WM Radiotherapy Clinical Protocol

Breast Radiotherapy Protocol

Revision history

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Approved By

This document was ratified by the Radiotherapy Expert Advisory Group (EAG) at its June 2026 meeting.

Working in partnership with West Midlands cancer alliance

WEST MIDLANDS RADIOTHERAPY NETWORK

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1. Purpose

To provide a standardised protocol for planning and delivery of external beam radiotherapy for patients. Complex cases may not have clear evidence to pursue one treatment protocol over another.

The role of radiotherapy clinical trials to be considered at the time of MDT.

This protocol is based on Fast Forward Trial protocol, the Import Low trial, the Import High trial, Postoperative radiotherapy for Breast Cancer: hypofractionation, RCR consensus statements (May 2021)[1] and the Royal College of Radiologists (RCR) Dose Fractionation Guidance (Version 4 February 2024)[2]

1.1 Information & Consent

- Each Patient should be consented with individualised information of planned treatment, risk / benefits, and toxicities
- Booking form and consent completed by IR(ME)R practitioner
- national consent forms can be used.
- Patients should also receive a local patient information sheet or MacMillan information booklets, with information on DIBH
- Patients should be signposted to West Midlands Radiotherapy Network breast radiotherapy information videos specific to the hospital where they are receiving care

1.2 Responsibility

- To comply with the Ionising Radiation (Medical Exposure) Regulations 2017 the following roles are defined:
- Referrer & Practitioner: The Consultant Clinical Oncologist, Specialist Registrar or Consultant Radiographer is responsible for the care of the patient including correct referral for treatment consent, justification prescription and treatment authorization as defined in departmental protocol but in accordance with this regional protocol.
- Operators: Radiographers, physicists and technologists Consultant clinical Oncologists and other medical staff are responsible for individual tasks associated with the plan production, verification, and treatment delivery as per departmental protocols but in accordance with this regional protocol and are undertaken on the auspices of the practitioner.
- It is the responsibility of department management teams to ensure departmental protocols are consistent with this regional protocol and that any disagreement with the content of this protocol is raised through the West Midlands EAG.

2. Clinical indications for radiotherapy

2.1 Adjuvant Radiotherapy to the breast after breast conserving surgery

Recommended for invasive breast cancer following breast conserving surgery with clear margins, accepted as 1mm, or positive margins where no further surgery is possible.

Radiotherapy to be recommended to the whole breast, and regional lymph nodes, as per RCR consensus for node positive disease, when presenting with axillary lymph node involvement and occult disease in the Breast following axillary surgery

2.2 Tumour Bed Boost

• Should be **recommended** for women less than 50 years old, national guidance
• Should be **considered** for involved or margins <1mm deep including where no further surgery is possible (invasive or in situ)[3, 4]

• May be **considered** for patients over 50 years old with higher risk for recurrence (which are not consistently evidenced in literature) such as:
  ○ Her-2 positive
  ○ triple negative
  ○ grade 3
  ○ LVSI
  ○ larger tumours
• Consider benefit and normal tissue toxicity reduction in local recurrence, no evidence to support improvement in overall survival

2.3 Adjuvant Radiotherapy to the chest wall after mastectomy, with or without reconstruction surgery

High risk of local recurrence: **Absolute recommendation** performance status permitting • Size of invasive breast cancer (T3/T4), inflammatory and locally advanced • Any axillary nodes positive for macro metastases • Involved resection margins Could be considered - for patients who have had mastectomy and axillary clearance: • pT2, grade 3 and lympho-vascular invasion have also been individually shown to increase risk of recurrence (more than one risk factor involved). Multifocal Disease with consideration to accompanying high risk factors and toxicity.
Radiotherapy **not offered** to patients considered to be at lower risk following mastectomy • T1-T2, Clear margins • Node negative • Post mastectomy for DCIS

2.4 Radiotherapy to loco-regional nodal areas (axilla and supraclavicular fossa)

Post SLNB: micro-metastasis only:	**No further surgery or axillary radiotherapy**

Post SLNB: 1-3 nodes positive:	Practise outside of the POSNOC trial for further axillary clearance **or** no surgery and radiotherapy to the axilla and supraclavicular fossa. If not fit for further surgery, consider radiotherapy to the axilla and supraclavicular fossa
Post ALNC: 1-3 nodes positive:	Axillary radiotherapy is **not usually recommended** post full clearance. Can discuss if there is evidence of extensive macroscopic disease. Clinical benefit and normal tissue toxicity to be discussed. Consider for further RNI with IMC if central/medially place tumour
Post ALNC: 4 or more nodes:	**Recommended** supraclavicular radiotherapy

