

# TBI treatment with AlignRT

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# University hospital Linköping

- Four Varian TrueBeam, with AlignRT
- Siemens CT with SimRT
- Treat 1600 patients per year



# Why Total body irradiation?

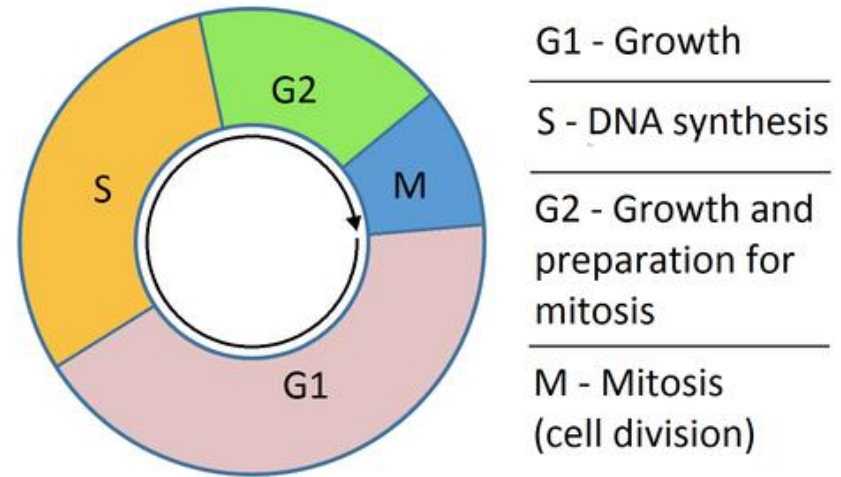
- For treatment of lymphoma, leukaemia, myeloma
- Preparation for stem cell or bone marrow transplant
  - High dose chemotherapy
  - Targeted cancer medicine
- Kills cancer cells
- Suppresses the immune system



