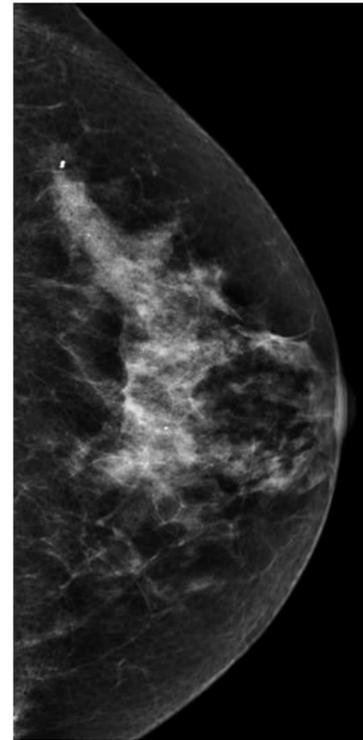


# Dose Reduction In Mammographically Guided Pre-Operative Breast Radioactive Seed Localization Procedures: Minimizing Radiation Dose Without Compromising Successful Clinical Performance

*D D D'Alessio, MD, New York, NY; C Thornton, RT; C C Riedl, MD; U Mahmood, MS; D J Long, PhD  
Memorial Sloan Kettering Cancer Center New York, NY*

## PURPOSE:

Patient radiation exposure is an important consideration in image guided procedures. The balance between optimizing the imaging technique to obtain pertinent clinical information and minimizing patient exposure to radiation during a radiology study is a significant component of quality patient care. When appropriate, some image guided procedures may be performed with imaging techniques that will minimize patient radiation exposure without compromising clinical utility or performance of the exam. The purpose of our project was to optimize imaging technique selection for mammographically guided preoperative breast seed localization procedures to reduce radiation dose and patient radiation exposure during the study without compromising successful clinical performance of the procedure by the radiologist.

