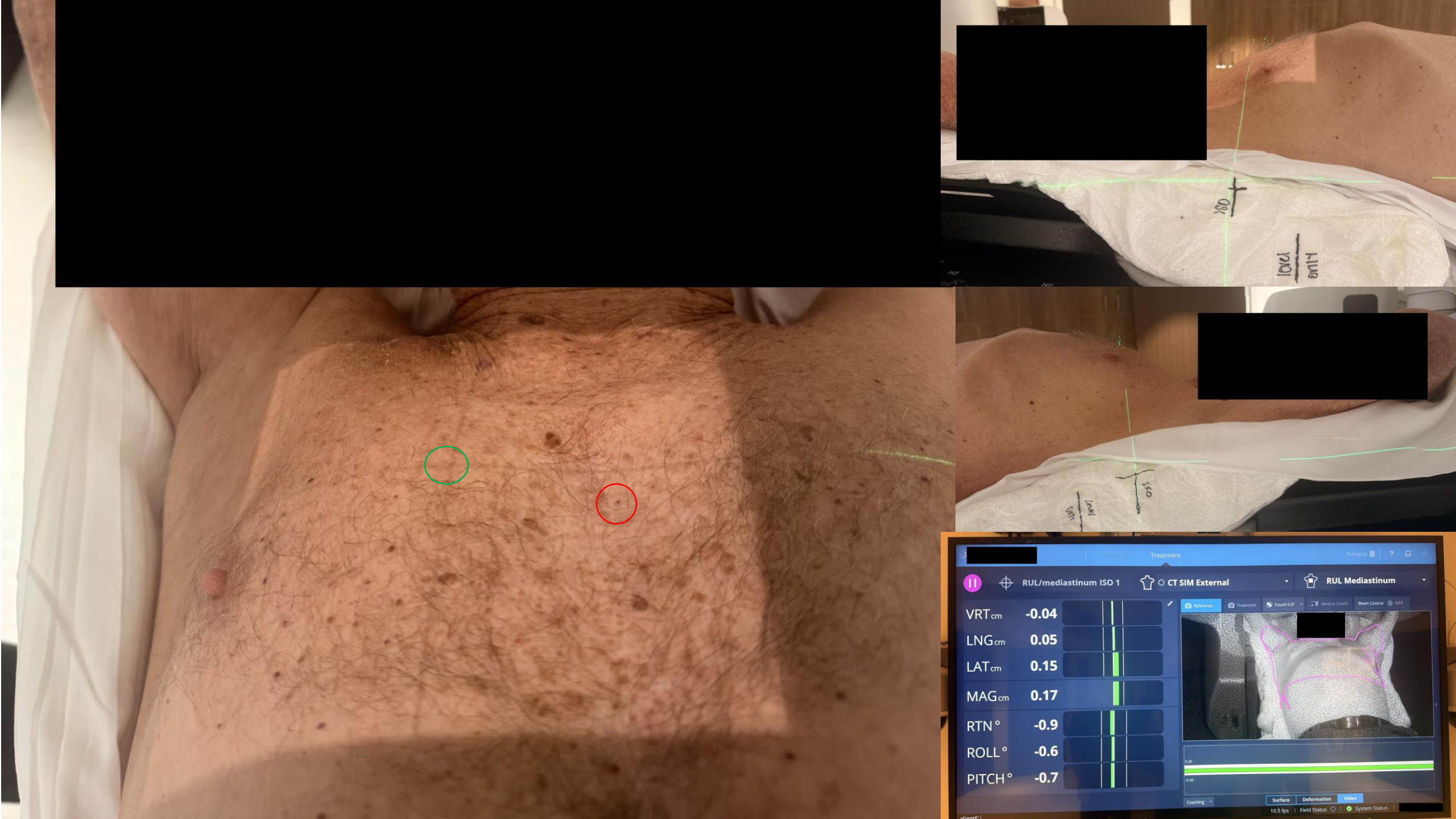
Take pictures of where lasers fall on patient for AP, Rt lat, & Lt lat in addition to setup photos for XRT

ROI's –
Lung/CW/T-L Spine/Ribs

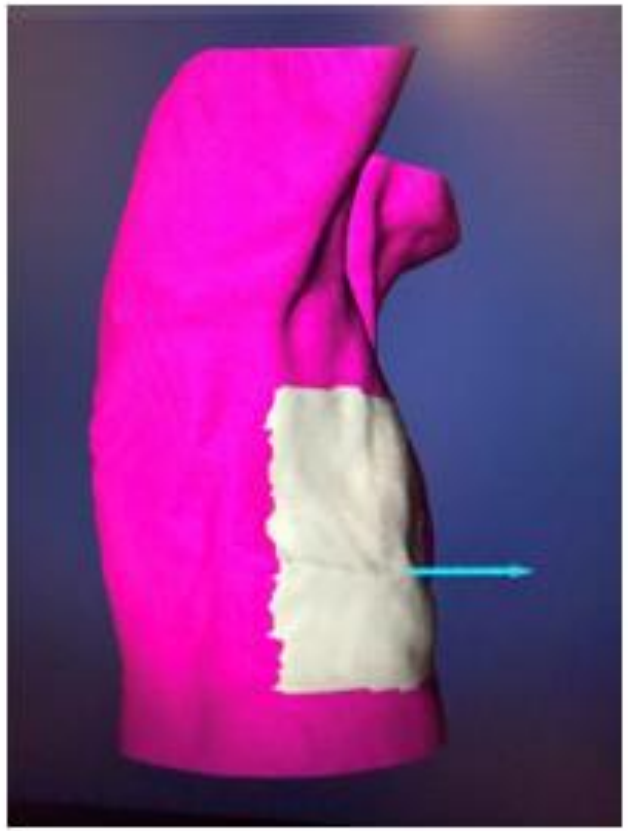
ROI's - Continued
Thorax/CW/T-L Spine/Ribs



ROI - SBRT Lung

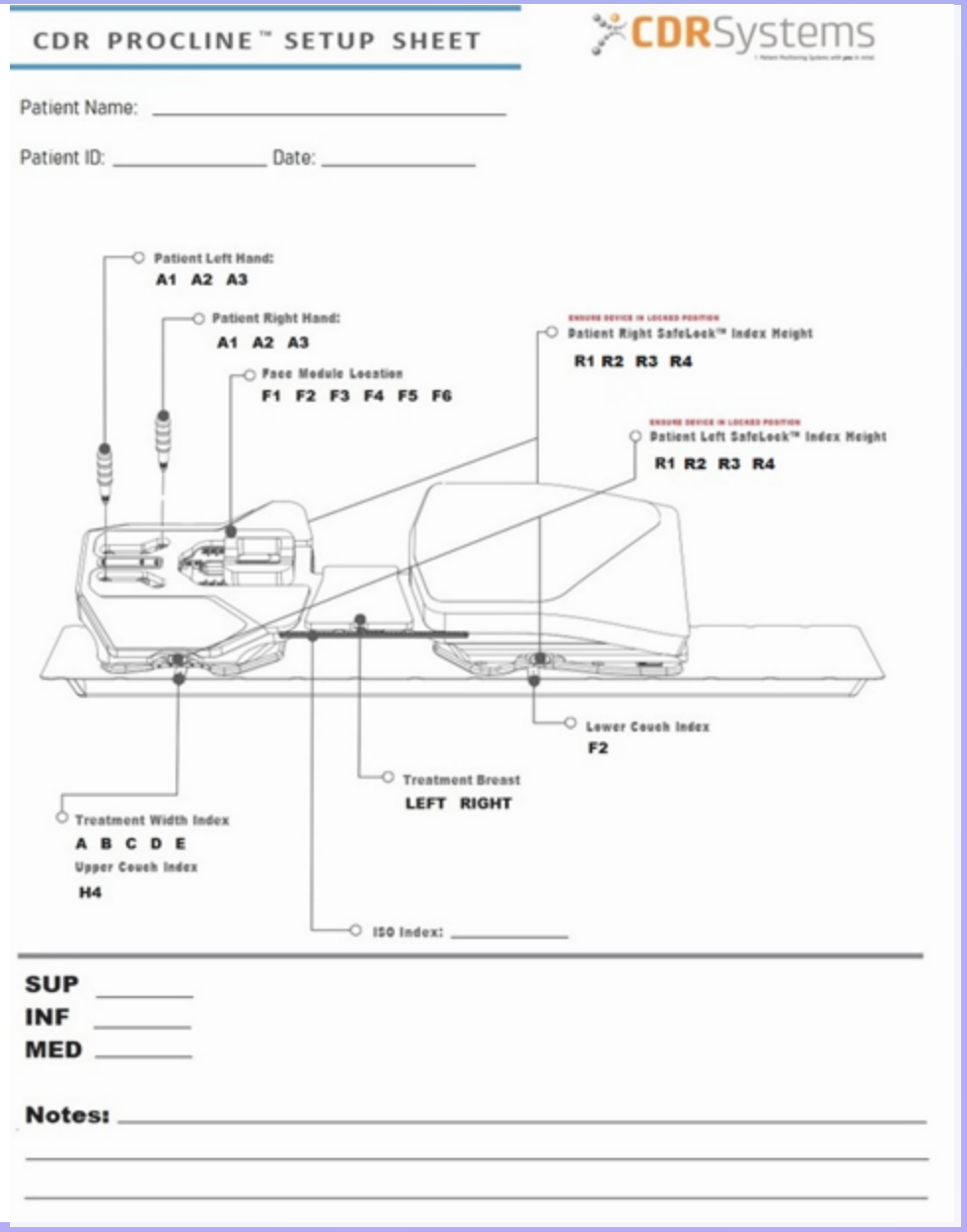

[redacted]
[redacted]
ISO
Level
[redacted]
ISO
Level
[redacted]
Treatment
RUL/mediastinum ISO 1
CT SIM External
RUL Mediastinum
VRT cm -0.04
LNG cm 0.05
LAT cm 0.15
MAG cm 0.17
RTN ° -0.9
ROLL ° -0.6
PITCH ° -0.7
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control
OFF
Surface
Deformation
Video
Coaching
10.5 fps
Field Status
System Status

