Feasibility of Accelerated Partial Breast Irradiation (APBI) following Neoadjuvant Systemic Therapy (NST) and Breast Conserving Surgery (BCS)

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Abstract

Purpose/Objectives: We have demonstrated that patients with pathologic complete response (pCR) or minimal residual disease following breast conserving surgery (BCS) and whole breast irradiation (WBI) have low in-breast recurrence rates (IBTR). Herein, we retrospectively evaluated the technical feasibility of accelerated partial breast irradiation (APBI) in this favorable population.
Methods: We contoured the GTVsb, a 1.0-1.5 cm margin for CTVsb, and a final 0.5 cm margin for the PTVsb_Eval. We also contoured the ipsilateral breast (IB) to calculate the ratio of the PTVsb_Eval volume to the IB volume (PTV/IB-R). Technical feasibility was defined as PTV/IB-R ≤ 30%. APBI treatment plans using VMAT were created for patients with PTV/IB-R in the range of 25-30%. Our primary endpoint was to establish the technical feasibility rate of APBI in this patient population with a rate of ≥70%.
Results: We identified 40 treated with NST, BCS, and WBI. Median age was 53 years (IQR 47-61 years), most patients were Hispanic White (50%), and 35% were pre-menopausal. When delineating the GTVsb, 92.5% had visible metallic clips, 52.5% had no associated seroma, and 10% underwent local tissue rearrangement during BCS. Median margin from GTVsb to CTVsb was 1.0 cm (IQR 1.0-1.5 cm). Median PTV_eval volume was 138.2 cc (IQR 98.3-232.5 cc), and median IB volume was 993.6 cc (IQR 708.3-1587.7 cc). Median PTV-IB/R was 15.3% (IQR 11.6%-19.5%). Three patients had PTV/IB-R values above 25% (29.2%, 25.5%, and 25.5%). The 3 corresponding VMAT plans met all dosimetric planning objectives and normal tissue constraints for acceptable APBI planning. Therefore, the technical feasibility rate of APBI in this patient cohort was 100%.
Conclusion: Our current analysis indicates that APBI is technically feasible in patients that receive NST followed by BCS. Pre-chemotherapy MRI ensures that the GTVsb is accurately defined. The current study supports the technical feasibility of APBI in this population, warranting further prospective evaluation.

Introduction

- APBI is an alternative to whole breast irradiation (WBI) in select stage I, HR+/HER2- women after lumpectomy (BCS)
- Women with pathologic complete response (pCR) or minimal residual disease **only** in the breast have low in breast tumor recurrence (IBTR)
- Neoadjuvant systemic therapy (NST) precludes APBI; minimal data of in-breast tumor recurrence (IBTR) with modern NST
- Evaluate the technical feasibility of APBI in low-risk women receiving NST and BCS
- Assess surgical bed delineation accuracy on planning CT scans, verified via concordance of tumor on breast MRI
- Identify a subgroup of patients treated with NST for whom prospective evaluation of APBI may be suitable to study

Methods and Materials

- Retrospective analysis of breast cancer patients at a single comprehensive cancer center treated with NST, BCS, and RT from 2017-2021
- Subset with pre-NST MRI and without oncoplastic mammoplasty

Target Delineation
- **GTVsb:** surgical bed and gross residual tumor, if applicable
- **CTVsb:** GTVsb + 1.0 – 1.5 cm anatomic expansion
- **PTVsb_Eval**: CTVsb+ 0.5 cm, cropped 0.5 cm from skin
- **IB:** Ipsilateral Breast

Feasibility Criteria:
- GTVsb in same quadrant as primary tumor on MRI
- PTV / IB-R ≤ 30%
- Target: ≥ 70% feasibility rate

APBI Planning:
- VMAT plans for PTV/IB-R 25-30%
- 3000 cGy in 5 fractions (Florence APBI regimen)