Hemato oncology

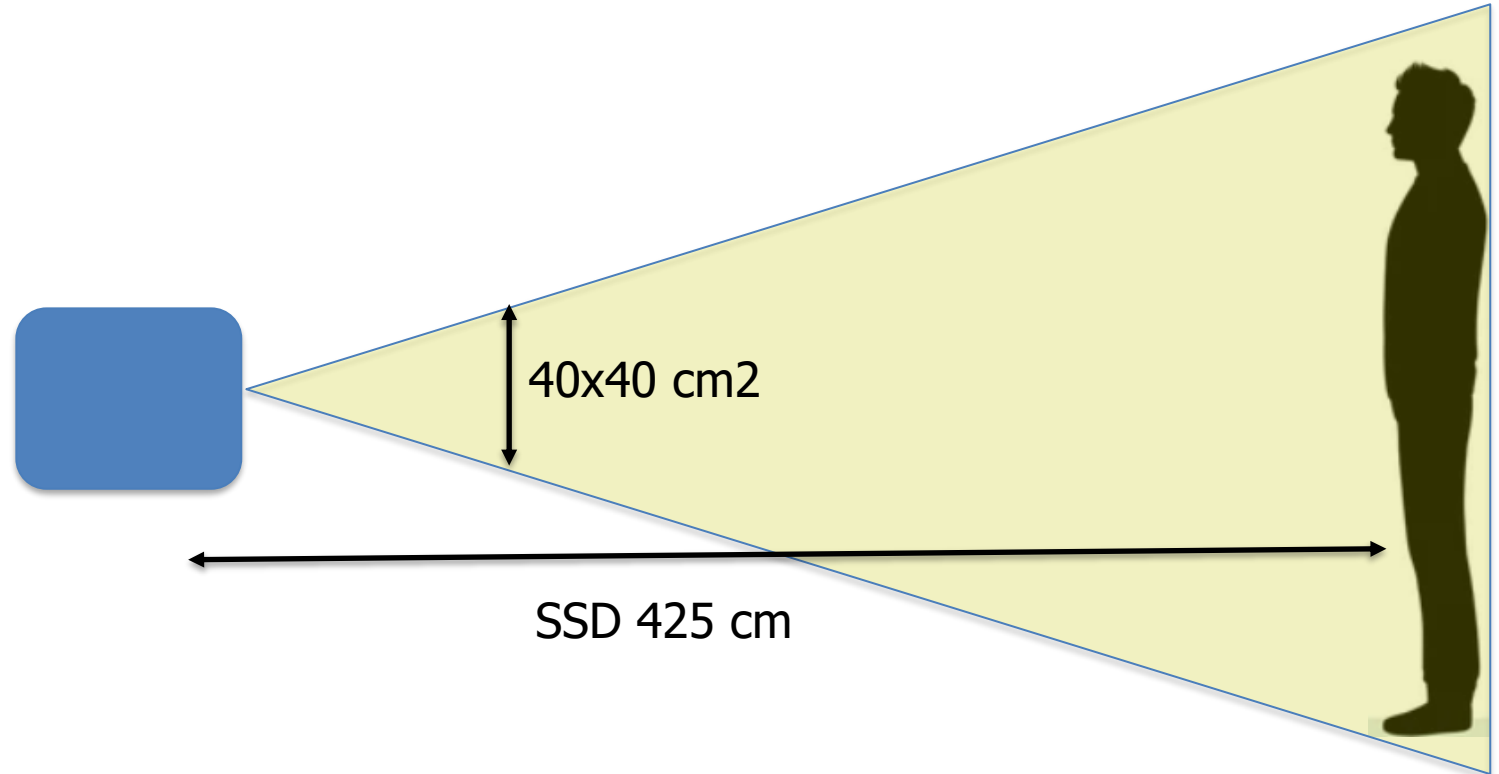
# Fractionation

- Treat 1-3 patient each year
- 2 Gy x 6 twice a day
- At least 6 hours between fractions
- Main OAR: lungs
  - Reduce dose 9 Gy

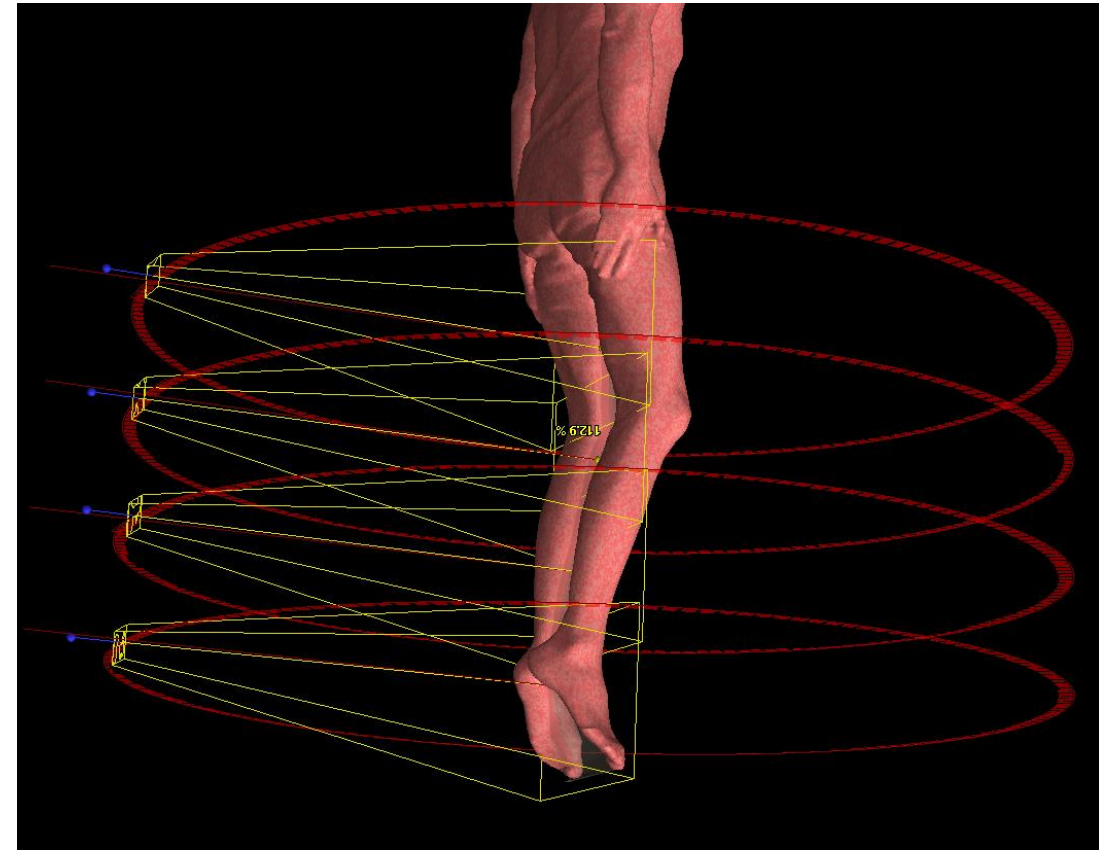
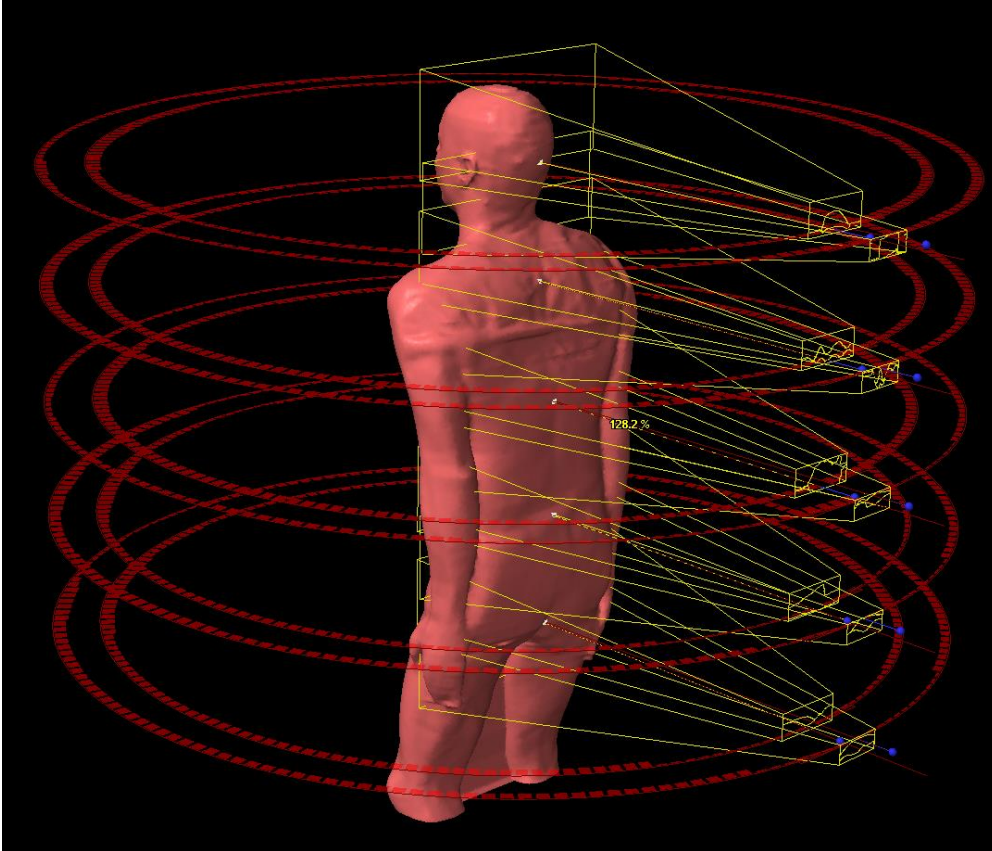


