SGRT in Treatment Planning: Surface Guided Clearance Mapping

David Parsons

May 11, 2022
SGRT 2023

UTSouthwestern
Medical Center

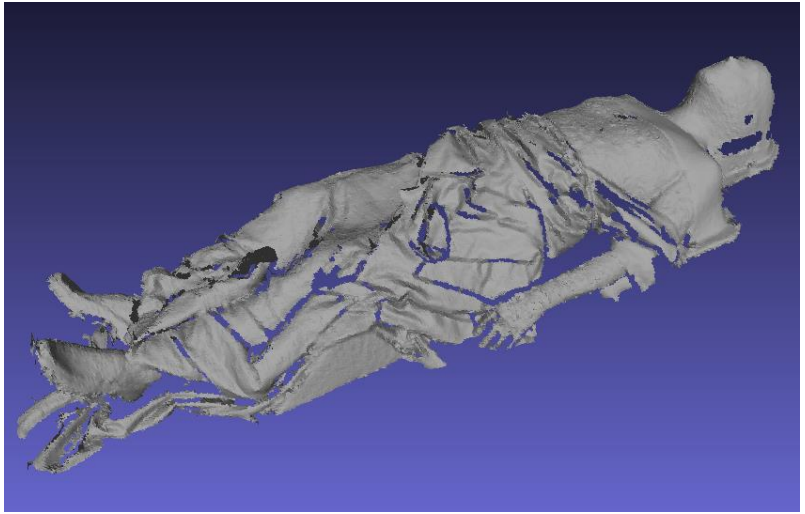
Outline

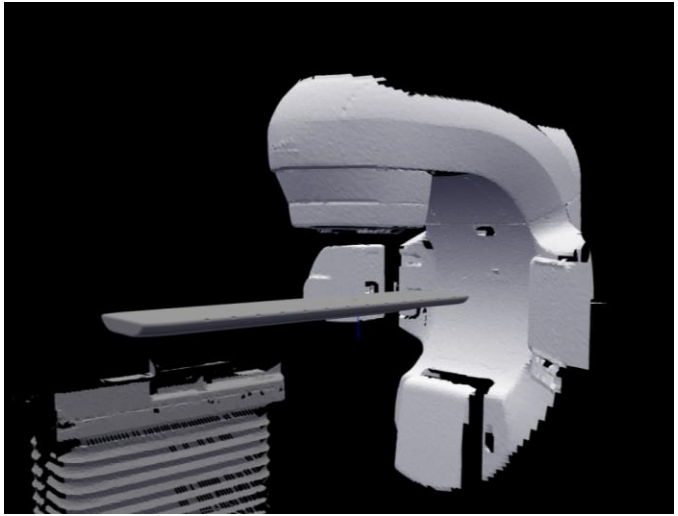
- What is MapRT?
- Why clearance mapping is important in modern radiotherapy
- Initial implementation
- Case Example
- Summary

1. What is MapRT

MapRT

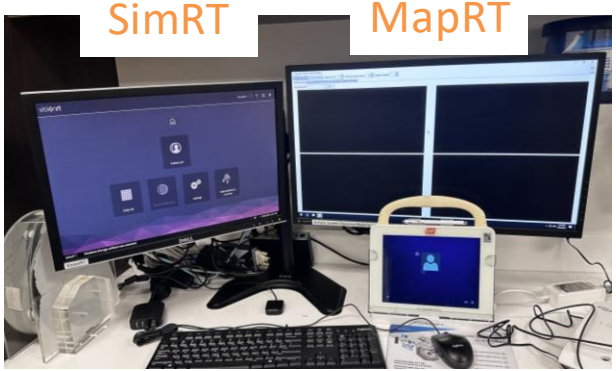
- **MapRT is a SGRT virtual clearance mapping software**



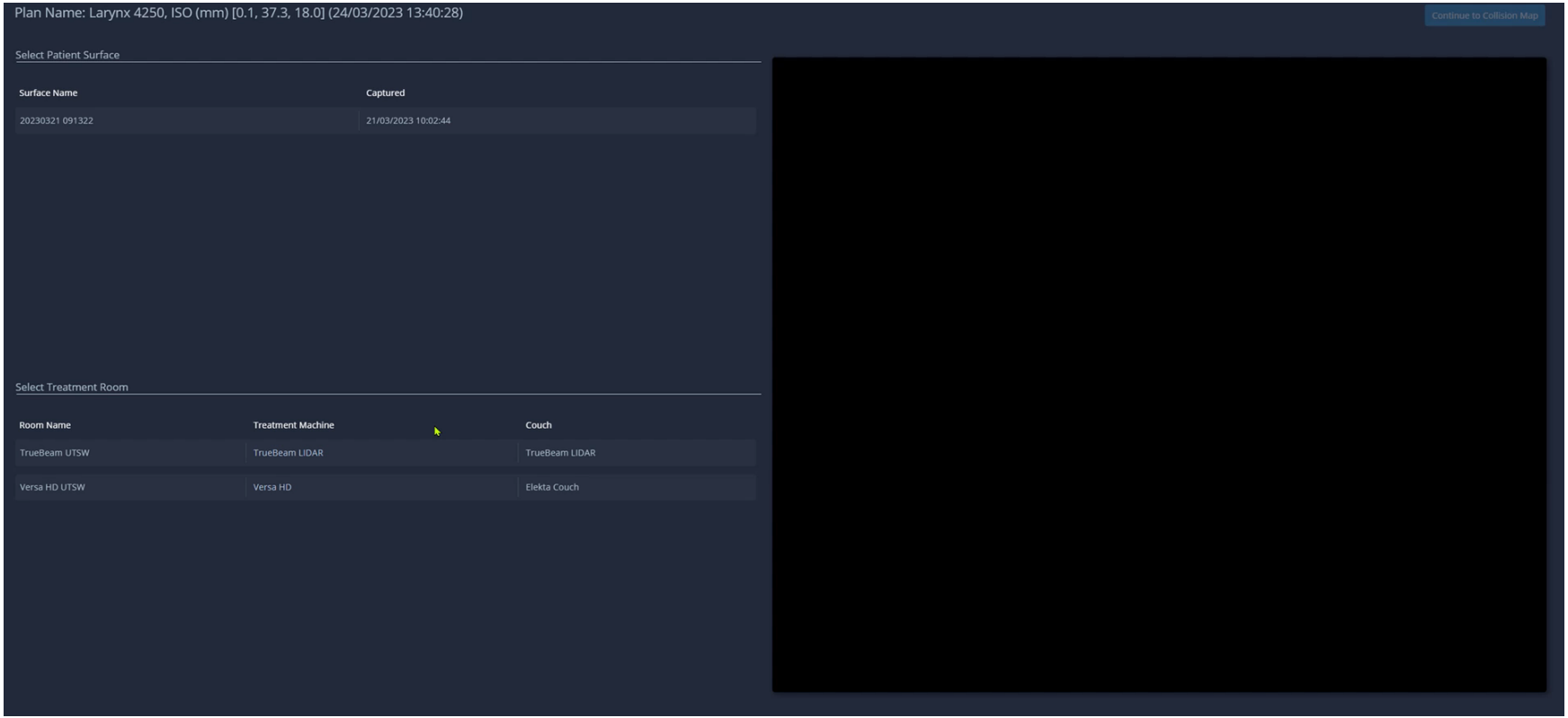


MapRT

- MapRT is a SGRT virtual clearance mapping software
- Consists of 2 Horizon cameras in the CT vault



MapRT

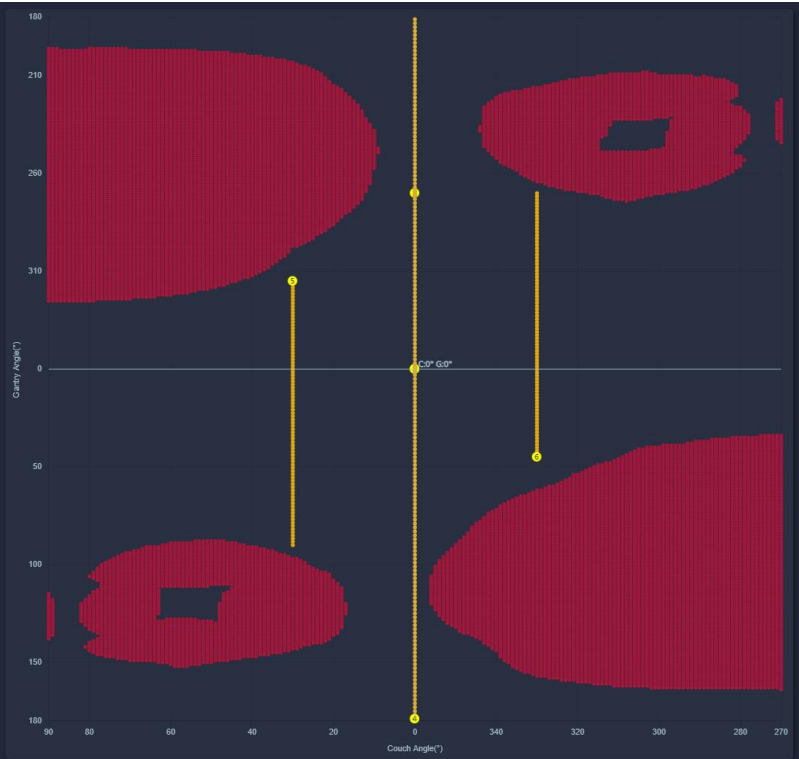

Plan Name: Larynx 4250, ISO (mm) [0.1, 37.3, 18.0] (24/03/2023 13:40:28)
Continue to Collision Map
Select Patient Surface
Surface Name
Captured
20230321 091322
21/03/2023 10:02:44
Select Treatment Room
Room Name
Treatment Machine
Couch
TrueBeam UTSW
TrueBeam LIDAR
TrueBeam LIDAR
Versa HD UTSW
Versa HD
Elekta Couch

MapRT

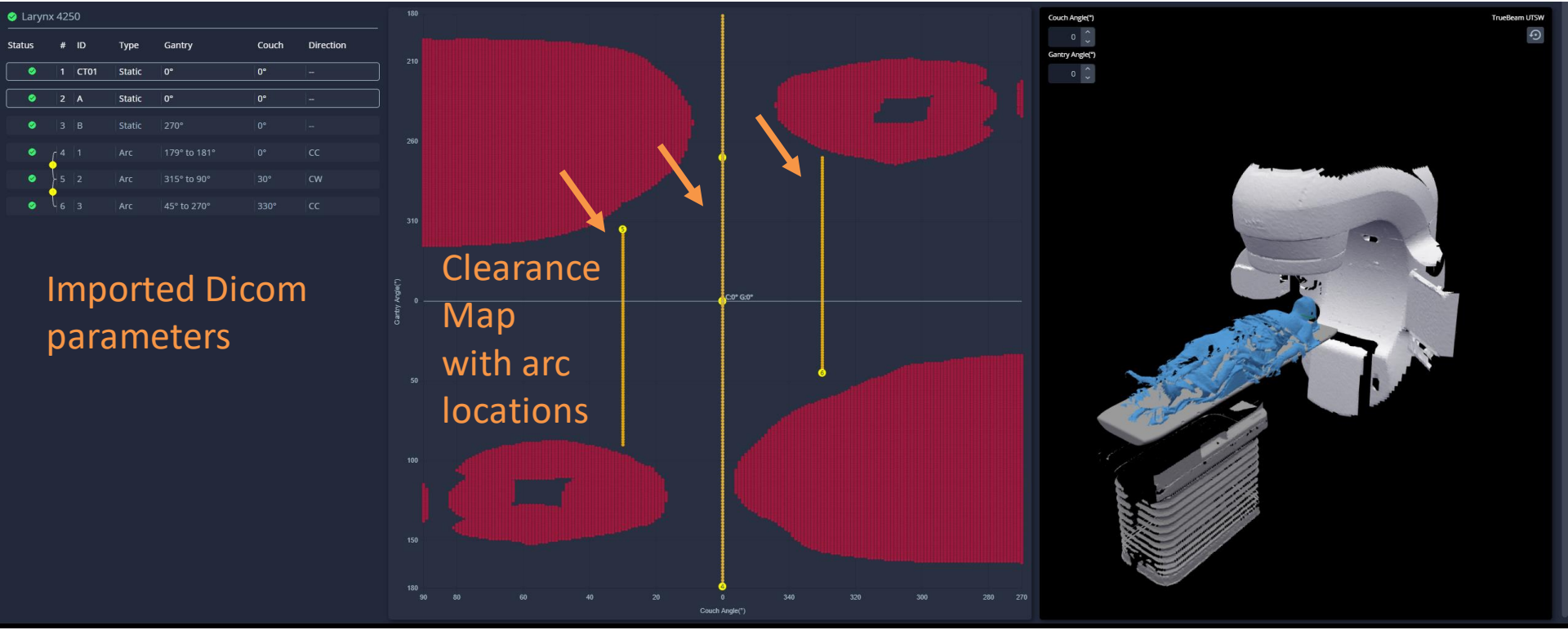
Larynx 4250

Status	#	ID	Type	Gantry	Couch	Direction
✓	1	CT01	Static	0°	0°	--
✓	2	A	Static	0°	0°	--
✓	3	B	Static	270°	0°	--
✓	4	1	Arc	179° to 181°	0°	CC
✓	5	2	Arc	315° to 90°	30°	CW
✓	6	3	Arc	45° to 270°	330°	CC