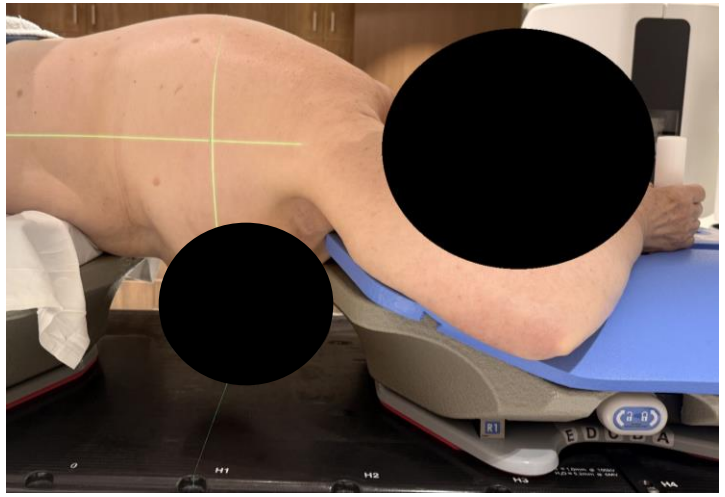
ROI – Breast or CW

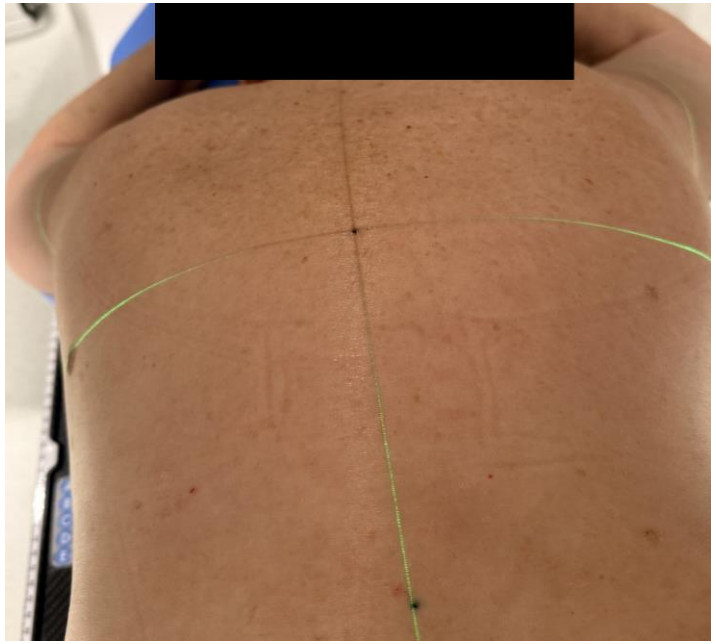


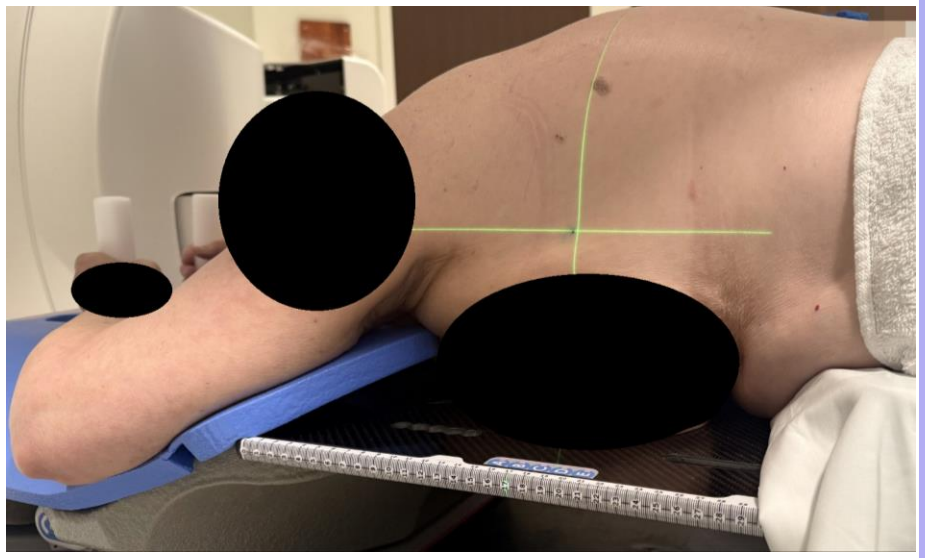
Prone Breasts

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

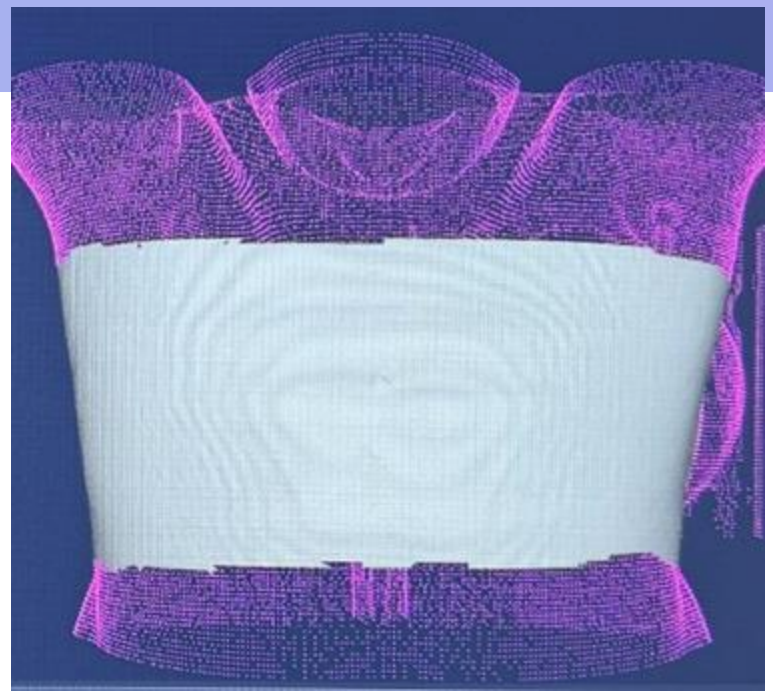


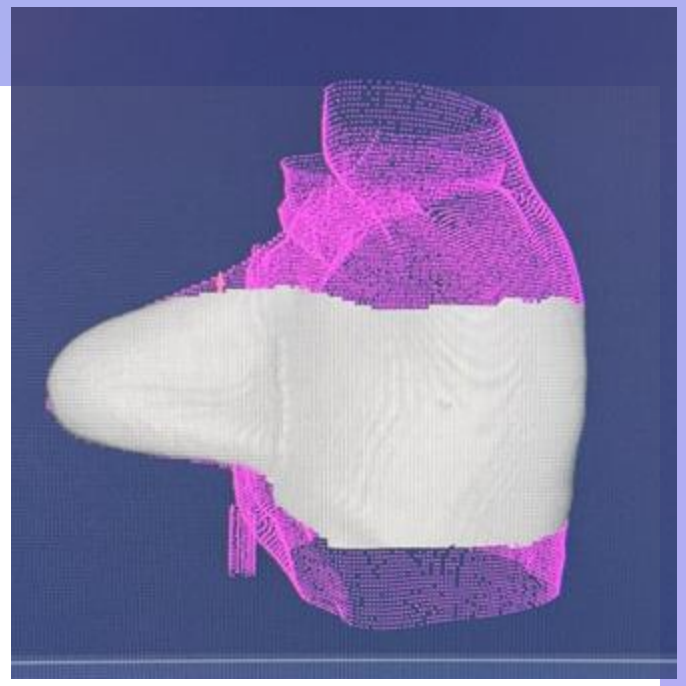


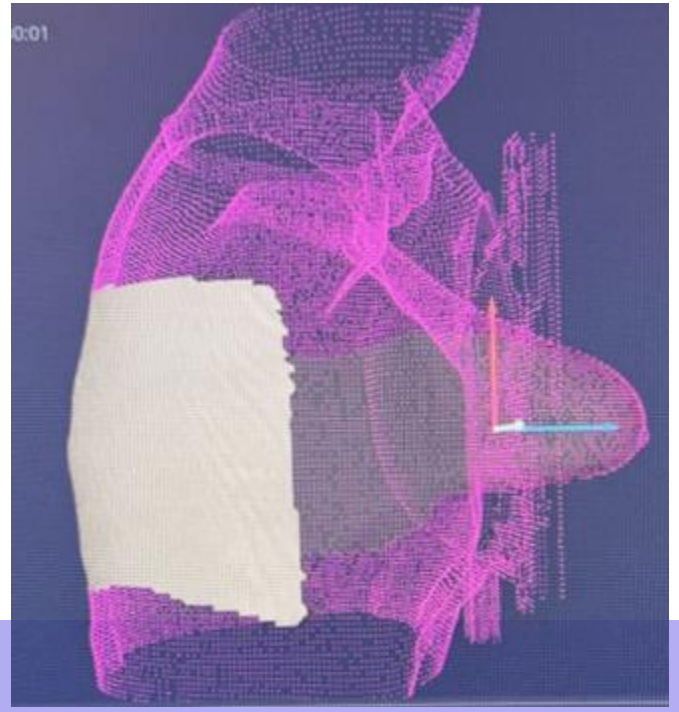


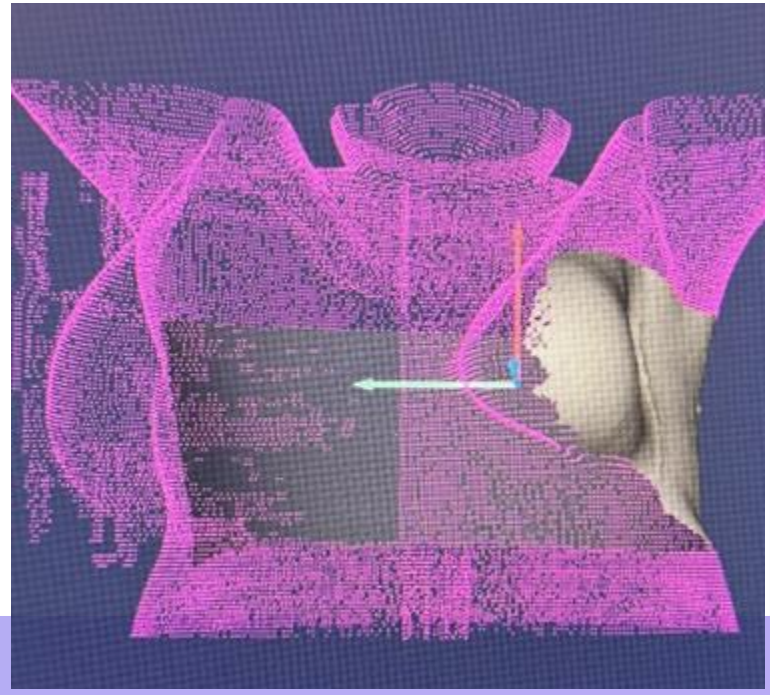


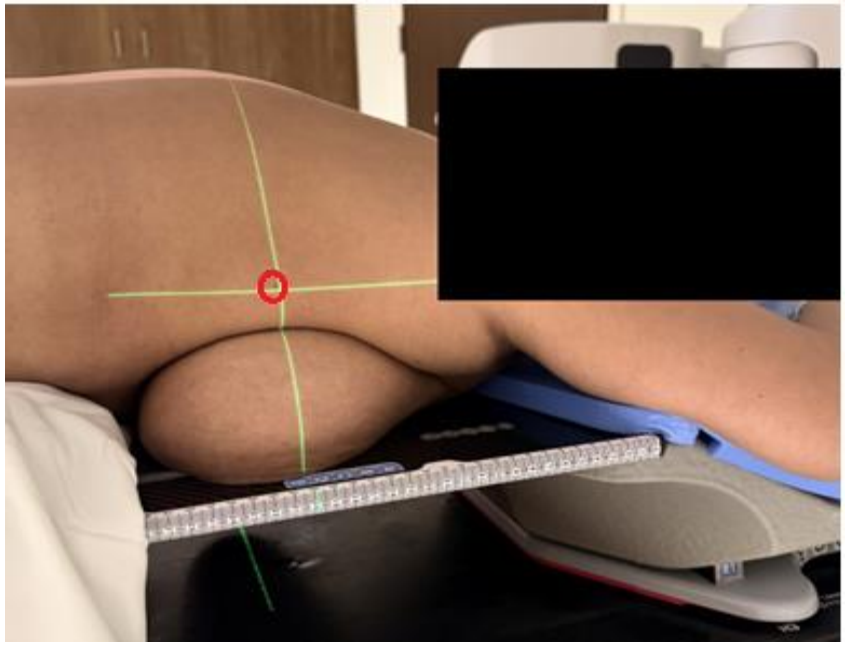
ROI – Prone Breast



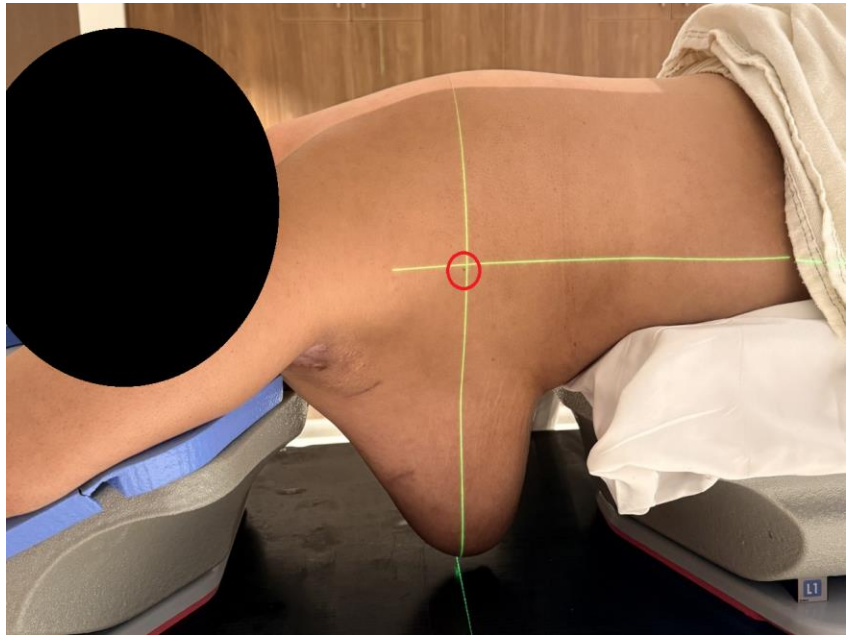


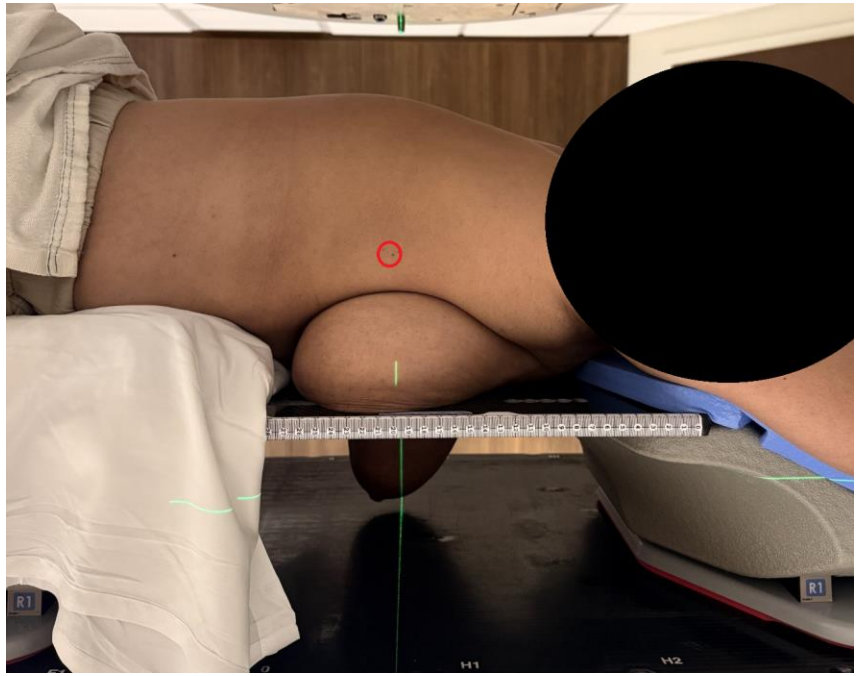


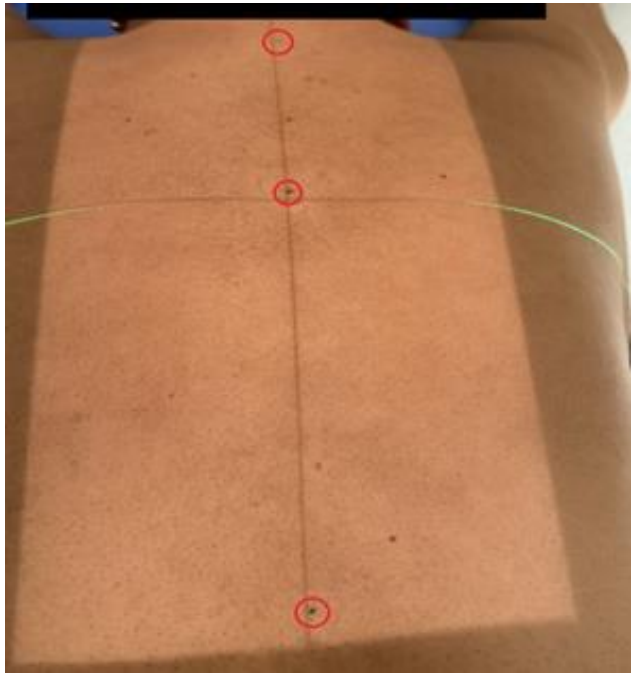


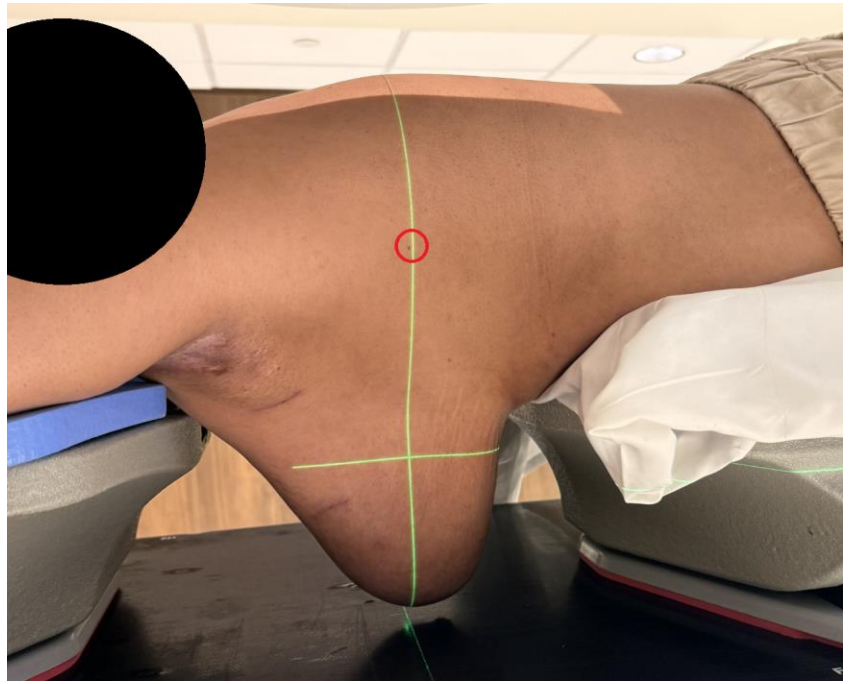


Prone Breast Continued…

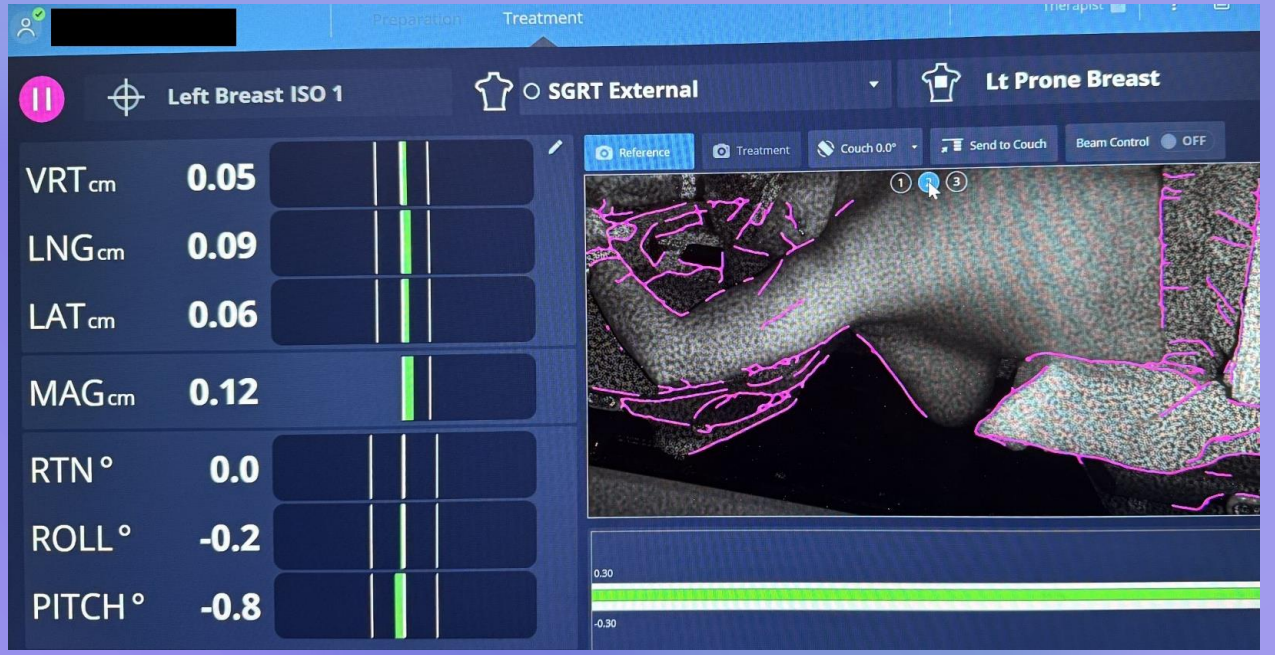


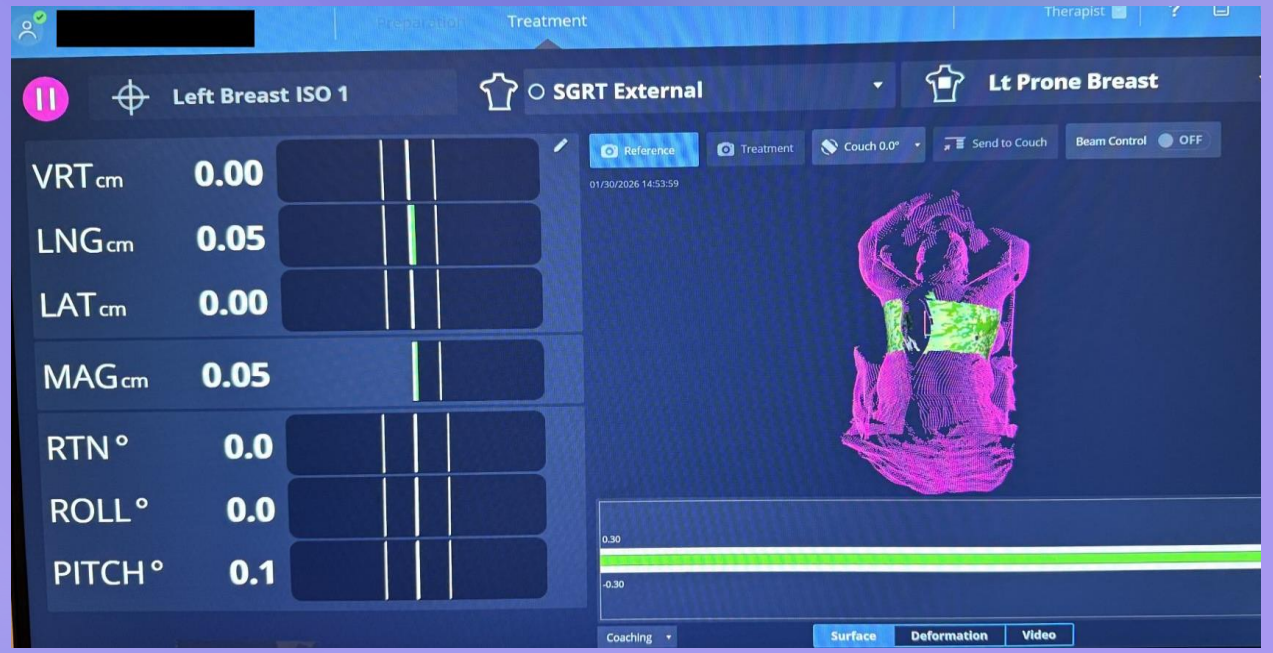







Preparation
Treatment
Therapist
