

Purpose: Digital tomosynthesis (DTS) was evaluated as an alternative to CBCT for minimizing possibility of collisions and reducing imaging dose. While feasibility of DTS was demonstrated for APBI patient setup, clinical implementation has not been optimized for this technique. This work characterizes data acquisition/registration parameters and establishes clinical protocol for accurate setup using: Varian OBI system for data acquisition; and non-clinical Varian DTS software for DTS reconstruction/registration for APBI patient setup.

Methods: Backprojection-and-deblurring algorithms were used for DTS volume reconstructions. DTS volume registrations were done manually and automatically (cross-correlation). Subsequent triangulation on two short DTS arcs was done to improve registration accuracy. Software performance was evaluated on a breast phantom and nine breast cancer patients, under an IRB-approved protocol. Parameters investigated include arc lengths, arc orientations, number of arcs, reconstruction slice spacing and other limiting factors relevant to clinical practice. Shifts determined from the registration of DTS volumes were compared to the shifts based on registration between planning CT and CBCT. The difference between these shifts was used to evaluate the software performance and accuracy. The findings were quantified and optimal parameters for clinical use of DTS technique were determined.

Results: At least two arcs were necessary for accurate setup evaluation. Registration accuracy of 2 mm was achieved when reconstruction arc length was > 5 deg for clips with $HU > 1000$; larger arc length (> 8 deg) was required for low HU clips. Optimal arc separation was found to be > 20 deg. Optimal arc length was determined to be 8-10 deg. No dependence on DTS slice spacing was found. Time required for DTS reconstruction was 10s- 45s and it was less than 20s for registration.

Conclusions: Optimal data acquisition/registration parameters were determined for DTS imaging utilized for APBI patient setup, and performance of the software was objectively quantified.

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