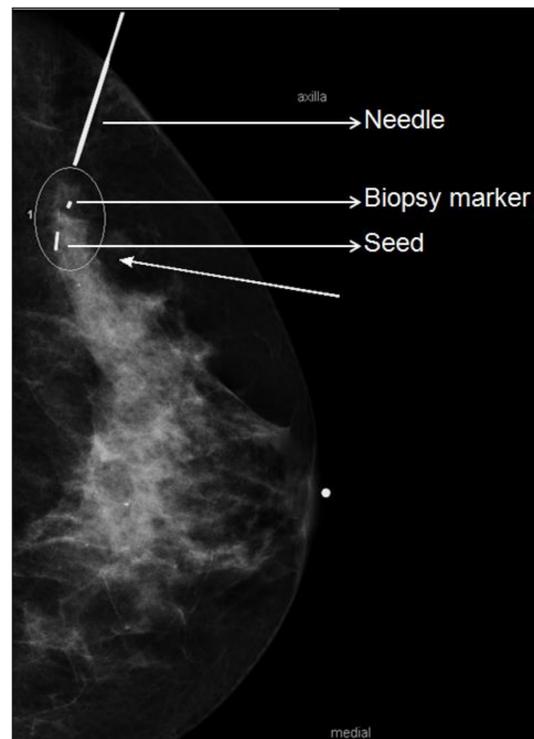


**Left:** Post-biopsy mammogram performed at original diagnostic technique.

**Below:** Seed localization procedure image of the identical breast at approximately 40% reduced radiation dose.

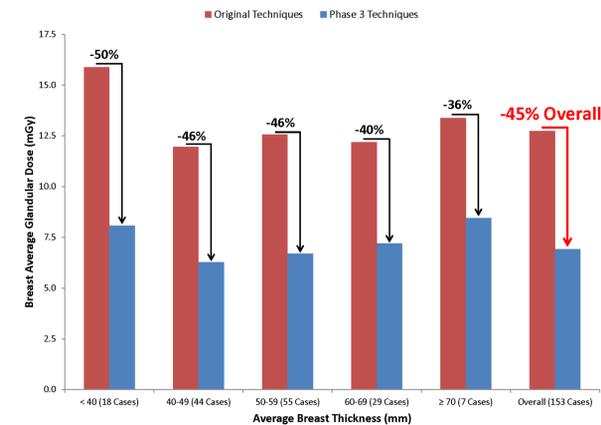
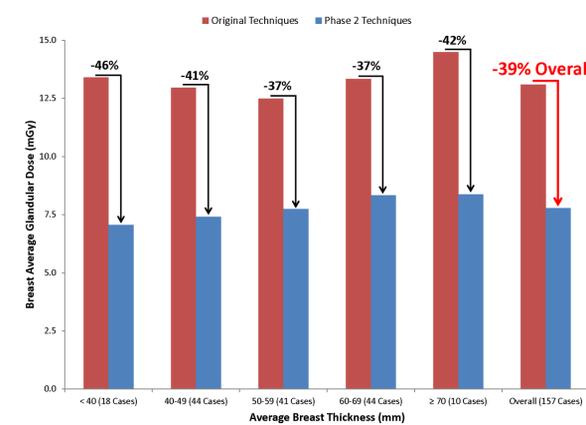
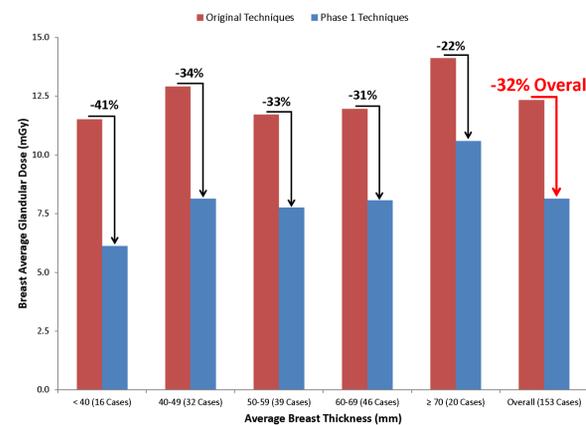
## METHOD:

This HIPAA compliant study was performed with IRB approval. Cases were selected based on the number of sites to be localized and the presence of a radiopaque marker placed at the time of diagnostic breast biopsy. Single site procedures where the target for localization was a single radiopaque biopsy marker were included. Image acquisition technique charts for the procedure were made by medical physics for both the GE Senographe Essential and 2000D used for these procedures to lower the techniques from diagnostic parameters based on the thickness of the breast and the density of the breast tissue surrounding the radiopaque marker target for localization and subsequently used in cases deemed appropriate. The techniques were lowered in three phases to assess for radiologist impressions of procedure performance and to evaluate the average glandular dose (AGD) reduction for patients.



## RESULTS:

Images for seed localization procedures from each phase of the project were extracted from PACS and anonymized. Relevant DICOM header information for dosimetry including compressed breast thickness, system-reported breast glandularity, target/filter combination, kVp, mAs, and mammography system ID was extracted from each image and structured into an input file using a script. For each image, a duplicate input file was created with techniques representative of those that would have been assigned for that image's compressed breast thickness and glandularity under the original protocol of using AOP CNT mode typically used in diagnostic mammograms. Input files were then fed into another script for average glandular dose (AGD) calculation. The script first estimates the entrance skin exposure (ESE) and half-value layer (HVL) for each image based upon the image technique parameters and curves fitted from physical measurements on each machine used for the procedures. Using the calculated ESE, HVL, system-reported breast glandularity, breast thickness, kVp, and target/filter, the AGD is estimated for each image using a parameterization of normalized AGD tables. The total AGD delivered for the patient's procedure for the new protocols and the original protocol are summed over all images and compared using a percent difference: % difference = (AGD<sub>new</sub> – AGD<sub>original</sub>)/AGD<sub>original</sub> x 100. The resulting percent differences were averaged over breast thickness groups and over the entire patient population in each phase. The first phase of the project involved 153 patient cases, and resulted in an overall AGD reduction of approximately 32% compared to the original protocol. The second phase reduced the prescribed mAs values from the first phase by 5 to 10%, and resulted in an overall AGD reduction of approximately 39% for the 157 patient cases involved. The third phase involved an additional 5 to 10% mAs reduction and resulted in an overall reduction of approximately 45%. For all cases, seed localization and subsequent surgical excision were successful.



Patient dose results from (Left) Phase 1; (Center) Phase 2; and (Right) Phase 3.

## CONCLUSION:

Altered image acquisition techniques resulted in an average overall AGD reductions from 30 to 45% in over 450 patients while maintaining successful performance of mammographically guided pre-operative breast radioactive seed localizations. Radiology imaging acquisition technique for mammographically guided preoperative breast radioactive seed localization procedures can be reduced as compared to diagnostic mammograms to minimize patient radiation exposure without compromising clinical performance. This change improves quality patient care and minimizes patient radiation dose. The project will be expanded for an additional phase to determine if the use of AOP DOSE mode on both units can achieve similar reduction as compared to the techniques used in Phase 3 while simultaneously providing easier procedure workflow. Additionally, this protocol will be expanded to include multiple biopsy marker targets for localization thereby increasing the number of patients that may benefit from these dose reduction techniques.