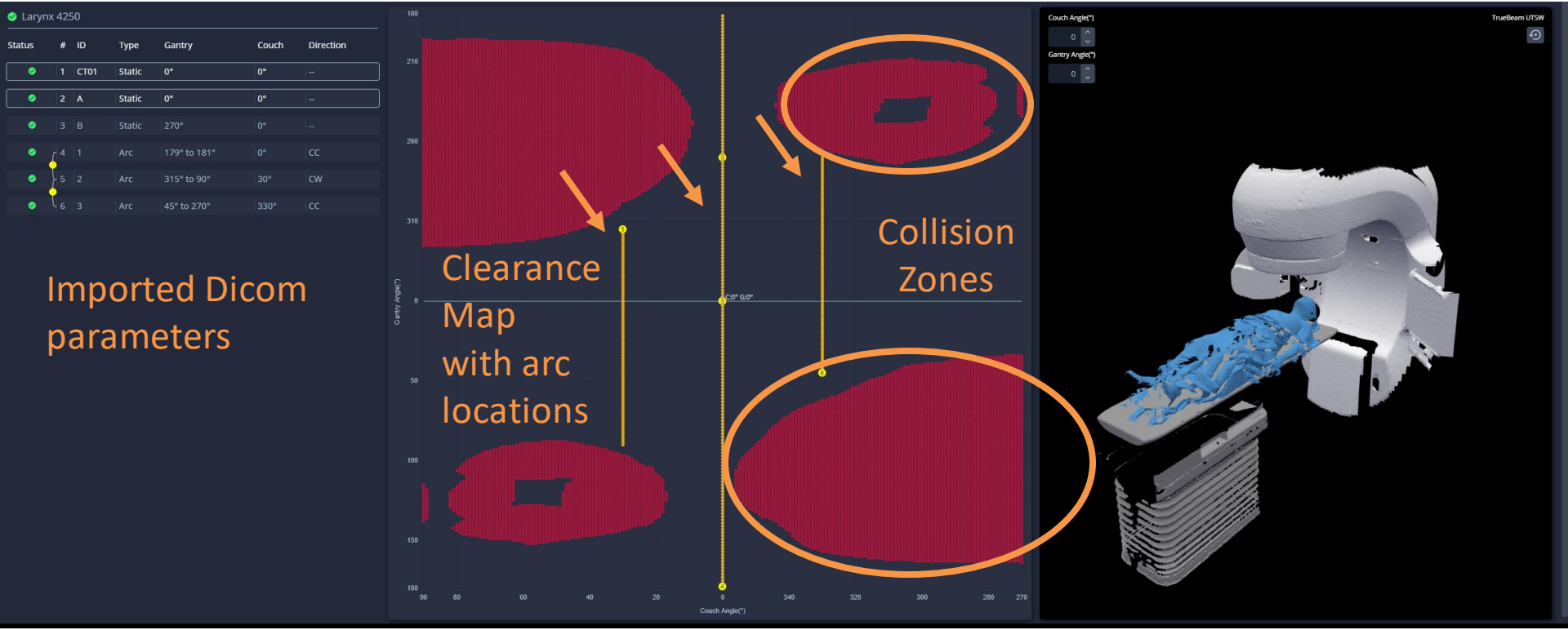
Imported Dicom parameters



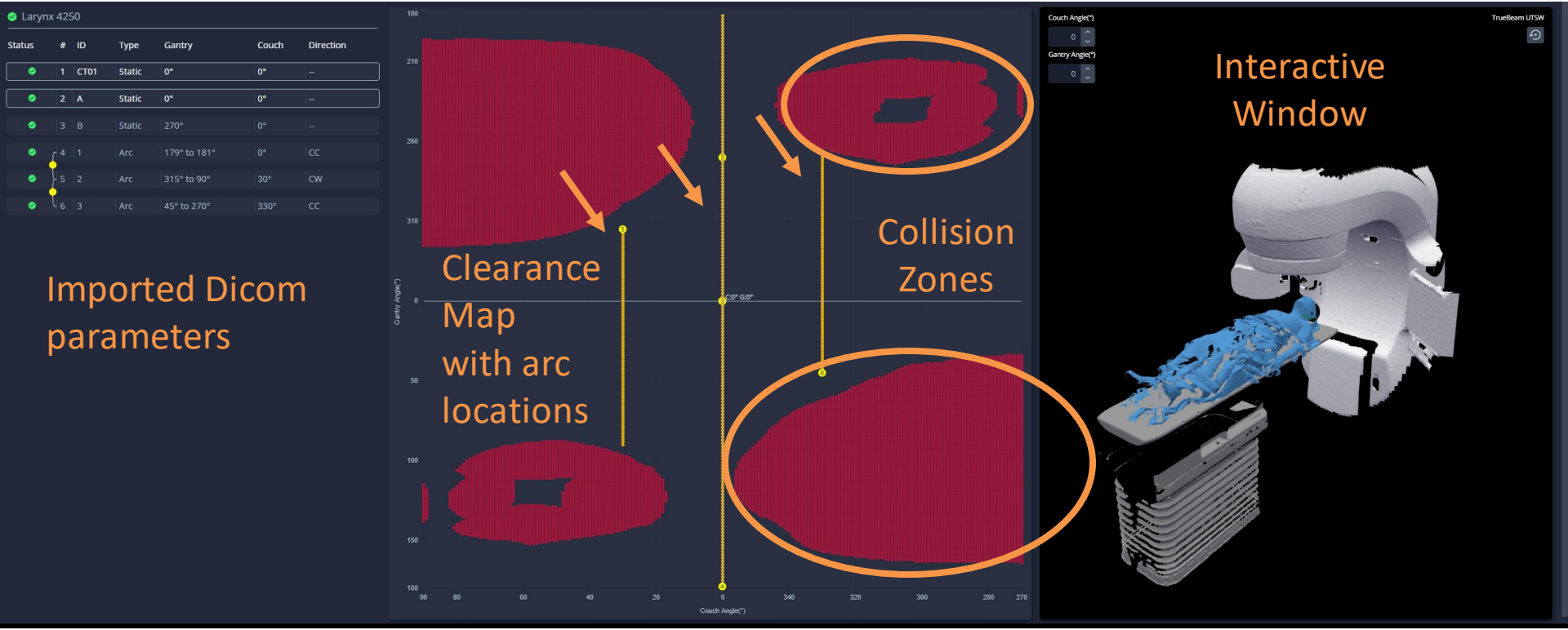
MapRT


Larynx 4250
Status # ID Type Gantry Couch Direction
1 CT01 Static 0° 0° --
2 A Static 0° 0° --
3 B Static 270° 0° --
4 1 Arc 179° to 181° 0° CC
5 2 Arc 315° to 90° 30° CW
6 3 Arc 45° to 270° 330° CC
Imported Dicom parameters
Clearance Map with arc locations
Gantry Angle(°)
Couch Angle(°)
C:0° G:0°
Couch Angle(°)
Gantry Angle(°)
TrueBeam UTSW

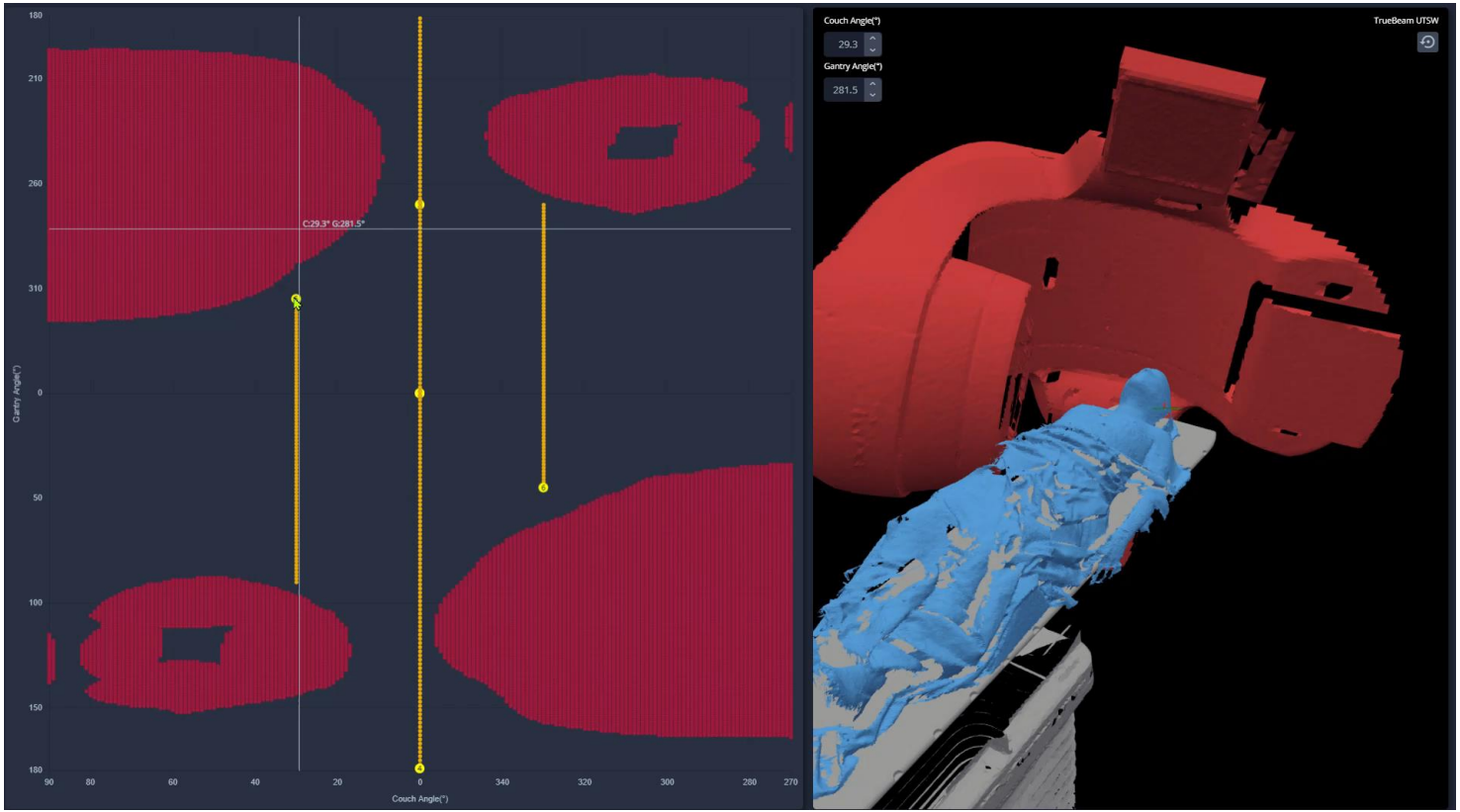
MapRT


Larynx 4250
Status # ID Type Gantry Couch Direction
1 CT01 Static 0° 0° --
2 A Static 0° 0° --
3 B Static 270° 0° --
4 1 Arc 179° to 181° 0° CC
5 2 Arc 315° to 90° 30° CW
6 3 Arc 45° to 270° 330° CC
Imported Dicom parameters
Clearance Map with arc locations
Collision Zones
Gantry Angle(°)
Couch Angle(°)
C:0° G:0°
Couch Angle(°)
Gantry Angle(°)
TrueBeam UTSW

