Over 10 years with SGRT; from single system to every linac

Marina Khan

RT R&D Lead Radiographer

Christopher Thomas

RT Principal Clinical Scientist

Presentation Outline

- History of SGRT at Guy's and St. Thomas'
- Implementation
- Acceptance, Commissioning, QC
- Use Cases
  - Breast DIBH
  - Lymphoma DIBH
  - SRS
  - PM free for breast and Lymphoma
  - Limbs
  - Cardiac SABR
- Postural Video 2024
- Future Developments
- Summary

Guy's and St Thomas' Radiotherapy

- **Serving a total population of 2.6 million**
- **2 Hospital sites**
  - Guy's
  - Queen Mary's (satellite)
- **9 Varian TrueBeam linacs**
- **9 AlignRT systems**
- **1 Flexitron HDR**
- **1 Xstrahl**
- **3 GE CT scanners**

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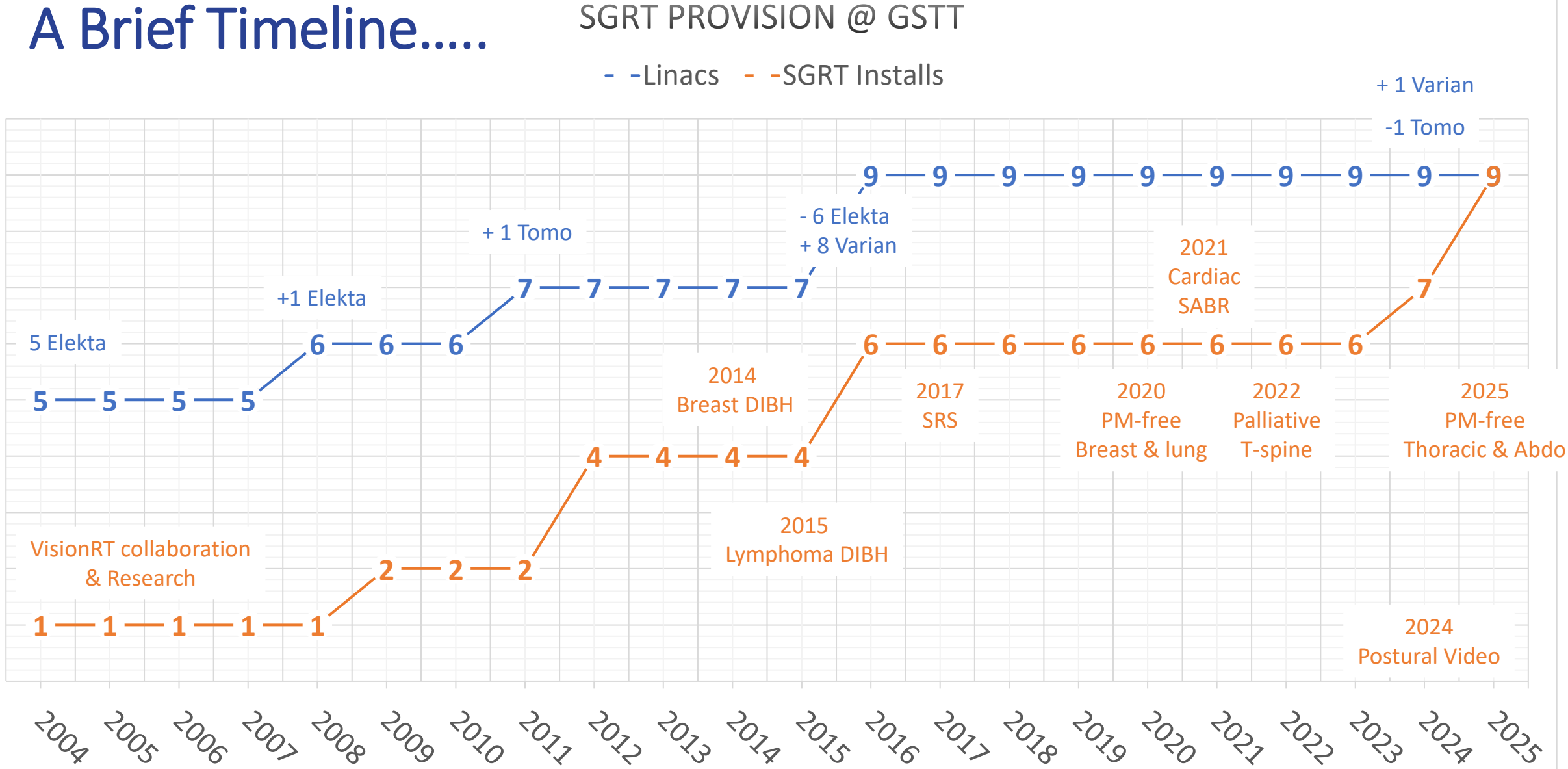
Guy's Cancer

A Brief Timeline.....



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Implementation

Governance

Finance

Documentation

Training

Roll out to SoC

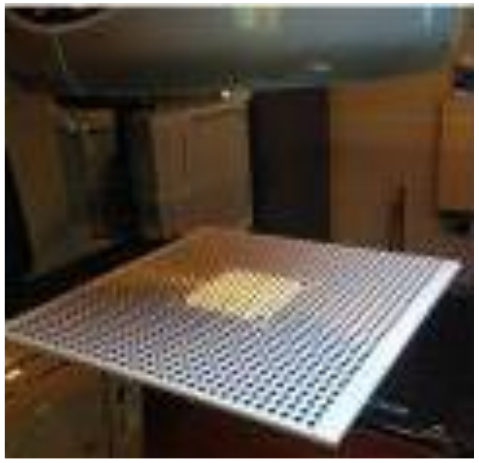
Guy's Cancer Charity

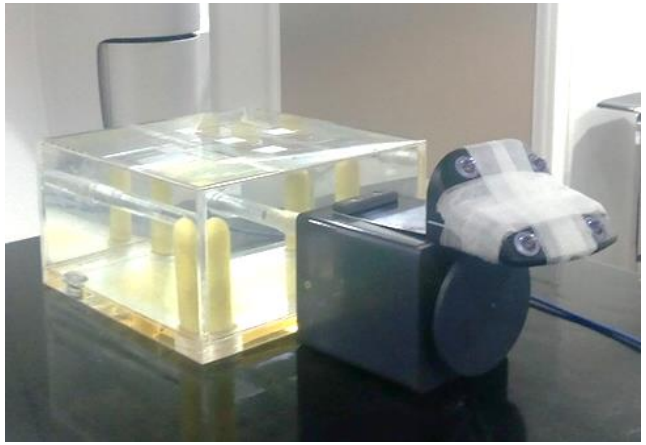
Acceptance, commissioning , QC

Install	• 3 x cameras, cabling, power • Ancillary equipment, server, user workstation
Connectivity	• Treatment planning system, treatment unit • Server, UPS
User Configuration	• User accounts (clinical, admin, physics ..) • Skin tone settings, lighting, clinical site tolerances
Acceptance	• VisionRT User Acceptance Testing • Connectivity
Commissioning	• Spatial accuracy, temporal accuracy, gating accuracy • full end to end test

Routine QC (@ GSTT)

Daily	• System run-up (camera switch-on) • Calibration check
Fortnightly	• AlignRT to MV isocentre verification (SRS machine)
Quarterly	• Gating and Monitoring • Spatial accuracy and shifts





Breast DIBH

Clinical in 2014 at St Thomas

One of the first centres to treat with DIBH

2 linacs had clinical SGRT

2 sets of data

- At set up position in free-breath.
- At ISO in DIBH.

