Royal Surrey
NHS Foundation Trust

Use of AlignRT InBore in a Lung SABR Workflow on a Ring Gantry Linac

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The Royal Surrey County Hospital

- NHS Foundation Trust – across 8 hospital sites
- Provide services to a population of 330,000 across south west Surrey
- Large teaching hospital
- Treat most adult cancer patient cases to a population of up to 2 million from neighbouring boroughs

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The Royal Surrey Cancer Centre

- Across 2 sites – approx. 27 miles apart
- Offer surgery, chemotherapy and radiotherapy
- 7 Linac department – 3 True Beam, 2 Halcyon and 2 Ethos, Brachytherapy and Superficial unit

Aiming to continue our linac replacement programme over the next few years with more SGRT installations

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Introduction of SGRT

In 2024, our Satellite Centre received two state-of-the-art installations:

- a Varian Halcyon Linac
- a Varian Ethos Linac

Both equipped with:

- HyperSight imaging capabilities
- AlignRT InBore Surface-Guided Radiotherapy (SGRT) system

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Our SGRT journey so far

Current cases

- All pelvis patients
- Chest
- Breast/SCF/DIBH +/- bolus (multi-isocenter)
- Palliative (all sites)
- Haematology H&N
- Abdomens
- PA nodes
- Radical brains
- Limbs
- Lung SABR

Future cases

- Adaptive bladder & cervix treatment
- Tattooless radiotherapy
- Head & Neck

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Introduction of SABR with SGRT

Initially the SABR service was moved to the main site and the reintroduction of lung SABR treatments had a profoundly positive impact on our patients.

The implementation working party was made up of an MDT:

- SABR planning study for ring-gantry treatments
- Staff training
- 4D-CBCT workflow amendments
- SGRT monitoring – ROI options
- 10 patient audit of using AlignRT to monitor Lung SABR on a ring gantry

Planning

- SABR plans were required that would allow for a hard pause in treatment between Arcs, where an interim CBCT could be acquired.
- Plan 1 and 2 relied on an operator to stop the automatic start of Arc 2 within a short time of 2 seconds and 6 seconds respectively.
- Plan 3 had 2 isocentres (2.5mm) apart stopping Arc 2 from automatically moding up.

Plan 1
- 1 isocentre, 2 arcs, same gantry and collimator angle for both arcs
- Time between arcs - 2 seconds

Plan 2
- 1 isocentre, 2 arcs, gantry and collimator twist between arcs
- Time between arcs - 6 seconds

