DIFFERENT RADIOTHERAPY TECHNIQUES, DOSIMETRIC ANALYSIS IN BREAST CANCER PATIENTS AND THEIR IMPACT ON ORGANS AT RISK

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INTRODUCTION

Radiotherapy is an integral part of treatment of breast cancer. It improves disease control and lowers the rate of local recurrence. It is also used as salvage therapy. There are draw backs of breast radiation therapy, both short term and long term. This is mainly due to the irradiation of organs at risk. The dose to the organs at risk more often than not influences the treatment planning. We always aim to attain an equilibrium where we give adequate dose to the target while minimizing the dose to the organs at risk as much as possible. One of the ways of achieving this balance has notably been with the use of newer technology. This has led to the comparisons between these different techniques.

AIM OF THE WORK

The aim of this study was to make a dosimetric comparison between conventional 3DCRT tangential radiotherapy with virtual wedges (wedge) and field-in-field forward planned IMRT (FiF) in patients undergoing whole breast radiotherapy.

SUBJECTS AND METHODS

This study included 20 breast cancer patients who were being treated with whole breast radiotherapy following breast conserving surgery.

Inclusion criteria: All patients who were prescribed whole breast radiotherapy following breast conserving surgery.

Exclusion criteria: Patients who were to receive bilateral whole breast irradiation. Patient simulations were done in supine positions. To different treatment plans were done on the same planning CT scan images. The plans were done using conventional 2 tangential fields with 6 MV photon beams. All the patients received 40.05 Gy in 15 fractions. The data were analyzed using IBM SPSS version 20.0.

RESULTS

There were 20 patients in total all of whom were female. 10 (50%) had left breast disease while the other half had right breast disease. 11 (55%) had T1 disease while 9 (45%) had T2 disease. All the patients underwent BCS. 11 (55%) underwent ALND in addition to BCS while 3 (15%) underwent SLNB in addition to BCS. The average mean dose to CTV was 39.71 ± 1.05 Gy in the FiF vs 40.57 ± 0.84 Gy in wedge technique, p-value <0.001. The average CTV homogeneity index for field-in-field technique was 1.269 ± 0.364 whereas that of wedge technique was 1.166 ± .048, p-value 0.721.

The average CTV conformity index for the field-in-field technique was 0.878 ± 0.065 vs 0.921 ± 0.048 for the wedge technique, p-value 0.002. The average mean dose to the ipsilateral lung in field-in-field was 7.97 ±1.45 Gy while it was 9.78 ± 2.14 Gy in the wedge technique, p-value <0.001. The difference in V20 percentage volumes of the ipsilateral lung between the two plans was significant. In the FiF technique, the average volume was 16.76 ± 4.72% whereas in the wedge technique it was 21.47 ± 6.49%.

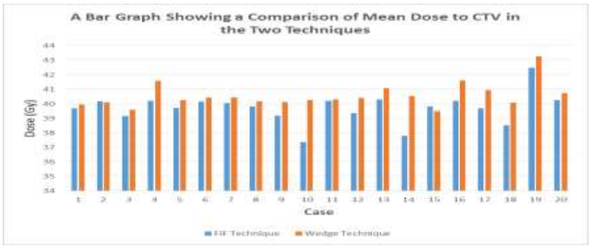
The p-value was <0.001. The average mean dose to the contralateral lung was 0.484 ± 0.078 Gy in FiF plan and 0.440 ± 0.071 Gy for the wedge technique with a p-value of <0.001. The average mean dose to the heart in left sided breast disease was 2.75 ± 0.47 Gy in FiF vs 4.57 ± 1.69 Gy in wedge technique with a p-value of 0.005. There was a significant difference in the V20 heart volumes in cases with left-sided disease favouring the FiF technique with a p-value of 0.011.

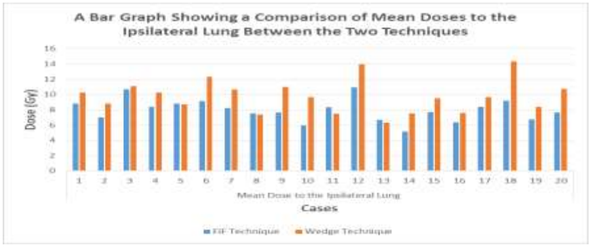
Table 1: Comparison between the two techniques according to Dose Characteristics to the CTV

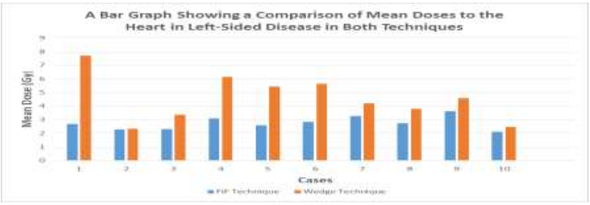
CTV	Field-In-Field (n = 20)	Wedge (n = 20)	Test of Sig.	p
Mean dose (Gy)				
Min. – Max.	37.36 – 42.48	39.50 – 43.28	Z= 3.696*	<0.001*
Mean ± SD.	39.71 ± 1.05	40.57 ± 0.84		
Median (IQR)	39.81 (39.28 –40.20)	40.36 (40.10 –40.85)		
HI				
Min. – Max.	1.090 –2.670	1.110 – 1.290	Z= 0.357	0.721
Mean ± SD.	1.269 ± 0.364	1.166 ± .048		
Median (IQR)	1.155 (1.12 – 1.19)	1.150 (1.13 – 1.19)		
CI				
Min. – Max.	0.750 – 970	0.780 – 0.990	t= 3.507*	0.002*
Mean ± SD.	0.878 ± 0.065	0.921 ± 0.048		
Median (IQR)	0.890 (0.84 – 0.92)	0.925 (0.90 – 0.95)		

Table 2: Comparison between the two techniques according to Dose to the Heart in Left-Sided Disease

Heart in Left-Sided Disease	Field-In-Field (n = 10)	Wedge (n = 10)	t	p
Mean dose (Gy)				
Min. – Max.	2.11 – 2.11	2.35 – 7.69	3.702*	0.005*
Mean ± SD.	2.75 ± 0.47	4.57 ± 1.69		
Median (IQR)	2.71 (2.30 – 3.10)	4.39 (3.36 – 5.65)		
V20 (cm^3)				
Min. – Max.	9.50 – 38.72	11.0 – 103.66	3.102*	0.013*
Mean ± SD.	21.37 ± 9.61	52.82 ± 36.03		
Median (IQR)	18.25 (13.63 – 29.25)	40.35 (27.97 – 96.95)		
V20 (%)				
Min. – Max.	1.44 – 5.29	1.67 – 15.81	3.177*	0.011*
Mean ± SD.	3.09 ± 1.30	7.42 ± 4.53		
Median (IQR)	2.77 (2.04 – 4.19)	6.61 (3.96 – 10.13)		







CONCLUSION

In as much as the field-in-field technique has shown its superiority in sparing the organs at risk, the tangential 3DCRT technique with wedges may still have a role especially in centres that may not have access to newer technologies. It still has a marginally superior target coverage and is indeed a worthy option especially in right breast cancer patients.