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SGRT & Liver SABR

Orla McKivitt
SABR/SRS Clinical Specialist
Cork University Hospital

Aims

- Cork University Hospital's journey with Vision RT
- Liver SABR and AlignRT
- Motion management in Liver SABR using AlignRT
- Challenges faced

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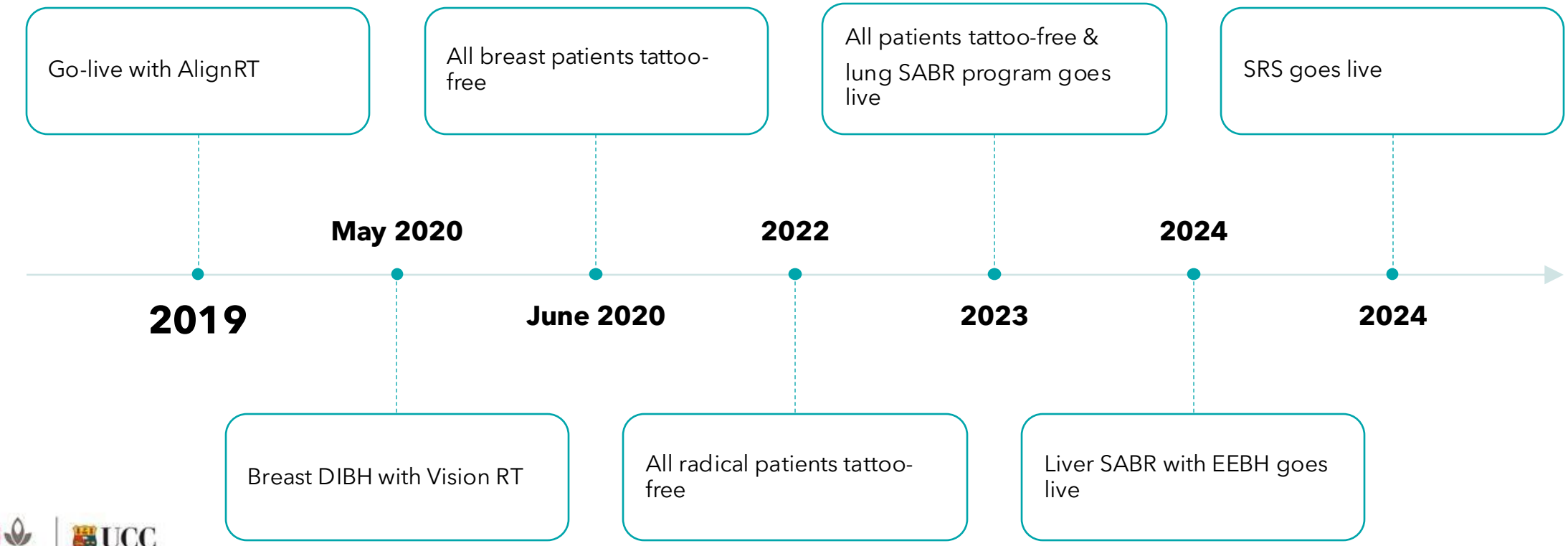
CUH and Vision RT



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Liver SABR

- Meetings began in 2023
- Radiation Therapists were confident that Vision RT could play a role in motion management for these patients
- No published evidence for the use of SGRT in treating abdominal cancer patients in end-expiration breath-hold (EEBH)
- CUH has over 5 years' experience with Vision RT and did not want to introduce a new system
- But there were concerns from the wider MDT

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ABC

- CUH had used it in the past, but new systems would be required
- Issues previously with patient compliance
- Extra QA daily
- More computer terminals for RTs to monitor
- Staff training
- Publications supporting its use

RPM

- Elekta department
- Staff training
- QA
- Publications supporting its use

So Why Not Use AlignRT?