Left Breast ISO 1
SGRT External
Lt Prone Breast
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control
OFF
VRT cm -0.14
LNG cm -0.01
LAT cm -0.01
MAG cm 0.16
RTN ° 1.4
ROLL ° -1.3
PITCH ° -3.5
0.30
-0.30

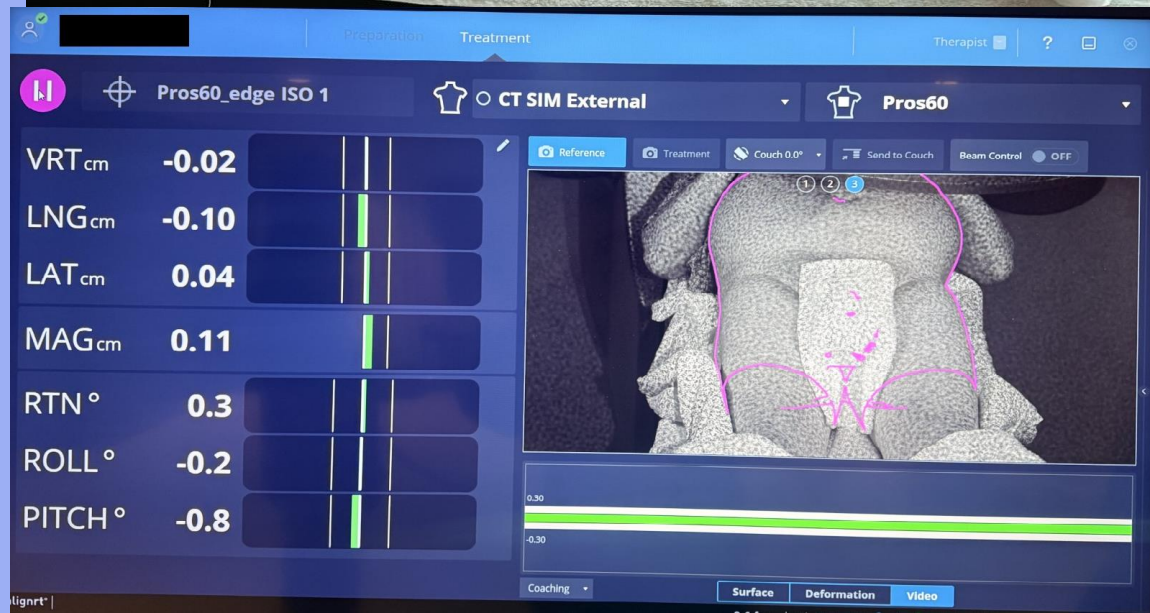

Preparation
Treatment
Therapist
Left Breast ISO 1
SGRT External
Lt Prone Breast
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control
OFF
VRT cm 0.05
LNG cm 0.09
LAT cm 0.06
MAG cm 0.12
RTN ° 0.0
ROLL ° -0.2
PITCH ° -0.8
0.30
-0.30


Preparation
Treatment
Therapist
Left Breast ISO 1
SGRT External
Lt Prone Breast
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control
OFF
01/30/2026 14:53:59
VRT cm 0.00
LNG cm 0.05
LAT cm 0.00
MAG cm 0.05
RTN ° 0.0
ROLL ° 0.0
PITCH ° 0.1
0.30
-0.30
Coaching
Surface
Deformation
Video

