

AbstractID: 10697 Title: Improved volumetric imaging with tomosynthesis using combined orthogonal sweeps

Purpose: Traditionally, brachytherapy treatment planning relies on two-dimensional imaging using orthogonal radiographs to provide basic positioning. True organ volumetric 3D information would improve planning and the ability to better conform dose delivery. Modern brachytherapy suites include imaging devices capable of producing cone beam CT (CBCT) images; however collision and patient dose may limit the viability of complete axial rotation. Digital tomosynthesis (DTS) or limited arc techniques overcome these problems but have reduced edge information in two planes. In this study, we compare the efficacy of different combinations of short-arc techniques to CBCT and CT for volumetric fidelity.

Method and Materials: The Digital Integrated Brachytherapy Unit (Nucletron, Veenendaal, The Netherlands), with combined L-arm and C-arm construction, is capable of multiple axes of isocentric rotation and allows imaging with non-axial arcs. For this study, a comparison is made between CT and DTS using multiple image-sweep combinations: 190-degree L-arm sweep (190-L), 50-degree L-arm sweep (50-L), combination of 50-degree L-arm sweep and 90-degree offset orthogonal 50-degree C-arm sweep (L+C), and combination of two orthogonally spaced 50-degree L-arm sweeps (L+L). Our phantom consists of a contrast-filled plastic sphere immersed in water. Data from CT reconstructions are considered the standard for which comparisons are made. For each of the four reconstructions and each orthogonal plane, central slice diameters were measured and compared for fidelity to the CT dataset.

Results: As expected, the 190-L results matched closest with CT. The 50-L images (standard DTS) showed the lowest fidelity. The two combined-arc techniques gave improved results over a single arc. Of the limited arc techniques, the combined L+C reconstruction gave superior overall results and compared well with the 190-L volume.

Conclusion: Short-angle orthogonal-sweep imaging may give adequate volumetric data versus CBCT and improvement versus single-arc DTS.

Conflict of Interest: Research supported by Nucletron, B.V. and T32-CA113267.