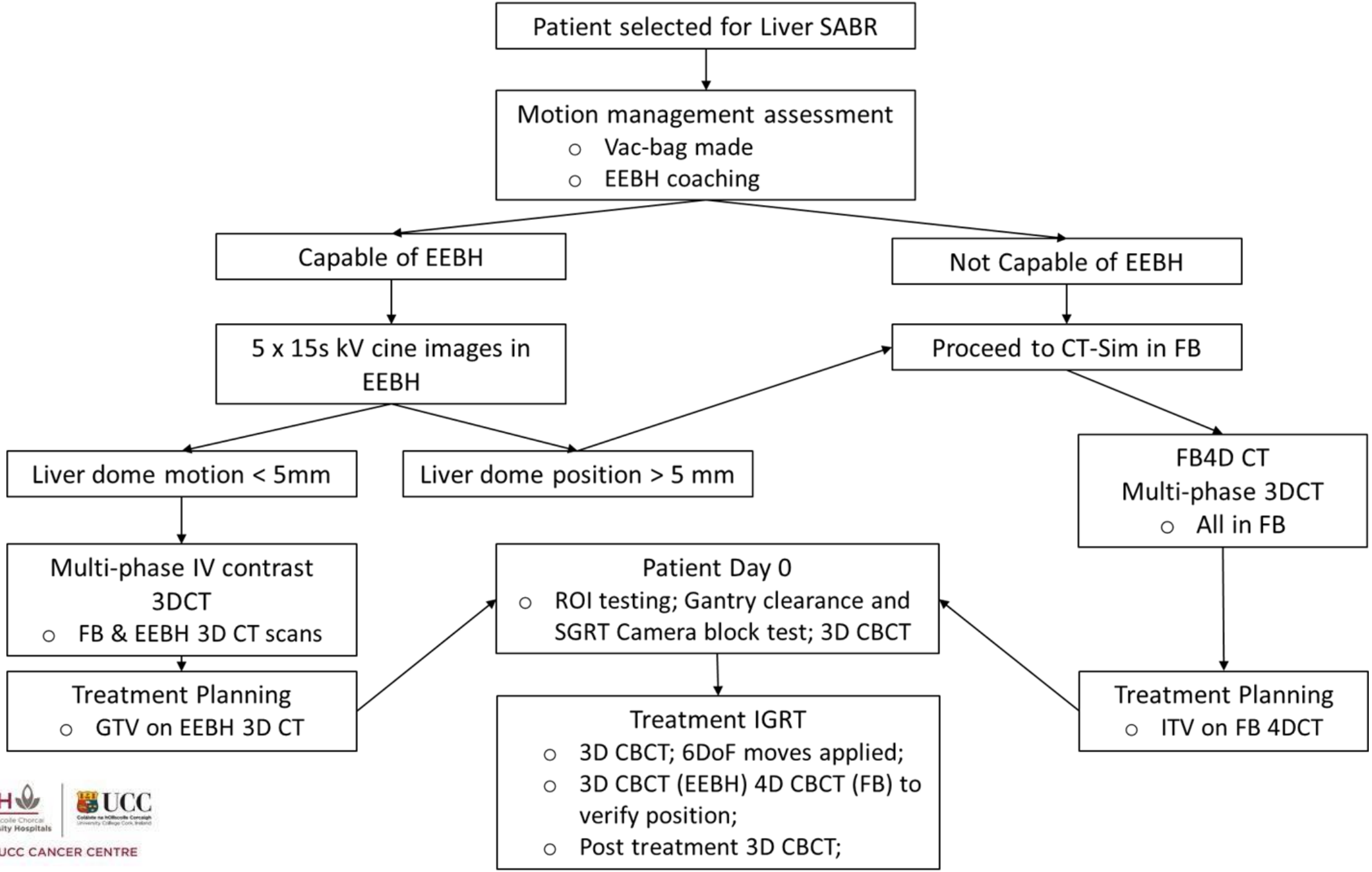
- Limited published data
- No other centre in Ireland, UK or US using AlignRT alone for EEBH in abdominal SABR
- Many technical aspects needed to be considered
- Staff training
- Accuracy

But....

- CUH have lots of experience with AlignRT
- Very successful in breast and thorax DIBH
- No cost to the department
- Only some training for RTs
- AlignRT linked us with The Alfred Hospital in Melbourne

Considerations

- Monitoring Tolerances
- Region of Interest (ROI's)
- Camera Block
- CT-simulation- tracking patch/capture
- Multi-phase IV contrast for CT simulation
- CBCT acquisition
- Capture quality
- Implementing Moves



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Motion Assessment

Vac bag is made

A generic SGRT patient was created to allow for the patients surface to be captured

5x kV cine images are acquired for 15 seconds while the patient maintains EEBH as indicated on the AlignRT terminal

Any liver dome motion seen on the images is documented

If within tolerance the patient proceeds to CT-simulation in EEBH

If motion is out of tolerance the patient proceeds in Free-breathing

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CT-Simulation Workflow

Patient Set-Up

The patient is positioned in a full-body vac-bag with a knee support, replicating their motion assessment position. Arms can be placed either up or down depending on the patients ability.

Free-Breathing CT

A free-breathing 3D CT scan is first acquired while the patient's breathing trace is monitored on SGRT. IVC is injected 40 seconds prior to the scan begins. This is a late arterial phase scan.

EEBH CT- HCC only

A second EEBH 3D CT scan is performed post IVC injection for HCC patients only. Scan borders are set, and the patient is coached into EEBH. This delayed venous phase scan is performed 6-minutes after IVC injection.

Challenges

If the patient does not achieve the correct EEBH and several attempts need to be made, the optimal timing for the portal venous & delayed phase scan may be missed.

Contrast enhancement can vary between patients. Bolus tracking which monitors IVC flow by measuring the Hounsfield unit in the aorta can be used to improve IVC enhancement by triggering the scan at the correct time. While it can improve scan quality, its integration with SGRT and EEBH adds complexity.

SGRT Capture

A surface capture of the patient is obtained, and the SGRT tracking patch is placed on the xiphisternum (see Fig. 1). The patient is educated and coached into EEBH, performing multiple practice breaths. A minimum EEBH duration of 15 seconds is required. The patient may use the SGRT coaching screen to aid them in achieving the same BH amplitude.

EEBH CT

CT scan borders are set, and a new SGRT surface capture is obtained. The patient is coached to achieve the predefined EEBH amplitude before the scan is acquired. This portal venous phase scan is performed 70 seconds after IVC injection.

Planning

Planning is performed on either of the EEBH scans, while the arterial phase scan can assist with delineation. The free-breathing patient surface is necessary for patient setup with SGRT.

