

Intensity Modulated Radiation Therapy (IMRT) Results in a Significant Decrease in Clinical Toxicities when Compared to Conventional Wedge Based Breast Radiation Therapy

Asif Harsolia, MD Larry Kestin, MD Inga Grills, MD Michelle Wallace, RN Shruti Jolly, MD Cortney Jones, MD Moinaktar Lala, MD Alvaro Martinez, MD, FACR Scott Schell, MD, PhD Frank Vicini, MD, FACR

Department of Radiation Oncology
William Beaumont Hospital
Royal Oak, Michigan



Beaumont
William Beaumont Hospital

Purpose

We have previously demonstrated that intensity modulated radiation therapy (IMRT) with a static multi-leaf collimator (sMLC) process results in a more homogenous dose distribution compared with conventional wedge based breast radiation treatments. It remains to be seen whether this translates into a benefit in clinical outcomes.

Methods

172 patients with stage 0-IIB breast cancer treated between 1999-2001 at our institution. All patients underwent CT scans prior to treatment. Patients were treated with whole breast tangential radiation to 45 Gy (1.8 Gy fractions) plus an external beam boost to 61 Gy. 79 patients (46%) were treated with wedges and 93 (54%) with IMRT. Median follow-up was 4.7 years (0.1 to 5.7).

Results

A significant reduction in acute grade ≥ 2 dermatitis, edema, and hyperpigmentation was seen with the use of IMRT compared to wedges. There was a trend towards reduced acute grade ≥ 3 dermatitis (6% vs. 1%, $p=0.09$) in favor of IMRT. Chronic grade ≥ 2 breast edema was also significantly reduced in the patients who underwent IMRT compared to conventional wedges. There was no difference in cosmesis scores between the two groups. In patients with larger breasts (≥ 1600 cc, $n=64$), IMRT resulted in: (1) reduced acute (grade ≥ 2) breast edema (0% versus 36%, $p<0.001$) and hyperpigmentation (3% versus 41%, $p=0.001$) and chronic (grade ≥ 2) long-term edema (3% versus 30%, $p=0.007$). Similar changes were also noted in patients with breast volumes < 1600 cc.

Table 1: Characteristics for IMRT Versus Wedges - Median (Mean)

Characteristic	IMRT	Wedges	p-value
Number - %	93 pts - 54%	79 pts - 46%	
Age	58 years (57.9)	62 years (60.3)	0.16
Breast Volume	1326 cc (1474)	1489 cc (1559)	0.42
Follow-up Time	4.6 years (4.6)	5.0 years (4.6)	0.60
Race			0.52
Caucasian	91%	95%	
African American	8%	5%	
Other	1%	0%	
T-Stage			0.57
Tis	28%	23%	
T1	57%	57%	
T2	15%	20%	
N-Stage			0.47
NO	97%	94%	
N1	3%	6%	
Stage			0.71
0	28%	23%	
I	55%	54%	
IIA	16%	20%	
IIB	1%	3%	
Hormonal Therapy			0.10
Yes	80%	67%	
No	20%	33%	
Chemotherapy			0.62
Yes	28%	32%	
No	72%	68%	
Mixed Beam			<0.001
Yes	32%	9%	
No	68%	91%	

Table 2: Clinical Toxicity for IMRT vs. Wedges

Toxicity	IMRT	Wedges	p-value
Acute Grade ≥ 2			
Dermatitis	41%	85%	<0.001
Breast Edema	1%	28%	<0.001
Pain	8%	8%	0.78
Hyperpigmentation	5%	50%	<0.001
Chronic Grade ≥ 2			
Hyperpigmentation	7%	17%	0.06
Breast Edema	1%	25%	<0.001
Fat Necrosis	0%	1%	0.46
Induration/Fibrosis	0%	6%	0.11
Cosmesis			
Good/Excellent	99%	97%	0.60
Locoregional Recurrence	5%	4%	0.62

Table 3: Mean Breast Volume by Toxicity

ToxicityGrade	≤ 1	Grade ≥ 2 p-value	Linear t-Test p-value	Regression
Acute				
Dermatitis	1377 cc	1600 cc	0.04	0.002
Breast Edema	1495 cc	1649 cc	0.32	0.03
Pain	1495 cc	1566 cc	0.70	0.16
Hyperpigmentation	1506 cc	1468 cc	0.75	0.86
Chronic				
Hyperpigmentation	1442 cc	1851 cc	0.02	0.14
Breast Edema	1468 cc	1866 cc	0.03	0.03
Fibrosis/Induration	1461 cc	1516 cc	0.71	0.95

Table 4: Grade ≥ 2 Toxicity By Breast Volume

Toxicity	<1000 cc	1000-1599 cc	≥ 1600 cc	p-value
Acute				
Dermatitis	49%	62%	69%	0.10
Breast Edema	13%	10%	17%	0.47
Pain	4%	14%	7%	0.15
Hyperpigmentation	21%	34%	22%	0.25
Chronic				
Hyperpigmentation	10%	6%	20%	0.07
Breast Edema	10%	7%	15%	0.48
Induration	0%	8%	0%	0.14