Changed process with experience and confidence

Individual site specific training and competencies

No MMI (no automated beam-hold)

Lymphoma DIBH

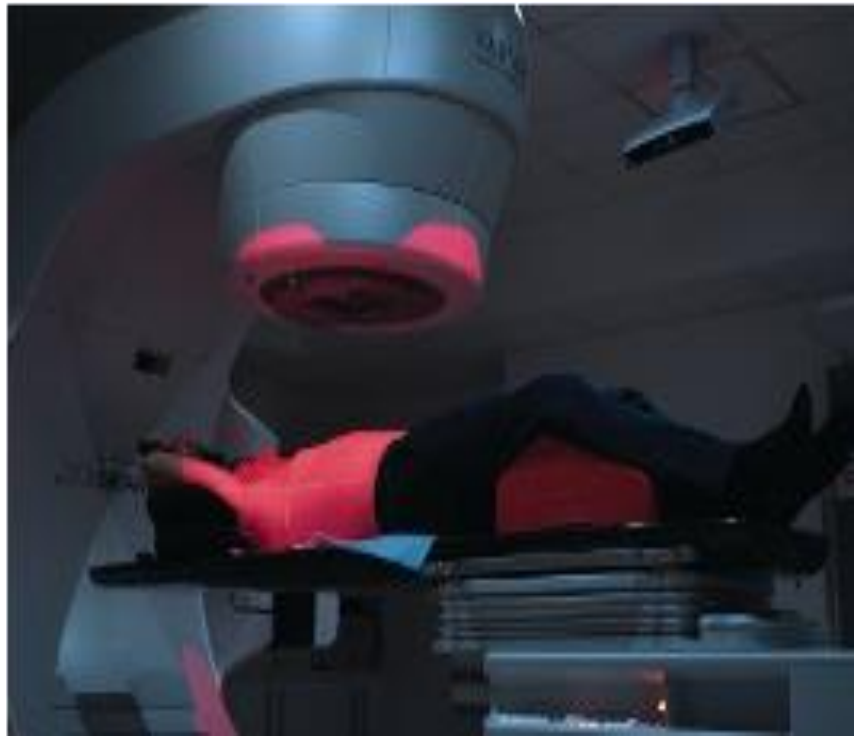
Clinical in 2015 at St Thomas'

2 linacs had clinical SGRT

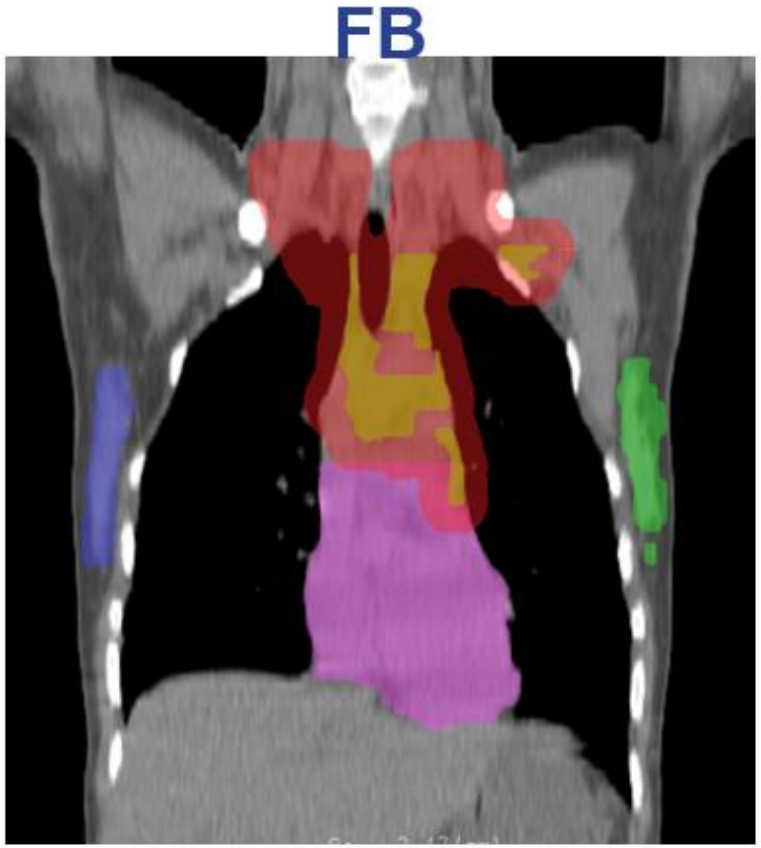
Changed process moving to the cancer centre

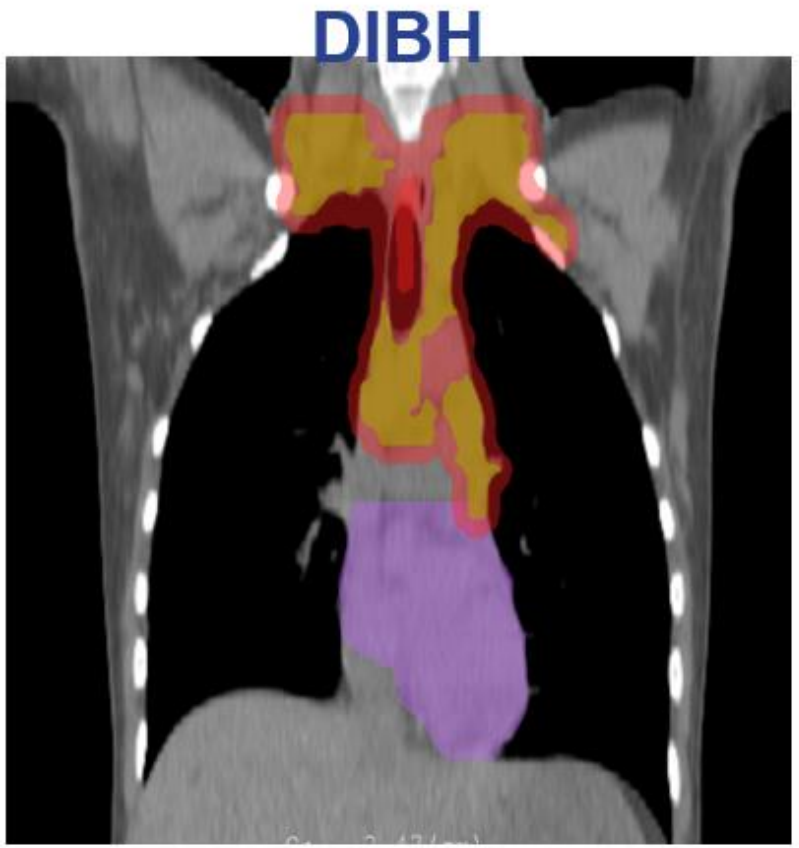
Butterfly Lymphoma technique

Individual site specific training and competencies



Lymphoma DIBH – PTV reduction and OAR position





DIBH

- allows stable anatomy
- allows OARs to move away from target region

SGRT

- Allows accurate DIBH setup due to good correlation between surface and internal anatomy
- Allows confident DIBH monitoring

