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A comparative dosimetric evaluation in carcinoma right breast for convex chest wall, post breast conservation surgery using two distinct radiotherapy techniques

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AIM

The aim of this research was to compare a six-beam Dynamic Multi Leaf Collimator (DMLC) technique with a restricted tangential volumetric modulate arc therapy (tVMAT) technique for convex chest wall after breast-conserving surgery (BCS).

METHOD

Twenty patients with carcinoma right-breast whose chest walls were convex or barrel shaped (curvature distance equal to or more than 3 cm) were selected for this study. All the patients were already treated with breast conserving surgery. Patients were prescribed 45Gy in 25 fractions followed by boost to the tumor bed. They were planned using two different techniques including: 1) Six beam DMLC; and 2) Tangential volumetric Arc Therapy (tVMAT). All other normal tissues and OAR including ipsilateral lung, contralateral lung, contralateral breast, heart, spinal cord, thyroid, liver and esophagus were contoured according to the RTOG guidelines. The planned volumetric dose of PTV and OARs were compared and analyzed.

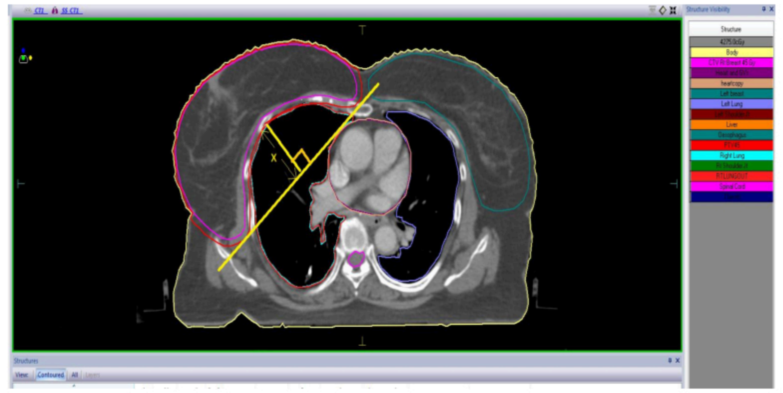


***Figure 1**. Curvature distance 'x' found by drawing a straight line joining the medial and lateral edges of the PTV and further putting a perpendicular bisector of from lower middle border of ribs PTV edge*

RESULTS

Homogeneity Index (HI) and Conformity Index (CI) were comparable for both tVMAT and DMLC. PTV volume receiving 95% of prescription dose was better in DMLC (96.41±1.03) as compared to tVMAT (92.24±13.31). V100% was much better in DMLC (83.91±3.25) as compared to tVMAT (70.18±9.74). V107% was reduced in tVMAT (1.93±3.39) than DMLC (2.59±5.08). D95 (Gy) was better in DMLC (96.41±1.03) than tVMAT (92.24±13.31). For ipsilateral lung, V10 and V5 were greatly reduced in DMLC (36.77±2.31, 47.61±2.84) but for tVMAT, V10 was more than the limits (43.95±10.15) but V5 was well within the limit (56.94±18.37). The V20, V30 and mean ipsilateral lung dose was less in DMLC. Mean heart doses in DMLC and tVMAT were 2.61±0.94 and 4.57±2.61. D0.03 of heart was much better in DMLC (24.72±10.70) as compared to tVMAT (32.38±9.65). Mean contralateral breast dose was better in DMLC (2.39±1.28) as compared to tVMAT (4.07±1.70). All other OARs like contralateral lung, Esophagus, Spine, Thyroid and Liver were slightly better in DMLC as compared to tVMAT. Volume of 50% isodose line (3409.63 cc) as well as 20% isodose line (4296.85) was greatly reduced in DMLC as compared to VMAT (3626.70 versus 4750.48 respectively). Total number of monitor units required for delivering both the treatment plans was comparable.

