



September 26 -
September 30, 2026

Thomas M. Menino Convention
& Exhibition Center, Boston, MA

← MAIN SESSION

SEP
29

QP 32 - Patient Reported Outcomes/QoL/Survivorship Quick Pitch

1189 - DEVELOPMENT STAGE-SPECIFIC BREAST DOSE RECONSTRUCTION IN CHILDHOOD CANCER SURVIVORS: A NEW FOUNDATION FOR SUBSEQUENT BREAST CANCER RISK MODELING



🕒 05:30pm - 05:35pm ET

📍 Room 256

PRESENTER(S)



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Purpose/Objective(s): Organ-level breast dosimetry is essential for developing robust dose-response models of subsequent breast cancer (SBC) risk in female childhood cancer survivors. Historically, epidemiologic studies relied on surrogate metrics such as prescription dose due to absence of 3D imaging in the pre-CT era of radiotherapy (RT). No prior large-scale study has incorporated breast developmental staging into pediatric dose reconstruction. We present the first cohort-scale, development stage-specific breast dose reconstruction framework integrating pediatric breast models across all stages of growth, spanning infancy through post-pubertal development.

Materials/Methods: A hybrid breast dose reconstruction workflow was applied to 5,747 female survivors from the Childhood Cancer Survivor Study treated between 1970-1999 across eight childhood cancers. Stage-specific population-based breast models representing distinct development phases were integrated into complementary CT-derived voxelized and analytical computational phantoms, scaled to population-average height and body dimensions based on patients' age at RT using an in-house scaling algorithm. Individual historical RT records were reviewed to reconstruct patient-specific field geometry, beam energy, shielding design, and treatment parameters. Combined in-field and out-of-field dose contributions were estimated. Reconstructed RT metrics included mean whole-breast dose, subregion doses, and dose-volume (DV) parameters.

Results: Reconstructed dose distributions demonstrated wide variation by treatment field. Median mean whole-breast doses were 5.6Gy (IQR: 2.0-12.3Gy) following chest-directed RT (N=2,523) and 0.2Gy (IQR: 0.1-0.4Gy) following non-chest-directed RT (N=3,224). Among survivors receiving chest-directed RT, prescription dose systematically overestimated reconstructed breast dose, with median prescription-to-mean whole-breast dose ratios ranging 1-18 across disease sites, and an overall median of 4.8 (IQR: 1.8-12.8). DV analyses demonstrated substantial partial-volume exposure, with 47.8% (1,205/2,523) of survivors receiving >10Gy to >10% of breast volume. Subregion analyses further identified localized high-dose exposure in 11.4% (288/2,523) with mean whole-breast dose <10Gy but at least 1 subregion >10Gy.

Conclusion: This work represents the first large cohort-scale reconstruction of historical pediatric RT breast dose accounting for breast development and incorporating breast DV metrics and subregion doses. By moving beyond surrogate prescription metrics and single-template anatomies, this framework establishes a rigorous dosimetric foundation for improved SBC dose-response modeling, evidence-based survivorship screening, and translation of risk estimates to contemporary pediatric RT planning.