MapRT


Larynx 4250
Status # ID Type Gantry Couch Direction
1 CT01 Static 0° 0° --
2 A Static 0° 0° --
3 B Static 270° 0° --
4 1 Arc 179° to 181° 0° CC
5 2 Arc 315° to 90° 30° CW
6 3 Arc 45° to 270° 330° CC
Imported Dicom parameters
Clearance Map with arc locations
Collision Zones
Gantry Angle(°)
Couch Angle(°)
C:0° G:0°
Couch Angle(°)
Gantry Angle(°)
TrueBeam UTSW
Interactive Window

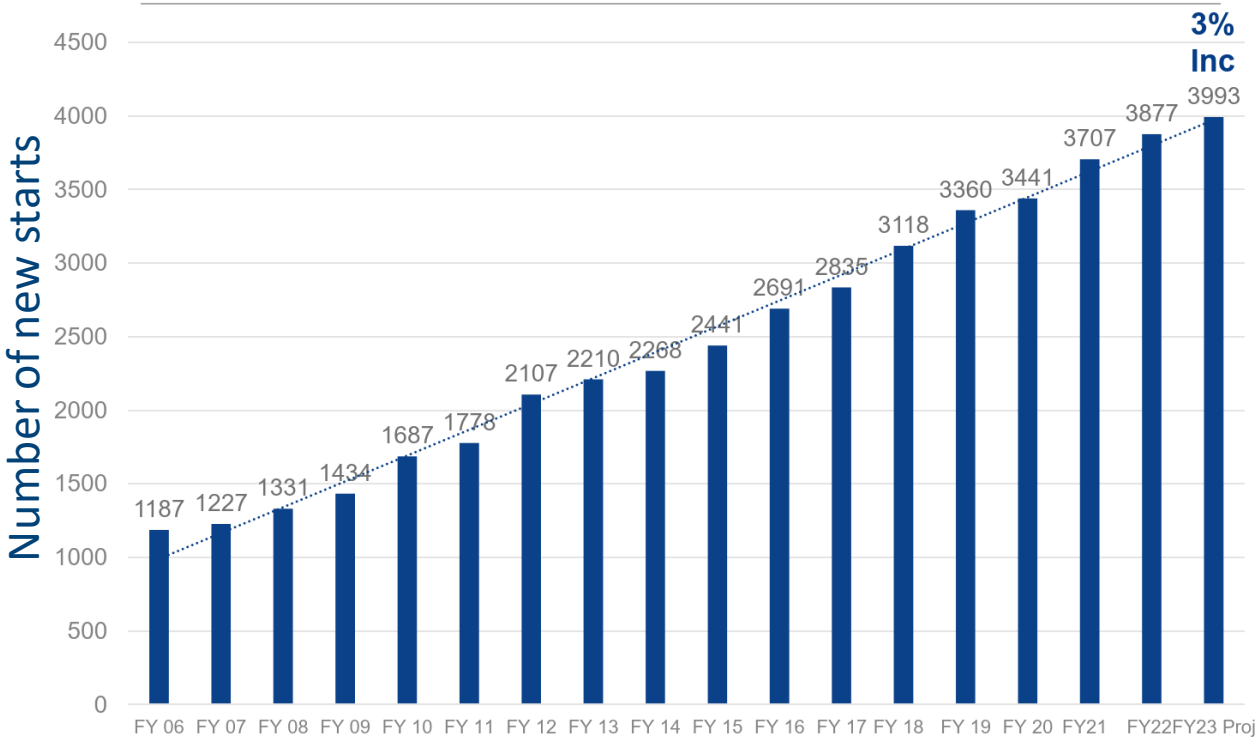
MapRT


180
210
260
310
0
50
100
150
180
Gantry Angle(°)
C:29.3° G:281.5°
90
80
60
40
20
0
340
320
300
280
270
Couch Angle(°)
Couch Angle(°)
29.3
Gantry Angle(°)
281.5
TrueBeam UTSW

2. Why clearance mapping is important

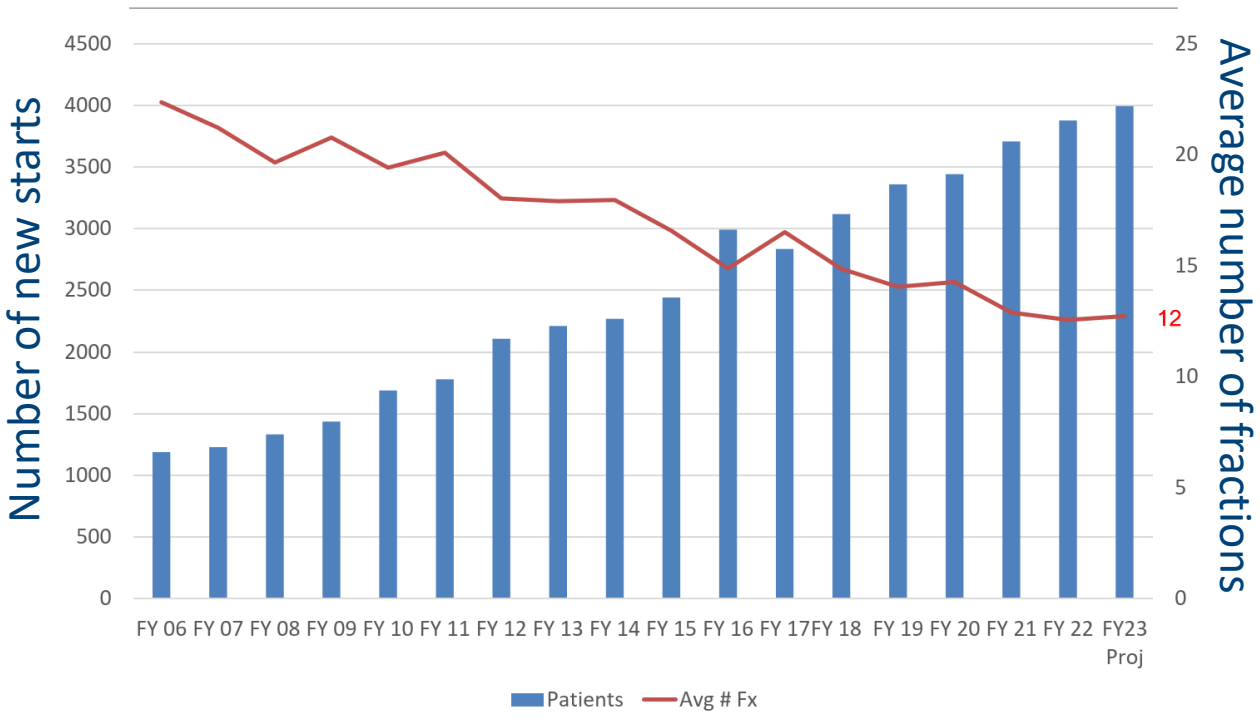
UT Southwestern Growth

- **In 2023, we are treating ~4000 patients**



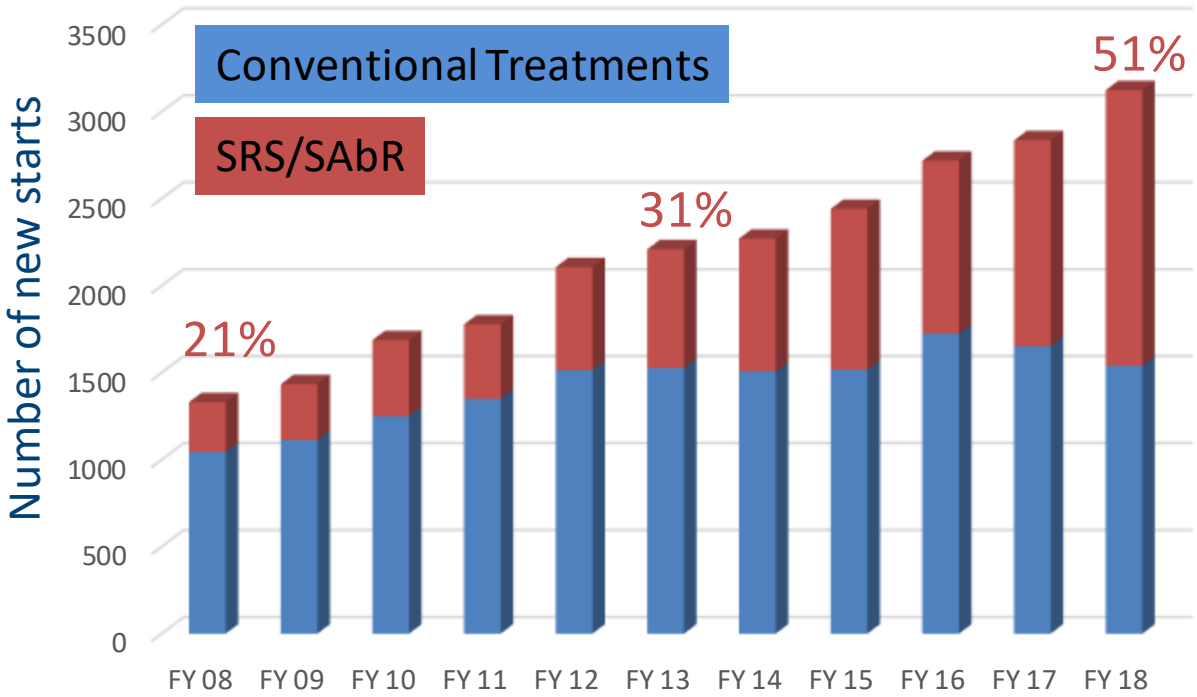
Drastic decrease in the number of fractions

- In 2023, we are treating ~4000 patients
- Average number of fractions is 12



More than half are stereotactic treatments

- In 2023, we are treating ~4000 patients
- Average number of fractions is 12
- >51% are SRS or SAbR



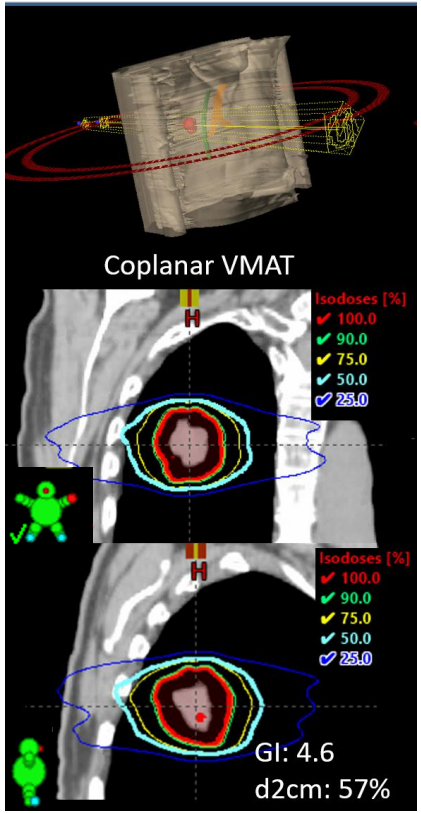
SAbR Planning: Priorities

Respect tumor coverage and "Dose Compactness" constraints

- These characterize (define) SAbR
- High dose conformality, d2cm, low gradient index (GI)
- Designed to require many beams, many angles, spread out entrance dose, etc…
- Effectively, isotropic dose falloff