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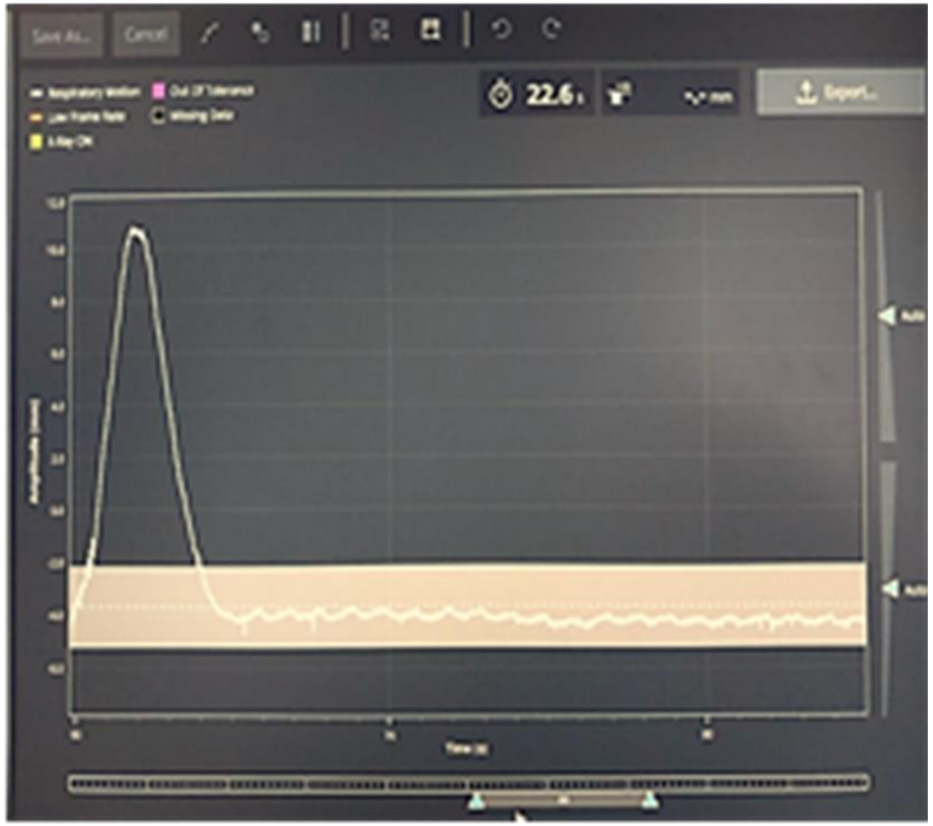
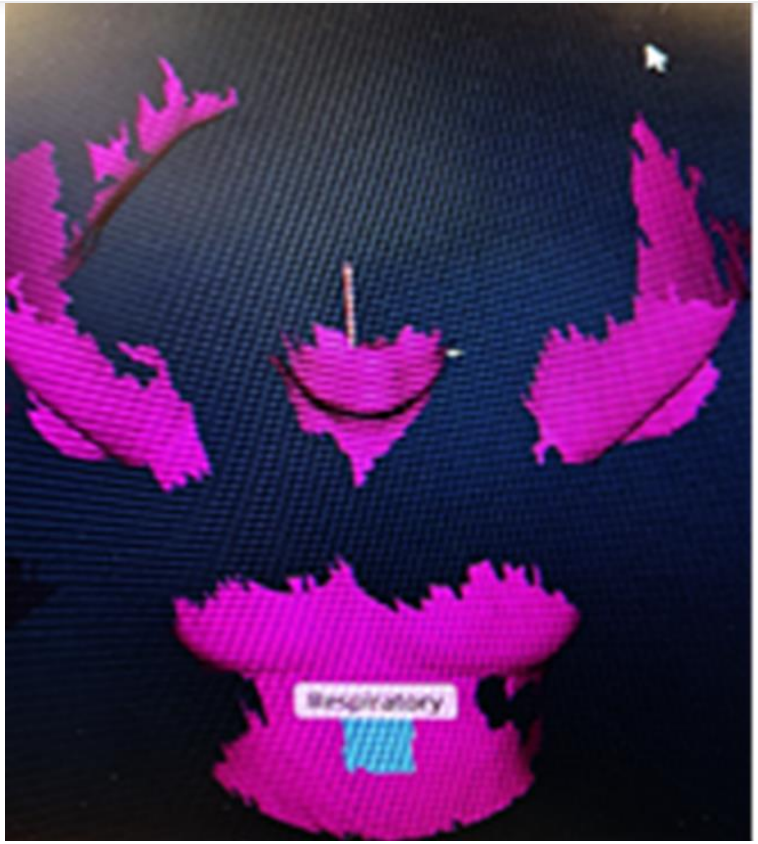
CT-Simulation- EEBH