# Treatment technique: traditionally

- SSD 425 cm
- Static open fields
- Lead lung blocks



# Treatment technique: VMAT





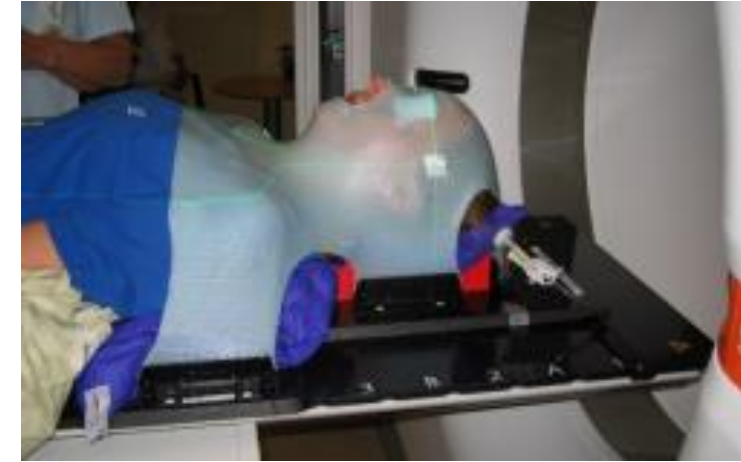
# Immobilization

- Patient support
  - Whole body vacuum shell
  - Five-point thermoplastic mask
- Enough visible surface for AlignRT



# CT scanning

- CT scan both head first and feet first (~150 cm)
  - Image registration
- Lead marks at reference point on the mask
- Lead marks at sternum, pelvis and knee
- Tattoos at the led marks
- Spend time on the fixation!