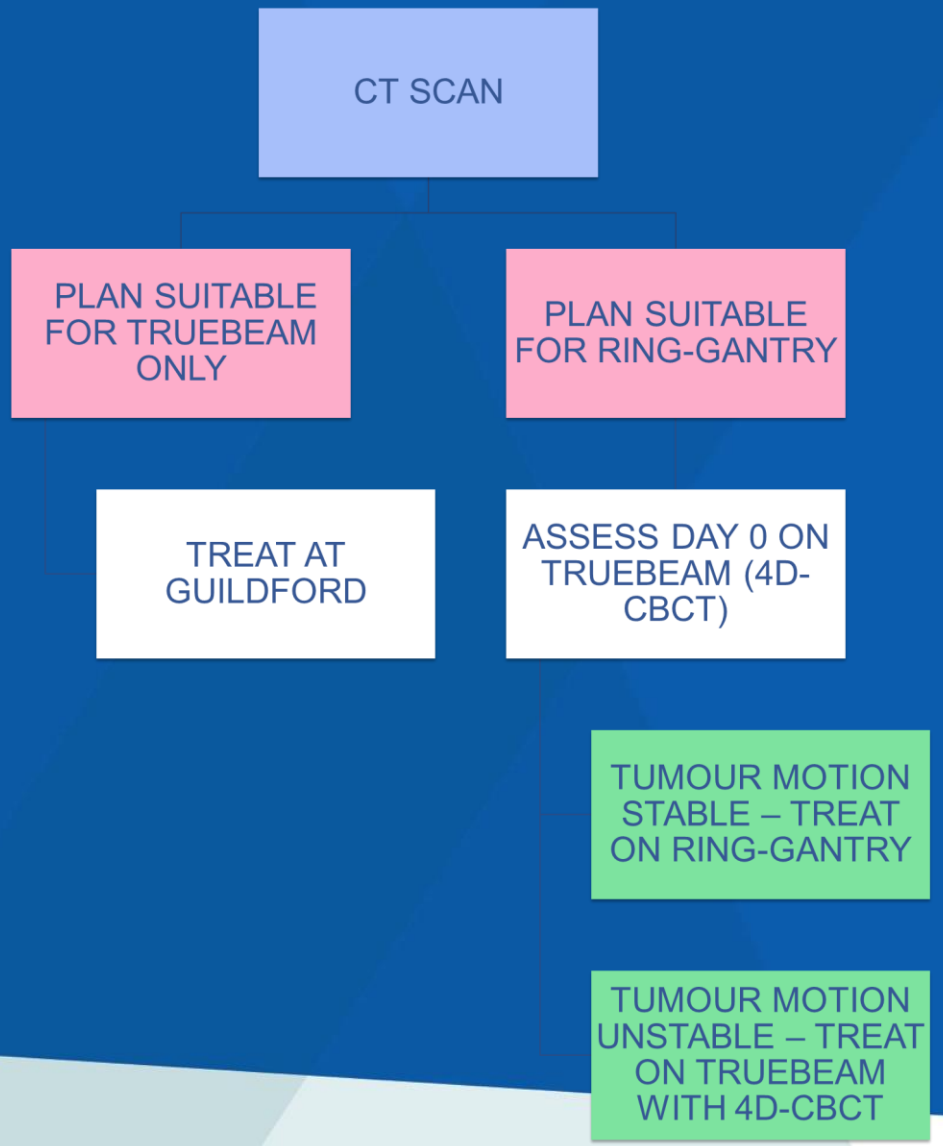
Plan 3
- 2 isocentre, 2 arcs, 0.25cm isocentre shift
- Time between arcs - unlimited

Treatment Verification Workflow

UK SABR consortium recommends 4D CBCT

Challenge of cross site working

- Staffing
- Patient specific equipment
- Travel for patient



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Audit Objectives

To ensure safe delivery we audited our first 10 patients to:

- Evaluate InBore SGRT with ancillary equipment e.g. abdominal belt compression.
- Compare the use of InBore SGRT monitoring to data from CBCTs prior to VMAT delivery.
- Evaluate the reliability of InBore SGRT for continuous motion monitoring.

Method

- Patients were planned with 2 isocentres (2.5mm apart in SUP/INF direction).
- Immobilisation - arms up on a wing-board with a vacuum bag for arm support.
- Patients with middle to lower lobe tumours were typically treated with an abdominal compression belt.
- An appropriate region of interest (ROI) was created.

Method

- For each patient real-time delta shifts (Vert, Long, Lat, Yaw, Roll and Pitch) from the InBore SGRT system, were noted at specific time points:

- For consistency/reliability deltas were always recorded at exhale.
- Change whilst acquiring/matching CBCTs: time points 1-2, 3-4.
- Change during Arc delivery: deltas at time points 3 and 5.
- The deltas from the online CBCT match were compared to time point 1.

Results

- 10 patients audited included 8 upper lobes and 2 middle lobes.
- The ROI excluded the abdominal belt.
- A standard thorax ROI was found to not be appropriate for SABR patients.

- Delta tolerances were: Vert, Long, Lat - 0.2cm and Yaw, Roll, Pitch - 3^{o}.