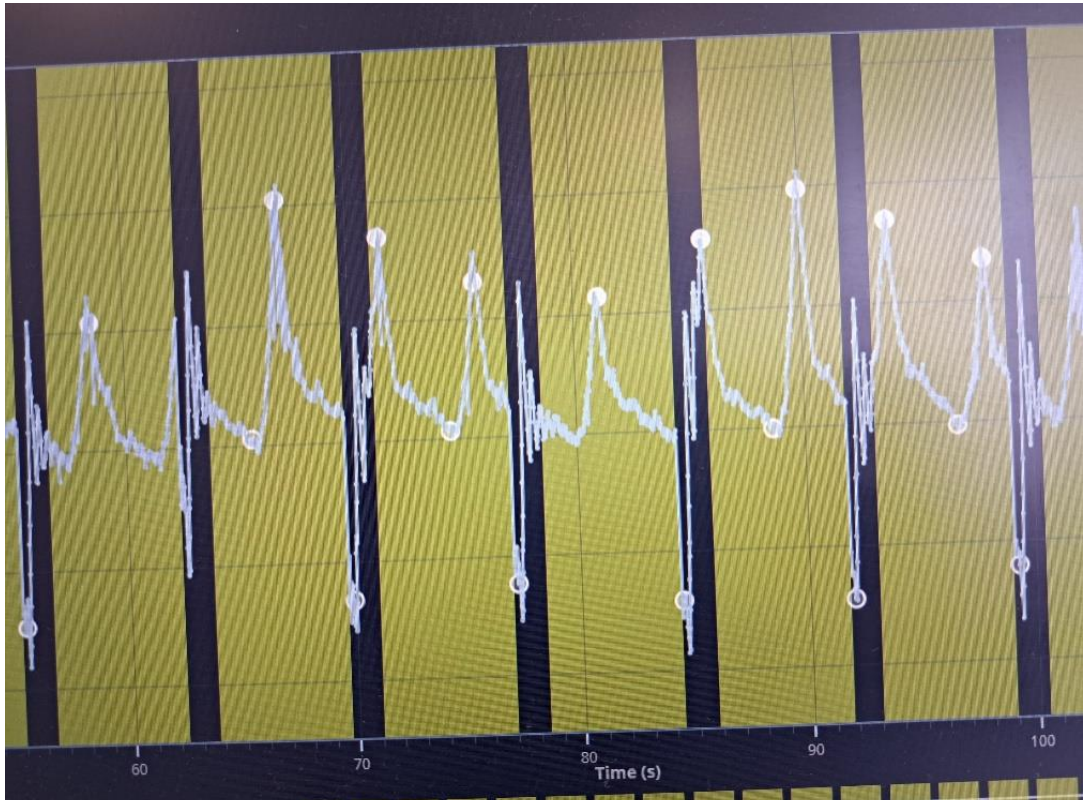
Free-Breathing pathway

- Sim-RT surface capture taken
- Tracking patch placed on xiphisternum
- Patients coached into a shallow regular breath
- 4D CT scan acquired
- Multi-phase 3D CT acquired in free-breathing

CT-Simulation- Free-Breathing

Instagram
(Physics)

Reality
(RT's)



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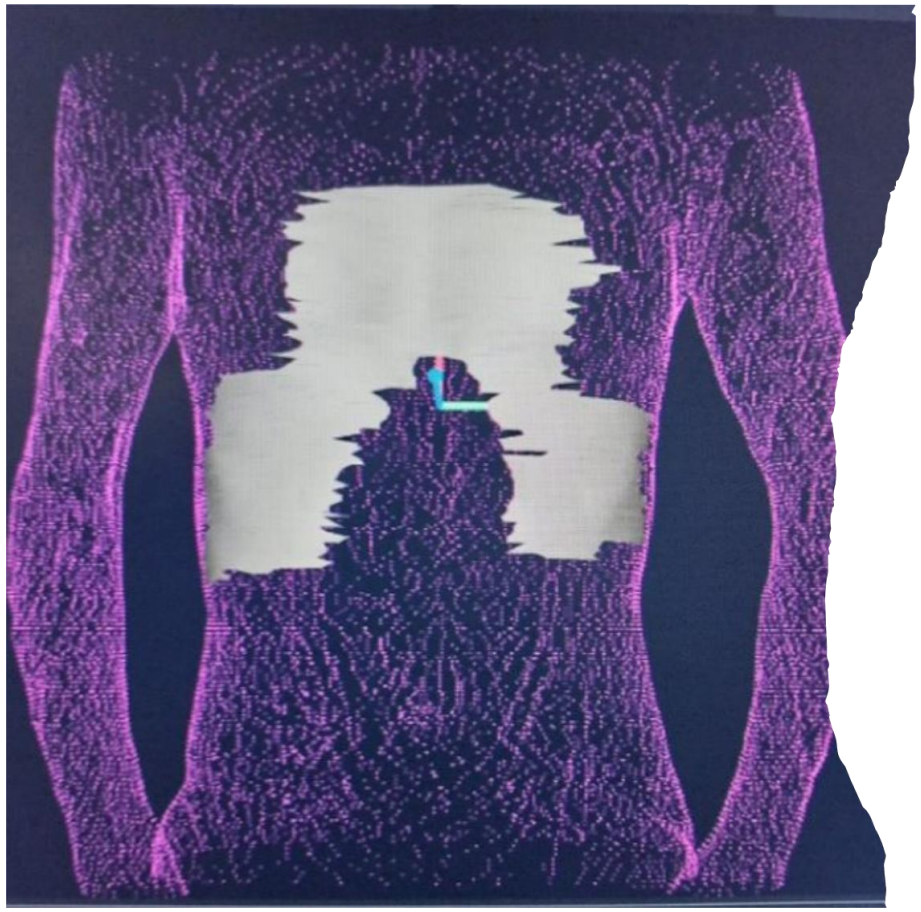

