

COIN = 0.79 vs. 0.67 for GO). Dose to OARs was also found lower with graphical optimization. Skin dose rose from median 34% in graphical optimization to 41% in GO plans. Chest wall dose was evidently higher with GO plans (median 24% compared to 18% for graphical optimization). **Conclusions:** Both conformity and dose homogeneity parameters favored graphical optimization for each insertion, as also dose to skin and chest wall. Consequently late toxicity and cosmetic outcome is likely to improve with graphical optimization with fine tuning, although it is significantly more time consuming than geometrical optimization.

PD35 Presentation Time: 9:50 AM

Dosimetric effects of an air cavity for a new PBI applicator

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Purpose: Partial breast irradiation (PBI) with brachytherapy has been shown to be a good alternative to whole breast irradiation. The first high-dose-rate (HDR) brachytherapy device for PBI was the MammoSite™ balloon which has a single central catheter and is typically used with a single dwell position. The SAVI™ device (Cianna Medical, Aliso Viejo, CA) has been developed to enhance this technique. Instead of a single catheter, the SAVI™ device has 8–10 catheters that surround a central catheter. These surrounding catheters allow geometric optimization of the dwell positions to account for close proximity of skin or pectoralis muscle, or cavity asymmetry. Unlike the MammoSite™ balloon, the SAVI™ device is not filled with water, which leaves the lumpectomy cavity full of air or partially filled with seroma. Since current HDR brachytherapy treatment planning systems do not employ heterogeneity corrections, calculating dose to breast tissue implanted with the SAVI™ device can result in errors. We will present Monte Carlo (MC) calculations and measured data for the SAVI™ device in several clinical applications and describe the degree of error when employing conventional dose calculation techniques without heterogeneity corrections.

Methods and Materials: We have investigated the magnitude of this error using MC simulations performed using the EGSnrc suite of programs. Since the source is cylindrically symmetric, we employed DOSRZnrc to calculate absorbed dose from a single source embedded in water and within a quasi-spherical cavity filled with air in order to model the shape created by the SAVI device. The effect of several sources in the device is simulated by using DOSXYZnrc both for water medium and for an air cavity.

Measurements were made in a solid water phantom with and without air gaps using the Ir-192 Varian HDR source and a PTW 30013 ion chamber. Homogeneous dose distribution were calculated using Varian BrachyVision version 7.0.

Results: The magnitude of the dose error depends on the size of the cavity, the arrangement of sources, and the relative dwell times. For a simple case, MC results indicate that the dose 1 cm away from the air-water boundary using only the central catheter is about 6% higher than the homogeneous MC calculation. Independent measurements in a solid water phantom with a similar air cavity gave comparable results. Additional scenarios will be discussed.

Conclusions: The dosimetric effect of the air cavity is non-negligible for some clinical cases. Ideally, future brachytherapy treatment planning systems will incorporate heterogeneity corrections into their dose calculation algorithms. Until then, prior to treating patients users should be aware of the possibility of dose errors with this device and make modifications to the treatment delivery, if necessary.

PD36 Presentation Time: 9:50 AM

Accelerated partial breast irradiation with the SenoRx balloon brachytherapy catheter: Preclinical treatment planning assessment

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Purpose: APBI brachytherapy is generally applied using a centrally positioned, single lumen balloon (SLB) catheter such as the MammoSite

(Hologic Inc.). To address increased dose to adjacent chest wall and skin, this approach was furthered using a multi-lumen balloon (MLB) catheter (Contura, SenoRx Inc.) with four offset lumens. The purpose of this study is to assess the dosimetric impact of the MLB design over current central lumen only catheters.

Methods and Materials: Ten CT datasets from patients treated with the MammoSite were used in this study. All were considered to have had acceptable balloon placement according to NSABP B39/RTOG 0413 protocol guidelines. PTV volume was defined as 10 mm outside of the balloon, and PTV_EVAL was defined as PTV excluding the chest wall and constrained 5 mm from the skin. PTV_EVAL is the structure used for DVH constraints, dosimetric analysis, and comparison of SLB and MLB plans. Other clinical structures included the healthy breast, skin, chest wall, and pectoralis muscle. To simulate clinical MLB results, the SLB plans were modified to account for the geometry of the SenoRx catheter offset lumens and dosimetry reoptimized. SLB and MLB plans were compared for 4 implant geometries; balloons placed < 5 mm, between 5–10 mm, beyond 10 mm from the skin or chest wall, and balloons with about 3 mm of radial asymmetry placed adjacent to the chest wall.

Results: For symmetric balloons placed >10 mm from skin and chest wall, SLB and MLB dosimetric results were similar. In the 5–10 mm skin distance range, when the balloon was adjacent to the chest wall or ribs, the MLB maintained good PTV_EVAL coverage ($V_{PTV95} > 90\%$), diminished V_{100} and V_{150} to breast tissue by about 30% and 20%, respectively, and reduced chest wall dose by about 40%. Similarly, for balloons placed at ≤ 5 mm skin distance, the maximum dose to skin was reduced to less than 115%, typically 30% less than the corresponding SLB. Furthermore, dose distributions better conformed to the target shape with dose to breast tissue outside PTV_EVAL reduced: V_{150} was reduced to zero, V_{100} was reduced by 22% to 56%. PTV_EVAL coverage was consistently increased by 5–15% with MLB.

Conclusions: Through evaluation of ten clinical cases, geometric scenarios have been identified where loading of only a central lumen presents dosimetric limitations. The Contura MLB, SenoRx design with a multi-lumen device can lead to significant improvements in dose coverage of the partial breast target with simultaneous dose reductions to adjacent skin and chest wall structures.

All coauthors are consultants, to SenoRx, Inc.

PD37 Presentation Time: 9:50 AM

Does skin distance matter with the ClearPath™ multicatheter device for accelerated partial breast irradiation?

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Purpose: The purpose of this study was to determine whether the Clearpath™ multicatheter hybrid device could achieve acceptable dosimetry in patients who were not good candidates for MammoSite™ brachytherapy due to the proximity of the breast surgical cavity to the skin surface.

Methods and Materials: This study consisted of eleven patients who had undergone MammoSite™ catheter placement. These patients were not subsequently treated with brachytherapy due to inadequate distance between the balloon and the skin surface. A phantom scan of the Clearpath™ multicatheter hybrid device was performed, and this was superimposed on each patient's MammoSite™ CT scan. The PTV was contoured according to the NSABP 39 protocol. All normal tissues were contoured, including skin, lung, ribs, and heart (for left-sided treatment.) Dosimetry was then performed using the different catheter devices to compare the doses to the PTV and the normal structures.

Results: The median MammoSite™ balloon size, diameter and minimum skin distance were 40 cc (range 35–50 cc), 4.1 cm (3.8 – 4.5 cm), and 5 mm (range 4–6 mm), respectively. The D90, V100, V150 and V200 with MammoSite™ vs. ClearPath™ were 95.29% vs. 97.06% ($p = .13$), 88.8% vs. 91.3% ($p = .10$), 35.7% vs. 38% ($p = .06$), and 9.4% vs. 9.6% ($p = .06$), respectively. The median maximum skin dose \pm SD was $161\% \pm 24$ vs. $113\% \pm 7.68$ ($p < .0001$). The median Dose Homogeneity