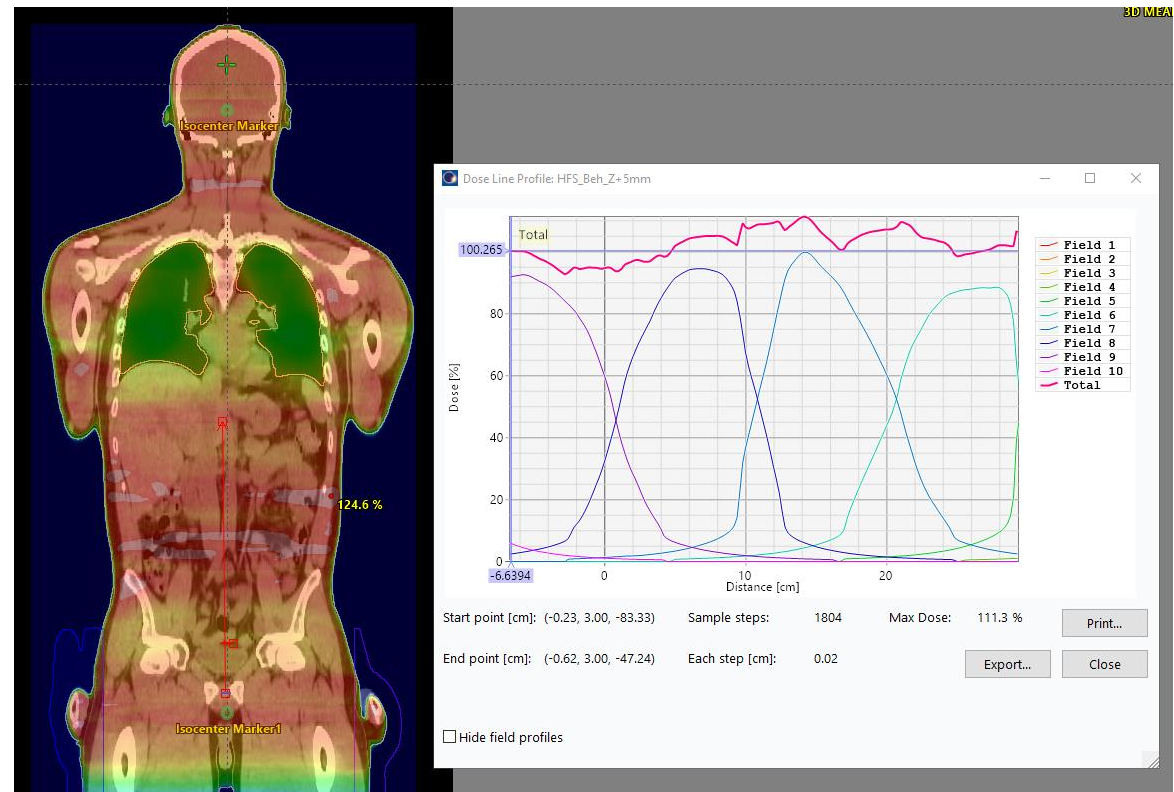
# Treatment planning

- CTV: body except lungs
- PTV: CTV + 1 cm (outside skin)
- OAR: lungs
- Place all isocenters
- Dry run with all fixation devices
- Optimize HFS
- Use HFS as base dose plan for FFS
- Evaluate
  - $85\% < \text{CTV} < 130\%$
  - Total lung mean  $< 75\%$
- Split each isocenter to a separate plan



