

Comparative Effectiveness of Tumor Bed Boost Plus Whole-Breast Irradiation Versus Whole-Breast Irradiation Alone in Ductal Carcinoma In Situ: A Systematic Review and Meta-Analysis

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Background & Objective

Whole-breast irradiation (WBI) after breast-conserving surgery lowers ipsilateral breast tumor recurrence (IBTR) in ductal carcinoma in situ (DCIS). A tumor-bed boost improves local control in invasive cancer, but its value in DCIS is uncertain.

Objective: To compare the efficacy of boost + WBI with WBI alone in women with ductal carcinoma in situ (DCIS).

Methods

Design: PRISMA guidelines followed; PubMed and Embase searched.

Eligibility: DCIS treated with breast-conserving surgery and WBI, comparing boost with no boost and reporting IBTR or LRFS.

Analysis: Random-effects pooling of hazard ratios (HRs, time-to-event IBTR) and risk ratios (RRs, crude IBTR and 5-/10-year LRFS); heterogeneity by I².

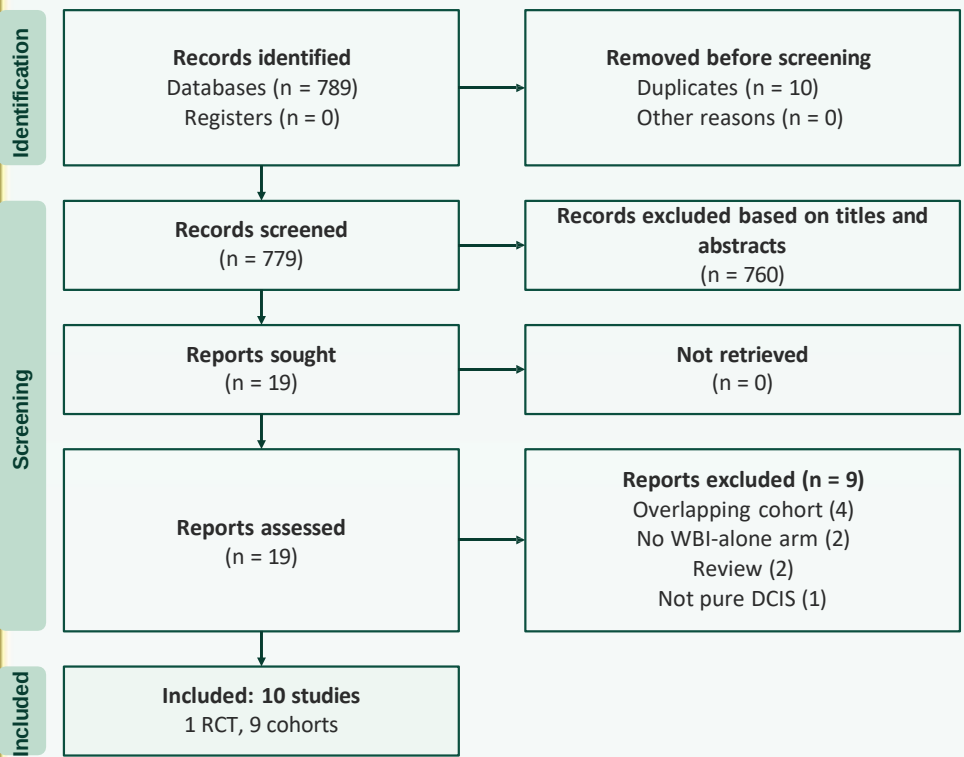
Subgroups: study design, margin (<2 vs ≥2 mm) and age (<50 vs ≥50 y), compared with the χ² test for subgroup differences.

Risk of bias: RoB 2 for the RCT; Newcastle–Ottawa Scale for cohorts.

Results · Studies & Quality

Study selection

789 records were identified and 19 full-text reports assessed; 10 studies were included (1 RCT, 9 cohorts; 12,066 participants).



