Introduction. The strut-adjusted volume implant (SAVI) (Cianna Medical, Aliso Viejo, California) was recently developed to overcome the MammoSite limitation of balloon asymmetry or inadequate balloon to skin distance.

**Purpose.** (1) Dose to the chest wall and skin was qualitatively analyzed in order to study normal tissue sparing where avoidance structures are used for the inverse treatment planning. (2) Radiation toxicity was studied by examining the higher-order dose volume history (DVH). (3) Qualitative determination was carried out for an impact of potential motion of the SAVI applicator on the dose distribution. (4) The SAVI applicator was experimentally simulated with and without seroma or tissue invagination into the cavity because the dose calculation algorithms in some treatment planning system for brachytherapy do not account for heterogeneity which may lead to a dose discrepancy.

**Materials and Methods.** Multi-methods were employed to verify SAVI implantation prior to treatment. Multiple planar CT (3D) image (Fig. 1(a)) and CT image fusion (Fig. 1(b)) were used in addition to AP and lateral CT scout. The CT image fusion is also able to give a direct slice-to-slice comparison between the two fractions. Figures 1(c) and (d) show clear seroma in the CT images for the first and 7th treatment. Tissue invagination was shown in The SAVI devices were covered by a condom in order to form an air cavity. The SAVI applicator with the cavity filled with air and water was merged into a water phantom (as shown in Fig. 2(b)) and the delivered dose was measured using an ion chamber and film for the single and multi source loading. The measurements were compared with a homogenous dose calculation by the Nucletron Plato treatment planning system.

**Results.** (1) Clinical implementation. Twenty-nine patients to date at Mercy Medical Center, Baltimore, MD were treated with SAVI device. SAVI allows for patient-oriented conformal dose distribution for sparing skin, lung, and chest wall. The patients with a minimum skin distance of 2 mm are still treatable with SAVI applicator. SAVI has V300 of 2.7 cc in average, ranging from 1.1 to 4.3 cc, which is greater than the corresponding average value of 1.5 cc for MammoSite applicator.

<table>
<thead>
<tr>
<th>SAVI</th>
<th>Criteria</th>
<th>V90 (%)</th>
<th>V95 (%)</th>
<th>V150 (cc)</th>
<th>V200 (cc)</th>
<th>V300 (cc)</th>
<th>Skin dose</th>
<th>Skin distance</th>
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<tbody>
<tr>
<td>MammoSite</td>
<td>90</td>
<td>95</td>
<td>50</td>
<td>20</td>
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<td>N/A</td>
<td>100%</td>
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<tr>
<td>Clinic</td>
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<td>94.1</td>
<td>33.9</td>
<td>16.5</td>
<td>2.7</td>
<td>N/A</td>
<td>100%</td>
<td>≥ 7 mm</td>
</tr>
</tbody>
</table>

(2) Quality assurance. Multi-methods of AP and lateral CT scout films, multiple planar CT (3D) image, and image fusion were employed to verify SAVI implantation prior to treatment. Independent dose calculation for the SAVI applicator was performed. (3) Single and multi-source loading. The experimental setup as shown in Fig. 2(b) was used for a dose comparison between air and water filled cavity. One source dwell position was used in the center of the central catheter of SAVI applicator. An ion chamber (IBA model CC04) equipped on a Wellhofer water tank was used for the measurement. The chamber moved horizontally along with the bisection plane of the SAVI. A maximum difference of 7% in dose between the air and water cavity is found which is consistent with the profile measurements using a film. The dose variation from the translation motion and rotation of the implanted SAVI applicator is calculated. The resultant data were shown in Figs. 2(c) and 2(d). The 3 mm translational motion or the 3° rotation brings about a 3% variation in dose in average. Furthermore, the 4-mm translational shift or the 5° rotation produces a 5% average dose variation.

**Conclusion.** The maximum dosimetric effect of an air cavity is 7% off compared with a water filled cavity when a single dwell source position is used in the center of the central catheter. Multiple catheters of the SAVI applicator produce the discrepancy of less than 3% and allow for optimal and conformal dose distribution to a lumpectomy cavity while minimizing the dose to adjacent normal structures. The SAVI applicator shows the advantages in treating the shallower, elliptical, and asymmetric cavity.

![Figure 1](image1.png)

Figure 1 (a) CT image fusion, (b) conformal dose distribution around the SAVI cavity, and CT images of an implanted SAVI applicator (c) without and (d) with tissue invagination.

![Figure 2](image2.png)

Figure 2 (a) SAVI applicator. (b) Experimental setup for dose measurement. (c) Relative dose variations by SAVI applicator shift along with the SAVI long axis. (d) Relative dose variations versus the SAVI applicator rotation around the SAVI long axis.