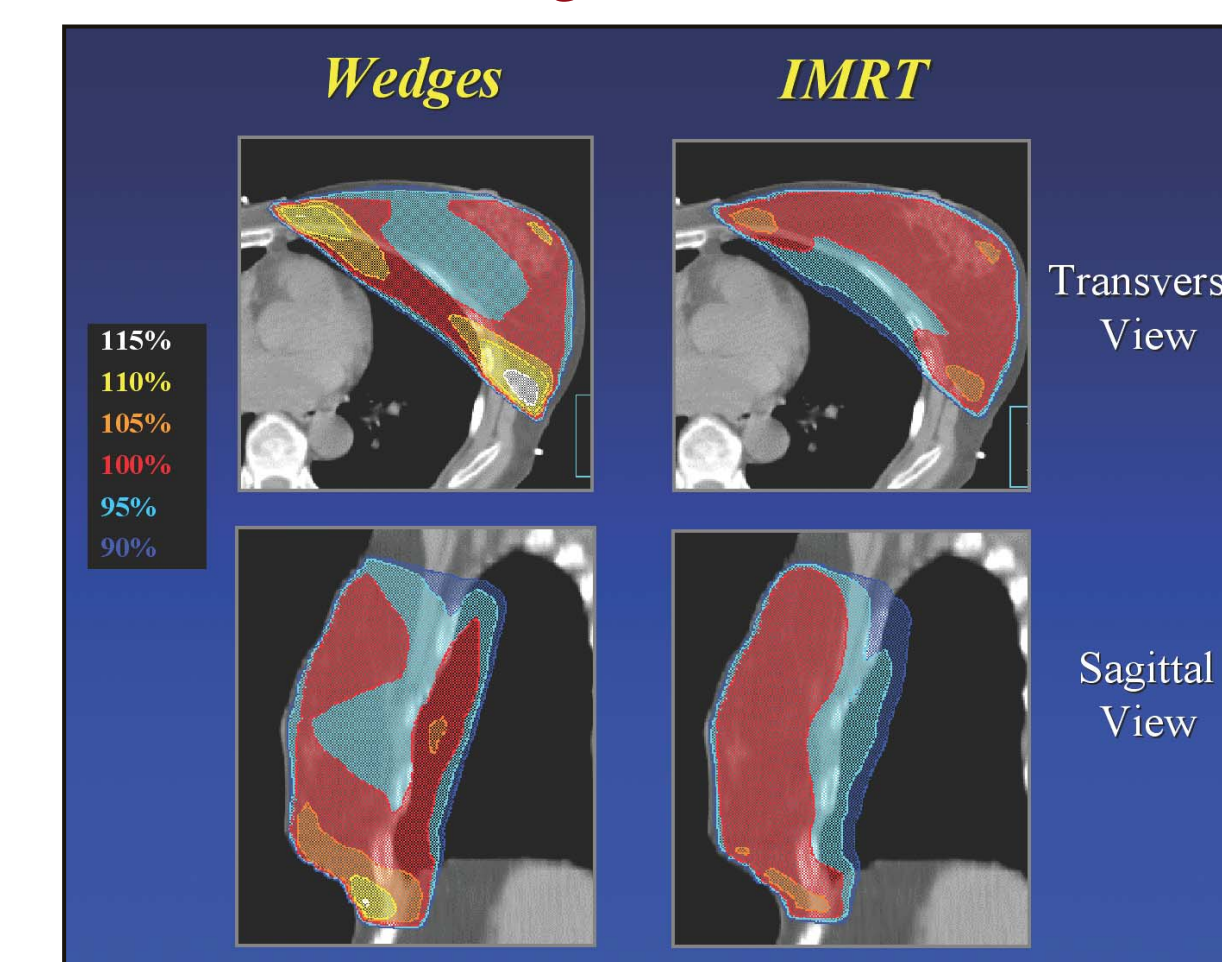
Table 5: Toxicity Analysis for Large Breast Volume ≥ 1600 cc (n=64)

Toxicity	IMRT	Wedges	p-value
Acute Grade ≥ 2			
Dermatitis	62%	77%	0.28
Breast Edema	0%	36%	<0.001
Pain	11%	4%	0.37
Hyperpigmentation	3%	41%	0.001
Chronic Grade ≥ 2			
Hyperpigmentation	11%	29%	0.16
Breast Edema	3%	30%	0.007
Induration	16%	25%	0.71

Table 6: Toxicity Analysis for Small Breast Volume < 1000 cc (n=45)

Toxicity	IMRT	Wedges	p-value
Acute Grade ≥ 2			
Dermatitis	29%	82%	0.001
Breast Edema	4%	29%	0.02
Pain	4%	6%	0.99
Hyperpigmentation	0%	53%	<0.001
Chronic Grade ≥ 2			
Hyperpigmentation	4%	21%	0.09
Breast Edema	0%	28%	0.01
Induration	26%	7%	0.22

Figure 1: Sample Dose Distribution (Wedges vs. IMRT)



Conclusion

The improved dose distribution with the use of IMRT in the treatment of the whole breast results in a significant decrease in acute dermatitis, edema, and hyperpigmentation as well as a reduction in the development of chronic breast edema compared to conventional wedge based radiation treatment.