Risk of bias

Study	Design	NOS score	Quality
Omclin 2006	Cohort	6/9	Good
Wai 2011	Cohort	8/9	Good
Wong 2012	Cohort	4/9	Poor
Meattini 2013	Cohort	7/9	Good
Rakovitch 2013	Cohort	9/9	Good
Kim 2014	Cohort	7/9	Good
Moran 2017	Cohort	8/9	Good
Cambra 2019	Cohort	7/9	Good
Dreyfuss 2023	Cohort	7/9	Good
Chua 2022	RCT	RoB 2	Low risk

nine of ten cohorts were good quality; Wong 2012 was poor (no adjustment, short follow-up). The RCT was low risk in all RoB 2 domains.

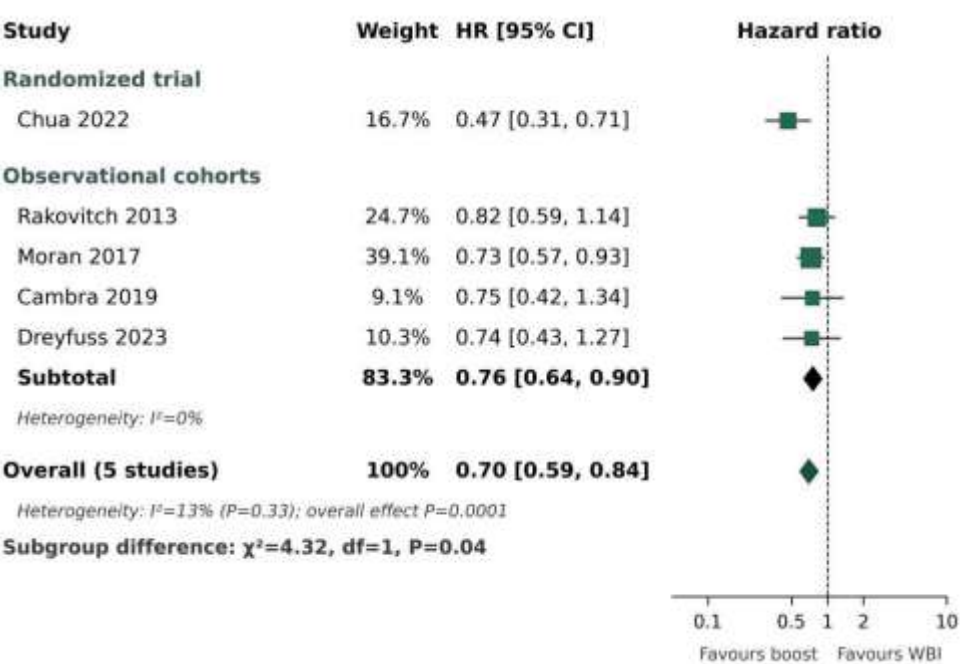
Results · Main Analyses

Table 1. Pooled estimates

Outcome	Studies	Estimate (95% CI)	P
IBTR, time-to-event	5	HR 0.70 (0.59–0.84)	0.0001
IBTR, crude events	5	RR 1.06 (0.80–1.42)	0.68
LRFS, 5-year	3	RR 1.02 (0.99–1.05)	0.15
LRFS, 10-year	4	RR 1.02 (0.99–1.06)	0.17
LRFS, time-to-event	3	HR 0.66 (0.46–0.95)	0.02

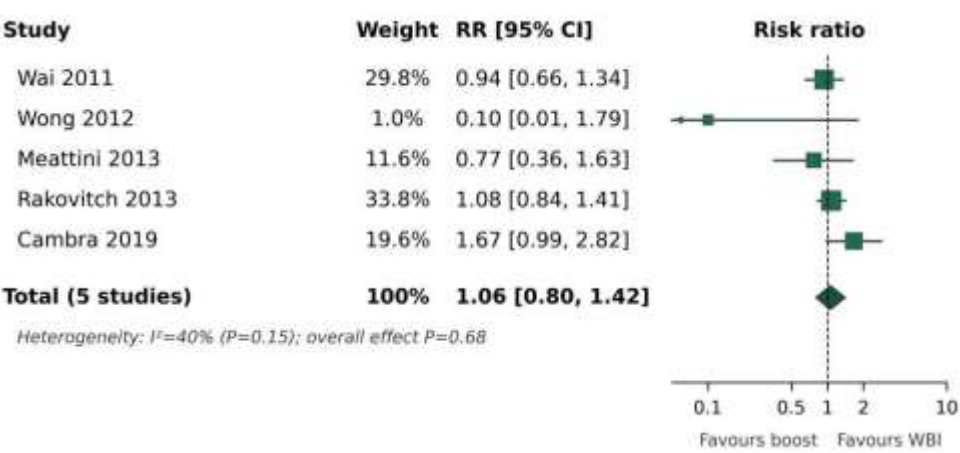
Boost lowered the hazard of IBTR by 30% when follow-up time was accounted for. Crude event rates and fixed-time LRFS showed no difference, because boost was mostly given to higher-risk patients.