DIBH and SGRT

- allowed PTV margin reduction from 10mm to 5mm
- gives reduction of OAR doses

Stereotactic Radiosurgery

Motion monitoring

Sub-millimetre accuracy

Challenges

Couch rotation

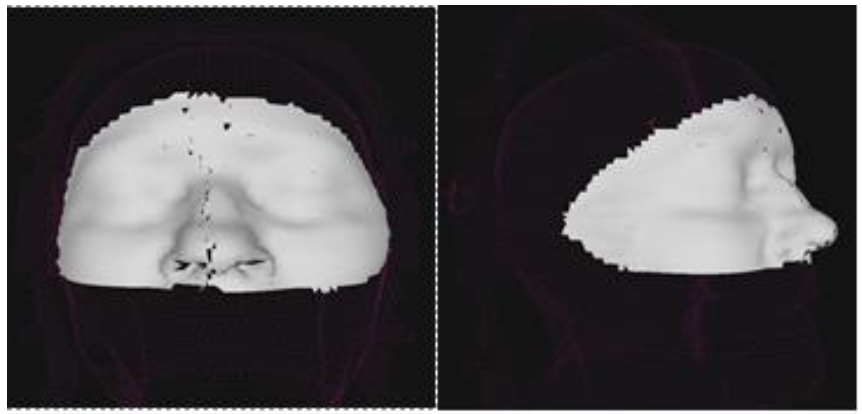
Small ROI

Blocked cameras

Solutions

No MMI on G6

(no auto beam-hold)



Benefits:

Patients

Accurate treatment delivery

Less set up issues=less time on the couch

Staff

Faster set up

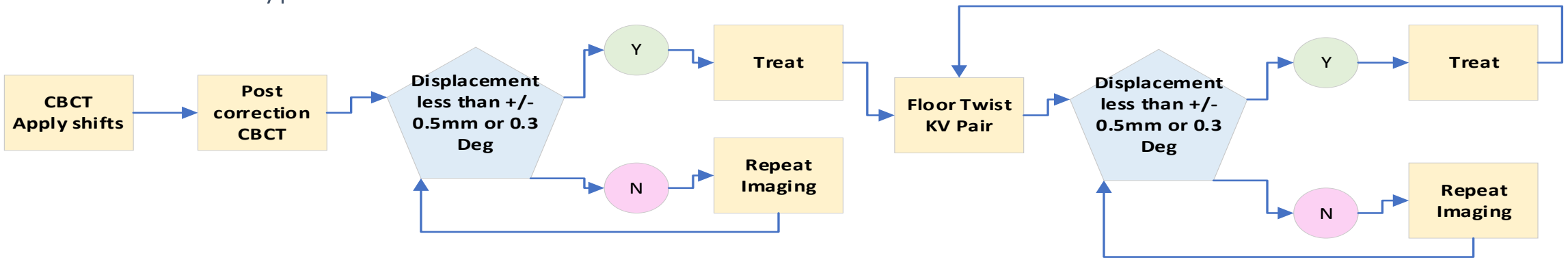
Reassurance of accurate treatment delivery

Stereotactic Radiosurgery

220 SRS patients in past year

13 day pathway

Recent move to Hyperarc treatment



No additional imaging on the last treatment field for 60% patients

Case Study

Patient with Parkinson's disease

Made shell then monitored movement on Align RT prior to any pre-treatment imaging

Patient unsuitable of radiotherapy as moving too much.

Improved workflow, reduced unnecessary workload and improved patient outcome.

From DIBH to PM Free

Opening of the Cancer Centre –> Processes Evaluated

Considerations

- Couch movements for CBCTs
- Interruption of CBCT
- PM free set ups
- Butterfly Lymphoma Technique

Governance processes for implementation

Training process revisited and optimised

Documentation

- Consent
- Patient Information Leaflets
- Work Instructions, Training and Competencies Separated

From DIBH to PM Free – Patient Benefit

No permanent marks as a reminder

Reduced cardiac toxicity

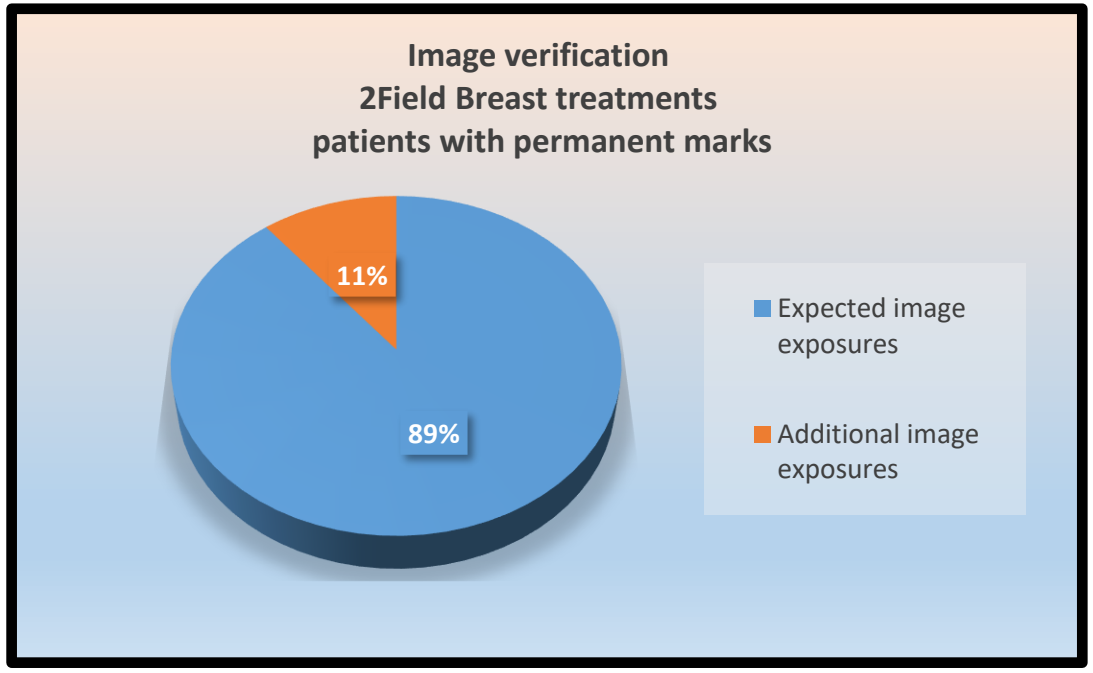
Fewer set up issues = less time on the couch