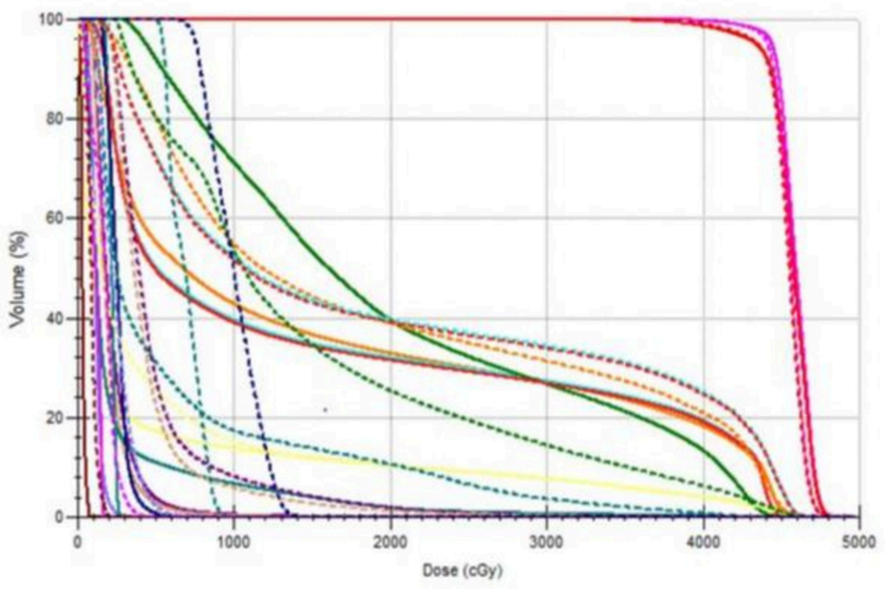
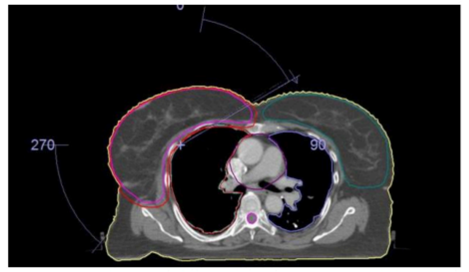


***Figure 2**. Dose Volume Histogram comparison of both the techniques where dotted line is for tVMAT and solid line represents DVH for DMLC.*



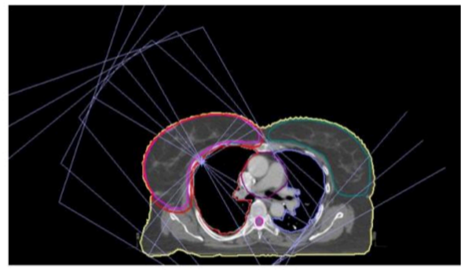
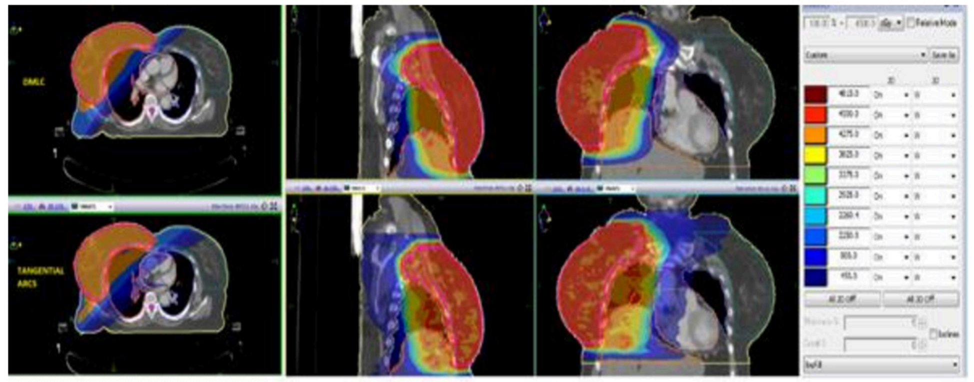


***Figure 3**. and **Figure 4**. Beam arrangements for both planning techniques are depicted. For DMLC planning, 6 coplanar tangential beams with gantry angles 60º, 50º, 40º and 210º, 220º, 230ºdegree were selected. For tVMAT planning, two coplanar tangential arcs of 50 degree were selected. Gantry angles were decided to be 60 degree and 250 degree.*



*A comparison of dose distributions for a right breast cancer patient between (a) DMLC and (b) Tangential VMAT on axial, sagittal, and coronal planes is shown in **Figure 5**. PTV45 is shown in thick red color with its isodose color wash ranging from 5500 cGy down to 500 cGy are also depicted. Organs at risk (OARs) including ipsilateral (Right) lung, contralateral (Left) lung, contralateral (Left) breast, and heart with its isodose color wash ranging from 4815 cGy down to 450 cGy are also shown*

CONCLUSIONS

6-beam DMLC treatment planning techniques are more suitable for treatment of BCS patients with barrel-shaped or convex shaped chestwall. The tVMAT plans are more conformal but their utility is limited with beam arc angles and also have increased lower-dose areas in organ at risks especially lungs. The evaluated DMLC plan in this study provided a very useful replica of tangential VMAT. With this DMLC technique, the dose distribution can be further optimized to obtain better sparing of various OARs with improved coverage of treatment volumes and less Integral dose. Although, the tangential VMAT plan optimization is a less time-consuming technique than DMLC, majority of our DMLC plans using Monaco Planning stations had good optimization in initial run only. In the end, this analysis is completely applicable on Left side convex chest wall patients as well.

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