- Dummy run of treatment
- ROI's tested
- Camera block angles noted
- Clearance checked
- EEBH practice
- CBCT acquired

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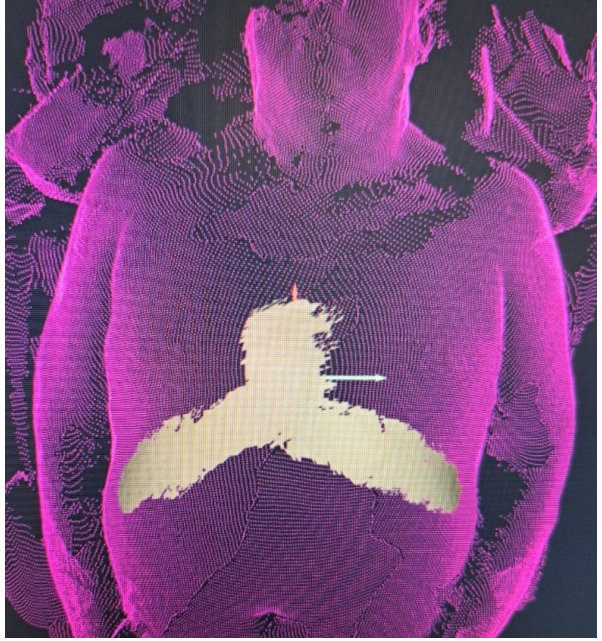
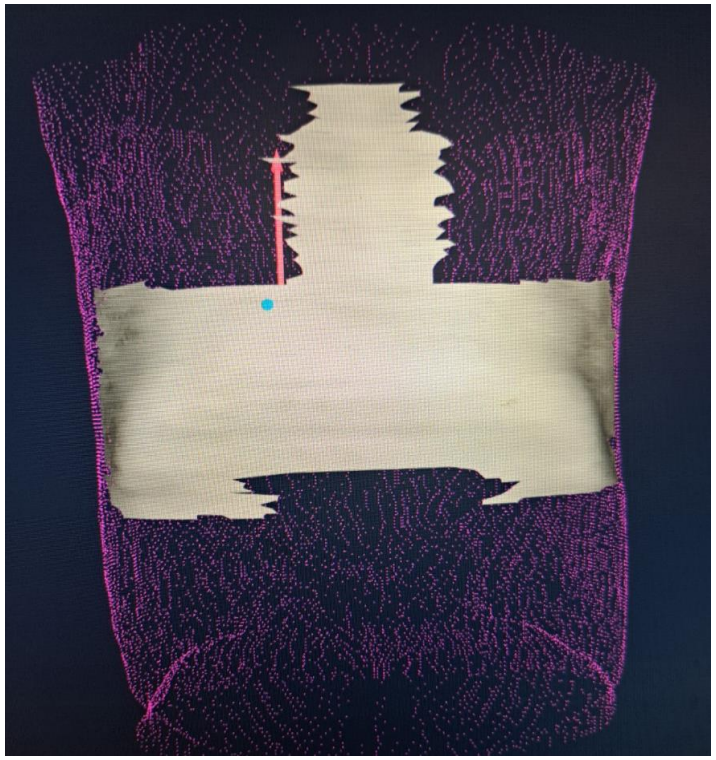
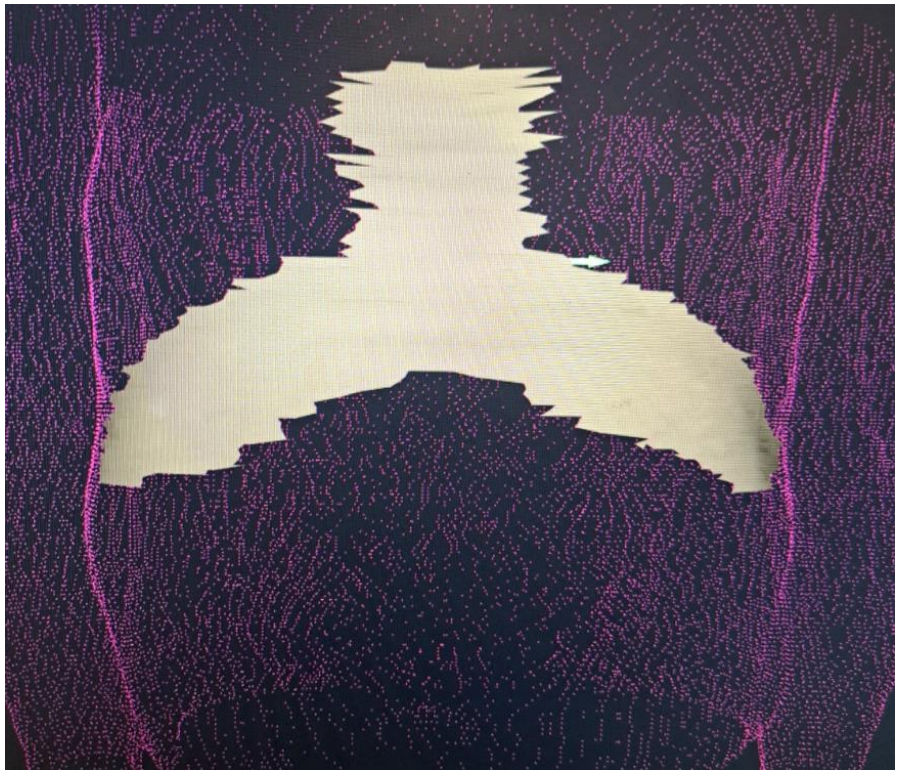
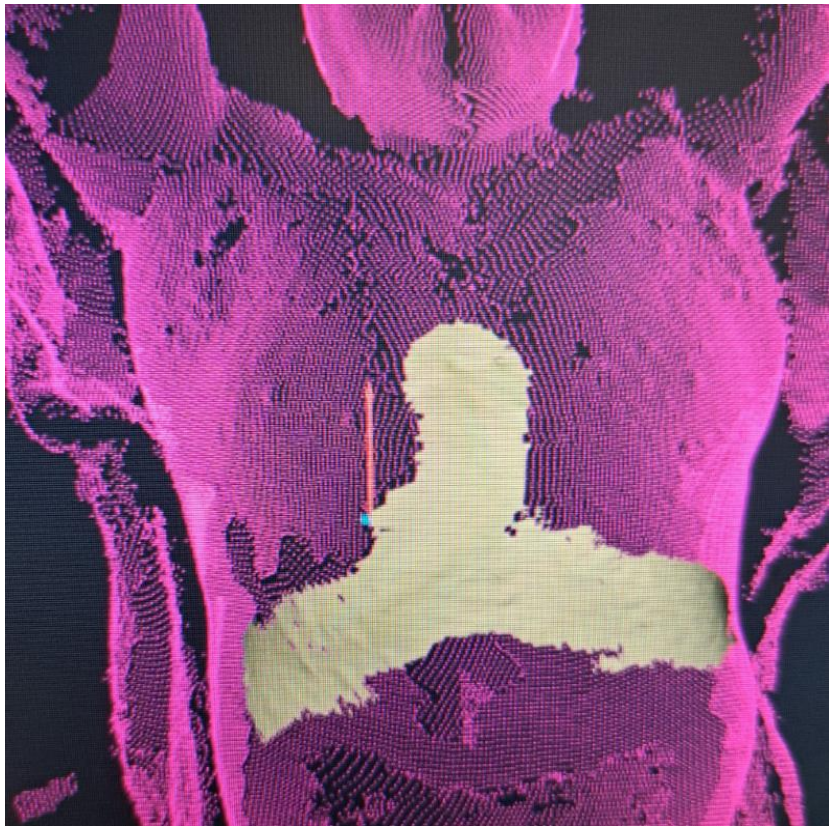
Customise your ROI's









