



A dosimetric comparison of PBI brachytherapy techniques: SAVI, Contura, and Tube and Button

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Purpose



Fig. 1. PBI Brachytherapy techniques: SAVI, Contura, and Tube and button interstitial.

A number of **partial breast irradiation (PBI) brachytherapy options** which include Strut based (SAVI), balloon based (Contura), and interstitial tube and button have been developed in the past several years and used to treat early stage breast cancer [1-4].

We investigated the dosimetry of PBI brachytherapy techniques using the **Strut Adjusted Volume Implant (SAVI), Contura, and Tube and Button (T&B)** in order to evaluate similarities/differences in target coverage and dose to organs at risk.

Materials and Methods

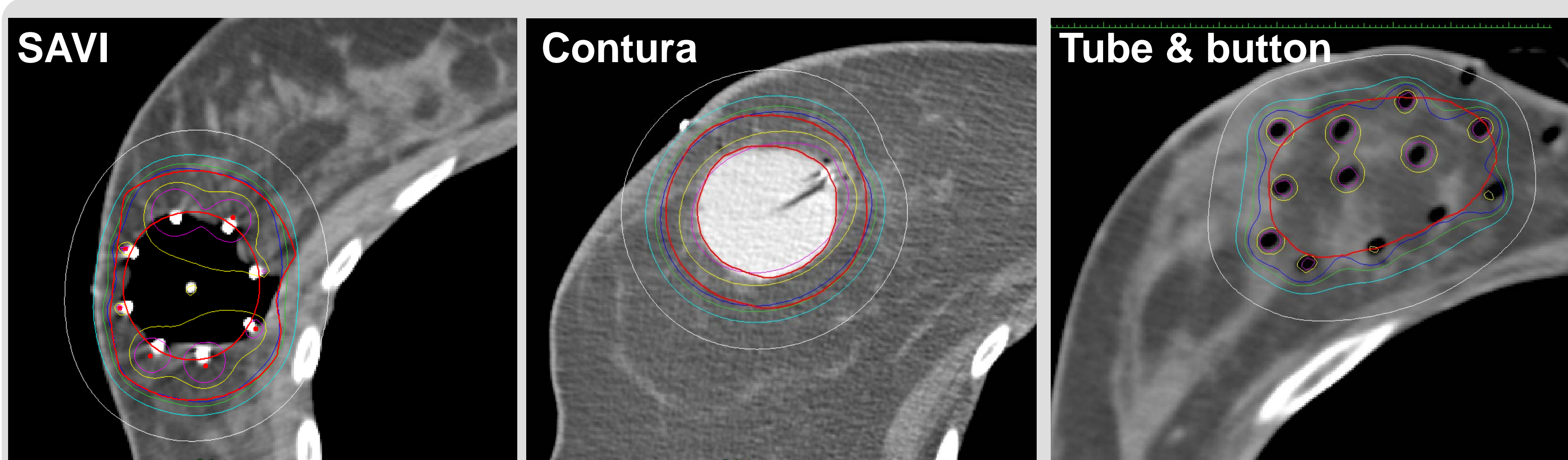


Fig. 2. PTV_EVAL (red) covered by isodose lines 200% (magenta), 150% (yellow), 100% (blue), 90% (green), 75% (cyan) and 50% (white) from SAVI, Contura, and T&B techniques.

- A total of 56 breast-cancer patients have been treated with PBI brachytherapy (28 SAVI, 6 Contura, and 22 T&B) since 2010. The technique was selected based on the size, shape, and location of the lumpectomy cavity and cavity-to-skin distance. CT scans were performed for treatment planning.
- The target (PTV_EVAL) was delineated following **NSABP B-39 guidelines**. For the breast T&B cases, the PTV, including the lumpectomy cavity, was contoured directly by physicians.
- All 3D plans were generated using the Oncentra MasterPlan brachytherapy planning system (Nucletron, Netherlands) and optimized first using the **Inverse Planning Simulated Annealing (IPSA) algorithm** to deliver 3.4 Gy per fraction to the target and minimize dose to organs at risk (OAR). Graphical optimization was then used to fine tune the final dose distribution.
- The minimum cavity-to-skin distance and lumpectomy cavity volume were measured. In order to compare dosimetric properties of the PBI techniques, **target coverage (D90, V90, V95, V100, V150, V200)** and **maximum dose to the OAR (D0.1cc to skin, pectoralis muscles, ribs, and lung)** extracted from dose volume histograms were evaluated. **Dose homogeneity index (DHI)**, as represented by the volume ratio (1-V150/V100), was calculated.

Table 1. UCLA Planning criteria

	SAVI	Contura	T&B
PTV_EVAL V90 (%)	> 90	> 90	> 90
Breast V150 (cc)	< 50	< 50	< 70
Breast V200 (cc)	< 20	< 10	< 20
Skin D _{0.1cc} (%)	< 100	< 100	< 100

Results

The average cavity-to-skin distances for the SAVI and Contura cases were 4.1 mm (0.5-9.6 mm) and 11.7 mm (7.1-15.4 mm), respectively. The average target-to-skin distance for the T&B cases was 8.7 mm (5.0-13.7 mm).

Table 2. **Target (PTV_EVAL) coverage**. D90 is defined as the minimum dose received by 90% of PTV. Vxx is PTV_EVAL receiving xx% of the prescribed dose.

Target Coverage	SAVI (28)	Contura (6)	T&B (22)
D90 (%)	102.1	98.7	106.6
V90 (%)	97.3	97.0	98.6
V95 (%)	95.8	93.0	97.3
V100 (%)	91.7	87.5	95.1
V150 (%)	43.5	28.4	23.8
V200 (%)	21.4	6.4	8.6
DHI	0.55	0.70	0.76

Table 3. **Location and volume of the hot spots (V150 and V200)**. Vxx represents the volume covered by xx% of the prescribed dose.

	SAVI (28)		Contura (6)		T&B (22)
	PTV_EVAL	Cavity	PTV_EVAL	Cavity	PTV_EVAL
Avg. volume (cc)	73.7	38.7	95.6	57.9	64.7
V150 (cc)	32.0	29.4	29.5	57.2	18.3
V200 (cc)	15.7	14.6	7.3	50.1	7.1

Table 4. **Dose to the OAR**. D_{0.1cc} is the minimum dose in the most irradiated 0.1 cc tissue volume.

OAR Dose	SAVI (28)	Contura (6)	T&B (22)
Skin D _{0.1cc} (%)	91.9	93.1	69.1
Pectoralis D _{0.1cc} (%)	84.7	77.8	61.8
Ribs D _{0.1cc} (%)	60.1	51.3	41.5
Lung D _{0.1cc} (%)	45.1	40.5	31.9

Conclusions and Future Work

- All applicators provided clinically acceptable target coverage and met all dose constraints for the OAR.
- The SAVI device provided a lower skin dose at close cavity-to-skin distances while providing excellent target coverage.
- However, the T&B and Contura applicators produced more homogeneous dose distributions or higher DHI in the target than the SAVI plans.
- The correlations between dosimetric properties and follow-up mammogram results are under investigation. The clinical correlation is needed to determine whether the differences in DHI are meaningful.

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