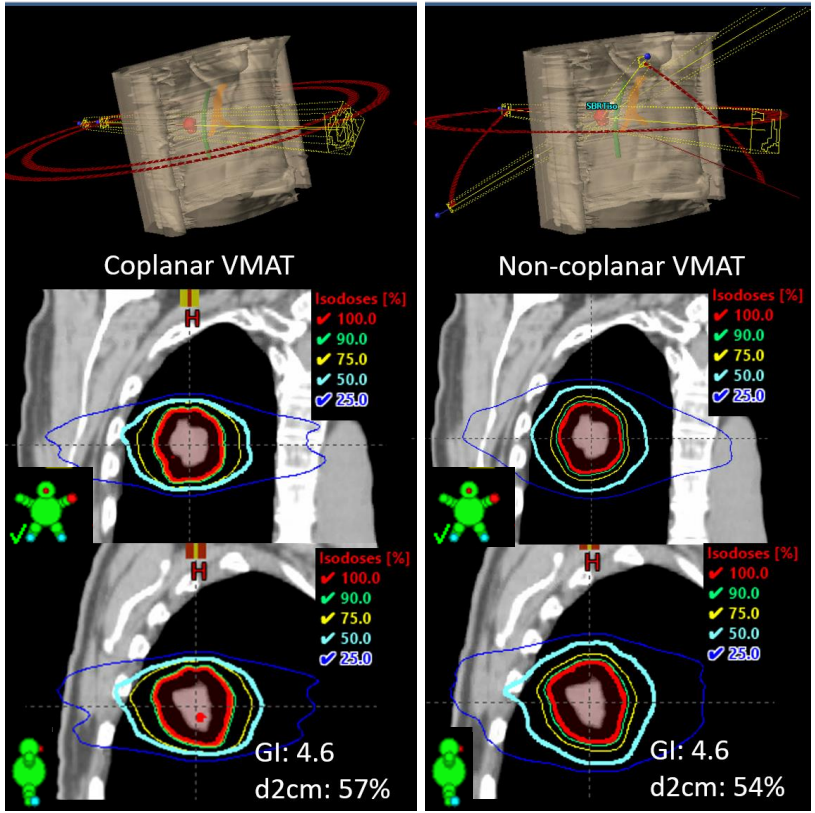
Slide courtesy Robert Timmerman

SAbR Planning: Lung Beam Orientation



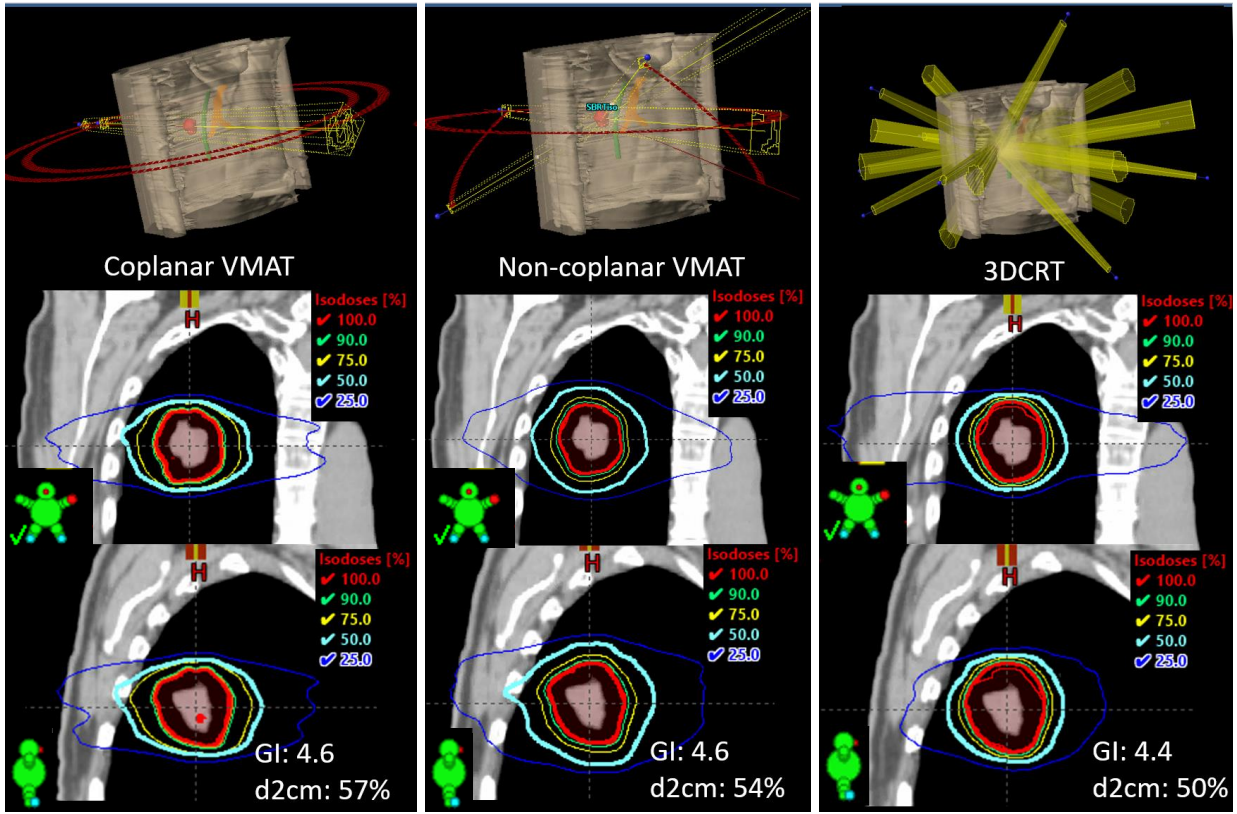
Slide courtesy Mu-Han Lin

SAbR Planning: Lung Beam Orientation



Slide courtesy Mu-Han Lin

SAbR Planning: Lung Beam Orientation



Slide courtesy Mu-Han Lin

3. Initial Implementation

Study Design

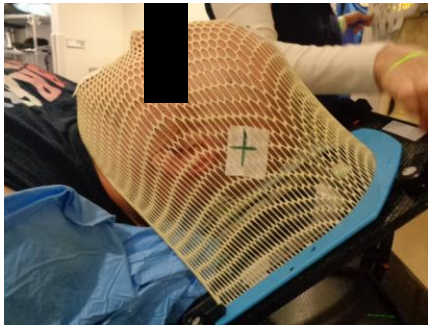
- 30 SAbR or conventional brain patients
  - Therapists-led dry-run clearance check
  - MapRT virtual clearance map
- Record in-vault time for the dry-run clearance check
- Record time from request to dry-run completion

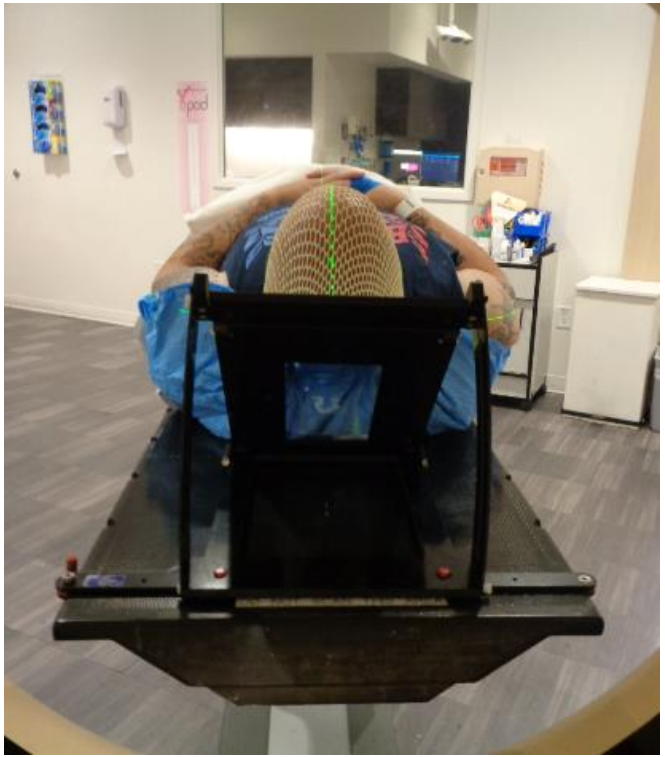
Clearance Variability

- Therapists-led dry-run clearance checks
  - 29 / 30 were True Positive
  - 1 / 30 was a False Positive
- MapRT virtual clearance map
  - 30 / 30 were True Positive
  - 0 / 30 were False Positive

Clearance Variability

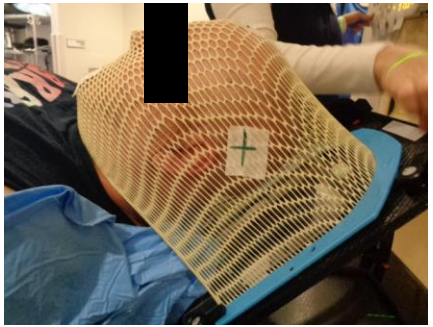
- Therapists-led dry-run clearance checks
  - 29 / 30 were True Positive
  - 1 / 30 was a False Positive
- MapRT virtual clearance map
  - 30 / 30 were True Positive
  - 0 / 30 were False Positive