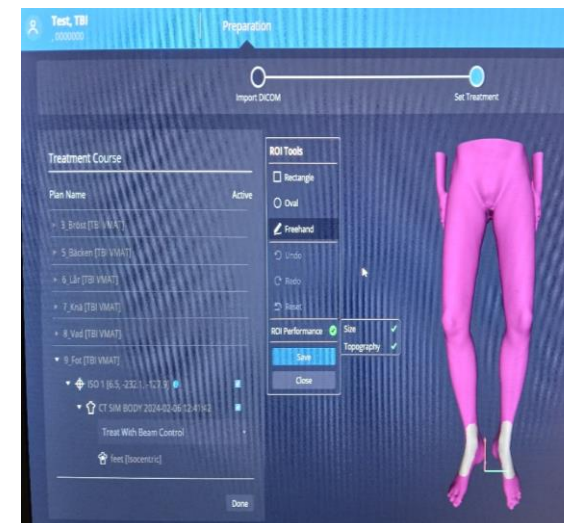
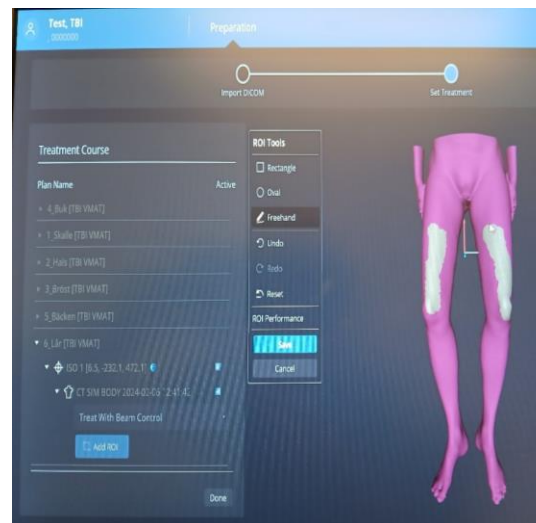
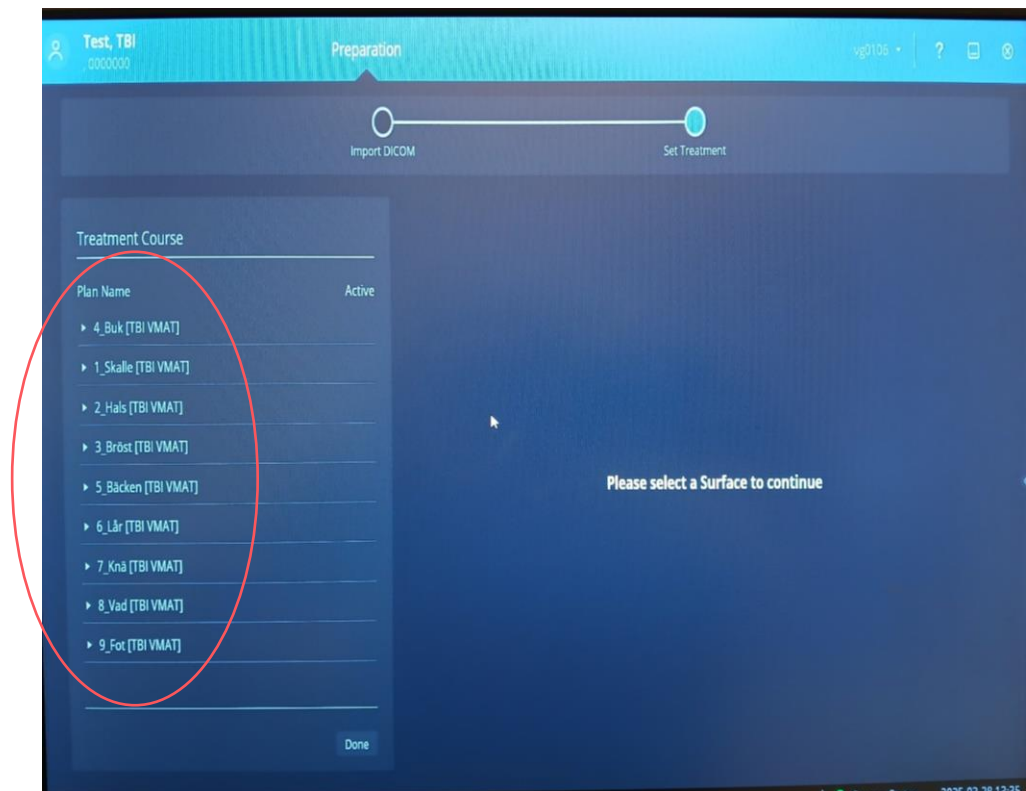
# QA

- Robust evaluation of total plan: 1 cm
- Smooth junctions
- Mobius
- Portal dosimetry



# AlignRT preparation

- Import all plans
- ROI:s



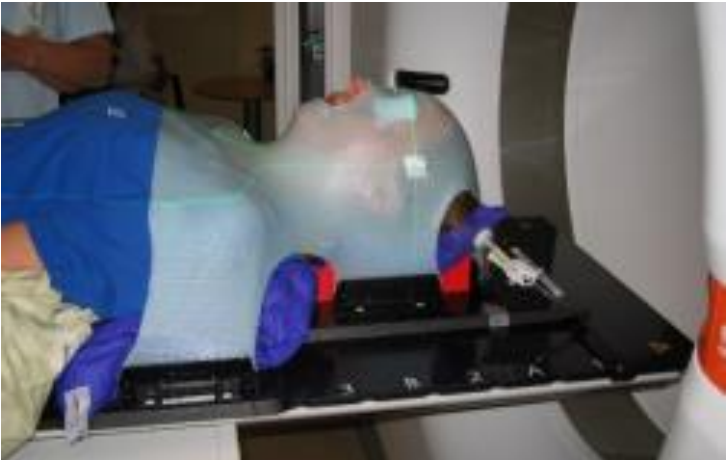
# Patient set-up: laser and tattoos

- Head first
  - Tattoos agree with marks on the vacuum shell (thorax, pelvis, knee)