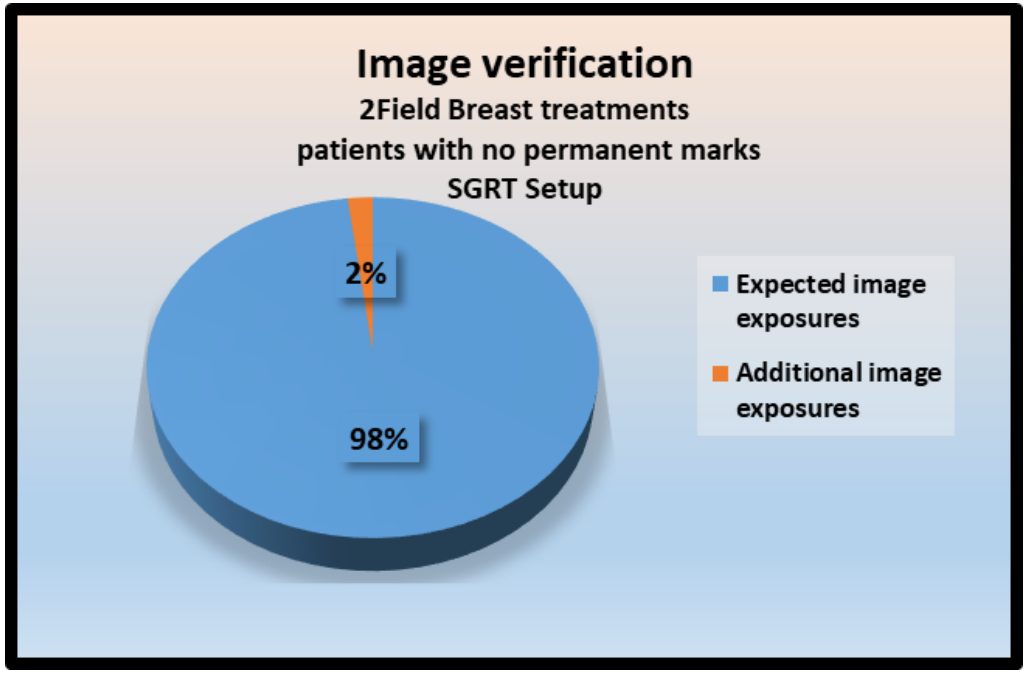
Less dose from imaging

“I was really pleased to find out I wouldn’t be left with tattoo marks as the last thing you want is to be reminded of your cancer all the time. When lots of women have radiotherapy they have already undergone chemotherapy and may be struggling with hair loss and other side effects so this is one less thing to worry about.”

From DIBH to PM Free – Benefits to the Patient

Reduced on-set Imaging





From DIBH to PM Free – Benefits to the Staff

Less manual handling
Reduced paperwork (fewer/no systematic corrections)
Faster set up
Problem solving tool
Contour change

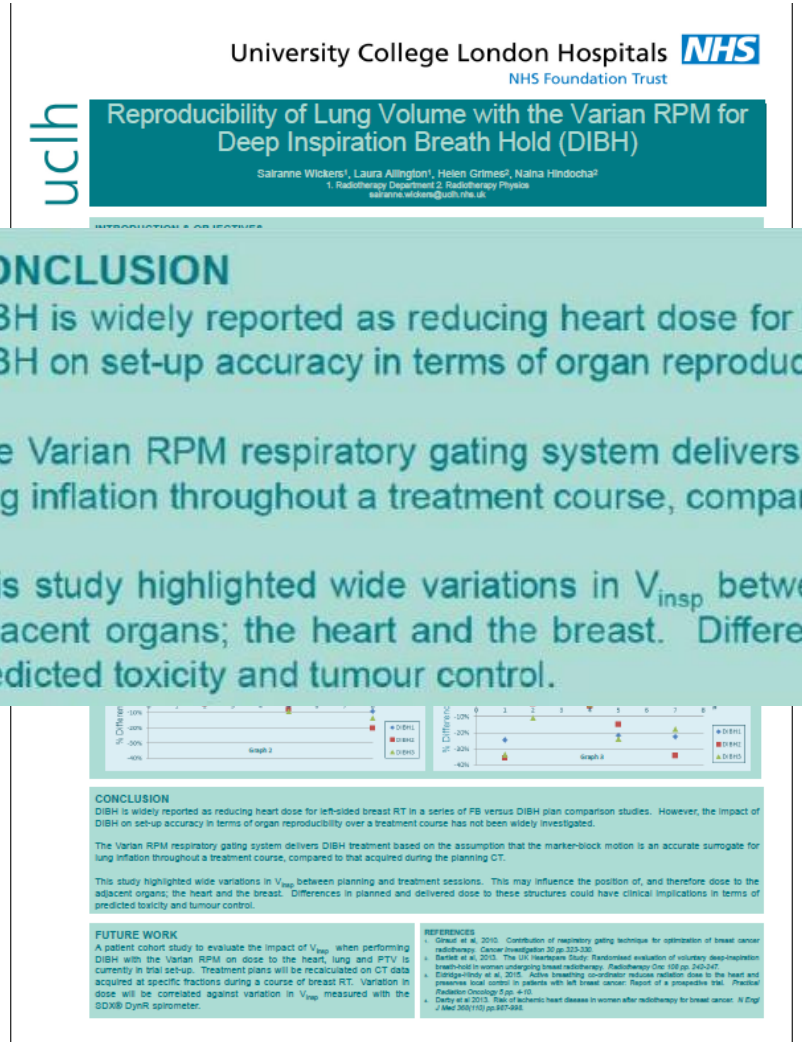
Efficiency Savings at Guys Cancer Centre

Treatment code	Average PM technique (Mins)	Average PM Free technique (mins)	Difference
CT Breast	34.12	25	9.12
CT DIBH Breast	40.5	39.6	0.9
breast Tans	14.77	13.09	1.68
DIBH breast Tans	16.94	16.93	0.01
Breast + SCF & +/- Post axilla	18.17	16.88	1.29
DIBH Breast + SCF & +/- Post axilla	23.26	22.78	0.48
Breast 5# + CBCT	24.37	18.9	5.47
DIBH Breast 5# + CBCT	27.67	20.35	7.32
Photon Boost	20.1	15.58	4.52
DIBH Photon Boost	23.56	27.03	-3.47