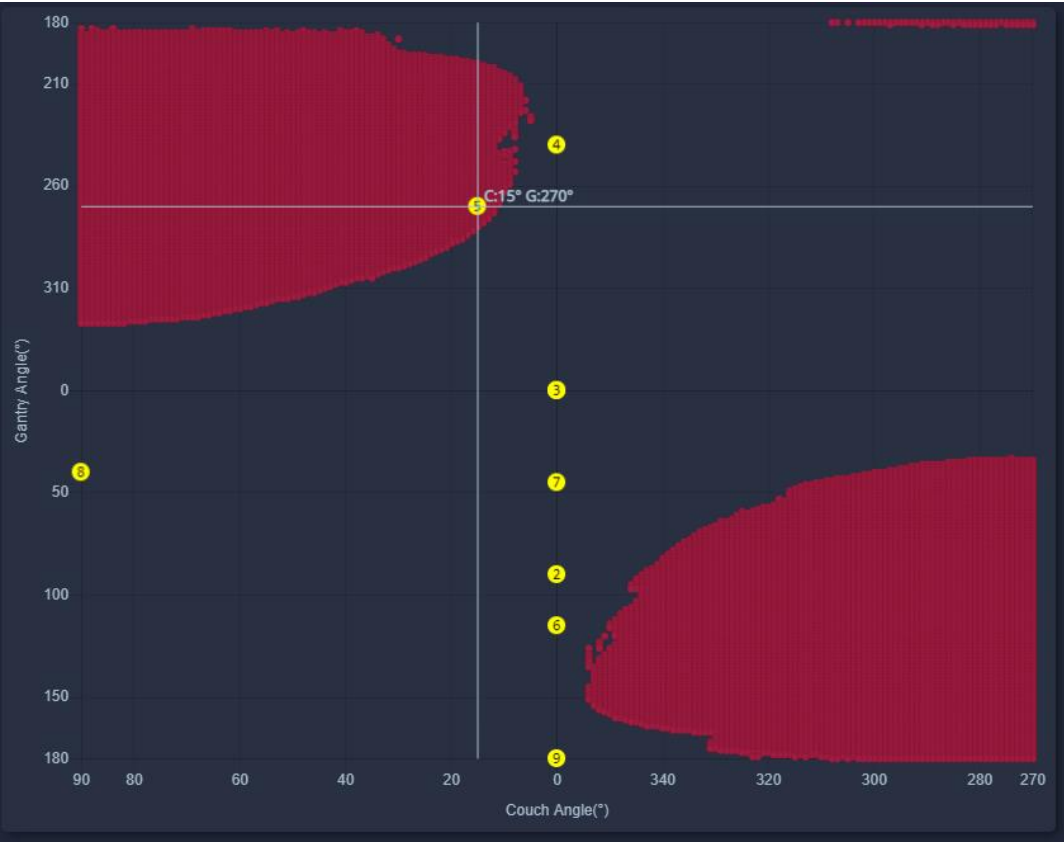


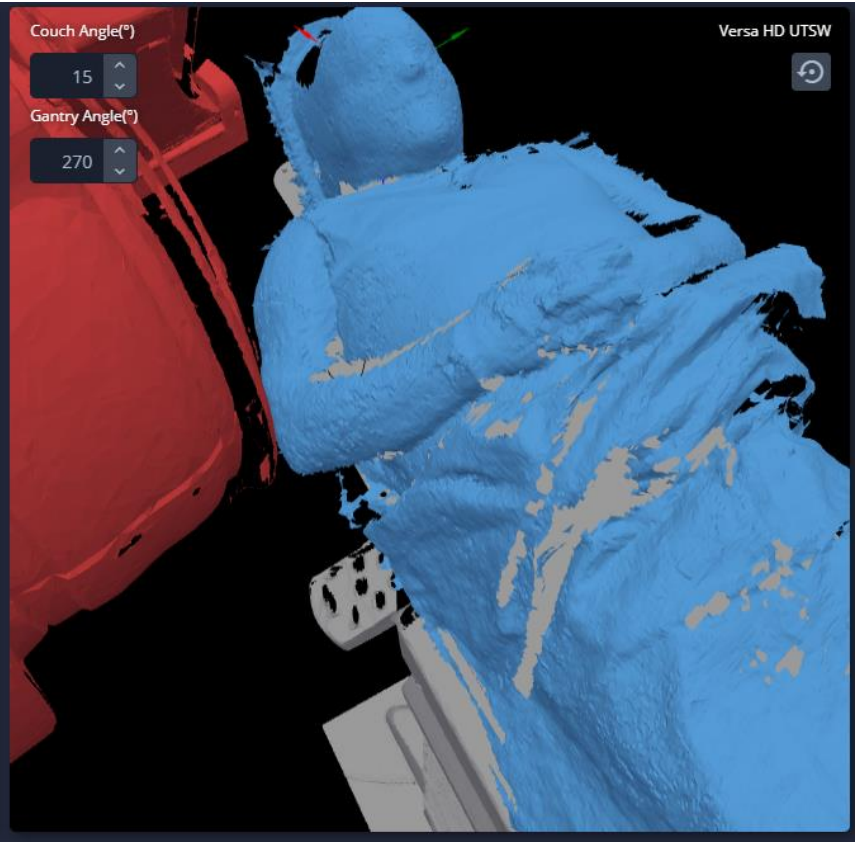
Clearance Variability

- Therapists-led dry-run clearance checks
  - 29 / 30 were True Positive
  - 1 / 30 was a False Positive
- MapRT virtual clearance map
  - 30 / 30 were True Positive
  - 0 / 30 were False Positive



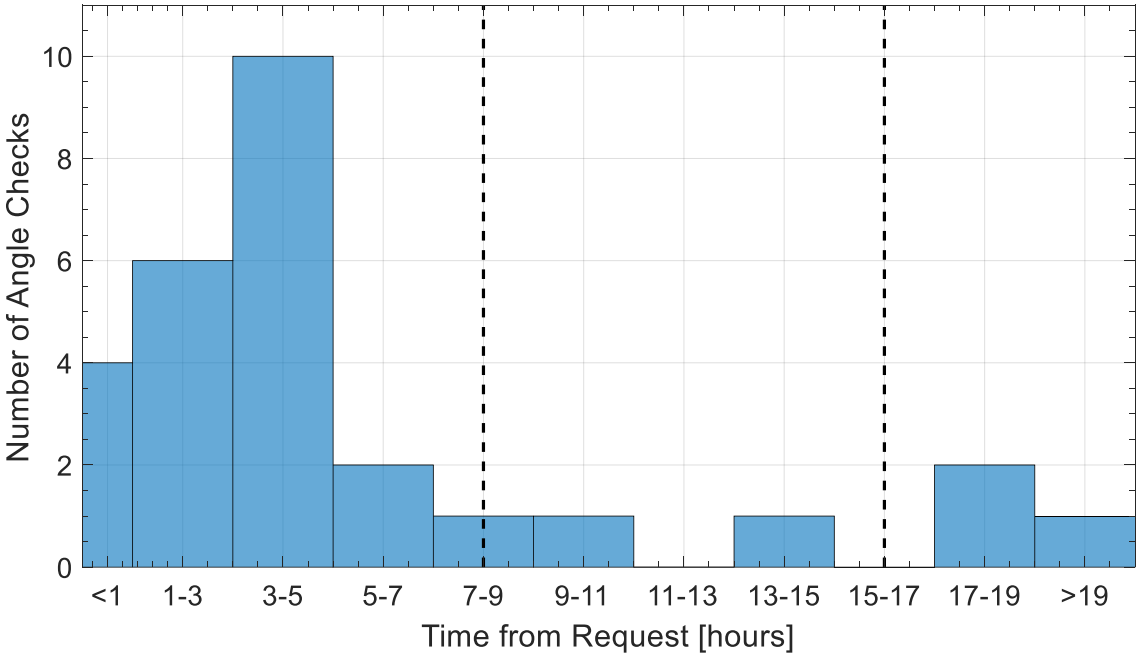
Clearance Variability





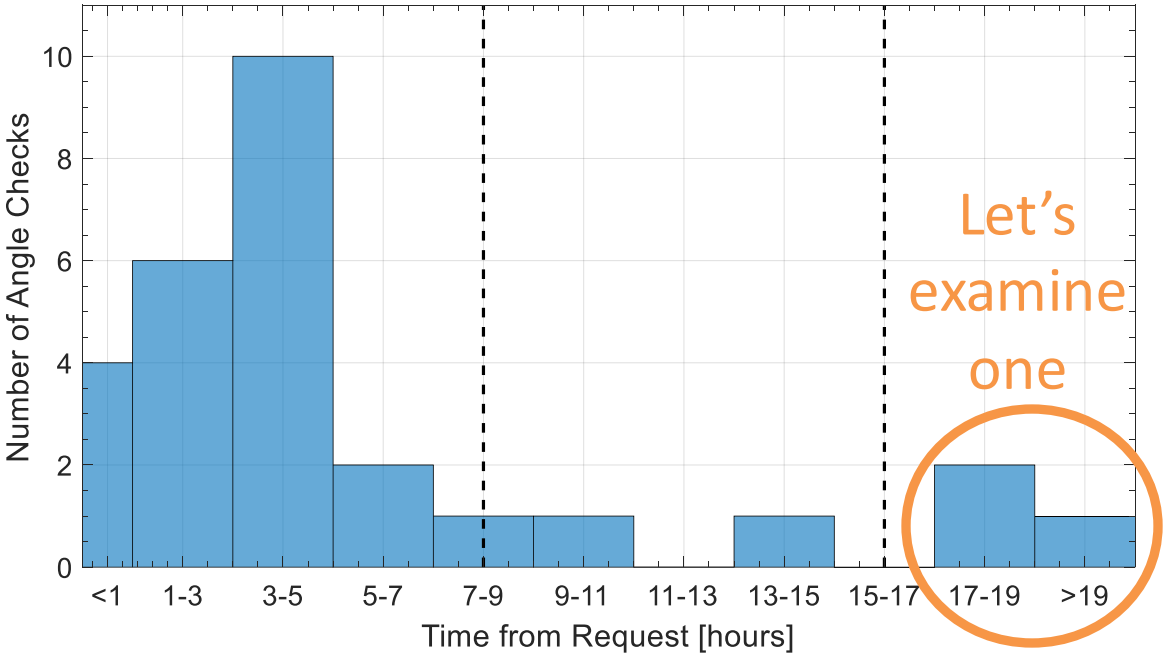
Time Required

- Average waiting period
  ~4 hours
- In-vault time taken
  ~300 minutes
  This is:
  - 5 SAbR treatments
  - 20 3D breast treatments



Time Required

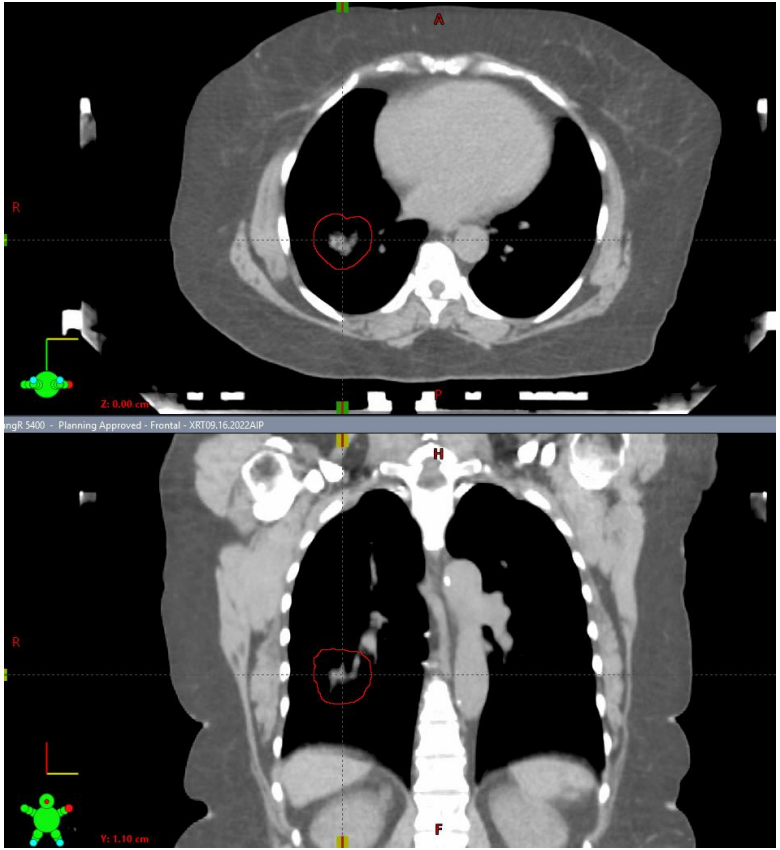
- Average waiting period
  ~4 hours
- In-vault time taken
  ~300 minutes
  This is:
  - 5 SAbR treatments
  - 20 3D breast treatments



4. Case Example

How this is done in practice

- 60-year-old female
- 40 cm^3 right lung legion
- SAbR candidate with 54Gy in 3Fx
- 10 field 3D conformal approach was chosen



This creates a prolonged planning process

9/16
Patient Sim

9/23
@1pm
Fx1

This creates a prolonged planning process

This creates a prolonged planning process

Time to begin planning!