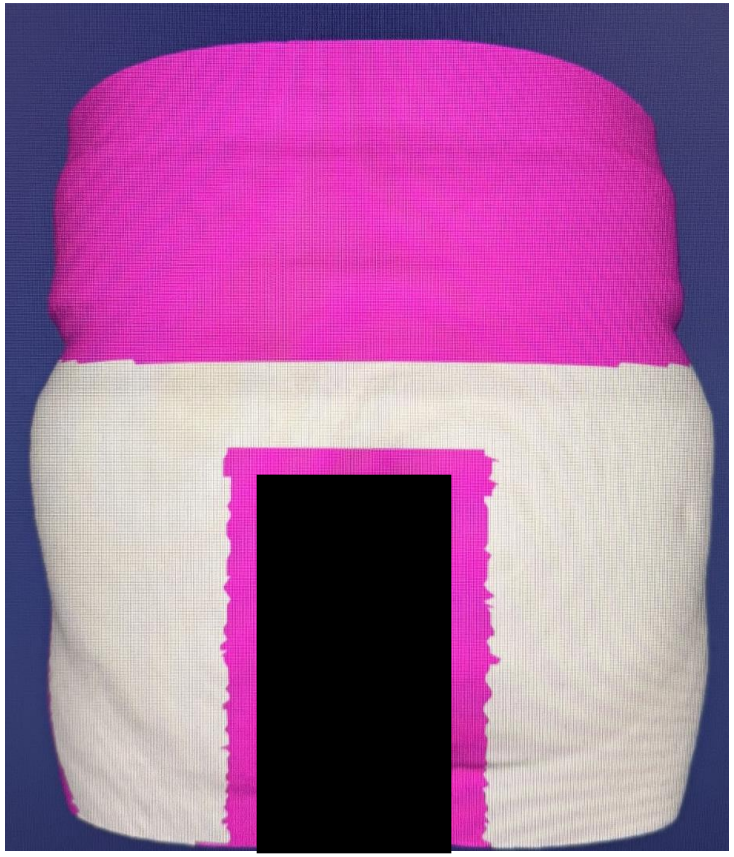
ROI - Pelvis

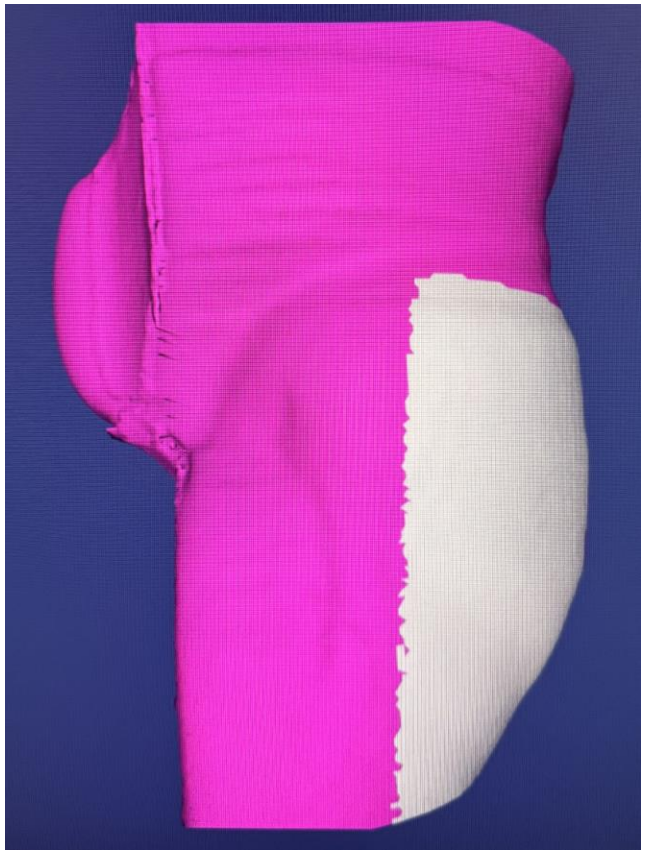

civco
A B C
F5
F4
F3


Treatment
Prostate ISO 1
CT SIM External
prostate
VRT cm -0.03
LNG cm -0.15
LAT cm 0.11
MAG cm 0.19
RTN ° 1.3
ROLL ° 1.2
PITCH ° 0.2
Surface
Deformation
Video


Preparation
Treatment
Therapist
Pros60_edge ISO 1
CT SIM External
Pros60
VRT cm -0.02
LNG cm -0.10
LAT cm 0.04
MAG cm 0.11
RTN ° 0.3
ROLL ° -0.2
PITCH ° -0.8
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control OFF
0.30
-0.30
Coaching
Surface
Deformation
Video

ROI - Prone Pelvis

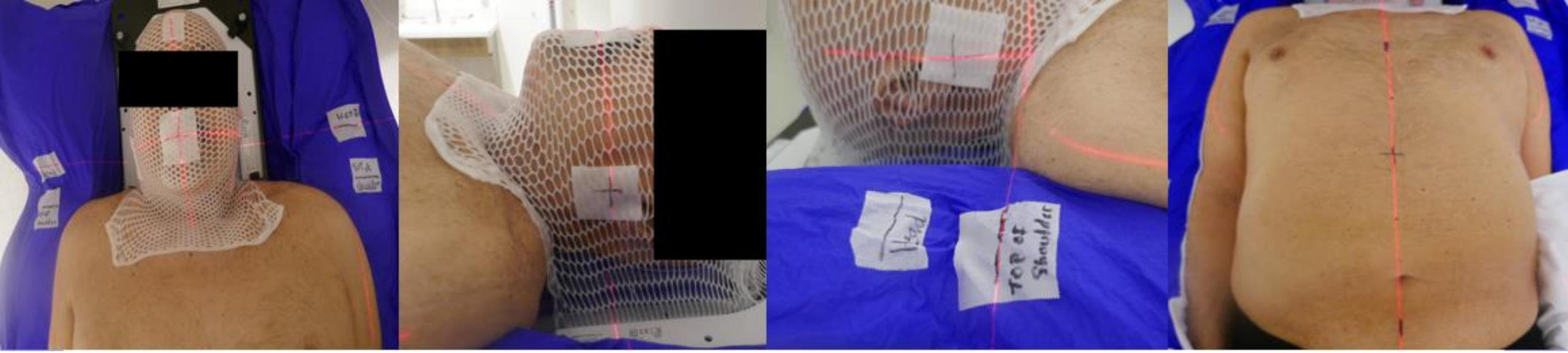




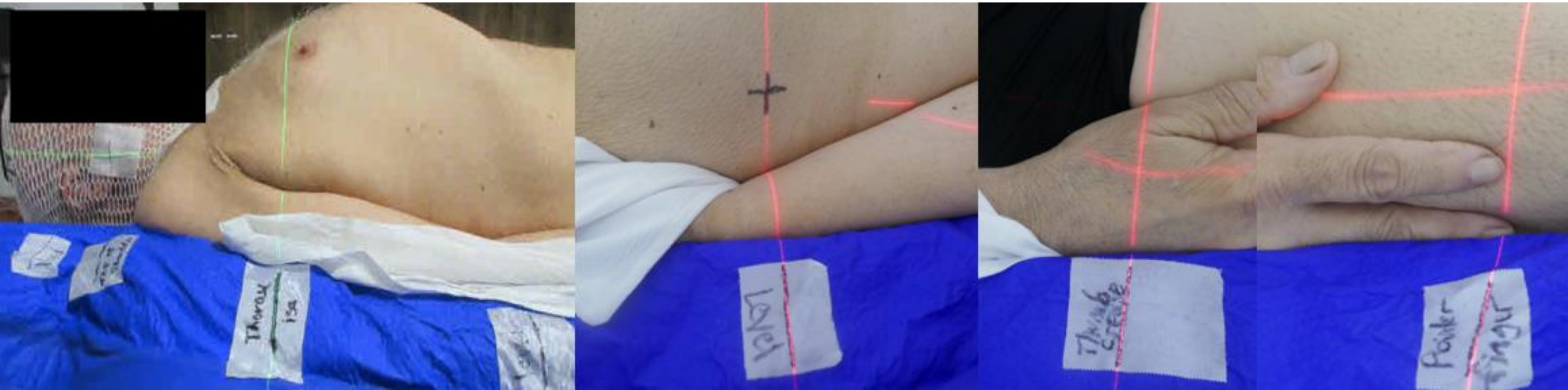

Preparation
Treatment
Therapist
Rectum ISO 1
CT SIM External
Rectum
Reference
Treatment
Send to Couch
Beam Control OFF
VRT cm -0.01
LNG cm -0.03
LAT cm 0.03
MAG cm 0.10
RTN ° -1.6
ROLL ° -0.9
PITCH ° -2.8
0.30
-0.30
Surface
Deformation
Video

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



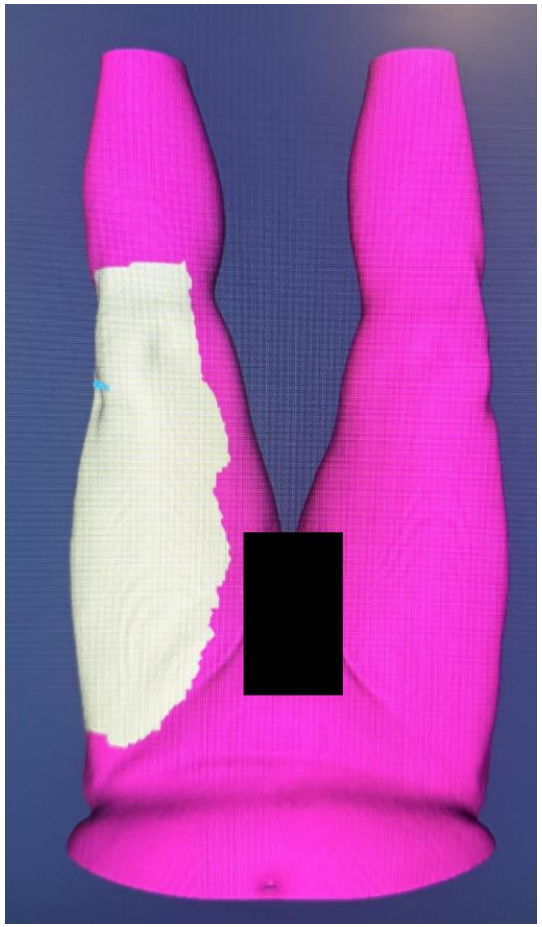
Extremities

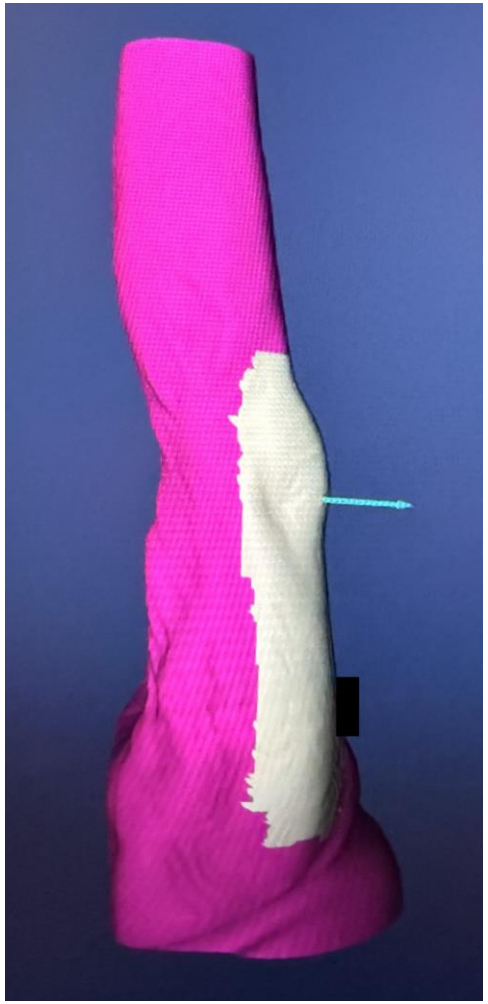
Make custom vac-loc cradle

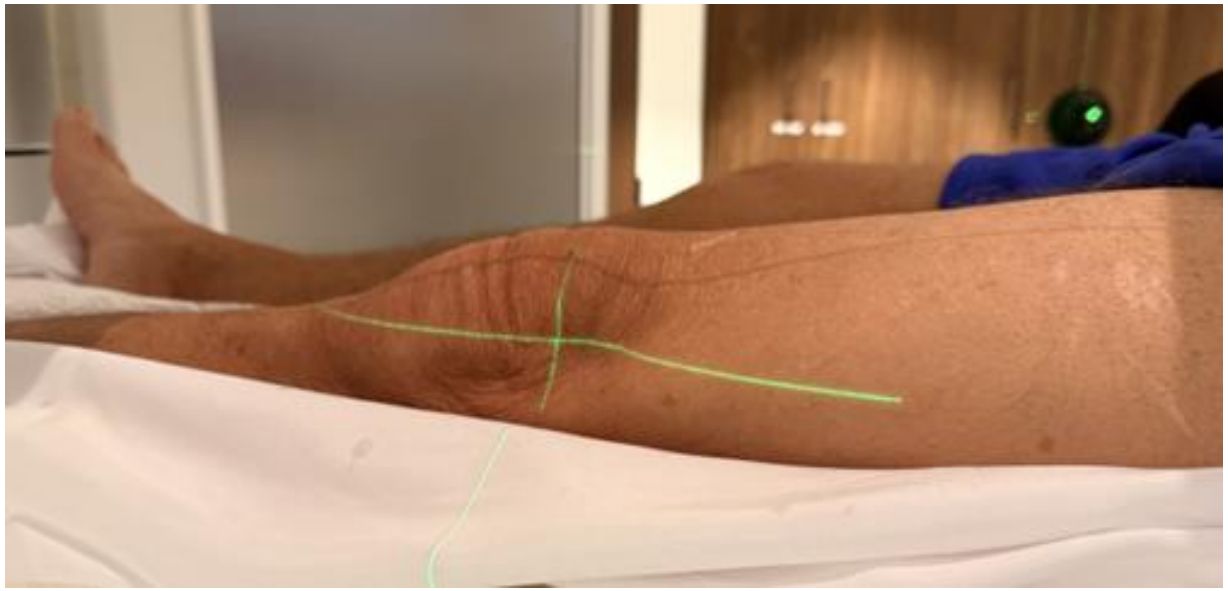
Verify enough lateral side view of XRT site can be visualized by Align RT cameras