From DIBH to PM Free – Benefits cont. – staff survey

	Yes	No	No different / undecided
Do you find setting Patients up using Align RT **easier** than a conventional set up with tattoos?	**22 (84 %)**	**2 (8%)**	**2 (8%)**
Do you find setting Patients up using Align RT **quicker** than a conventional set up with tattoos?	**24 (92%)**	**2 (8%)**	**0**
Do you think setting Patients up using Align RT is more **accurate** than a conventional set up with tattoos?	**20 (77%)**	**3 (11.5%)**	**3 (11.5%)**
Would you be happy to treat DIBH patients without Align RT?	**6 (23%)**	**17 (65%)**	**3 (12%)**

From DIBH to PM Free – Reproducibility Lung Volume



University College London Hospitals NHS
NHS Foundation Trust

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Reproducibility of Lung Volume with the Varian RPM for Deep Inspiration Breath Hold (DIBH)

Sairanne Wickers[1], Laura Allington[1], Helen Grimes[2], Naina Hindocha[2]
1. Radiotherapy Department 2. Radiotherapy Physics
sairanne.wickers@uclh.nhs.uk

CONCLUSION

DIBH is widely reported as reducing heart dose for left-sided breast RT in a series of FB versus DIBH plan comparison studies. However, the impact of DIBH on set-up accuracy in terms of organ reproducibility over a treatment course has not been widely investigated.

The Varian RPM respiratory gating system delivers DIBH treatment based on the assumption that the marker-block motion is an accurate surrogate for lung inflation throughout a treatment course, compared to that acquired during the planning CT.

This study highlighted wide variations in V_{insp} between planning and treatment sessions. This may influence the position of, and therefore dose to the adjacent organs; the heart and the breast. Differences in planned and delivered dose to these structures could have clinical implications in terms of predicted toxicity and tumour control.

FUTURE WORK

A patient cohort study to evaluate the impact of V_{insp} when performing DIBH with the Varian RPM on dose to the heart, lung and PTV is currently in trial set-up. Treatment plans will be recalculated on CT data acquired at specific fractions during a course of breast RT. Variation in dose will be correlated against variation in V_{insp} measured with the SDX® DynR spirometer.

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2. Bartlett et al. 2013. The UK Heartspare Study: Randomised evaluation of voluntary deep-inspiration breath-hold in women undergoing breast radiotherapy. *Radiotherapy Onc* 108 pp. 242-247.
3. Eldridge-Hindy et al., 2015. Active breathing co-ordinator reduces radiation dose to the heart and preserves local control in patients with left breast cancer: Report of a prospective trial. *Practical Radiation Oncology* 5 pp. e-10.
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UCLH presented a Poster at ESTRO 2015

study used the RPM® system on 15 staff volunteers

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Guy's Cancer

From DIBH to PM Free – Reproducibility Lung Volume

Original Research Article

Reproducibility of surface-based deep inspiration breath-hold technique for lung

ORLAM's group published paper presented in phiRO 2021

Conclusions

Lung SBRT in DIBH with the ring-mounted SGRT system proved reproducible. The surface monitoring provided by SGRT was found to be a reliable surrogate for internal target motion. Moreover, the implementation of DIBH technique helped reduce target volumes and lung doses.

ld

tumour within 1.5 mm and 1.5°

Limbs

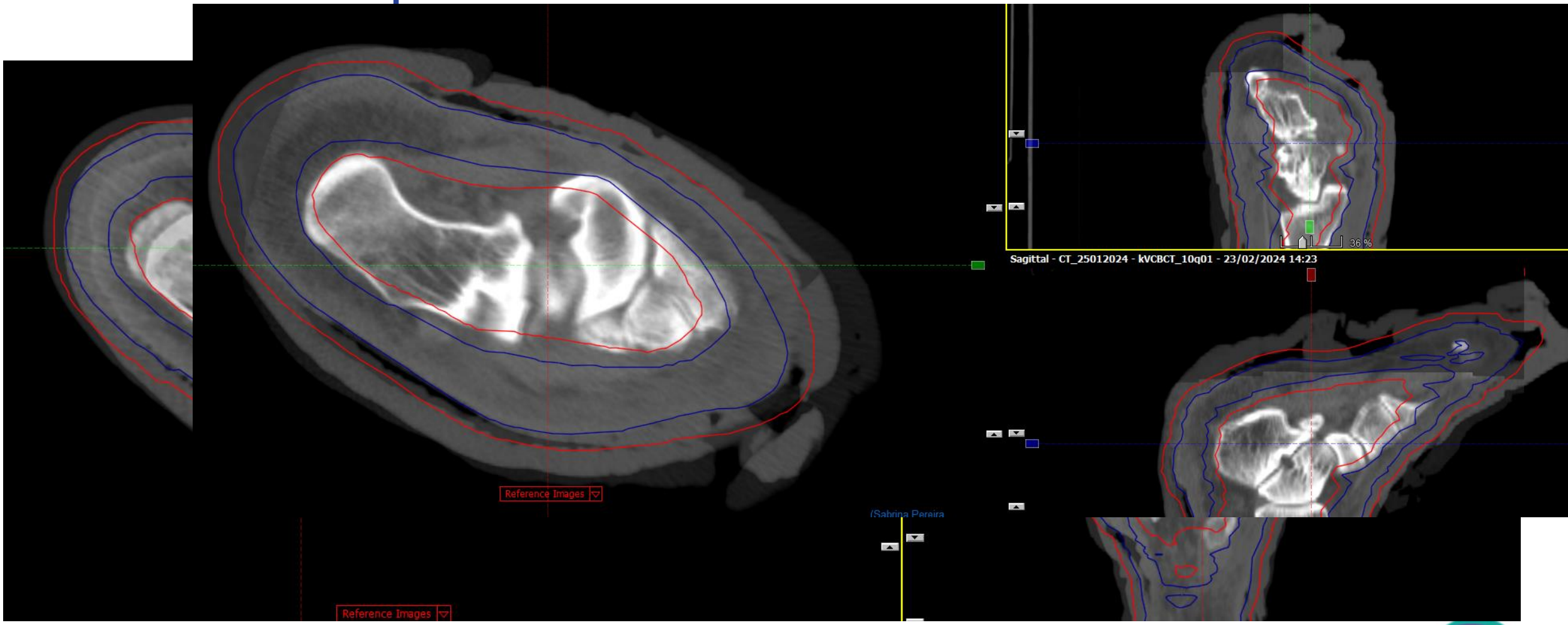
Often challenging to set up

Lengthy PTVs

Have been using AlignRT sporadically for limbs since 2016

Always improves set up

Difficult Set Ups - Limbs



Cardiac SABR

Set Up

Motion Monitoring

Re-set up

Used RPM for gating

Initial challenge

- Mosaiq & TrueBeam Interface
- No online 4D-CBCT

Benefits to the patient

- Accurate treatment delivery
- Less time on the couch (patients with limited mobility and high performance status)

Benefits to the staff

- Faster set up
- No need to reset up
- Less manual handling
- Reassurance of accurate treatment delivery

