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# Leveraging High-Fidelity Planning for Improved Online Adaptive Stereotactic Partial Breast Treatment Efficacy

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Published 03/05/2025



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**Categories:** Medical Physics, Radiation Oncology
**Keywords:** stereotactic partial breast treatment

**How to cite this abstract**
Pogue J A, Duan J, Harms J, et al. (March 05, 2025) Leveraging High-Fidelity Planning for Improved Online Adaptive Stereotactic Partial Breast Treatment Efficacy. Cureus 17(3): a1447

## Abstract

Objectives:

CBCT-guided online adaptive radiation therapy (OART) using Ethos presents benefits for stereotactic accelerated partial breast irradiation (APBI) by addressing target variations during treatment. However, Ethos v1 adaptive treatment times are long (≈30min) due to reliance on a complex planning template, thus increasing patient discomfort and inter-fraction motion. Here we investigate the in silico feasibility of utilizing “high-fidelity mode” (HF), a streamlined stereotactic planning module native to Ethos v2, with the specific aim of increasing OART treatment efficacy.

Methods:

Twenty patients were included in this IRB-approved study; 10 training patients were used to iteratively tune a HF planning template. For the remaining 10 validation patients, 5 OART treatment sessions were emulated using the non-HF template (29 objectives) and HF template (9 objectives), resulting in the analysis of 200 plans (adaptive + non-adaptive). Dose-volume histogram (DVH) metrics, optimization times, monitor units, and patient-specific quality assurance (PSQA) results were compared between HF and Non-HF via the Wilcoxon sign test to evaluate online treatment efficacy.

Results:

Per-fraction adaptive improvements ($p < 0.01$) using the non-HF template were observed for PTV V100% (0.6%), heart V1.5Gy (0.4%), and lung V9Gy (1.0%), while HF was superior ($p < 0.01$) for breast V30Gy (0.6%), breast V15Gy (2.9%), Paddick CI (0.01), and Paddick GI (0.2). Median PSQA passing rates and gamma values were similar among 20plans generated using HF and 20 plans generated using non-HF ($p > 0.05$). Notably, while monitor units were nearly identical ($p = 0.84$), there was a large reduction in per-session optimization time with HF ($p < 0.01$, Non-HF: 9.5min; HF: 4.4min).

Conclusion(s):

This work highlights in silico OART treatment differences between Non-HF and HF planning for APBI patients. The HF model demonstrated significant time savings, which could potentially enhance patient tolerability, reduce intra-fraction motion, and improve overall machine throughput, with only minimal DVH differences compared to the previously published non-HF template.