Results

Table 1. Patient Demographics and Tumor Characteristics

Variable	Patients (N=40)
Median Age (IQR)	53 years (47-61 years)
Median BMI (IQR)	30 kg/m² (26.9-35.2 kg/m²)
Menopausal Status (%)	
Pre-menopausal	14 (35%)
Post-menopausal	26 (65%)
Race and Ethnicity (%)	
Black/African American	4 (10%)
Asian	7 (7.5%)
Hispanic White	20 (50%)
Non-Hispanic White	9 (22.5%)
Smoking Status (%)	
Current or Former Smoker	15 (37.5%)
Never Smoker	25 (62.5%)

Results

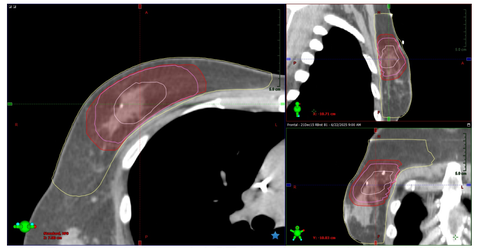


Figure 1. Representative axial CT showing surgical bed delineation.
Light purple: GTVsb; Pink: CTVsb (1.0 cm margin), Red: PTVsb_Eval; Yellow: Ipsilateral Breast (IB)
PTVsb_Eval: 100.4 cc, **IB**: 596.5 cc; **PTV/IB-R:** 16.8%

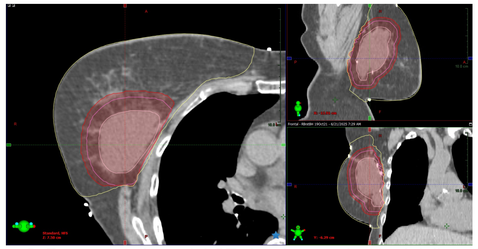


Figure 2. Representative axial CT showing surgical bed delineation for high PTV/IB-R plans.
Light purple: GTVsb; Pink: CTVsb (1.0 cm margin), Red: PTVsb_Eval; Yellow: Ipsilateral Breast (IB)
PTVsb_Eval: 483.5 cc, **IB**: 1894.5 cc; **PTV/IB-R**: 25.5%

Table 2. Surgical Bed Characteristics

Variable	Patients (N=40)
Visible metallic clips (%)	37 (92.5%)
No associated seroma (%)	21 (52.5%)
Local tissue rearrangement (%)	4 (10%)
GTVsb concordant with MRI (%)	**40 (100%)**

Results

Table 3. Tumor Bed APBI Volumetric Analysis

Parameter	Median (IQR)
GTVsb to CTVsb margin	1.0 cm (1.0-1.5)
PTVsb_Eval volume	138.2 cc (98.3-232.5)
Ipsilateral breast (IB) volume	993.6 cc (708.3-1587.7)
PTV / IB-R	**15.3% (11.6%-19.5%)**

For Patients with PTV/IB-R >25%: N=3
- Ratios: 29.2%, 25.5%, 25.5%
- All VMAT plans met dosimetric objectives
- All plans met normal tissue constraints

Discussion

- APBI is technically feasible in 100% of patients receiving NST followed by BCS, exceeding the pre-specified 70% threshold
- All patients with PTV/IB-R >25% achieved acceptable APBI dosimetry, demonstrating technical feasibility even with less favorable anatomy
- Pre-chemotherapy MRI is essential for accurate GTVsb definition
- Surgical clips aid cavity identification (92.5%)
- Median PTV / IB-R 15.3% indicates favorable target volumes
- Combined with our low IBTR data, supports prospective APBI evaluation in patients with pCR or minimal residual disease

Conclusions

- These technical feasibility data establish the basis for safely de-escalating radiation therapy in a population previously excluded from APBI
- Combined with our institution's low IBTR rates in women achieving pCR or low disease burden **only** in the breast following NST, these results support future prospective evaluation of APBI in this low-risk subgroup

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