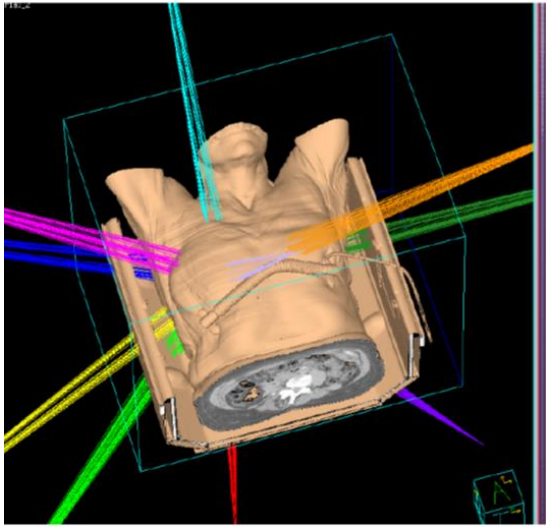
9/16
Patient Sim

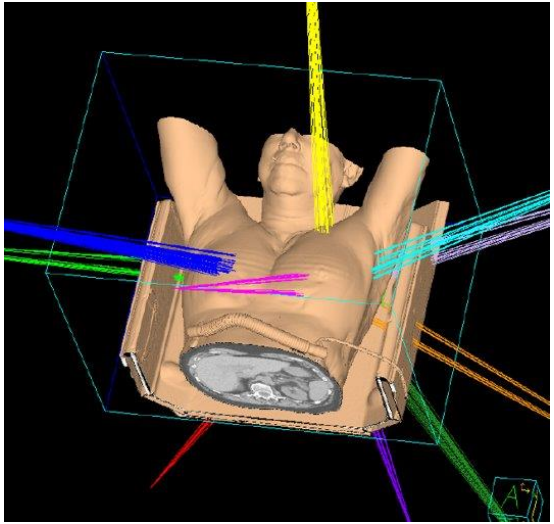
9/17
Contours
Done

9/23
@1pm
Fx1

Enter a generic template

Right	Side	Left	Side
Gantry	Couch	Gantry	Couch
150	0	210	0
90	0	270	0
45	345	315	15
330	90	30	90
30	90	330	90
315	0	50	0
270	15	90	15
270	345	90	345
220	10	160	350
180	0	180	0

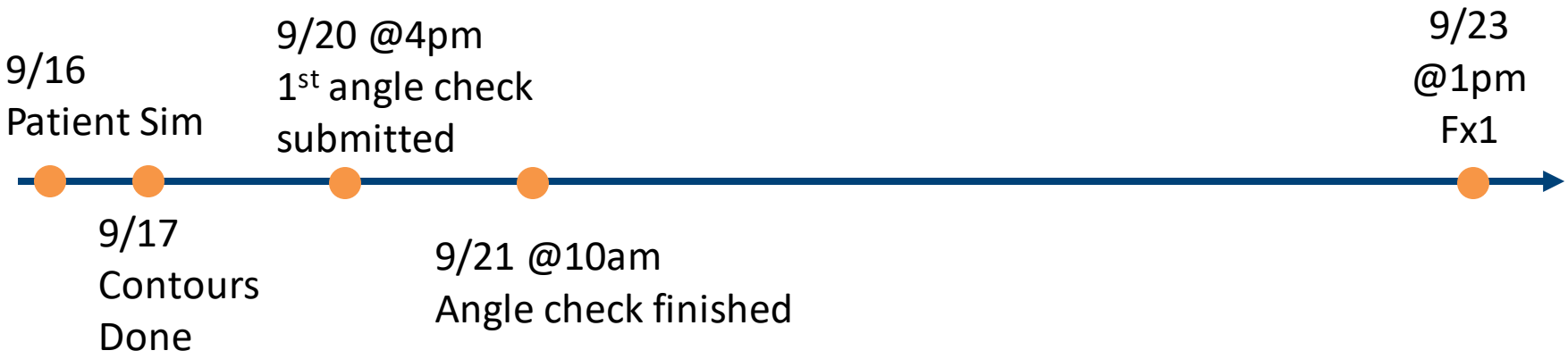




Slide courtesy Mu-Han Lin

This creates a prolonged planning process

This creates a prolonged planning process



Trouble!!!!

UTSouthwestern Medical Center

Angle Check Request

Patient: [redacted]

MRN: [redacted]

Initiated By: **Francisco, Jeric**

Initiated Date: **September 21st, 2022 - 10:09am GMT -05:00**

Attn. Phys: **Westover, M.D., Ph. D., Kenneth D**

Planning

Plan Name
LungR

Machine
TrueBeam2 - EROC

Status
- [x] Initial Check
- [ ] Re-Check

Start Date
September 23rd, 2022

Planning Comments
Failed - change Y to 120 for CBCT clearance. Center couch only changes lat. (Coll 175 for CBCT)

Angle Verification

Table Vertical

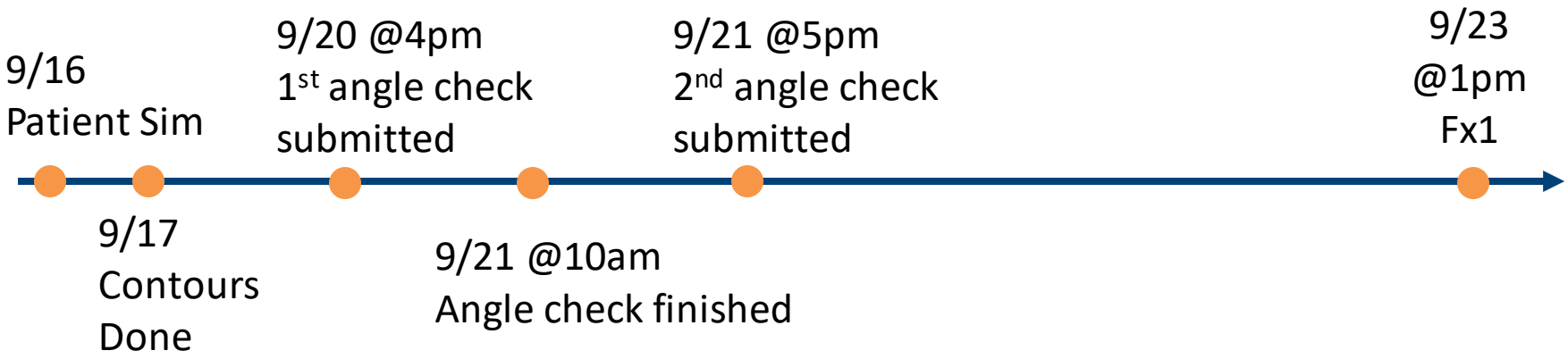
Table Lateral

Table Longitudinal

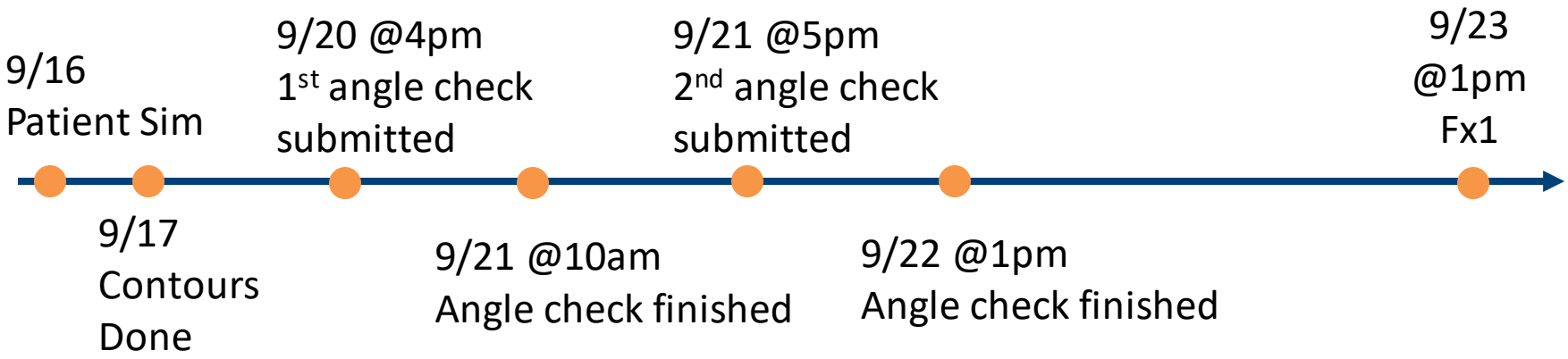
Angle Verification Comments
G180 change to 180.1, G30/couch90 change to G15/couch90, G40/couch 345 change to G35/couch345.

- CBCT won't clear iso too posterior
  - Collides with patient
- 2 couch/gantry combinations
  - Collides with the patient

This creates a prolonged planning process



This creates a prolonged planning process



2nd Angle check all good

UTSouthwestern Medical Center

Angle Check Request

Patient: [redacted]

MRN: [redacted]

Initiated By: **Mai, Trinh**

Initiated Date: **September 21st, 2022 - 4:59pm GMT -05:00**

Attn. Phys: **Westover, M.D., Ph. D., Kenneth D**

Planning

Plan Name
LungR

Machine
TrueBeam2 - EROC

Status
- [ ] Initial Check
- [x] Re-Check

Start Date
September 23rd, 2022

Planning Comments
new doc with new suggested iso & gantry are in mosaiq

Angle Verification

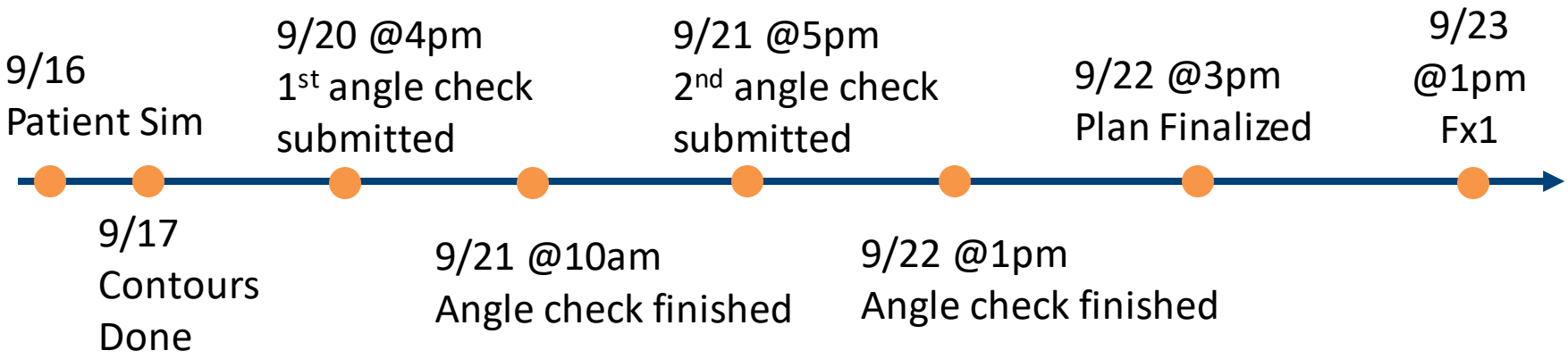
Table Vertical
13.8

Table Lateral
0

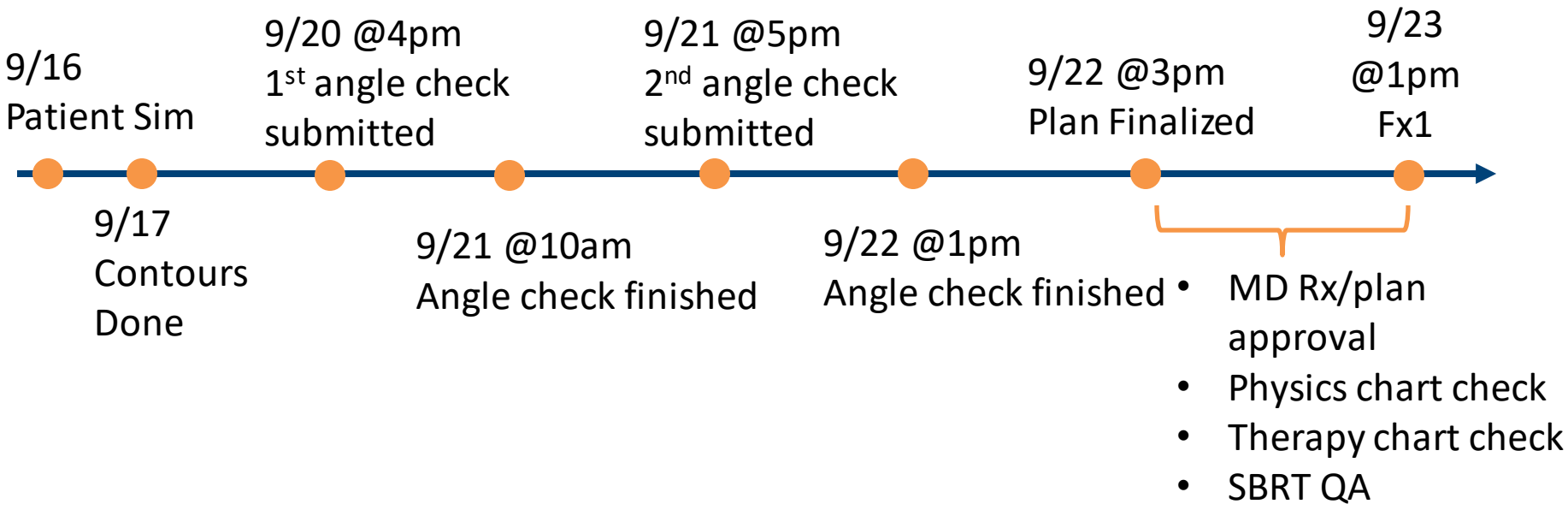
Table Longitudinal
118.62

Angle Verification Comments
all clear, watch L elbow - wg

This creates a prolonged planning process



This creates a prolonged planning process



This creates a prolonged planning process

~2 days of wasted time!

