The Implementation of Lung SABR with AlignRT. Clinical Results Update

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Introduction

In March 2020 NHS England (NHSE) decided to expand the number of Radiotherapy Centres commissioned to deliver Stereotactic Ablative Body Radiotherapy (SABR) for primary lung cancer and metachronous extracranial metastases. A deadline was set for the 31st of March 2021. The Berkshire Cancer Centre (BCC) in Reading achieved SABR approval for Lung cancer in February 2021.
Surface Guided Radiotherapy (SGRT) and daily Cone Beam Computed Topography (CBCT) were standard practice within the department.

SABR with SGRT

Regions of Interest (ROI) key to the accuracy of the SGRT system. Advice was sought from VisionRT, the clinical application specialists and the SGRT Community. Various ROIs had been used since the implementation of SGRT in 2019 with mixed success but ROI C was chosen alongside using a Gated Capture.

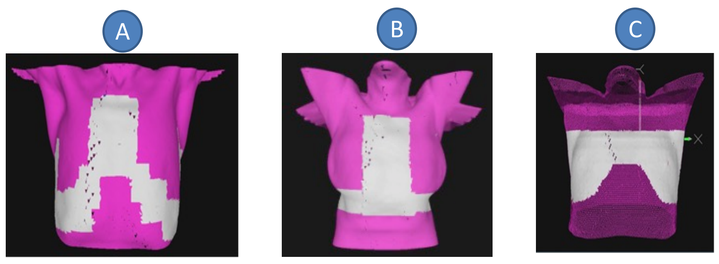

Figure 1 *ROI selection*

Gated Surface Captures (v5.1)

A gated surface capture captures 30 individual surfaces and displays this as a breathing trace with dots in the 2D plotter. Each dot represents a captured surface. (figure 2) The plotter also shows the amplitude of the breath (X). The aim is to choose a dot (surface) that represents a surface equivalent to mid ventilation as this will give Real time delta (RTD) values centred around zero when monitoring (Y).

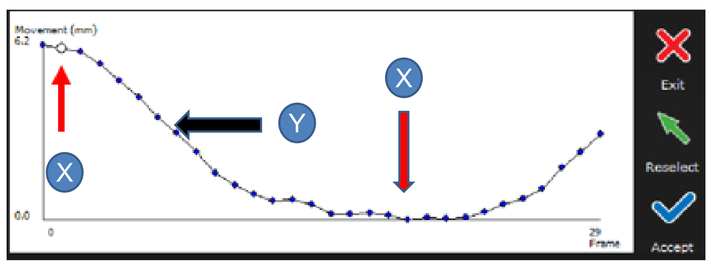

Figure 2 *Gated VRT breathing trace*

	Mid/Post Treatment CBCT shifts (cm)		
	Lateral	Longitudinal	Vertical
Mean	-0.04	0.09	-0.06
Median	-0.01	0.07	-0.05
Std dev	0.17	0.22	0.19

Figure 3 *CBCT mid and post treatment data analysis*

Results

Since May 2021; 15 SABR patients have been treated at the BCC, delivering 103 fractions, 93 of which were marker less.
The Average

- set up time is 90 seconds,
- 4D CBCT analysis is 55 seconds
- Treatment (from pre CBCT to end of second arc) is 23 minutes*

Data from 148 mid and post treatment scans were reviewed and shifts were found to be well within the department tolerance of 2mm (figure 3)

Discussion

Patients requiring SABR come with pre-existing medical conditions. One patient with sciatica (2 PTV / 4arcs) had to consistently rotate her feet during treatment in order to keep still. SGRT showed this did not compromise her treatment accuracy.

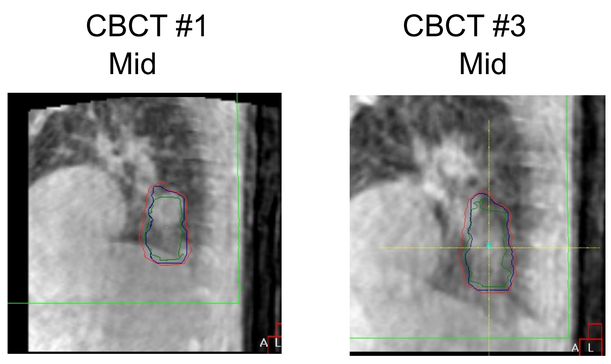

Figure 4 *CBCT images showing changes in mGTV position*

Clinical experience showed that due to the quick set up time, patients can often relax, acclimatising to the cool treatment bunker/ equipment and change their breathing pattern between the first and second CBCT. This was evidenced by one patient in particular with tight coverage of the motion GTV (mGTV) on the mid treatment CBCT (figure 4).
This was not positional change as there was no beam hold on SGRT

* Nb Time started after 15 minutes on treatment couch

We needed to understand when this occurred and was a re-plan required?. Based on observed difference between the pre and mid treatment CBCT shifts, we then allowed the patient to be on the couch for 15mins prior to any CBCT. The mid treatment image on #3 onwards improved (figure 4).
The RTD monitoring data was later analysed which showed the change occurred at the end of arc1 suggesting that for the treatment delivery the coverage was good.

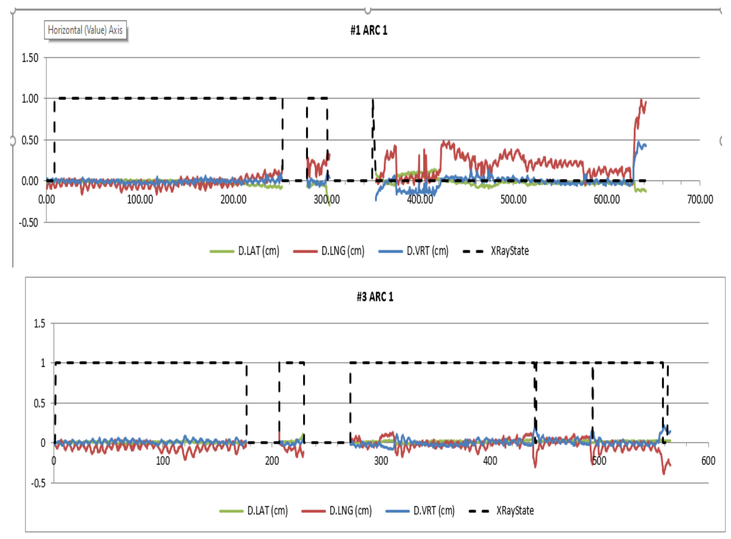

Figure 5 *RTD monitoring data plot for Arc 1 #1 and Arc 1 #3*

-------- radiation on beam not held
Red= Long Green = Lat Blue = Vert

Conclusions

SABR can be treated safely and timely with SGRT. All patients are well with complete response with no grade 3 toxicity reported at follow up
SGRT and CBCT work hand in hand which is crucial for SABR as SGRT is excellent at matching external surfaces, highlighting changes in contour, and intra-fraction monitoring to ensure patient positioning remains acceptable during beam delivery.
CBCT remains the gold-standard for detecting and monitoring internal changes.
Patients can move extremities without affecting treatment position even during the delivery of SABR. SGRT gives that note of confidence that the treatment is being delivered correctly.
The speed of set up might not always be optimal and the room temperature and patient specific factors including pre-existing conditions and in-room relaxation need to be taken into consideration to avoid and identify changes in internal anatomy.

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