2.5 Radiotherapy to the internal mammary nodes

patients at high risk of loco-regional recurrence T4 or with 4 or more axillary lymph node macro-metastases	Internal mammary radiotherapy **should be** considered (national guidance)
patients with 1-3 axillary macro-metastases who have been recommended loco-regional irradiation on risk factors (including age and tumour biology), in those with central/medially placed tumours	Internal mammary radiotherapy **could be** considered (national guidance)
T2 laterally placed and axillary node negative	Internal mammary radiotherapy should not be offered unless suspicious IMC nodes on MRI/CT scan and agreed at MDT

In those patients who have already been deemed necessary to receive loco-regional radiotherapy (supraclavicular radiotherapy +/- axillary dependent on extent of axillary surgery) internal mammary radiotherapy should be **considered** in the light of the EORTC 22922/10925, MA20 and DBCG-IMN. **(**Only DBCG-IMN demonstrated significant reduction in breast cancer-related mortality and OS benefit of 3.7% at 8years, but as prospective population-based cohort study cannot be considered as Level 1 evidence therefore internal mammary chain inclusion remains at clinicians' discretion)

Careful patient selection is advised due to risk of potential cardiac toxicity following IMN irradiation[5]. Second cancers should also be taken into account.

IMC radiotherapy should be delivered using techniques which minimise the dose to the heart and lungs: contralateral breast doses should be recorded. Aim to use DIBH for this.

2.6 Radiotherapy after neoadjuvant chemotherapy (NG101, NICE 2018)

To be offered in patients with locally advanced or inflammatory breast cancer after surgery to the primary breast and regional lymphatics

Offer post mastectomy radiotherapy after neoadjuvant chemotherapy if post-treatment histology shows node-positive (macro metastases) breast cancer or involved resection margins.

Offer post mastectomy radiotherapy after neoadjuvant chemotherapy if pre-treatment investigations show node-positive (macro metastases) breast cancer.

Offer post mastectomy radiotherapy after neoadjuvant chemotherapy if post-treatment histology shows node-negative T3 breast cancer.

Consider post mastectomy radiotherapy after neoadjuvant chemotherapy if pre-treatment investigations show node-negative T3 breast cancer.

Formal discussion at MDT if omission of radiotherapy being considered post neoadjuvant chemotherapy

While regional nodal radiotherapy remains the standard of care, clinicians may consider the omission of radiotherapy for patients undergoing mastectomy and axillary clearance who present as cT1–3N1 and achieve a pathological complete response.

Similarly, in those treated with WLE and SLNB following neoadjuvant therapy, who achieve a nodal pathological complete response, omission of radiotherapy to the lymphatics while offering radiotherapy to the breast only.

This approach is supported by findings from NSABP B-51 Phase 3 RCT, although longer-term follow-up is required, and this uncertainty should be discussed with patients when making shared decisions[6].

2.7 Cardiac Sparing

Cardiac sparing techniques should be considered the standard of care for patients with left sided breast cancer, for patients where IMC is included and right sided cases where left has had previous irradiation.

Cardiac sparing should be considered for all patients who have received or exposed to anthracycline based chemotherapy.

Cardiac sparing techniques should be considered the standard of care for all patients:

- with left sided breast cancer
- where IMC is included
- right sided cases where left has had previous irradiation
- considered for all patients who have received or have been exposed to anthracycline based chemotherapy

See below for planning technique.

2.8 Partial Breast Radiotherapy

Consider eligibility. As per **IMPORT Low UK Trial, patients aged 50** or over who have had breast conserving surgery for unifocal invasive ductal carcinoma, grade 1-2 tumour size ≤3cm node negative (pN0), minimum microscopic margins of 2mm or more, oestrogen receptor positive but Her 2 negative As the data from the IMPORT Low UK trial is now mature, partial breast radiotherapy could be offered to patients above the age of 50.
Consider in those with higher risk of late comorbidities (left sided tumours, higher risk collagen disease for late radiation toxicity) **Consider** patients who are willing to take adjuvant endocrine therapy for a minimum of 5yrs (as per NICE guidance)
Not to be considered for classical lobular carcinoma, multifocal disease, or associated extensive DCIS or those with vascular invasion

2.9 Omission of radiotherapy may be considered after breast conserving surgery

In women deemed to be at very low risk of local recurrence Women >65 years of age T1, T2 <3cm N0 ER positive PR positive, Her2 negative, Grade1/2 AND who are willing to take adjuvant endocrine therapy for a minimum of 5yrs AND have regular mammograms for 10yrs. Best offered in the context of UK PRIMETIME study PRIME II 1.3% local recurrence rate at 5yrs for RT vs 4.1% at 5yrs and 9.8% at 10yrs for no RT *Patients need to be counselled of the higher risk of recurrence if Radiotherapy not given[7].

2.10 Radiotherapy for DCIS

Recommended adjuvant radiotherapy to patients with all High grades of DCIS following adequate conservative surgery **Consider** for all intermediate grade, - discuss potential benefits and risks options, may not be favourable for radiotherapy in all circumstances decision to be made on clinical circumstances, grade, margins, age **Not to be considered** for low grade - adjuvant radiotherapy after breast conversation surgery can be omitted in low grade DCIS with clear surgical margins [8], [9], [10]
MSK Nomogram NICE guidance NG101 (2018)

Radiotherapy not indicated post mastectomy, unless margins are involved. In which case consider and discuss with patient.