# Patient set-up

- Head first
  - Position the patient with laser using marks on the mask (user origin)
  - Physicist calculates all isocenter couch positions

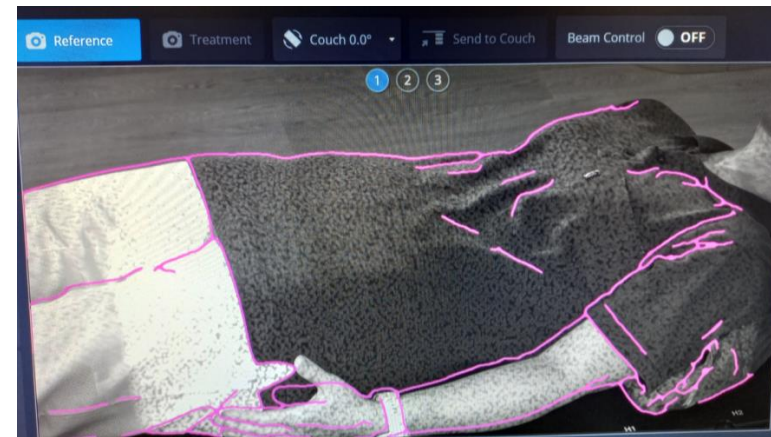


TBI VMAT - Protokoll för matchning								
Namn:	TBI test							
Pers.nr:	yymdd							
Fraktion:								Upplägg = ref.punkt(upplägg) - Plan
Flytt mellan iso:	20 cm							Behandling = Upplägg + Δflytt
HFS		ref.punkt	1Skalle	2Hals	3Thorax	4Buk	5Bäcken	Matchn.beslut
vrt (y)	Plan		3	3	3	3	3	
	Upplägg							
	Matchning							
	Behandling							
lng (z)	Plan		-6	-26	-46	-66	-86	
	Upplägg							
	Matchning							
	Behandling							
lat (x)	Plan		0	0	0	0	0	
	Upplägg							
	Matchning							
	Behandling							
CBCT info			upp och ner			upp		