Figure 1. IBTR (time-to-event) by study design



Both designs favour boost. The single RCT shows a larger effect (HR 0.47) than the cohorts (HR 0.76; P = 0.04), but this contrast rests on one trial.

Figure 2. Crude IBTR event rates



No difference on crude counts, consistent with confounding by indication rather than absence of benefit.

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Results · Subgroup Analyses

Subgroup	Category	k	n	Pooled effect (95% CI)	P value
Margin status	Close/positive (<2 mm)	3	1,117	HR 0.61 (0.30–1.24)	0.171
	Negative (≥2 mm)	3	4,174	HR 0.67 (0.53–0.84)	<0.001
Age	<50 years	3	1,881	HR 0.58 (0.38–0.90)	0.016
	≥50 years	2	4,174	HR 0.59 (0.44–0.79)	<0.001
Grade / comedo necrosis	Present	2	2,477	HR 0.56 (0.34–0.91)	0.020
	Absent	2	1,498	HR 0.81 (0.49–1.33)	0.407
Study design	RCT	1	1,608	HR 0.47 (0.31–0.72)	<0.001
	Cohorts	6	9,028	HR 0.68 (0.55–0.86)	<0.001
Median follow-up	< 8 years	4	3,988	HR 0.50 (0.34–0.73)	<0.001
	≥ 8 years	3	6,648	HR 0.74 (0.60–0.91)	0.005
Boost dose	>10 Gy	3	7,632	HR 0.66 (0.49–0.88)	0.004
	≤10 Gy	4	3,004	HR 0.58 (0.37–0.90)	0.015
Recurrence type*	Invasive	5	4,574	RR 0.84 (0.48–1.47)	0.546
	In situ (DCIS)	4	4,258	RR 0.75 (0.46–1.23)	0.259
Study design*	RCT	1	1,608	RR 0.49 (0.32–0.73)	<0.001
	Cohorts	4	3,039	RR 1.02 (0.63–1.63)	0.943

k = number of studies; n = patients contributing to each subgroup (Cambra counted as 624 tumours; Omclin = 316 women given RT with or without boost). P value = test of the pooled effect; shaded/bold = significant (P < 0.05). HR/RR < 1 favours boost + WBI. Random-effects (DerSimonian–Laird) pooling. HR rows = time-to-event IBTR (7 studies: Chua, Moran, Rakovitch, Dreyfuss, Cambra, Omclin, Meattini; Figure 1 uses 5 of these). *RR rows = crude recurrence counts. Margins by SSO/ASTRO/ASCO (2 mm); Omclin (≤45 y) in the younger group. Sensitivity: without Cambra, close/positive HR 0.50 (0.27–0.92); difference P = 0.47.

No patient or tumour factor changed the benefit: boost lowered IBTR similarly by margin status, age, grade/necrosis, boost dose and recurrence type. On crude counts the RCT still showed benefit (RR 0.49) but the cohorts did not (RR 1.02), consistent with confounding by indication in the cohorts.

Conclusion

Adding a tumor-bed boost to WBI reduces IBTR in DCIS by about 30%, and the benefit does not depend on margin status or age.

Observational cohorts underestimate the randomized effect, most likely through confounding by indication. Subgroup analyses were post hoc and based on few studies.