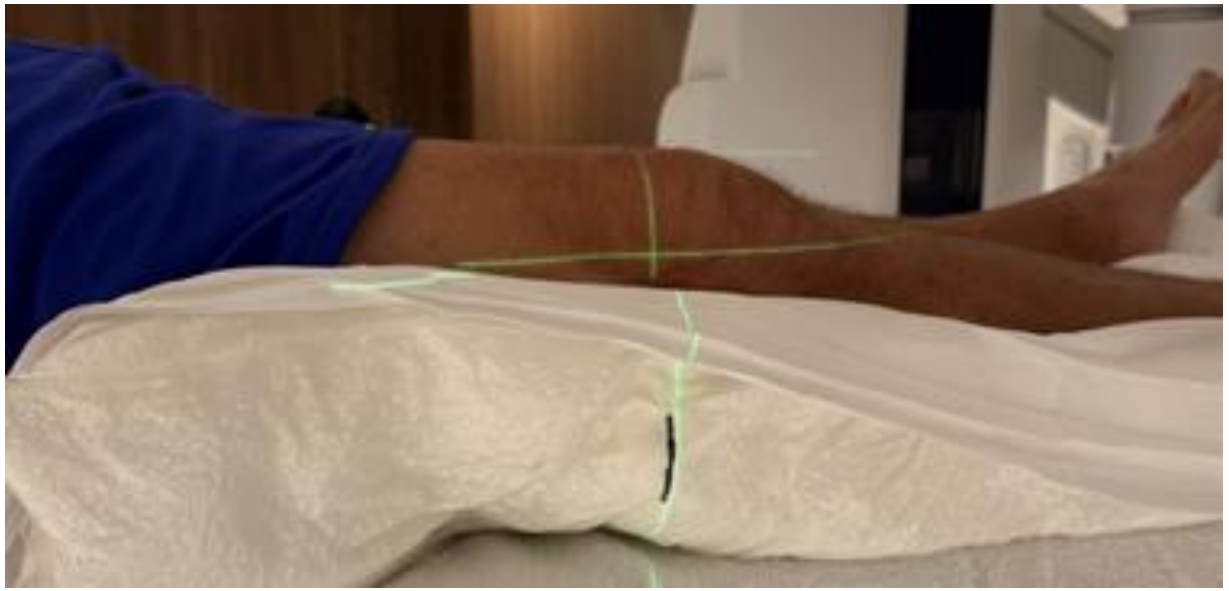
ISO set & lasers shifted to position. Pictures of AP, Rt lat, & Lt lat are taken where lasers fall and any additional setup photos

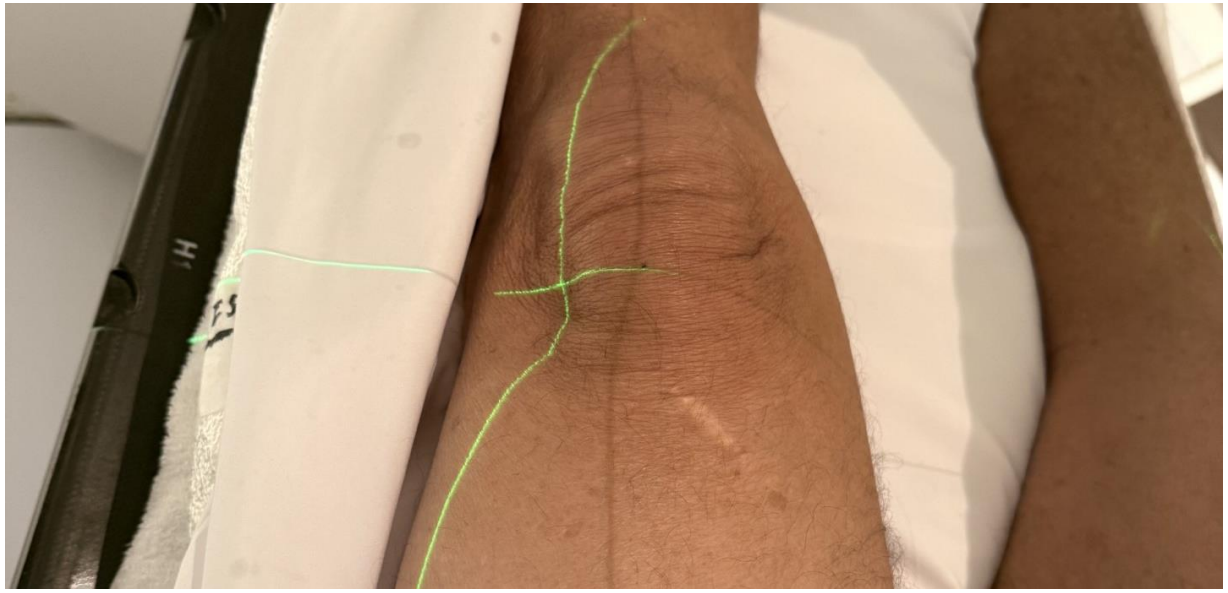
ROI - Extremity











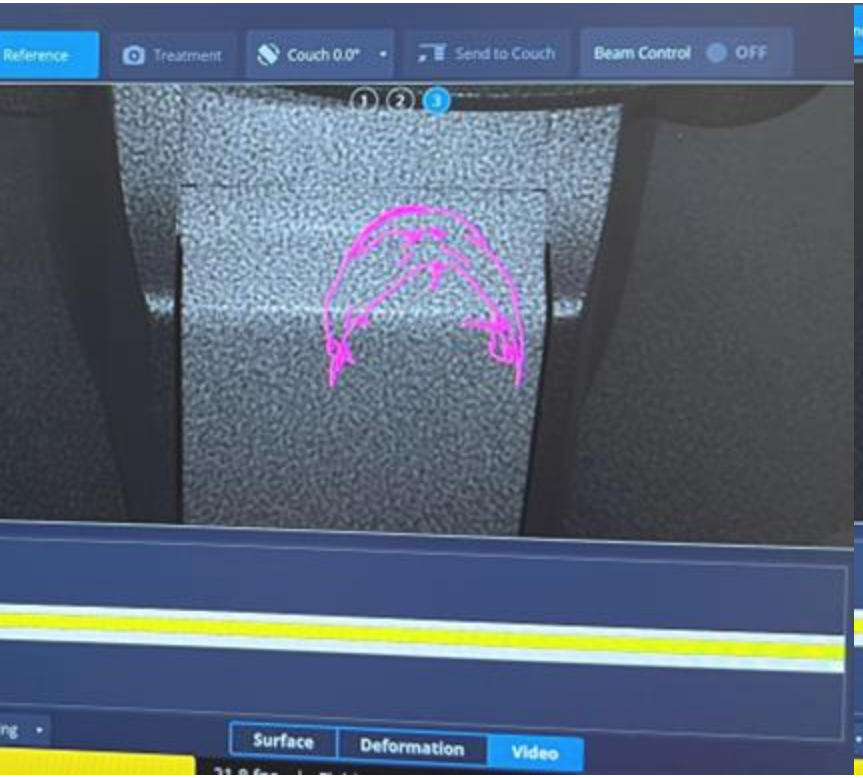

Lt knee ISO 1
CT SIM External
Lt Knee
VRT cm -0.04
LNG cm -0.17
LAT cm 0.14
MAG cm 0.23
RTN ° -0.7
ROLL ° 1.2
PITCH ° -1.8

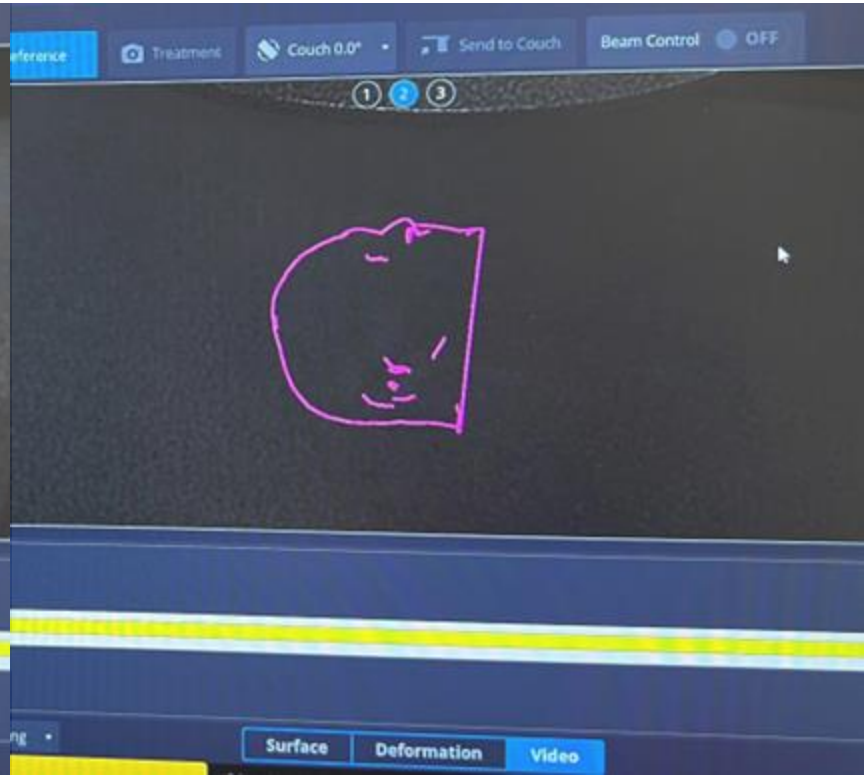
Masks: Use Align Rt to adjust patient prior to placing mask on patient, then place mask to make final adjustments (This helps reduce pitch/yaw/roll)