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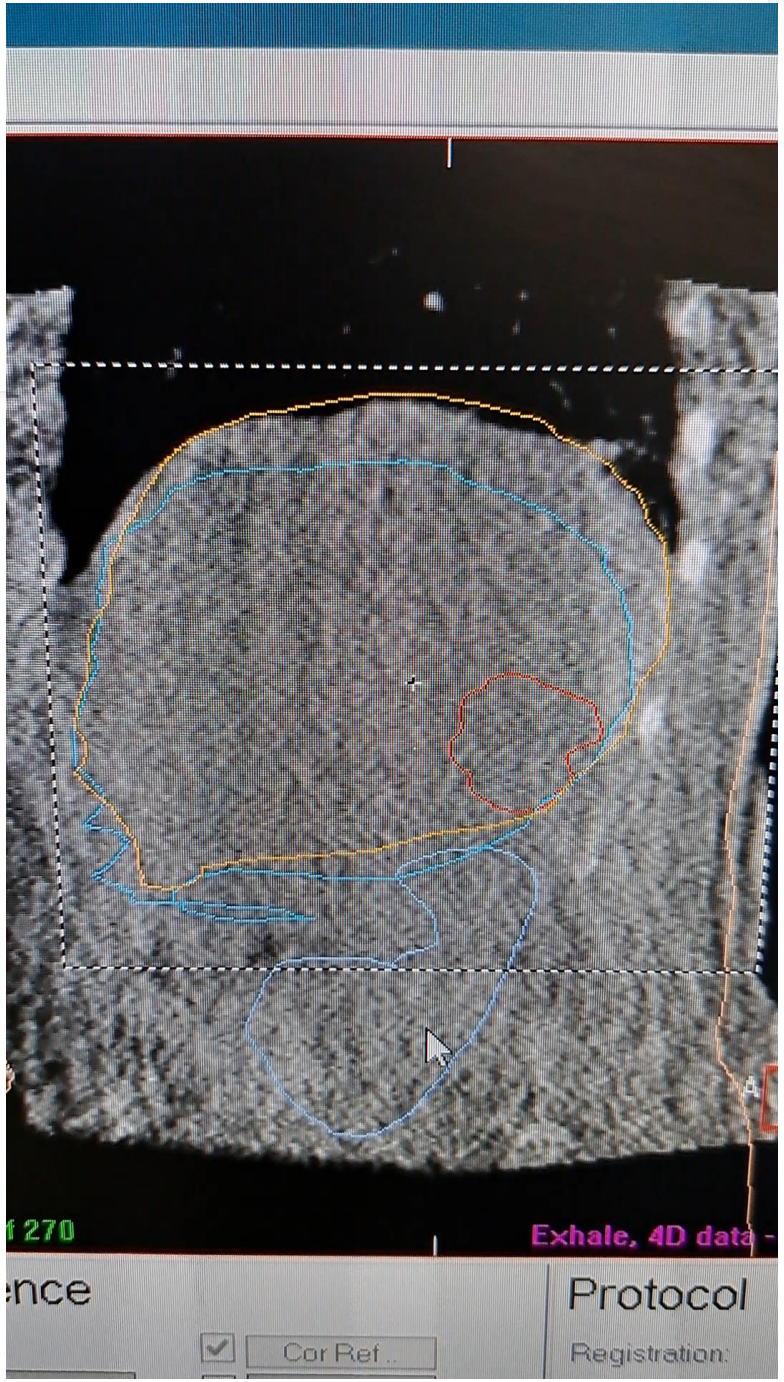
Treatment- EEBH

