PhD Thesis Title: Investigation of geometrical, clinical uncertainty and dosimetric studies in 3D interstitial brachytherapy of radical breast implants

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ABSTRACT:

Introduction of volumetric imaging in brachytherapy during the last decade witnessed the transition from conventional brachytherapy to CT based three dimensional (3D) conformal brachytherapy. Active source positions in the vicinity of the target volume, steep dose gradients and rapid dose fall off demands the overall accuracy in 3D conformal brachytherapy more stringent. Since brachytherapy is subject to various uncertainties, it is necessary to identify these uncertainties, their magnitude, and dosimetric impact for each treatment site and technique. The aim of this thesis was to investigate the uncertainties in CT image based 3D conformal interstitial breast partial breast brachytherapy implants, which have not been adequately addressed so far in the literature.

The major findings of this thesis are as follows:

The reconstruction error leads to geometrical uncertainties, which can be minimized by selection of smaller slice thickness and increasing the implant orientation from imaging plane. Significant inter-observer variation in the target delineation was found, which was significantly related to visualization of lumpectomy cavity. Excellent visualization yielded smaller variability in the target delineation. Target delineation variability showed an impact on source position along catheters. Significant impact on dose volume indices, such as decrease in coverage and conformality was found due to inter-observer variation in target delineation. Post-operative changes during the immediate post-op period after lumpectomy and catheter placement resulted in the change of target volume during partial breast brachytherapy treatment. These changes were found patient specific and showed significant reduction in the dosimetric coverage and conformality of the target volume.

References to author publications that relate specifically to the dissertation:

1. **Upreti RR**, Budrukkar A, Wadasadawala T, Misra S, Gurram L, Pathak R, Deshpande DD. “Interobserver variations of target volume delineation and its impact on irradiated volume in accelerated partial breast irradiation with intraoperative interstitial breast implant." Journal of Contemporary Brachytherapy. 2017; 9(2):139-145. https://doi.org/10.5114/jcb.2017.66027
2. **Upreti RR**, Budrukkar A, Upreti U, Misra S, Wadasadawala T, Kohle S, Deshpande DD. “Change of target volume and its dosimetric impact during the course of accelerated partial breast irradiation

using intraoperative multicatheter interstitial brachytherapy after open cavity surgery." Brachytherapy. 2017; 16(5):1028-1034. https://doi.org/10.1016/j.brachy.2017.05.004

3. **Upreti RR**, Budrukkar A, Upreti U, Wadasadawala T, Misra S, Gurram L, Pathak R, Deshpande DD. "Impact of inter-observer variation in target volume delineation on dose volume indices for accelerated partial breast irradiation with multi-catheter interstitial brachytherapy". Radiotherapy and Oncology 2018; 129(1):173-179. https://doi.org/10.1016/j.radonc.2018.06.029
4. **Upreti RR**, Budrukkar A, Wadasadawala T, Misra S, Gurram L, Pathak R, Deshpande DD. "Inter observer variation in delineating lumpectomy cavity and CTV for patients undergoing APBI using intra-operative implants and its impact on implant dosimetry." European Journal of Medical Physics. 2016; Volume 32, S3: 264. https://doi.org/10.1016/j.ejmp.2016.07.572
5. **Upreti RR**, Budrukkar A, Upreti U, Wadasadawala T, Misra S, Deshpande DD. "Interfraction variation in the target volume for accelerated partial breast irradiation (APBI) using intraoperative multicatheter interstitial brachytherapy and its dosimetric impact". Proceedings of ICARO2**.** 2017; Page-180.
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