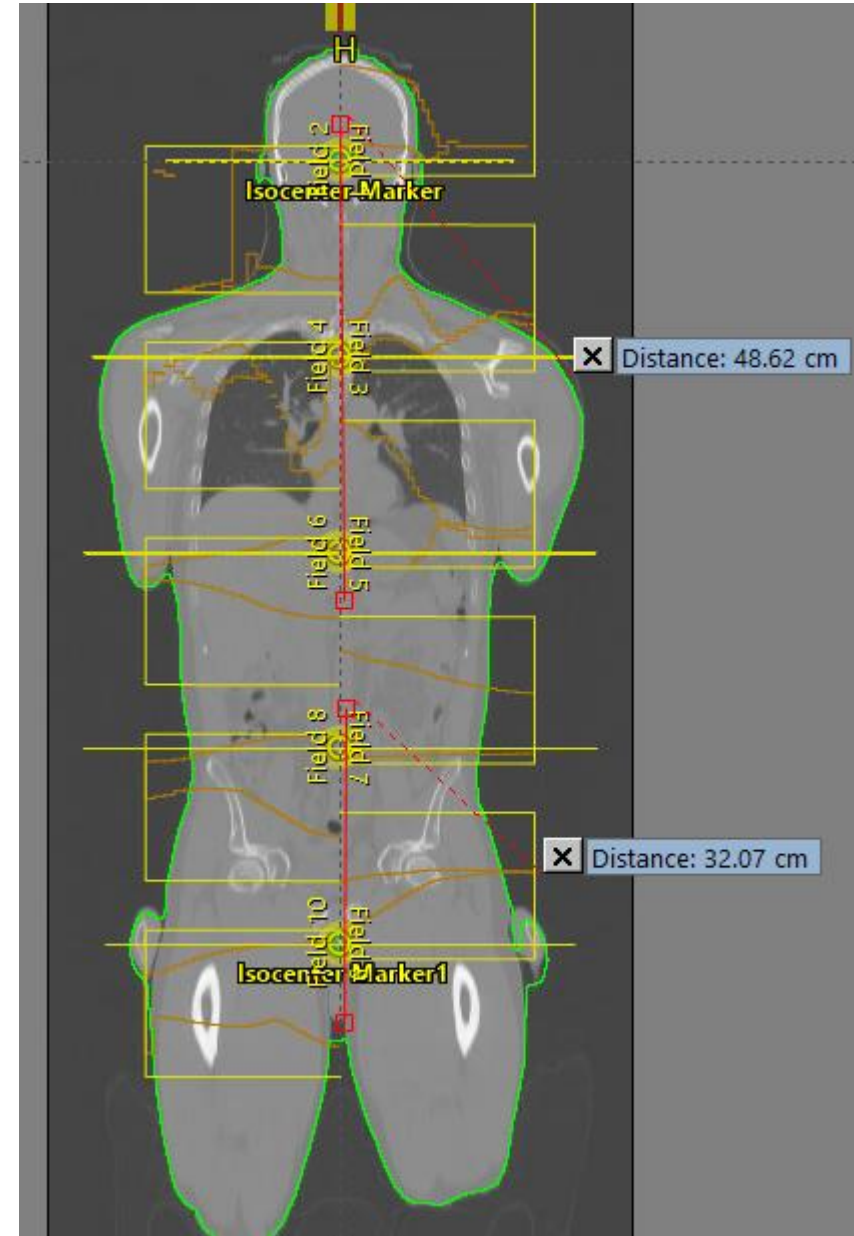
# Patient set-up: AlignRT

- Head first
  - Move to abdomen isocenter to get an overview
  - Use the postural video to adjust the patient



# Patient set-up: CBCT

- Two extended CBCTs (neck and pelvic)
- Auto-match and evaluate
- Average between the two extended scans
- Perform the couch corrections

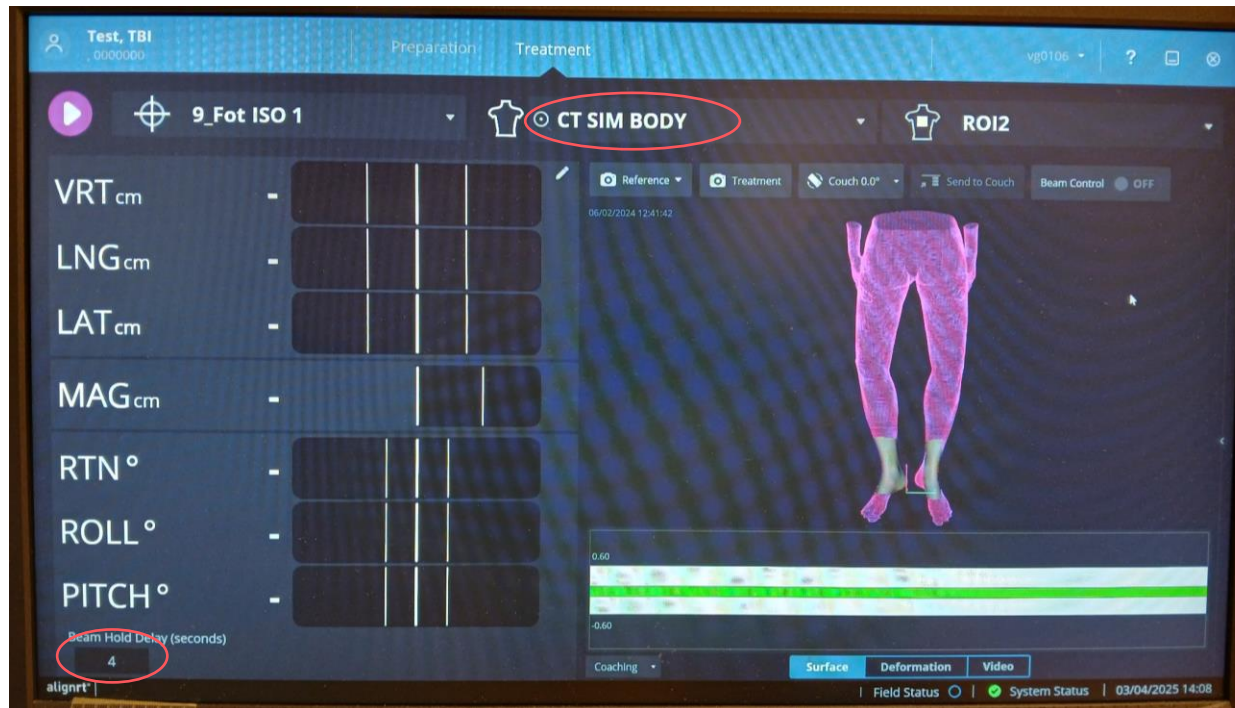


# Patient set-up: Reference capture

- Mode up pelvic plan (most caudal)
  - Reference capture
  - Acquire couch coordinates
- Move couch to abdomen (physicist keep the coordinates)
  - Reference capture
  - Acquire couch coordinates
- ...
- Finally head