- Set up as per CT-Simulation
- 3D CBCT taken in EEBH
- Image registration performed
- Patient coached into EEBH monitored by Vision RT console
- All moves applied in 6 degrees of freedom & new surface capture taken
- Confirmation 3D CBCT taken in EEBH & treatment position confirmed
- Treatment delivered
- Post treatment CBCT acquired for first 5 patients to validate pathway

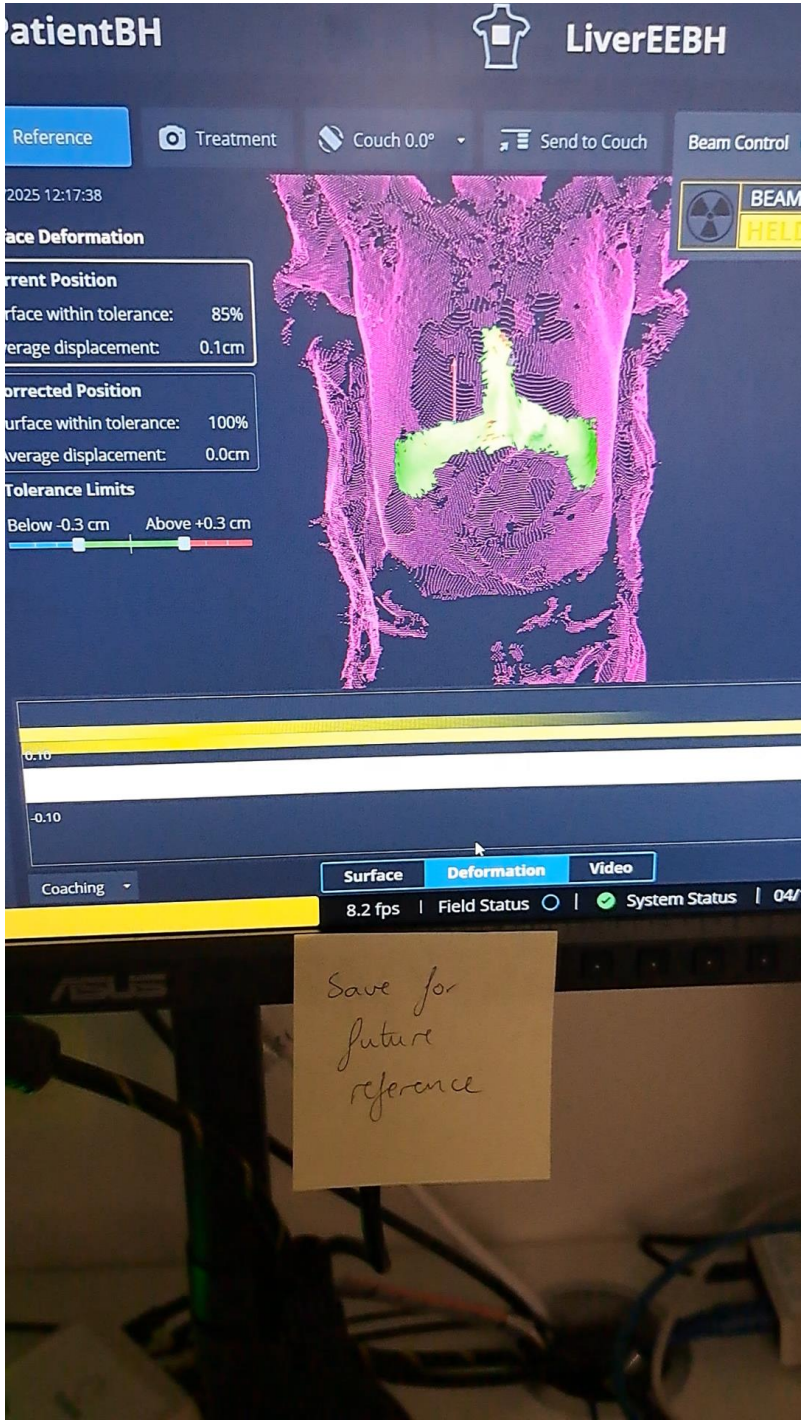
Treatment- Free-Breathing

- Set up as per CT-Simulation
- 3D CBCT taken in FB as monitored on SGRT (2mm and 2 degree tolerances)
- Image registration performed
- All moves applied in 6 degrees of freedom & new surface capture taken
- Confirmation 4D CBCT taken
- Treatment delivered



