

## ABSTRACT

**THESIS:** Evaluating Dosimetric Changes Caused by Positional Errors of SAVI Applicator Used for Breast Cancer Treatment

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Breast cancer is the most frequently detected cancer in women in developed countries and is generally diagnosed with women while rarely in men. It can be treated with different methods such as surgery and radiotherapy. Radiotherapy has sub-types of treatments such as external beam radiation and internal radiotherapy as known as Brachytherapy, which is the most convenient method to treat breast cancer. The research will focus on High-Dose-Rate (HDR) brachytherapy that is an accepted and effective internal radiotherapy to reduce the number of malignant tumor cells. Usually this treatment uses HDR brachytherapy sources and applicators especially with very limited stages of breast cancer. HDR brachytherapy is carried out by radiating the peripheral normal tissues that surround the lumpectomy cavity in which the original tumor site was removed. This research will investigate the effects of dosimetric changes, which are dependent upon geometric positioning errors of the radiation source dwell positions. The SAVI applicator combines the tissue-sparing dosimetry of interstitial brachytherapy with the single-entry ease of balloon brachytherapy. It is commonly used to deliver radiation to the site of breast lumpectomy post-surgery and this method is called Accelerated Partial Breast Irradiation

(APBI). The investigation will be done by simulating different positional errors through planning treatment software. These changes will be compared with previous patient's data. A CT scan will be used to interpret or analyze the anisotropy of delivered doses through various geometries. Also the CT is used to make sure that there is no movement of SAVI applicator location that would result in to change the entire treatment planning. Dose volume histogram (DVH) will be used to compare the result and evaluate the delivered doses in different organs close to the breast. The maximum dose of skin, chest wall, PTV\_Eval for  $V_{90}$ ,  $V_{150}$ ,  $V_{200}$  will be evaluated according to the NSABP PROTOCOL B-39. The PTV\_Eval is the volume that is evaluated for different percentages of the prescribed dose and is defined as the volume of the excision cavity that is expanded uniformly 1 cm margins from the original tumor bed. NSABP B\_39 recommends that  $V_{90}$  which is the volume that is receiving  $\geq 90\%$  of the prescribed dose,  $V_{150} \leq 70$  cc of the volume that receives 150% of the prescribed dose,  $V_{200} \leq 20$  cc of the volume that is receiving 200% of the prescribed dose, Dose Homogeneity Index (DHI)  $\geq 0.75$  and the maximum dose to the chest wall and skin should not exceed 125% of the prescribed dose.