Scanning Beam Intensity Modulated Proton Therapy for Accelerated Partial Breast Irradiation

Fantine Giap BS[4], Steven Sckolnik MD[2], Daniel Simpson MD[3], Anthony Mascia PhD[1], Richard Lepage PhD[1], Huan Giap MD PhD[1]
Scripps Proton Therapy Center[1], University of Arizona College of Medicine[2], University of California San Diego School of Medicine[3], UT Southwestern Medical School[4]

Background

Previous studies of accelerated partial breast irradiation (APBI) with passive scatter proton therapy have demonstrated promising dosimetric and clinical results. Scanning beam Intensity Modulated Proton Therapy (IMPT) has potential advantages over passive scatter proton therapy in regards to field selection, treatment duration, dose homogeneity and certain normal tissue sparing. This retrospective review represents the first known clinical experience using IMPT technique for treatment of breast cancer with APBI.

Materials & Methods

Between March 2014 and June 2015, 11 patients with IDC, DCIS, or ILC underwent IMPT treatment. All patients underwent CT-based simulation and treatment planning and were set up supine on a breast board or in the prone position. Daily setup and localization was accomplished with 4-6 skin surface fiducial markers tracked with orthogonal x-ray pairs. Treatment was administered while free breathing in 10 M-F daily fractions over a 2 week period, with 3800-4000cGy prescribed to the operative cavity and 3400-3850cGy prescribed to the clinical target volume which was defined as 10-15mm expansion of the operative cavity respecting anatomical boundaries. Treatment was delivered with a single enface scanning proton beam. Clinical outcomes were monitored during and after treatment and later abstracted from the EMR.

Results

Patient	Histology	Stage	Hormone Status	Laterality	Age	Dosing	Position	Field	Mean Time IN/OUT of Treatment Room (min)	Acute Toxicities
1	IDC, grade 3	pT2N0	ER-/PR-/Her2Neu+	Left	71	40/10(GTV) 34/10(CTV)	Supine	LAO	26.32	Grade 1 Dermatitis
2	DCIS, grade 3	pTisN0	ER+/PR+	Left	62	38/10(GTV) 34/10(CTV)	Supine	AP	11.17	Grade 1 Dermatitis
3	IDC, grade 3	pT2N0	ER-/PR-/Her2Neu-	Left	72	40/10(GTV) 34/10(CTV)	Prone	LL	14.35	Grade 1 Dermatitis
4	IDC, grade 2	pT2N0	ER+/PR+/Her2Neu-	Right	48	40/10(GTV) 34/10(CTV)	Supine	AP	18.63	Grade 1 Dermatitis
5	IDC, grade 1	pT1cN0	ER+/PR+/Her2Neu-	Right	43	38.5/10 (CTV)	Supine	RAO	10.35	Grade 1 Dermatitis
6	DCIS, grade 2	pTisN0	ER+/PR+	Right	68	38.5/10 (CTV)	Supine	RAO	20.98	Grade 1 Dermatitis
7	DCIS, grade 3	pTisN0	ER+/PR+	Right	69	40/10(GTV) 34/10(CTV)	Supine	RAO	9.78	None
8	IDC, grade 1	pT1cN0	ER+/PR+/Her2Neu-	Right	63	38.5/10 (CTV)	Supine	RAO	14.20	Grade 1 Dermatitis
9	IDC, grade 2	pT1cN0	ER+/PR-/Her2Neu-	Right	53	40/10(GTV) 34/10(CTV)	Supine	RAO	9.52	None
10	ILC, grade 1	pT1aN0	ER+/PR+/Her2Neu-	Left	72	40/10(GTV) 34/10(CTV)	Supine	LAO	11.62	Grade 1 Dermatitis
11	IDC, grade 1	pT1aN0	ER+/PR+/Her2Neu-	Left	47	40/10(GTV) 34/10(CTV)	Supine	LAO	13.12	Grade 1 Dermatitis

Table 1. Patient treatment characteristics.

Organ	Max (Gy)	Mean (Gy)
Heart	0.38 (Right Breast)	0.003 (Right Breast)
	7.27 (Left Breast)	0.05 (Left Breast)
Ipsilateral Lung	21.4	0.56
Chest Wall	35.0	6.79
Skin (5mm)	40.1	9.64

Table 2. Maximum and mean dose (Gy) to critical organs.

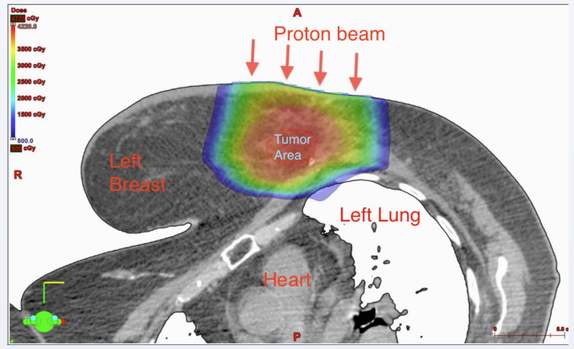

Figure 1. Example of scanning beam IMPT treatment planning.

Conclusion

Using single field IMPT is a feasible and effective approach for APBI. Improved treatment time and use of a single scanning beam helps to reduce delivery uncertainties and reduce intra-fractional motion and respiratory variance. IMPT provides excellent normal tissue sparing dosimetry and good acute toxicity profile.