Deformation Tool

- Can identify breathing type
- Shows areas where there are errors



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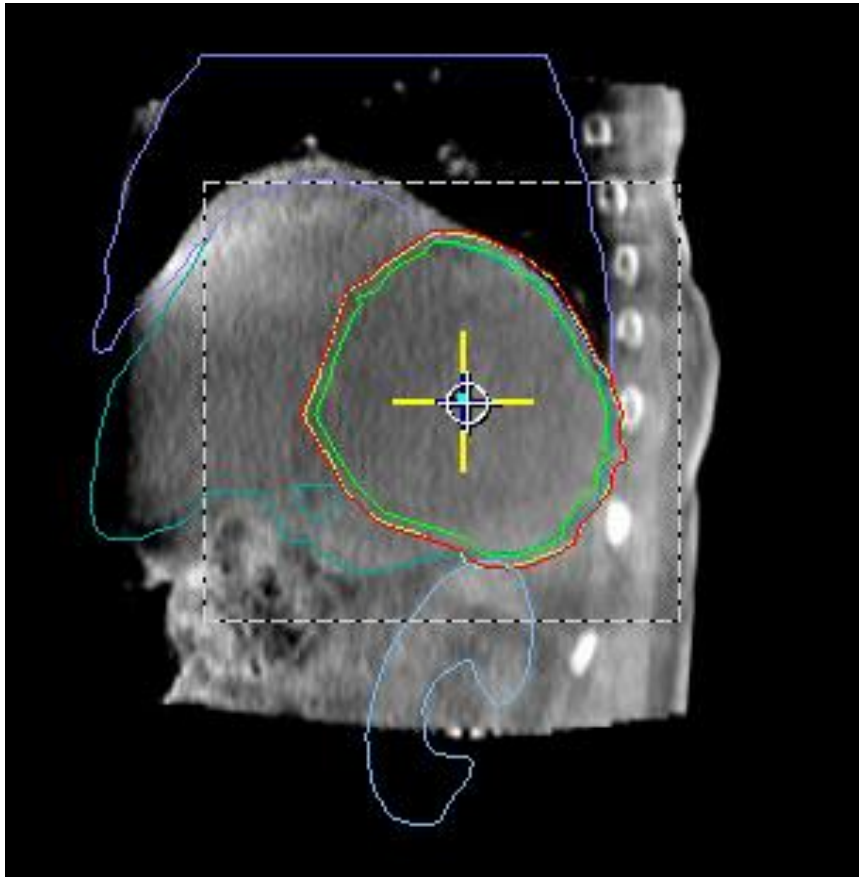
Challenges

- Breathing type
- ROIs
- Applying shifts in 6 DoF
- Camera Block
- Coaching training



Successful Implementation

- To date we have treated **19 liver SABR** patients in EEBH
- We aim to publish our reproducibility data next year, but preliminary results show across all CBCTs we have analysed, the absolute mean intrafraction difference in the S/I position of the diaphragm was 0.17 cm ± 0.15 cm

Thank You to the SABR team in
Cork University Hospital and
thank you for listening

References

- Dawson LA, Eccles C, Bissonnette J-P, Brock KK. Accuracy of daily image guidance for hypofractionated liver radiotherapy with active breathing control. International Journal of Radiation Oncology*Biology*Physics. 2005 Jul;62(4):1247–52. doi:10.1016/j.ijrobp.2005.03.072
- Brown E, Muscat E, O'Connor P, Liu H, Lee Y, Pryor D. Intrafraction cone beam computed tomography verification of breath hold during liver stereotactic radiation therapy. Journal of Medical Radiation Sciences. 2020 Oct 6;68(1):52–9. doi:10.1002/jmrs.441
- Lawler G. A review of surface guidance in extracranial stereotactic body radiotherapy (SBRT/SABR) for set-up and intra-fraction motion management. Technical Innovations&Patient Support in Radiation Oncology. 2022 Mar;21:23 doi:10.1016/j.tipsro.2022.01.001
- Heinzerling JH, Hampton CJ, Robinson M, Bright M, Moeller BJ, Ruiz J, et al. Use of surface-guided radiation therapy in combination with IGRT for setup and intrafraction motion monitoring during stereotactic body radiation therapy treatments of the lung and abdomen. Journal of Applied Clinical Medical Physics. 2020 Mar 20;21(5):48–55. doi:10.1002/acm2.12852
- Naumann P, Batista V, Farnia B, Fischer J, Liermann J, Tonndorf-Martini E, et al. Feasibility of optical surface-guidance for position verification and monitoring of stereotactic body radiotherapy in deep-inspiration breath-hold. Frontiers in Oncology. 2020 Sept 25;10. doi:10.3389/fonc.2020.573279