9/16
Patient Sim

9/17
Contours
Done

9/20 @4pm
1st angle check
submitted

9/21 @10am
Angle check finished

9/21 @5pm
2nd angle check
submitted

9/22 @1pm
Angle check finished

9/22 @3pm
Plan Finalized

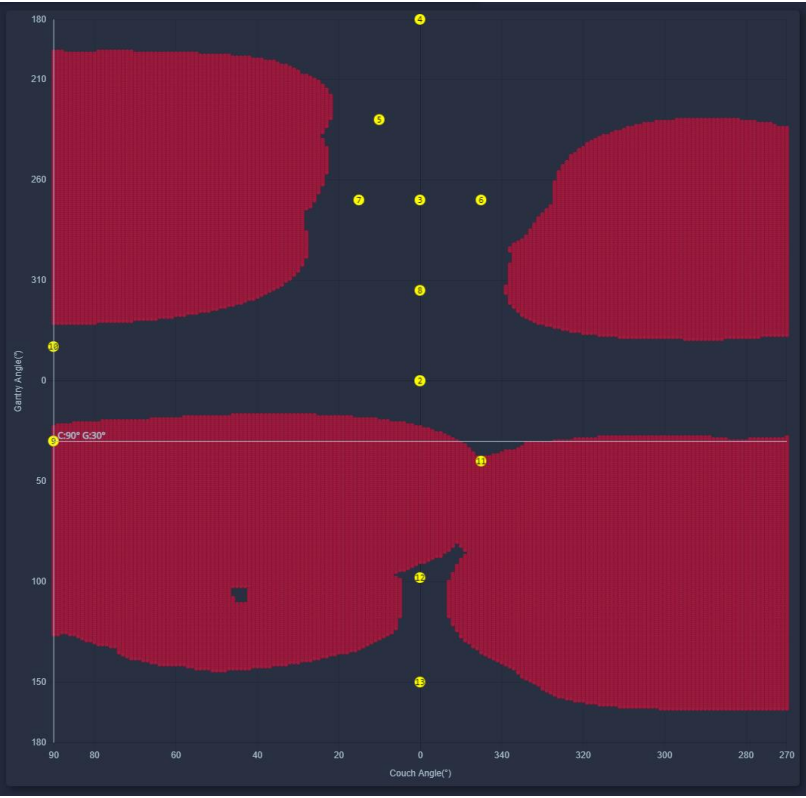
- MD Rx/plan approval
- Physics chart check
- Therapy chart check
- SBRT QA

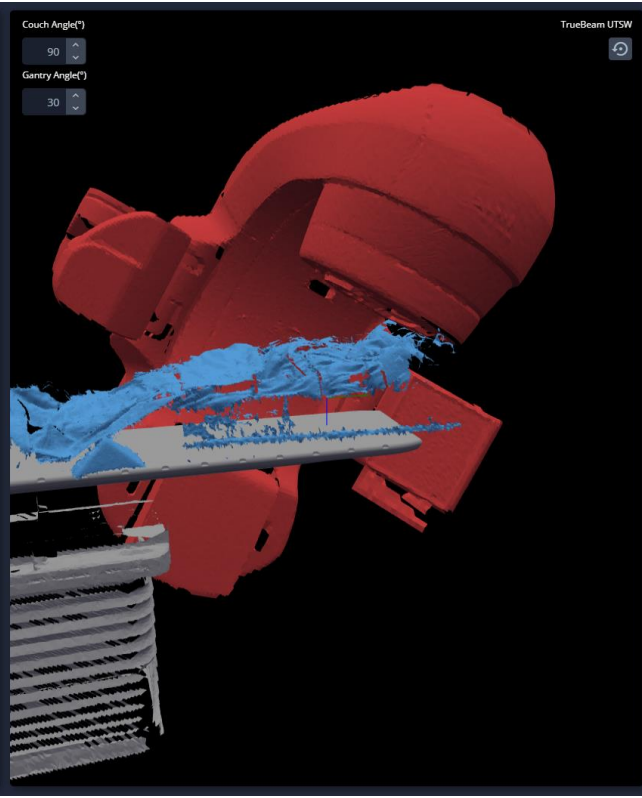
9/23
@1pm
Fx1

Enter MapRT

LungR Test

Status	#	ID	Type	Gantry	Couch	Direction
✓	1	CT	Static	0°	0°	--
✓	2	A	Static	0°	0°	--
✓	3	B	Static	270°	0°	--
✓	4	1	Static	180.1°	0°	--
✓	5	2	Static	230°	10°	--
✓	6	3	Static	270°	345°	--
✓	7	4	Static	270°	15°	--
✓	8	5	Static	315°	0°	--
✗	9	6	Static	30°	90°	--
✓	10	7	Static	343°	90°	--
✗	11	8	Static	40°	345°	--
✓	12	9	Static	98°	0°	--
✓	13	10	Static	150°	0°	--

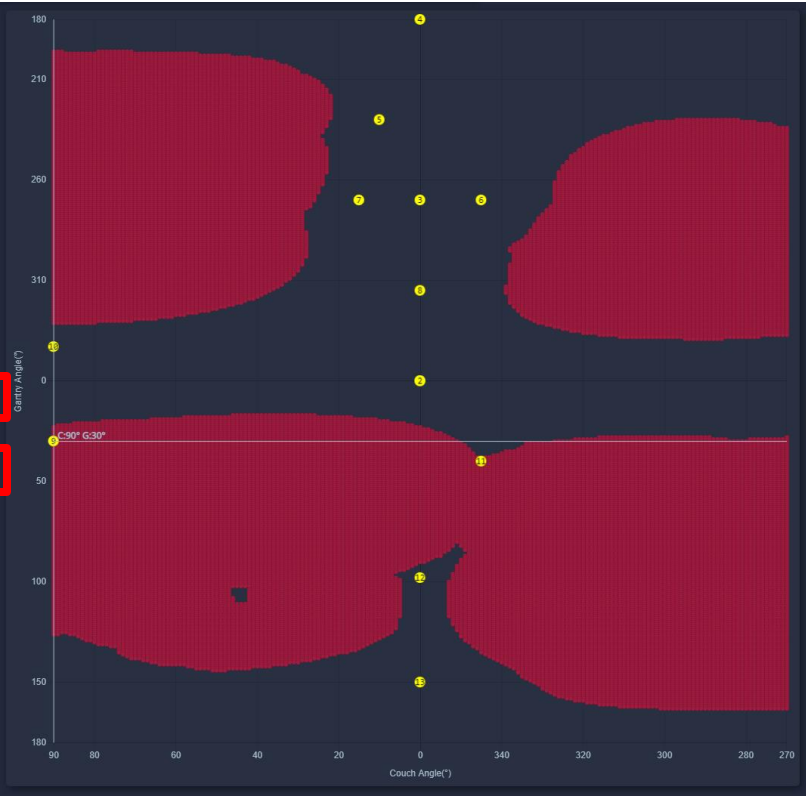


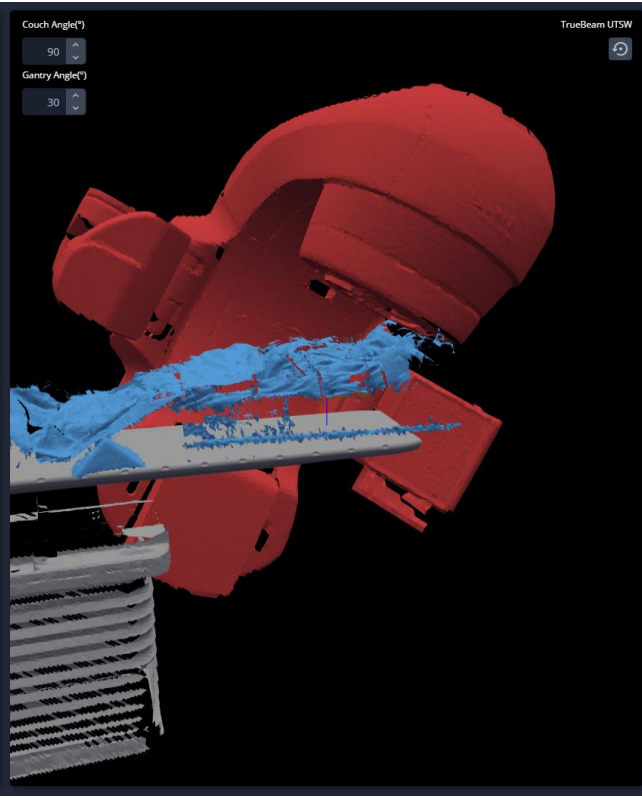


Identify the trouble spots

LungR Test

Status	#	ID	Type	Gantry	Couch	Direction
✓	1	CT	Static	0°	0°	--
✓	2	A	Static	0°	0°	--
✓	3	B	Static	270°	0°	--
✓	4	1	Static	180.1°	0°	--
✓	5	2	Static	230°	10°	--
✓	6	3	Static	270°	345°	--
✓	7	4	Static	270°	15°	--
✓	8	5	Static	315°	0°	--
✗	9	6	Static	30°	90°	--
✓	10	7	Static	343°	90°	--
✗	11	8	Static	40°	345°	--
✓	12	9	Static	98°	0°	--
✓	13	10	Static	150°	0°	--