Palliative Spine Set Ups

Started with T-Spine

Aid set up

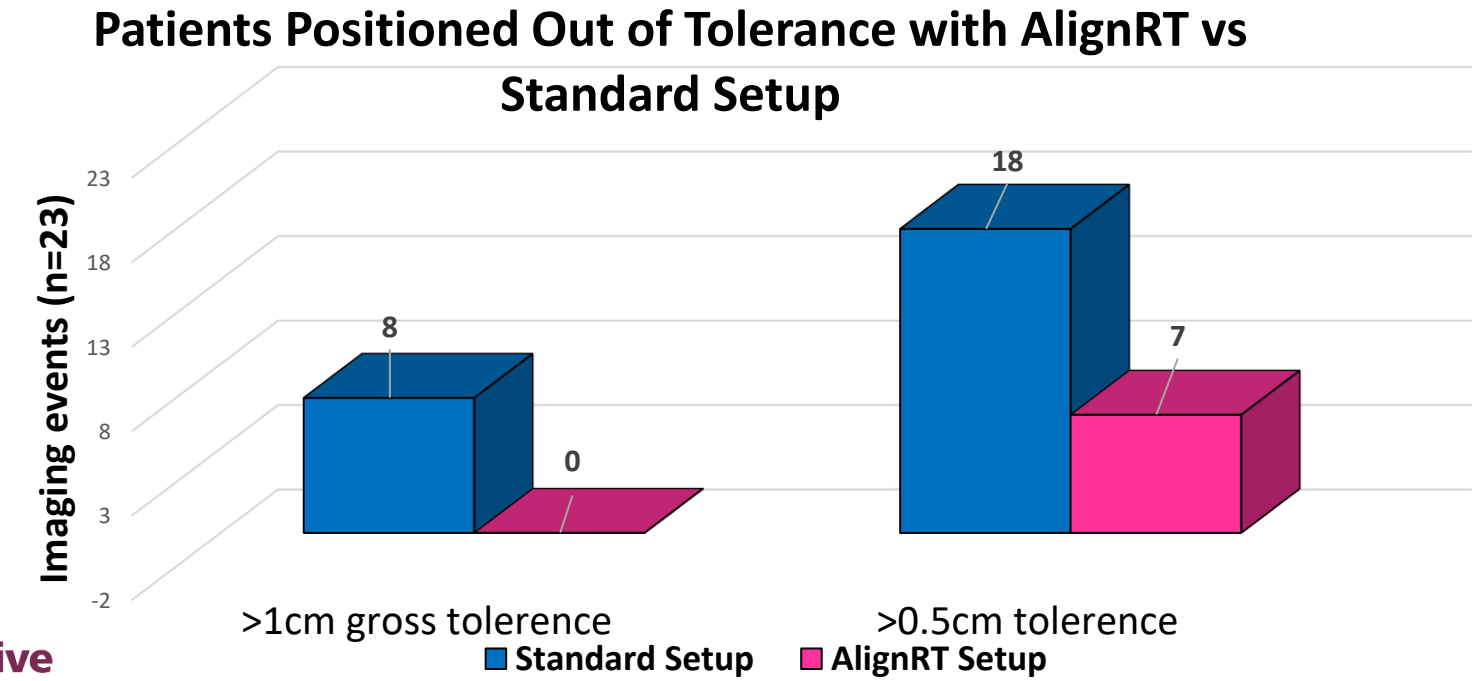
Motion monitoring

Eliminate potential geographical miss

Moving to PM free

Benefits to the patient

- Accurate treatment delivery
- Less set up issues = Less time on the couch
- Improved safety – automatic interruption.



Lung Social Distancing

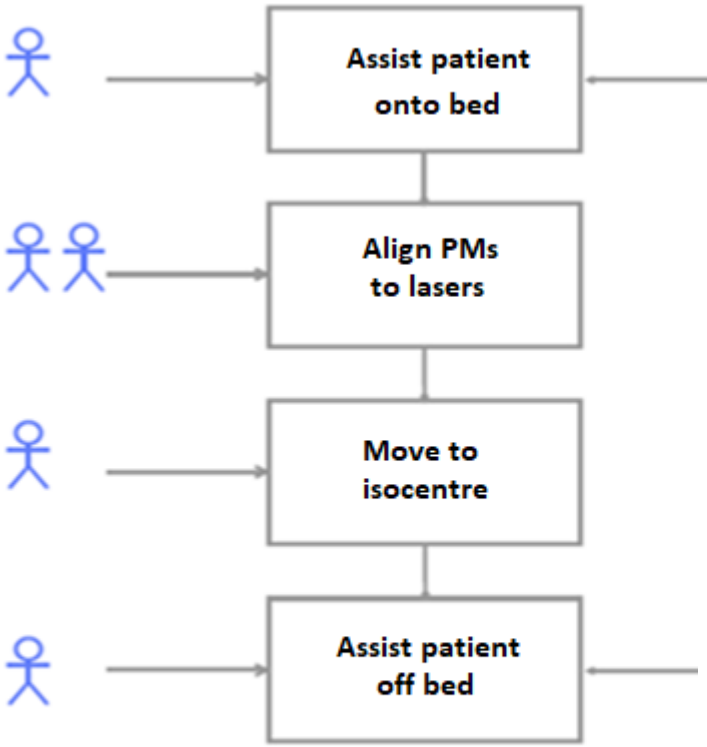


Diagram showing the number of close c
the conventional protocol (left) and the

Used at the beginning of the pandemic to

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ELSEVIER
Technical Innovations & Patient Support in Radiation Oncology

tipsRO
Technical Innovations and Patient Support in Radiation Oncology

▸ Tech Innov Patient Support Radiat Oncol. 2021 Dec 16;20:61–63. doi: 10.1016/j.tipsro.2021.11.005

Surface-guided radiotherapy for lung cancer can reduce the number of close patient contacts without compromising initial setup accuracy

Nicola Blake [a,*], Luciano Pereira [a], David J Eaton [b], Deirdre Dobson [a]