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

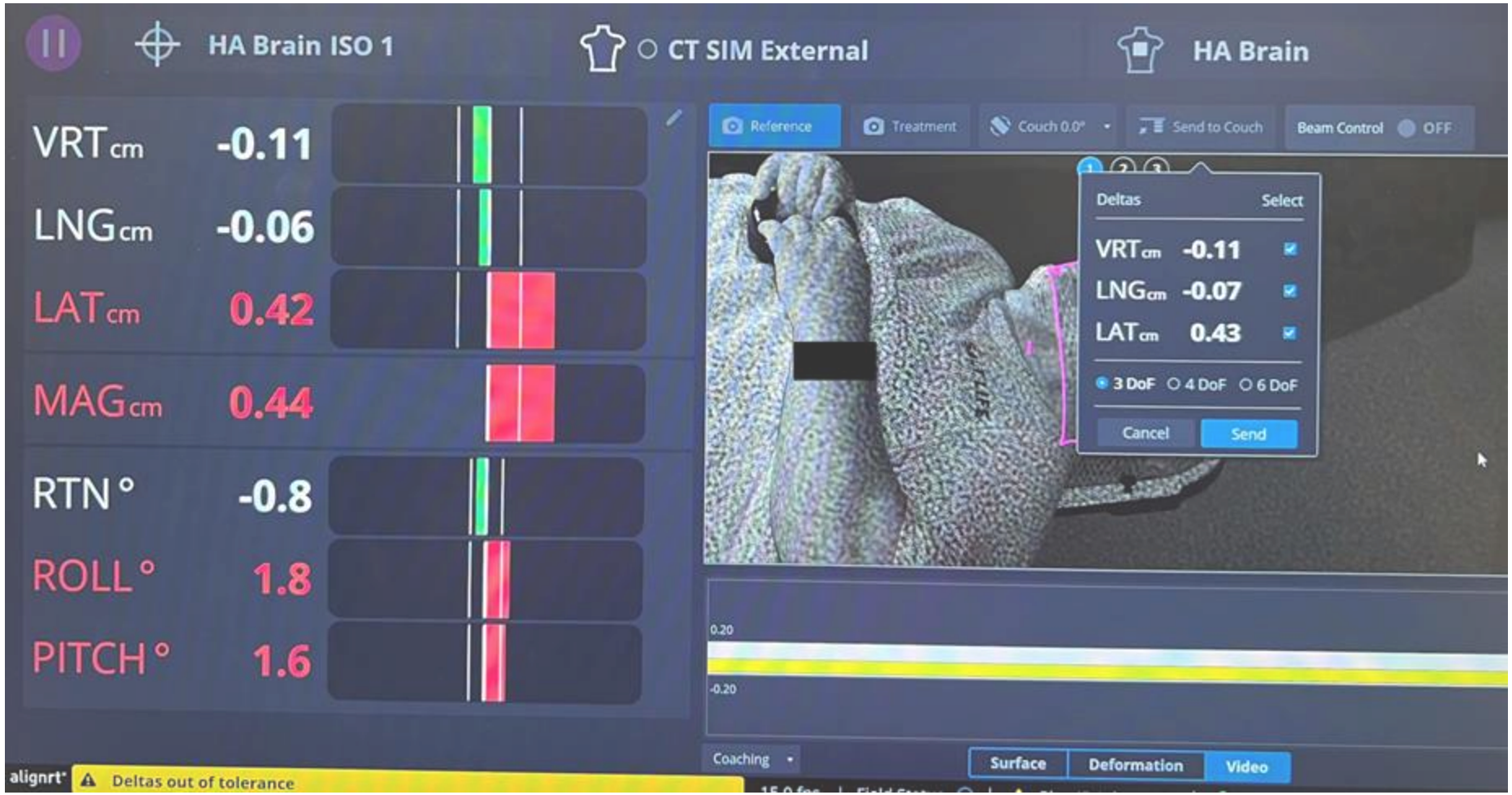
No immobilization devices: Visually make patient straight with lasers, not rolled, then adjust patient with Align RT

Example of Brain XRT





Example of Brain XRT Continued…



SSD'S

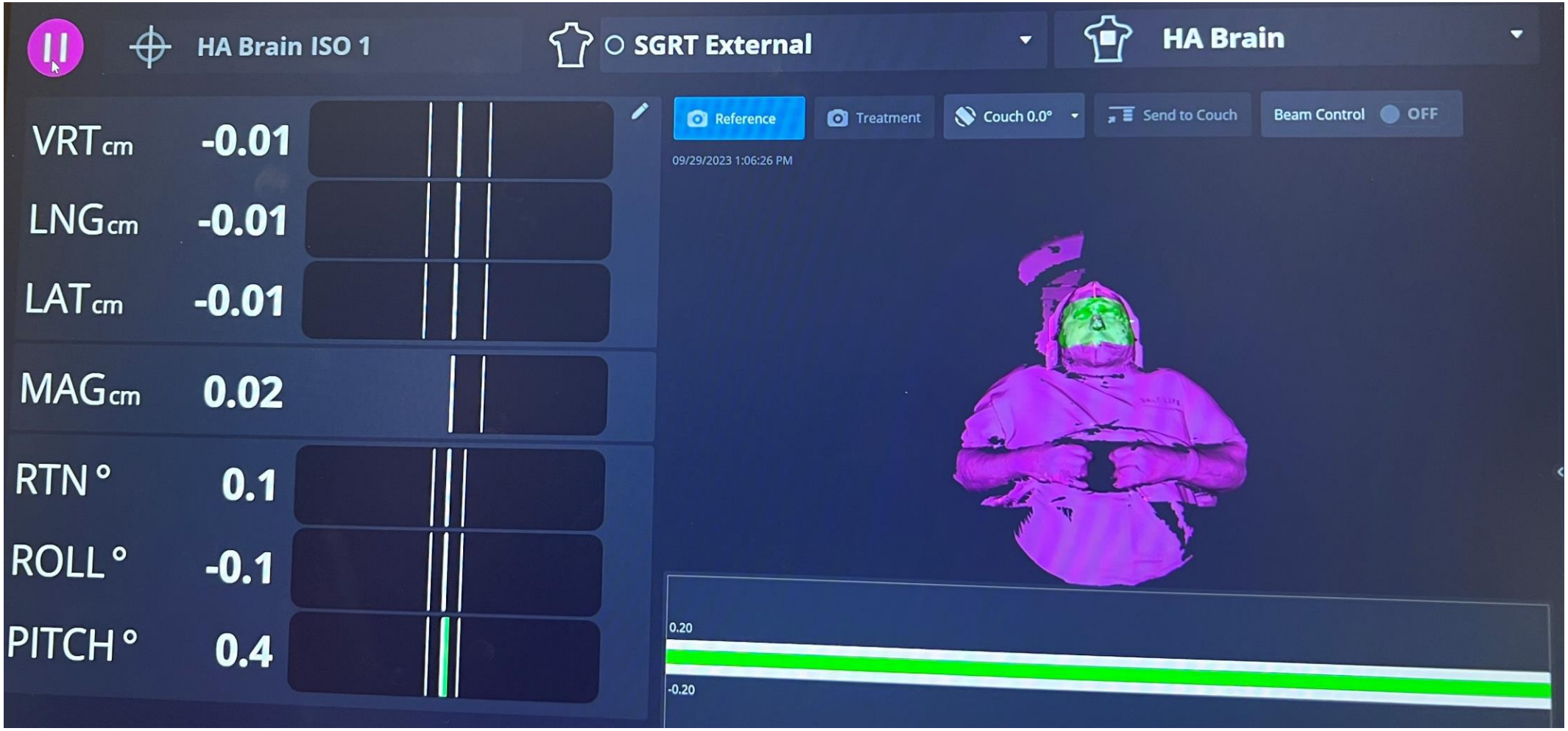

ISO 1
CT SIM External
HA Brain
VRT cm -0.02
LNG cm -0.01
LAT cm -0.02
MAG cm 0.03
RTN ° -1.0
ROLL ° 1.9
PITCH ° 1.7
Surface
Deformation
Video


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
Skin Tone
SSD
Report Screenshot
ROI Tools
Surface Display
Reset Surface

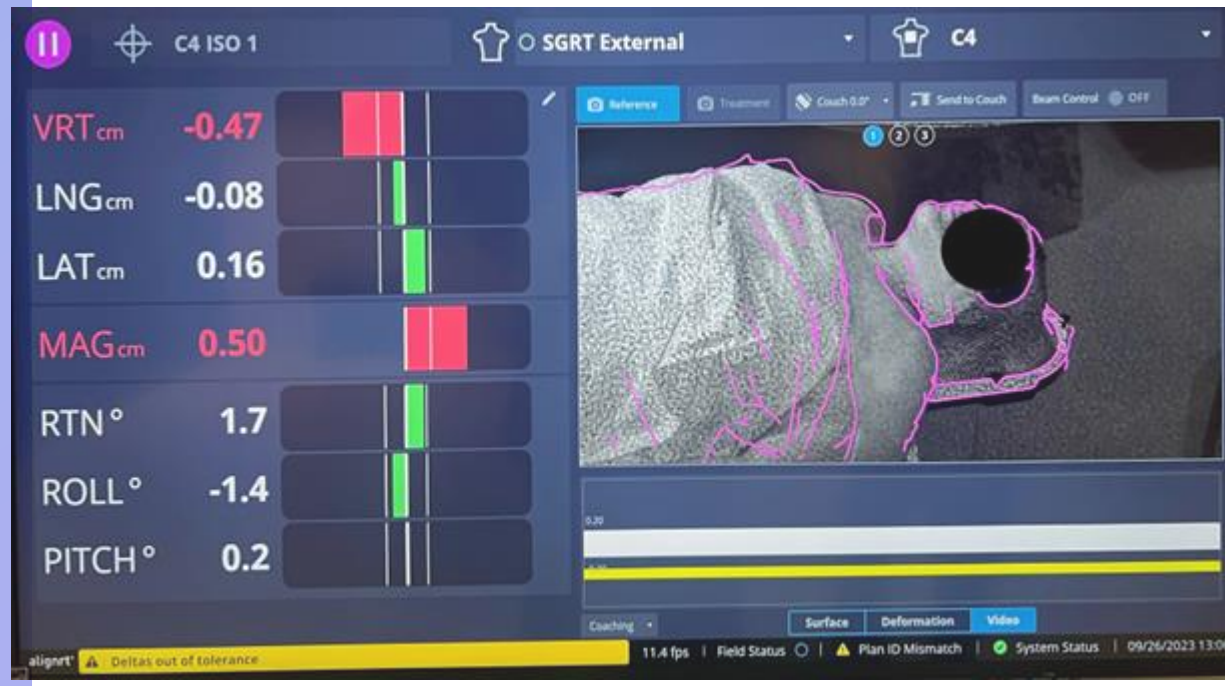
Example of Brain XRT Continued…

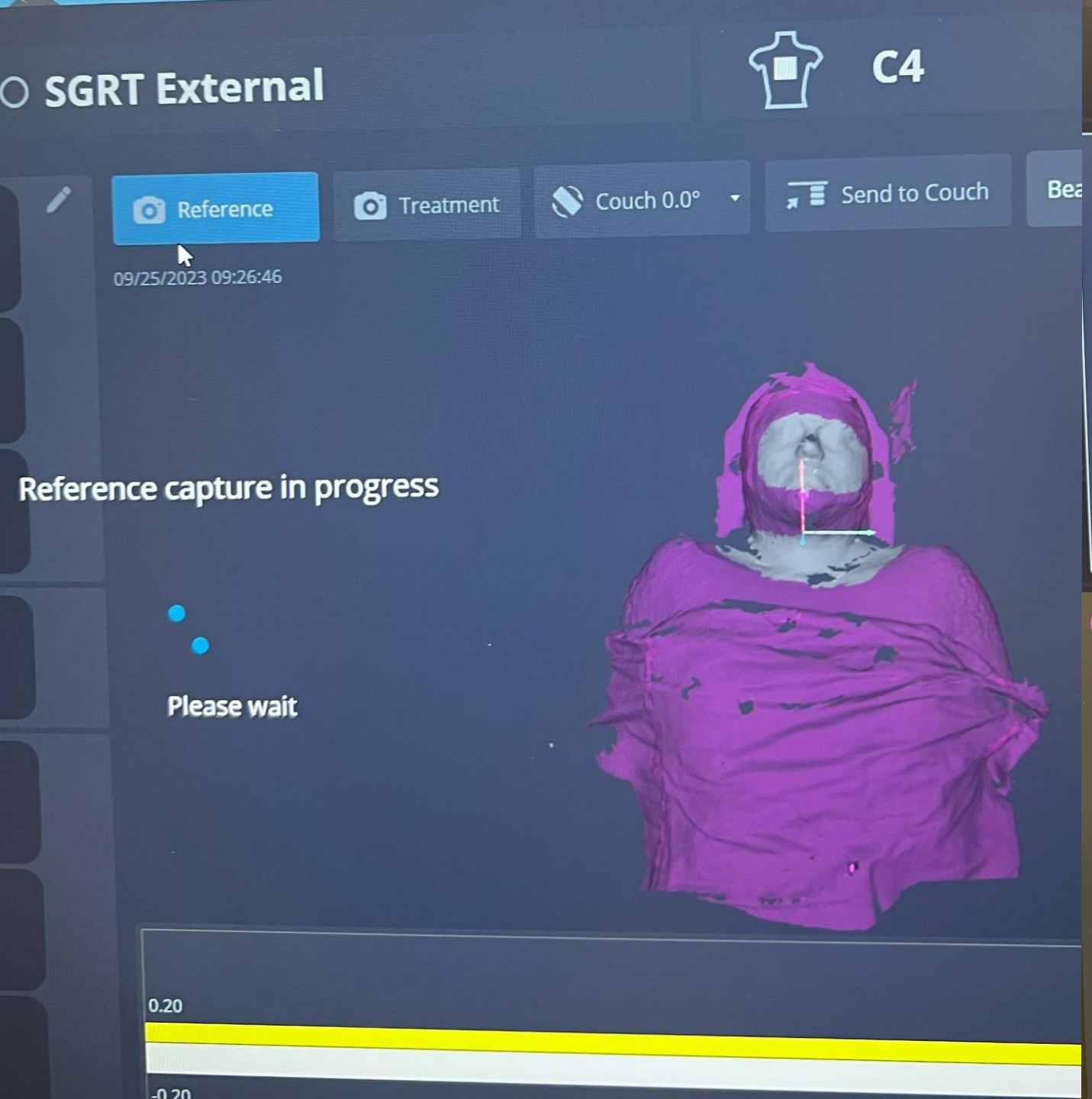
- After imaging and application of shifts, move gantry to 0, 180, or 180.1 (if not already there) to avoid camera blockage.
- "Reference capture" the patient's position
- Select "This session only"
  - If shifts > 5mm, select "This and future sessions"