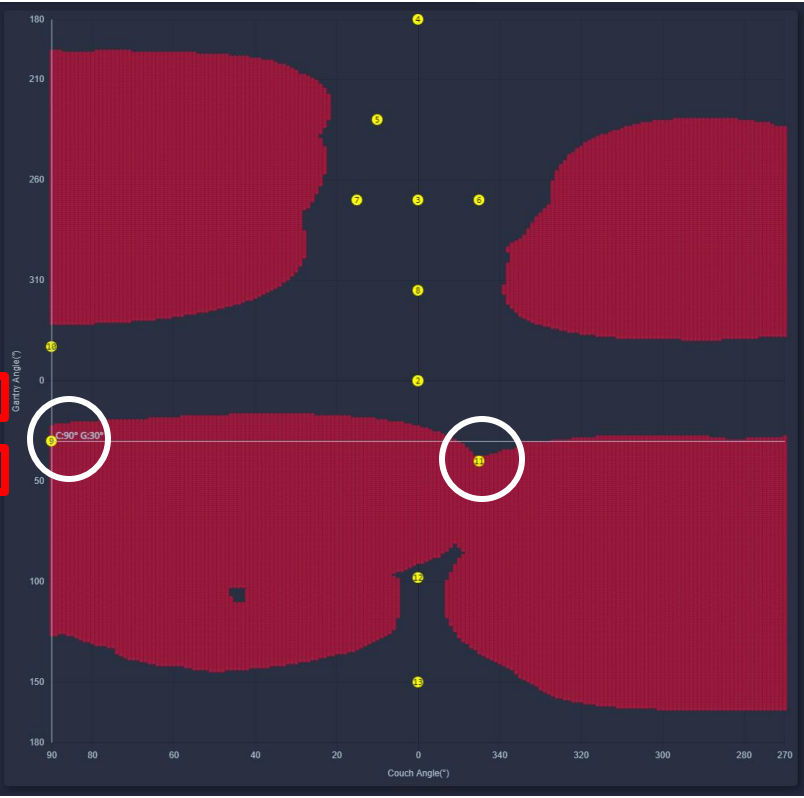


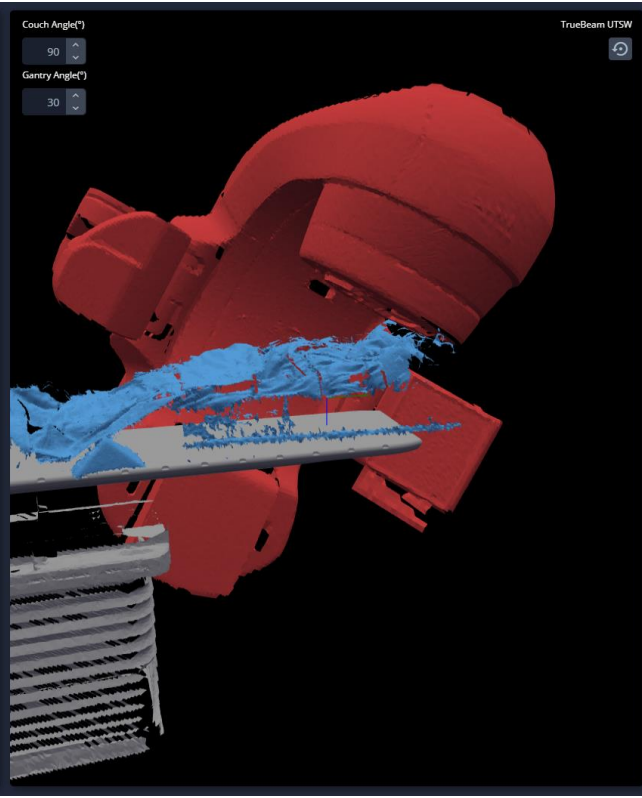


Identify the trouble spots

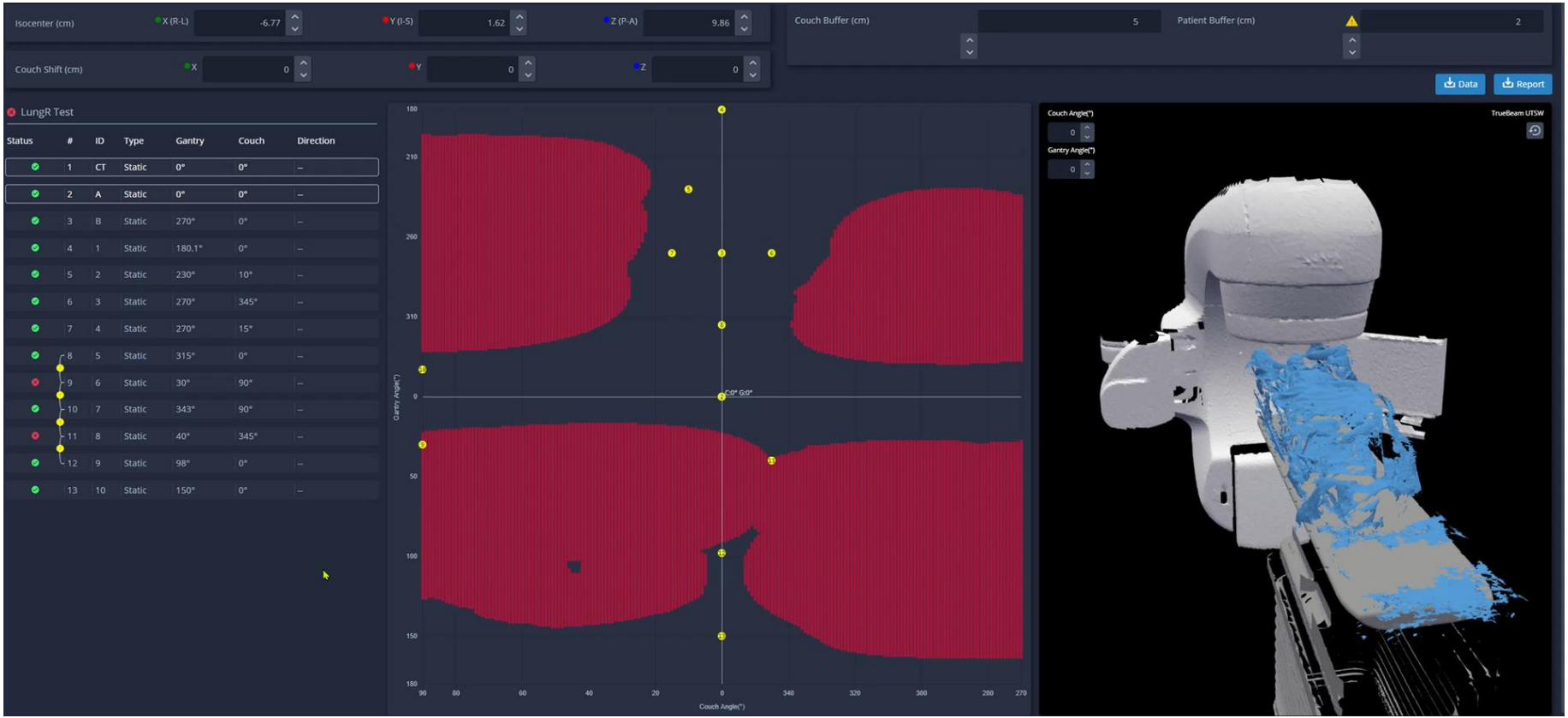
LungR Test

Status	#	ID	Type	Gantry	Couch	Direction
✓	1	CT	Static	0°	0°	--
✓	2	A	Static	0°	0°	--
✓	3	B	Static	270°	0°	--
✓	4	1	Static	180.1°	0°	--
✓	5	2	Static	230°	10°	--
✓	6	3	Static	270°	345°	--
✓	7	4	Static	270°	15°	--
✓	8	5	Static	315°	0°	--
✗	9	6	Static	30°	90°	--
✓	10	7	Static	343°	90°	--
✗	11	8	Static	40°	345°	--
✓	12	9	Static	98°	0°	--
✓	13	10	Static	150°	0°	--





Adjust the areas of interest

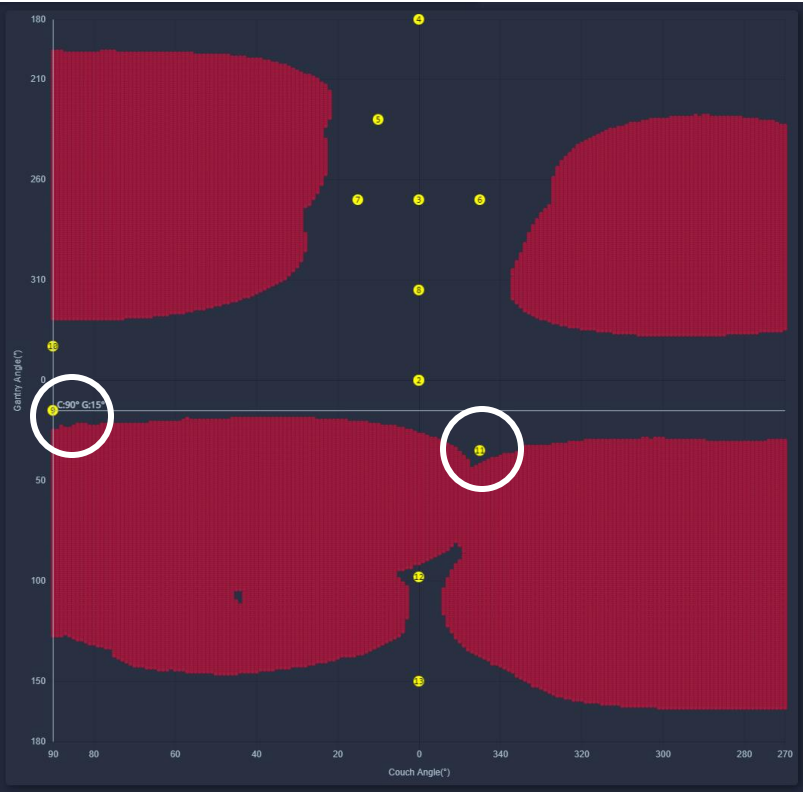


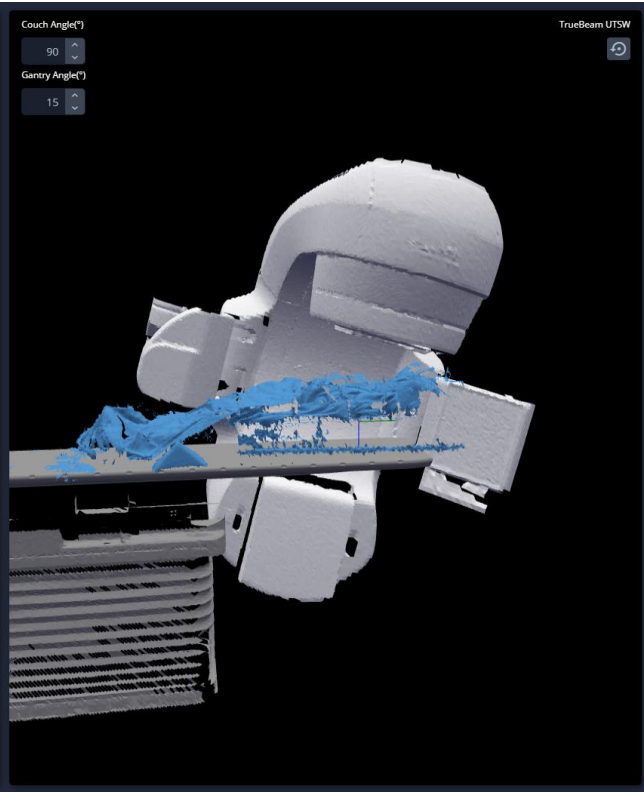
Check the revise the field arrangement

LungR 5400

Status	#	ID	Type	Gantry	Couch	Direction
✓	1	CT	Static	0°	0°	--
✓	2	A	Static	0°	0°	--
✓	3	B	Static	270°	0°	--
✓	4	1	Static	180.1°	0°	--
✓	5	2	Static	230°	10°	--
✓	6	3	Static	270°	345°	--
✓	7	4	Static	270°	15°	--
✓	8	5	Static	315°	0°	--
✓	9	6	Static	15°	90°	--
✓	10	7	Static	343°	90°	--
✓	11	8	Static	35°	345°	--
✓	12	9	Static	98°	0°	--
✓	13	10	Static	150°	0°	--

MapRT can reduce this process from days to several minutes!





Summary

- MapRT is a novel SGRT clearance mapping software
- More accurate than manual clearance checks
- Greatly reduces the planning time
- In short, MapRT enables confidence in non-coplanar treatments

Acknowledgments

- Andrew Godley
- David Sher
- Eric Chambers
- Siqiu Wang
- Yesenia Gonzalez
- Xinran Zhong
- Liyuan Chen
- Kara James
- Jennifer Cleaton
- Lindsi Seaux
- Phu Ho
- Rashad Campbell
- Gannon Arnold
- Jordan Getchell
- Weihan Lee
- Jeff Dubas
- Romona Frame
- Hung Ho