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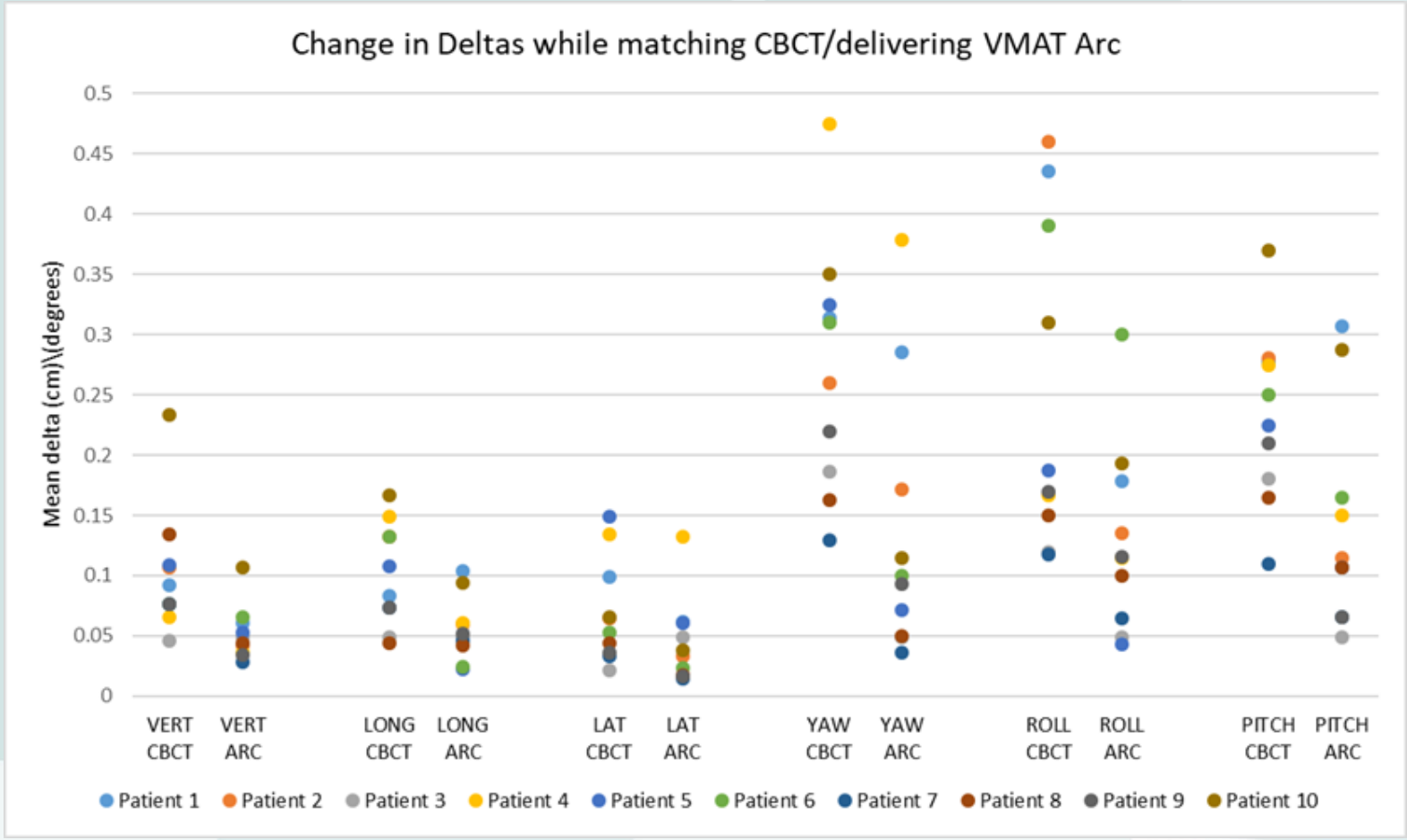
Results

Across all 10 patients mean change in deltas during the time CBCTs were matched and during Arc delivery:

- Vert, Long and Lat was ≤1mm
- Yaw, Roll and Pitch ≤ 0.3º



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Results

- The mean difference between AlignRT deltas and the CBCT match (soft-tissue) was 0.01±0.17cm, -0.02±0.25cm and 0.00±0.21cm for Vert, Long, Lat respectively.

- When AlignRT flagged a move and justified an additional image, a soft tissue positional change was confirmed.

- Patients experienced shorter treatment appointments by an average of 9 mins (average treatment time: 21 mins, range: 17 – 34 mins).

Conclusion

- InBore SGRT for Lung SABR was adopted easily with decreased time on the treatment couch and to date we have treated >50 patients.
- The sub-mm change in deltas during ARC delivery makes us confident that we have a safe treatment approach.
- There was no significant difference between AlignRT deltas immediately prior to CBCT matching and the agreed online match deltas.
- Moving forwards, one could consider omitting the interim CBCT and only acquiring if AlignRT deltas are out of tolerance.

Acknowledgments

We would like to thank all the staff involved in the working party to enable this project to be successfully established as standard practice within our cancer centre.

Questions?

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