# Treatment

- Starting at the patient head
- Move to next isocenter (in-room)
- Make sure the SGRT-surface (reference capture) is displayed
- Tolerances:  $\pm 7$  mm, Beam hold delay 4 sec



# Treatment

- If patient moves/coughs
  - Beam hold delay
  - Hopefully within  $\pm 7$  mm
  - Use postural video to verify position





# Treatment

- Short break after HFS
- Set-up the patient FFS, no need for mask
- Laser alignment, AlignRT, CBCT...
- Acquire couch coordinates and take reference captures
- Treat
- Rest!

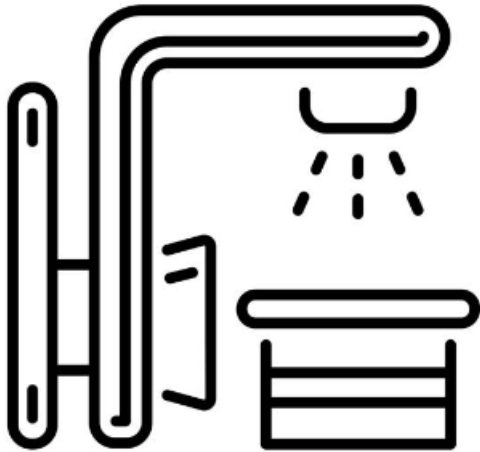


# Staff and time

1-2 h



> 1.5 h



1-2 week



# Reflections using Align RT

- Valuable tool for set up, especially extremities
- Necessary tool for patient monitoring
  - Long treatment times
  - Several field junctions
  - Movement during treatment
- Vacuum shell – better fixation?
  - Junction between shells
  - Risk of puncture of the shell
  - Don't need that much fixation when using SGRT?



# Tack!

## SGRT for set-up and monitoring VMAT Total Body Irradiations

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### Introduction

Historically, patients undergoing Total Body Irradiation (TBI) 12 Gy in 6 fractions has been treated with static fields at a long distance (SSD 425 cm) to cover the whole body. Led blocks have been used to reduce the lung dose to an acceptable level. Recently, VMAT has been introduced as treatment technique for these patients and the lung dose is reduced in the plan optimization process.

### Methods

#### Treatment technique and immobilisation

Varian TrueBeam linear accelerator is used for treatment. In order to cover the whole body the patient is positioned both head first and feet first supine. Around 10 isocenters are needed to get an acceptable dose distribution. Due to the many field junctions and long treatment time the patient setup and immobilisation is crucial for a correct dose delivery. The patient is fixed with a five-point thermoplastic mask and a whole body vacuum shell.

#### Patient setup

The setup is made using a combination of laser guidance, surface guidance and several extended CBCTs. AlignRT is used for surface guidance. The patient is aligned in the vacuum shell so that tattoos and markers on the vacuum shell aligns. The postural video that comes with AlignRT gives a multi-angle real-time view of the alignment compared to the reference position from the CT-scanning. This is primarily used to align the arms, hands, legs and feet in a fast and accurate way. CBCT-images are acquired to cover almost the whole body and the patient position is corrected accordingly. Before the treatment starts, SGRT reference captures are acquired at the position of each isocenter.



Example of the use of postural video to position the body (observe the thumb).

#### Treatment

The treatment starts from the head and the couch movement is only longitudinal between the isocenters. The SGRT reference captures are used to verify that the patient still is in the correct position after couch movement. SGRT is used with beam control, i.e. the beam will stop if the patient moves outside tolerance.

### Results and discussion

The use of AlignRT for VMAT TBI makes the setup time shorter and especially the positioning of extremities more accurate using the postural video function. Since the couch is moved several times during treatment the reference captures assures that the patient is still in its correct position verified by CBCT. Monitoring the patient during treatment gives a safer beam delivery as the beam will stop if the patient is outside tolerance.



Whole body phantom used for training, positioned in vacuum shell feet first supine.