Guy's Cancer

DIBH for non-English speaking patients

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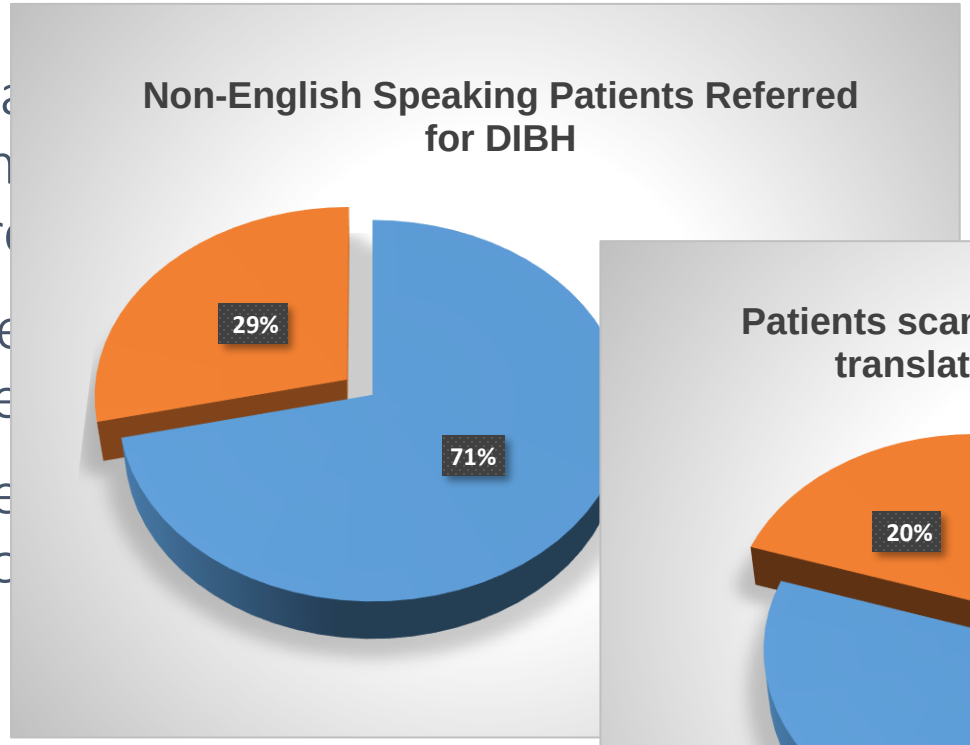