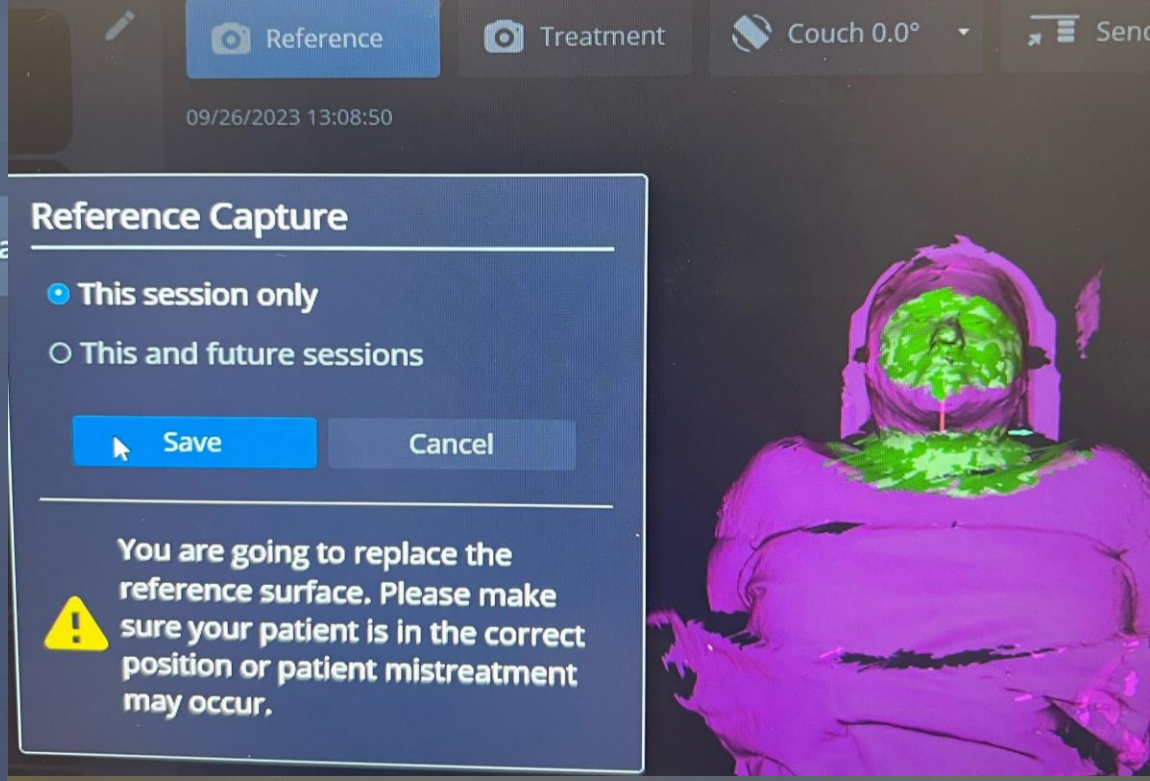
Example of Brain XRT Continued…

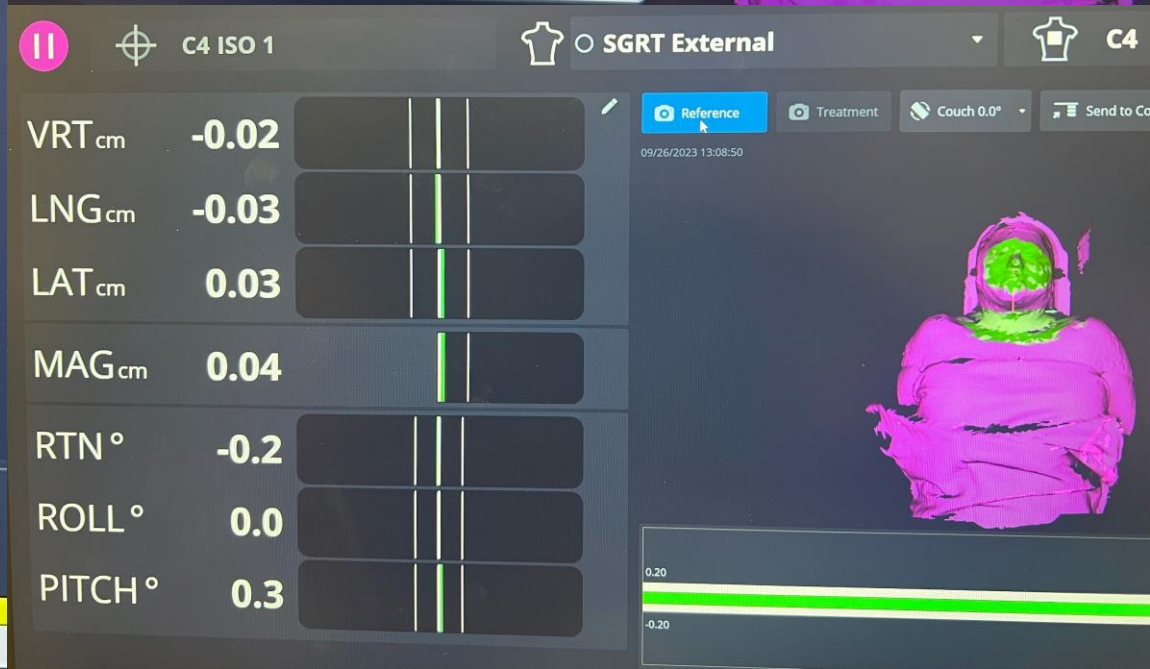


Example of C Spine XRT

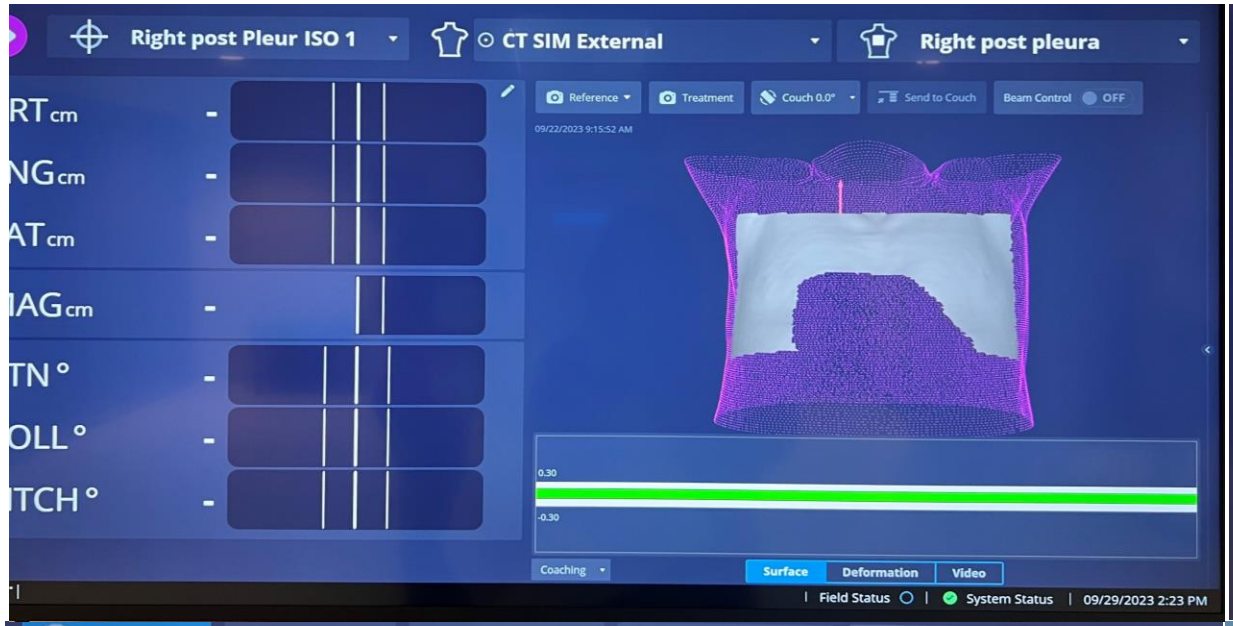


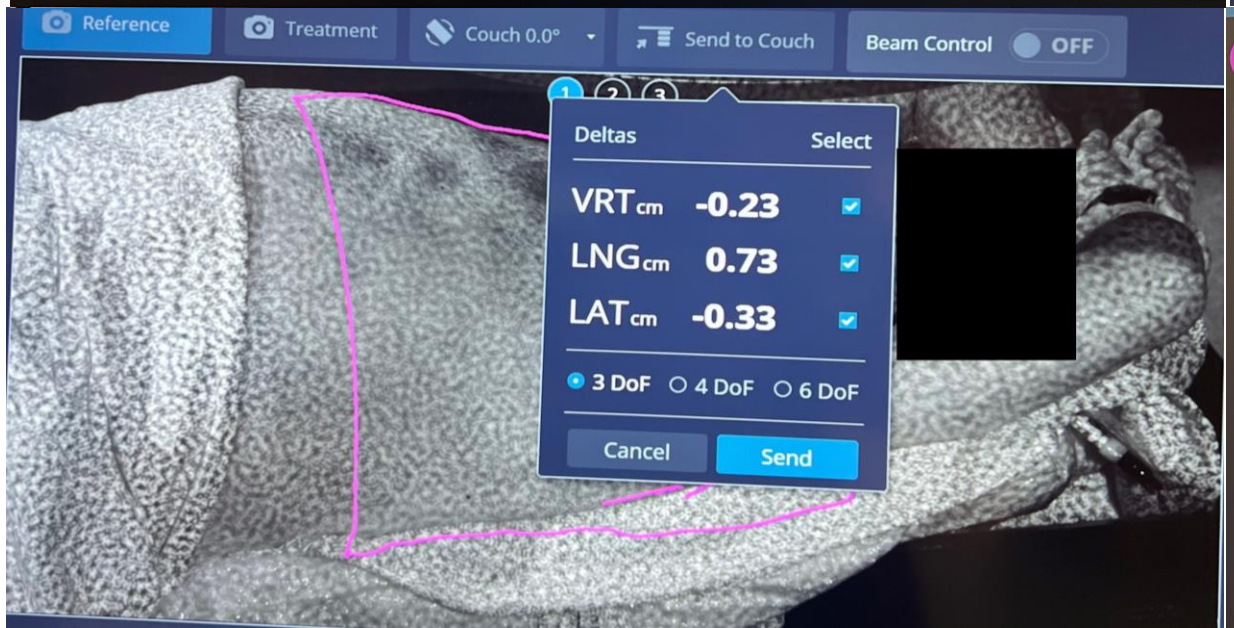

SGRT External
C4
Reference
Treatment
Couch 0.0°
Send to Couch
09/25/2023 09:26:46
Reference capture in progress
Please wait
0.20
-0.20


Reference
Treatment
Couch 0.0°
09/26/2023 13:08:50
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.


C4 ISO 1
SGRT External
C4
VRT cm -0.02
LNG cm -0.03
LAT cm 0.03
MAG cm 0.04
RTN ° -0.2
ROLL ° 0.0
PITCH ° 0.3
Reference
Treatment
Couch 0.0°
09/26/2023 13:08:50
0.20
-0.20

Example of Lung XRT (SBRT/Gating Reference)





Example of Lung XRT (SBRT/Gating Reference)

Right post Pleur ISO 1

SGRT External

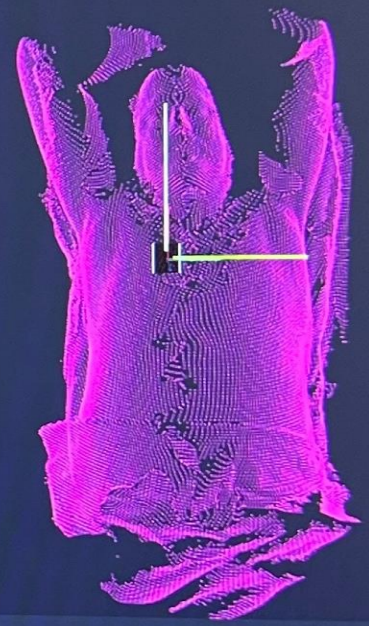
Right post pleura

VRT cm	0.03
LNG cm	-0.19
LAT cm	-0.05
MAG cm	0.19
RTN °	-0.1
ROLL °	0.0
PITCH °	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

