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Dose Comparison of Elekta Symmetry Scan versus Cone Beam CT

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INTRODUCTION

Cone beam CT (CBCT) used in image guided radiation therapy is an advantage for accuracy of the treatment. In moveable tumors such as lung tumors that are not fixed, it is important to use 4D CBCT to ensure the tumor is treated at all breathing phases. There is a cost in dose to the patient from these modalities.

AIM

We wanted to compare the dose delivered to a patient from a 3D CBCT versus 4D CBCT that more accurately tracks tumor excursion.

METHOD

Elekta's Infinity Linear Accelerator has the capability to acquire 4D images for more precise tracking of tumors using the Symmetry CT on it's XVI system. The IMRT lung phantom from Standard Imaging was put on a Standard Imaging Respiratory Gating Platform set with varying speeds from 15-30 breath per minute and tumor excustion from 5 - 20 mm excursion. Gated scans were obtained on the Philips Big Bore CT to verify settings, tumor excursion and allow images to be compared to those from the linac. The settings used for the CBCT were the settings used clinically for chest CBCT. The doses were measured using PTW ionization chambers attached to a Fluke electrometer at the center of the phantom between the lungs at the level of the tumor volumes. Best Medical MOSFET dosimeters measured dose at the surface of the phantom in the Mosfet calibration jig. The MOSFET was placed under 1 cm of bolus to provide dose build-up. All measurements were taken during each set of scans.

RESULTS

The doses we obtained were consistent with other reported doses taken at depth for the 3D CBCT scans. The doses measured at the center of the phantom was consistently almost double when a 4D scan was done versus a normal CBCT. The dose from the center of the phantom was 1.52cGy (range 1.47-1.55 cGy)from the CBCT and 2.97cGy (range 2.86-3.07cGy) from the symmetry scan. The dose taken at the surface of the phantom had a much larger difference between the two modalities. The increase in dose at the surface of the phantom was even greater, with 1.45cGy (range 1.35-1.69cGy) from CBCT and 11.70cGy (range 10.73-12.92cGy) from the Symmetry scan. These numbers were consistent across all breathing speeds and tumor movement.

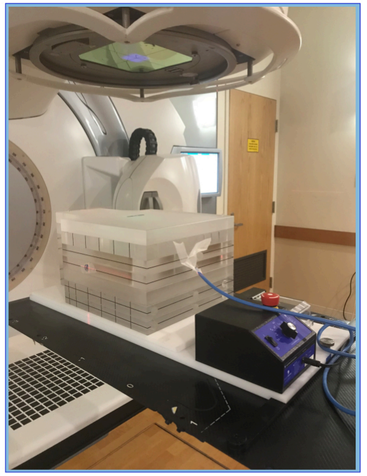

Figure 1. Electa Infinity with polystyrene phantom on respiratory gating jig.

Type of Scan	Center of the Phantom (depth of 10 cm)		Surface of the Phantom (depth of 1 cm)
Normal Cone Beam	151.99		4.38
Symmetry Scan	294.96		15.38
Percent Change	94.06%		250.95%

CONCLUSIONS

The difference in the amount of dose from a 3D CBCT and the 4D Symmetry scan was not unexpected. It was not anticipated that the dose to the surface would be as increased by that amount. This work indicates that the while the dose from the Symmetry scan is not excessive and it has been shown to be useful for initial verification of a mobile tumor, it should be used with caution. The increased dose does indicate that it should not be used for daily verification and measurement of dose to pacemakers should be done when a Symmetry scan is performed.

REFERENCES

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Imaging dose from cone beam computed tomography in radiation therapy
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