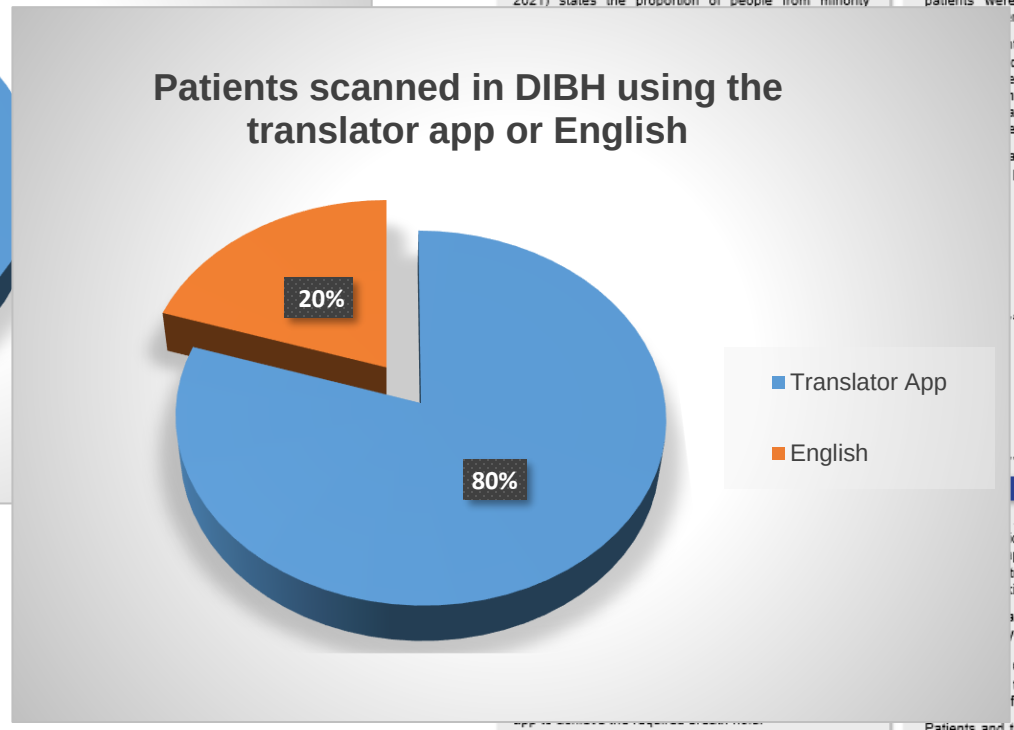

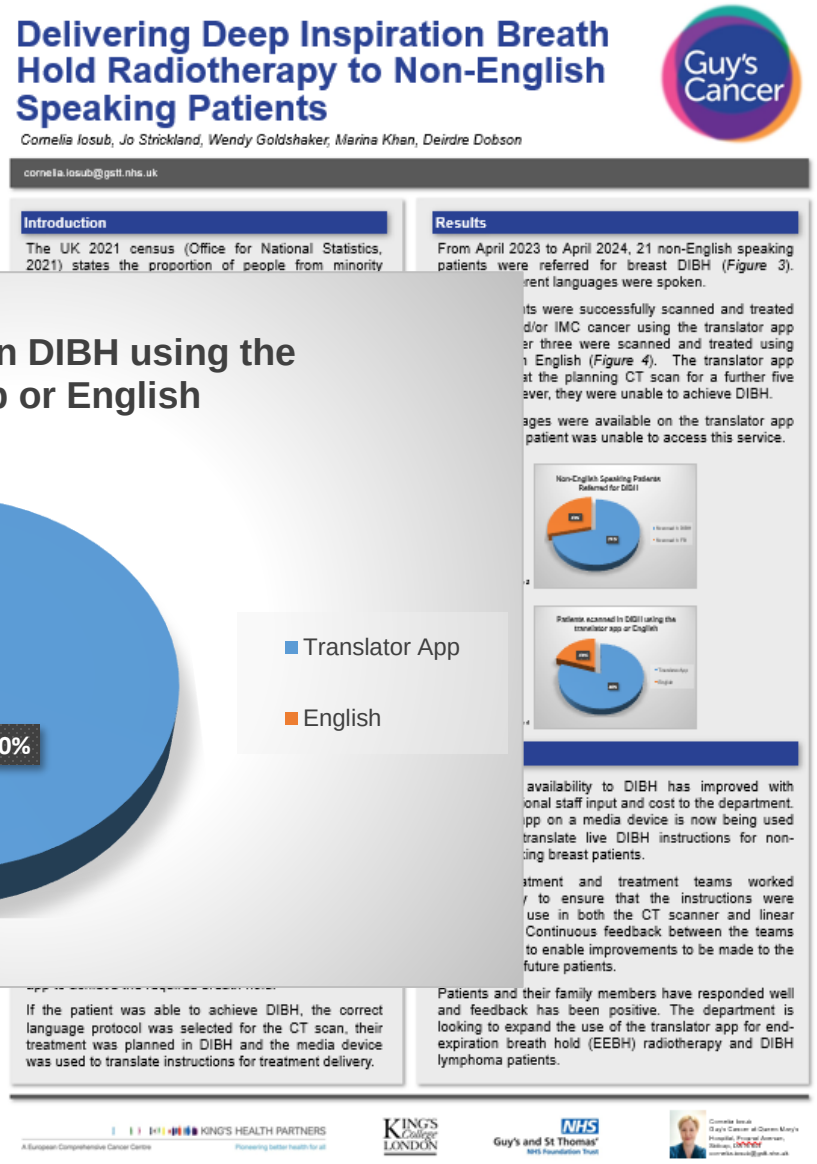

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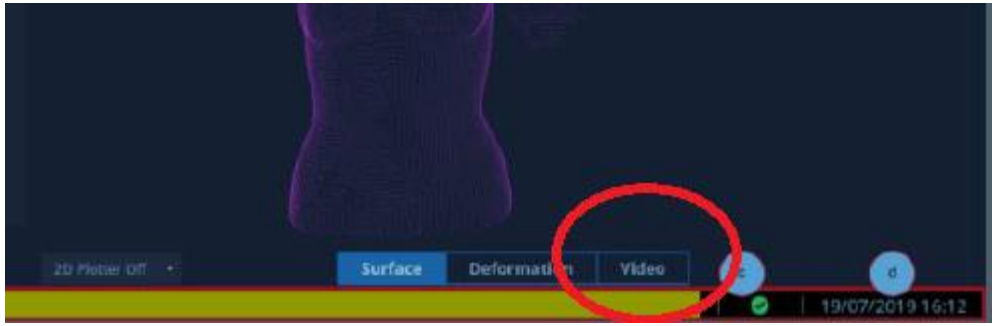
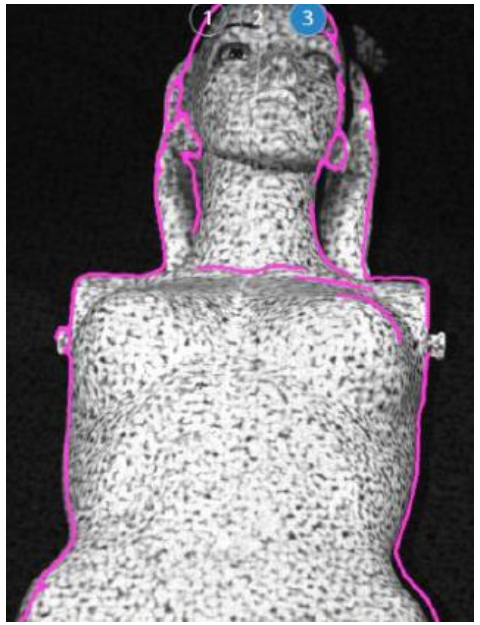
Postural Video

Helps improve set up using real time camera

Set up is more efficient as you can see where the patient should be





Tolerances

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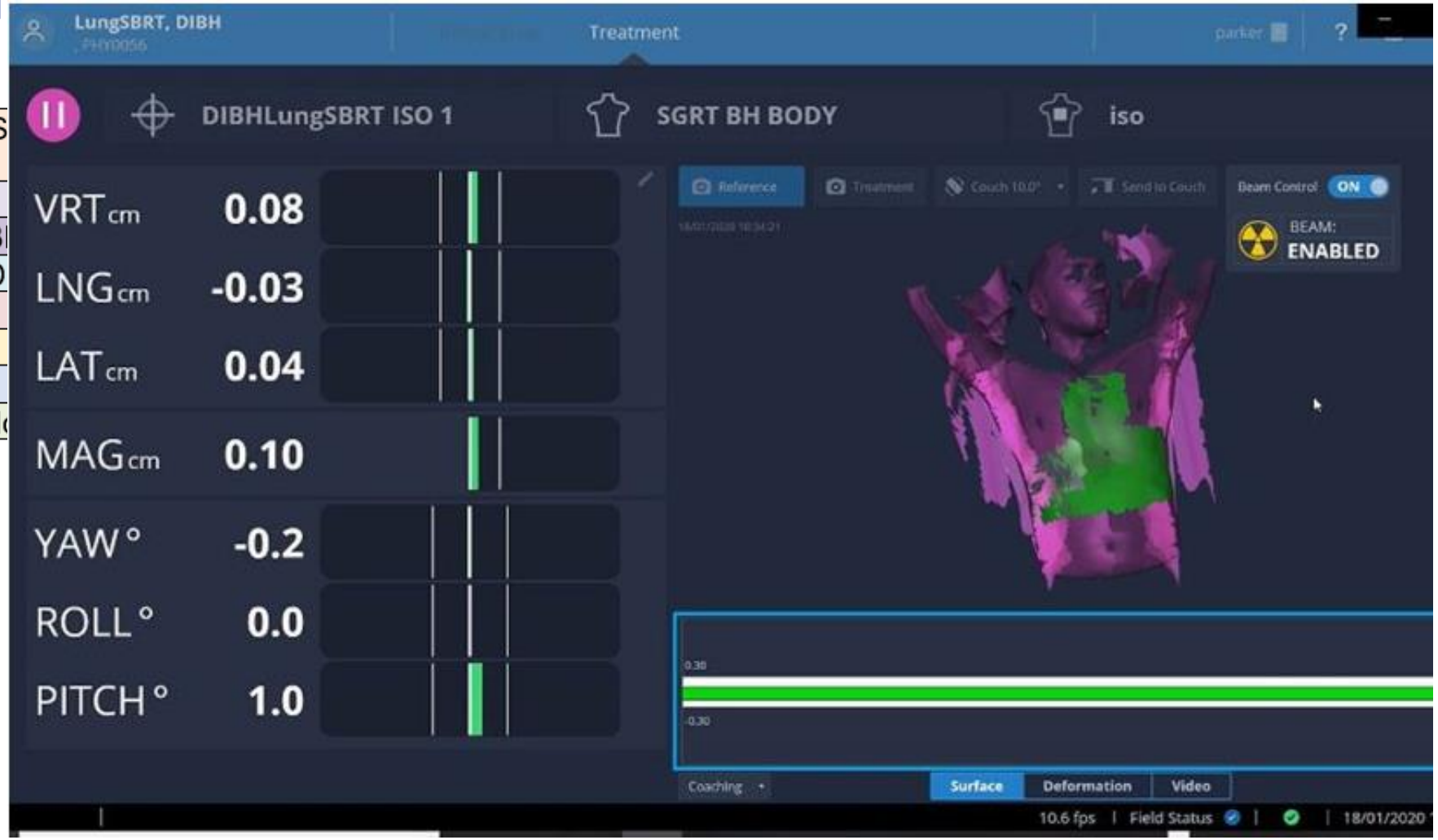
Other (Ad-H



Future Development

PM-free for all treatment sites

Respiratory Module

End Exhale Breath hold with the Respiratory Module

Maskless H&N and Neuro

Summary

Key Functions of SGRT

Patient set-up

Patient monitoring

3D non-invasive imaging

Benefits

Allows sub-millimetre accuracy for setup and monitoring

Facilitates breath-hold treatments

Brings efficiency & time-savings

Assists with difficult setups

Acts as a visual problem-solving tool

Delivers better patient experience (quick set-up, no tattoos, maskless treatment)

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Difficult Set Ups - Pelvis