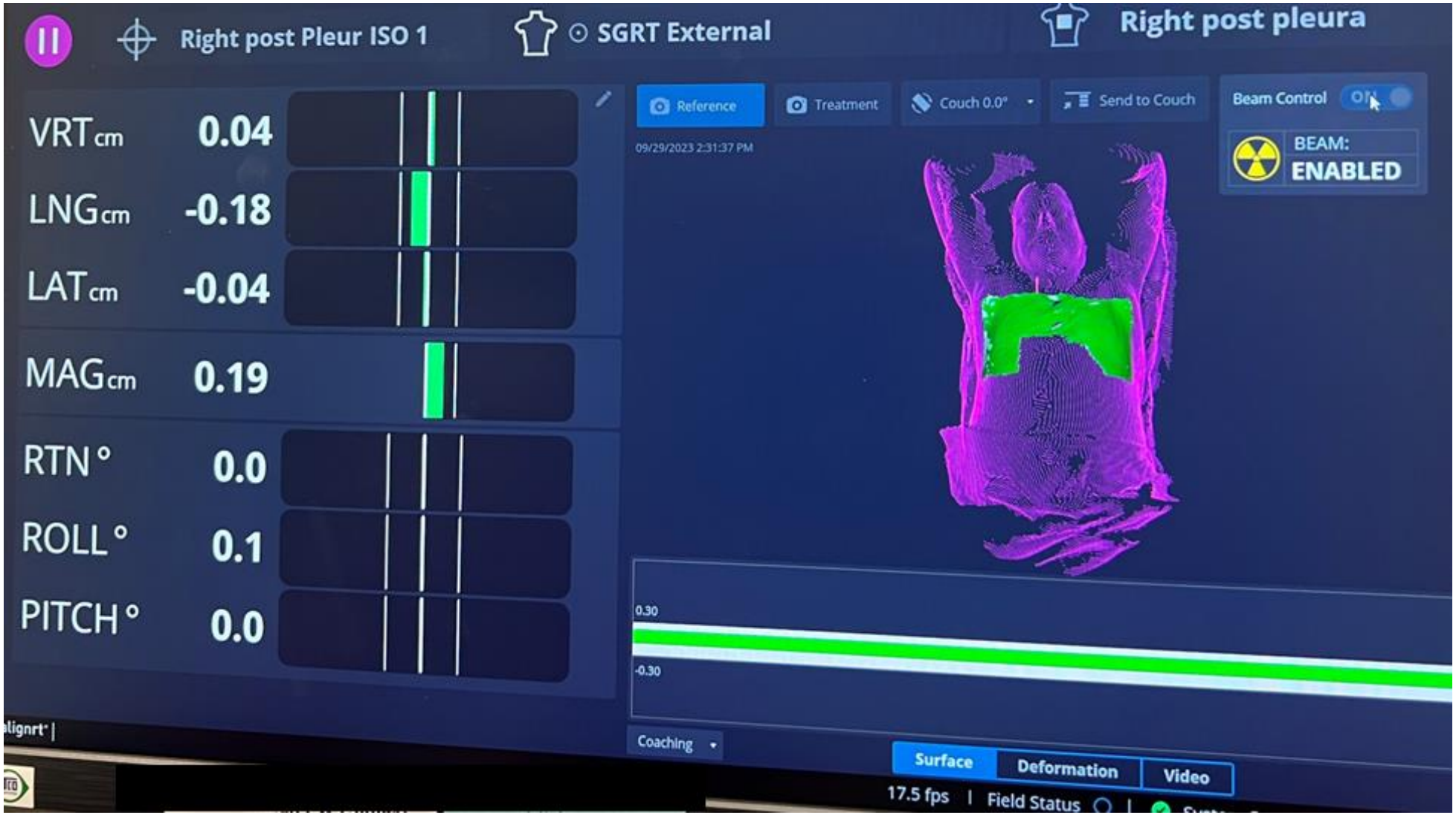
Recapture

alignrt®

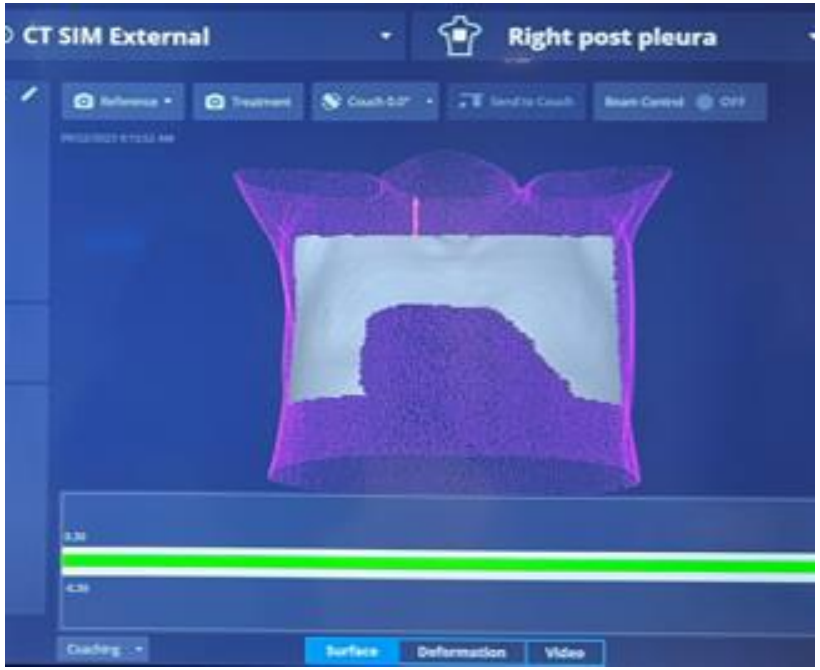
Surface | Deformation | Video

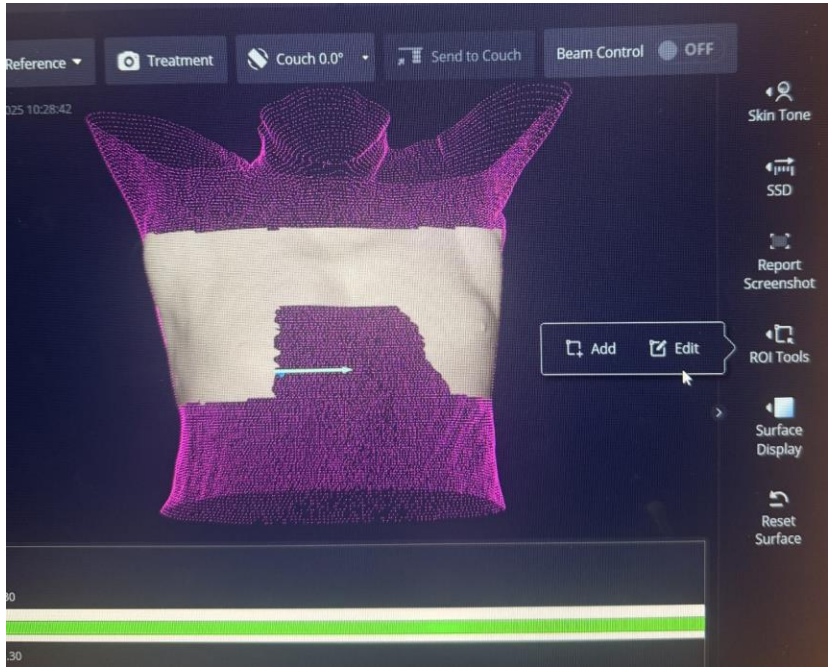
Field Status | Plan ID Mismatch | System Status | 09/29/2023 2:33 PM

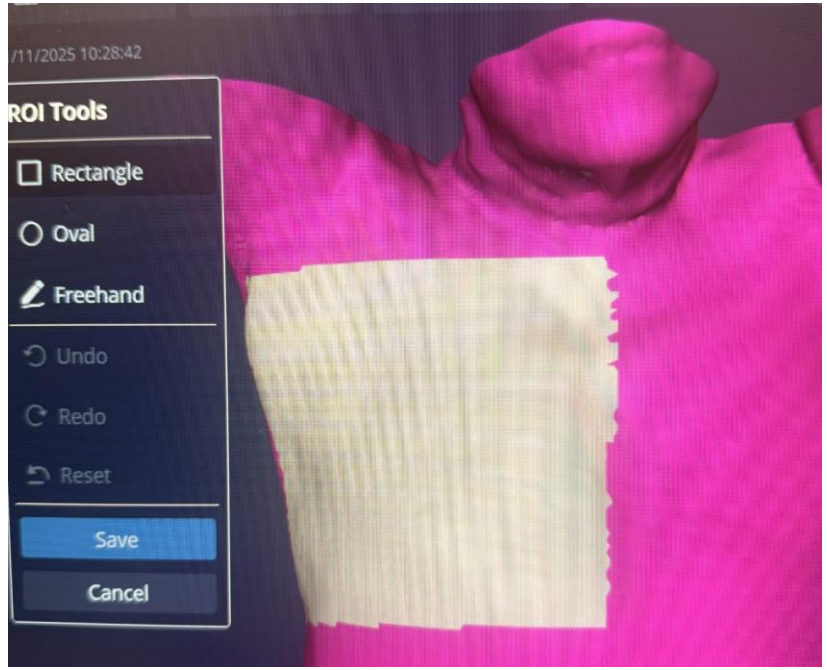
Example of Lung XRT (SBRT/Gating Reference)



Example of Lung XRT (SBRT/Gating Reference)



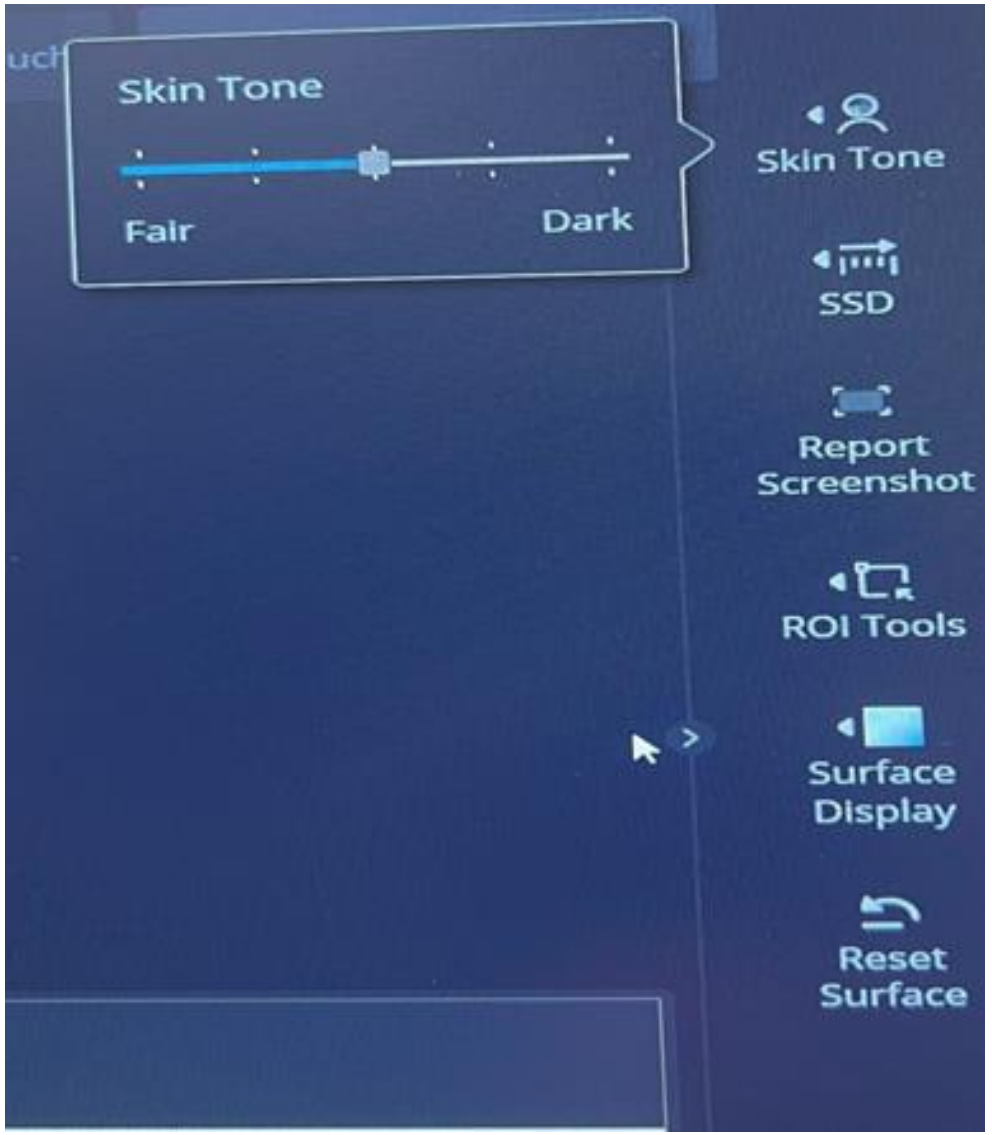





Right post Pleur ISO 1
SGRT External
Right Post Pleur
VRT cm -0.08
LNG cm -0.05
LAT cm 0.04
MAG cm 0.10
RTN ° 0.1
ROLL ° -0.1
PITCH ° -0.1
Reference
Treatment
Couch 0.0°
Send to Couch
Beam Control ON
BEAM:
ENABLE
09/27/2023 1:53:36 PM
0.30
-0.30
Coaching
Surface
Deformation
Video
alignrt
10.2 fps
Field Status
Plan ID Mismatch

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!