3. Planning Technique

- Patients should be supine. For larger breasted patients, alternative positioning should be considered such as bras or prone technique. Consider referral as appropriate.
- Use appropriate breast immobilisation devise, i.e. Breast board, WingBoard +/- vac bag and knee rest etc.
- Patients may be elevated on a 5, 7.5'' or10' incline
- For a small group of patients, the thermoplastic immobilisation (e.g. Orfit) might be helpful to stabilise breast tissue
- Consider wire markers to delineate the visible breast tissue, + sup and inf boarders, as per local scanning breast patients work instruction
- When <5mm anterior skin margin and no boost required, bolus can be applied to the scar to enhance skin surface dose, 5mm - 10mm bolus – this is a decision made by individual departments due to the lack of good evidence for bolus use (see 4.4 below)
- DIBH – see indications above
- Scanning levels will be as local departmental documentation e.g. C5 or C7/T1 space down to L1/l2
- IV Contrast may be considered if loco-regional nodal areas (axilla and supraclavicular fossa) and / or internal mammary nodes are to be treated.
- SGRT will be employed where available

4. Target Delineation

4.1 Intact Breast

Breast

Creation of breast volumes for dose optimisation and reporting is strongly encouraged. Automatic techniques based on tangential field beam edges are acceptable. PTV reporting volume should be cropped from the skin and lungs as described below. Suggested margins are below, but local margins can be used.

CTV_{wb} = Soft tissue of whole breast
PTV_{wb} = CTV_{wb} + 1 cm growth all round. It is recommended that the Phys_prefix on PTV names is used where they are used for dose reporting/optimisation; and that they have fluence coverage around the whole geometric PTV.

PTV is cropped 0.5 cm from the lung, and 0.5 cm below the skin surface. (This would be a Phys PTV).

The superior margin may be reduced if matching to nodal field.

Partial Breast

Define the whole breast volume (ratio of planned volume to whole breast ratio to be provided)
Clinician to define the tumour bed

CTVpb = Tumour bed to be outlined by the clinician, reviewing the volume around the surgical clips and including any changes in the surrounding tissue architecture. This is then grown by 15mm to give a

partial breast CTV cropped by 5mm from the skin surface and 5mm from the lung and chest wall interface (based on IMPORT LOW protocol)

PTVpb = CTVpb + 10mm

A PTV reporting structure should be cropped 0.5 cm from the lung and skin surface.

4.2 Tumour bed boost

CTV as defined by radiological information, pre and post chemotherapy, clinical assessment operative intent and histological findings, seroma and architectural changes plus titanium surgical clips as placed by BASO guidelines in order to locate and define the pre-treatment tumour bed, with reference to histological orientation and calculated histological surgical margins

CTV tumour bed should not extend beyond normal breast tissue or the whole breast PTV
75% of recurrences occur in the quadrant containing the tumour bed (within 30mm of primary tumours)

PTV = CTV _tb +5-10mm according to departmental protocols

4.3 Chest wall / Post mastectomy

Cranial Superior	Reference to the 2nd rib insertion / caudal edge of sterno clavicular joint
Caudal Inferior	Apparent loss of CT defined breast tissue (post mastectomy clinical reference – the loss of apparent breast tissue compared to contralateral breast)
Anterior	Skin (CTV 5mm behind the skin) – unless involved
Posterior	Pectoralis muscle /chest wall muscle and ribs
Lateral	Mid axillary line exclude latissimus dorsi
Medial	Midline

Mastectomy scar often included but may extend beyond the midline and the radiotherapy field. NB: Scar is not part of CTV unless skin was involved (wired at the time of CT scanning)

Chest wall CTVcw = as defined above, with reference to available pre-mastectomy imaging
PTVcw = CTVcw + 10 mm margin – cropped 5mm inside skin or bolus, and lung

4.4 Bolus Post Mastectomy

- Routine use of bolus for chest wall, para-scar or immediate reconstruction irradiation is not recommended[11]

- The use of bolus will be left to the discretion of treating physician on an individual patient basis considering those to be at "higher" risk of local recurrence (e.g, direct skin invasion, positive margins, triple negative or non-luminal phenotype, LVI, thin chest wall etc.)[12]
- Due to the scarce of data recommending the pros and cons of para-scar (3-4 cm parallel to either side of the scar) vs whole chest wall bolus and when used will be left at to the discretion of treating physician[13]
- There is significant variation in bolus thickness required in the literature ranging 5-10mm.[14] [15] [16] [17]This will also be at the discretion of treating physician or institution.
- If bolus is being used it should be used throughout the whole course of radiotherapy. It is not recommended to use it for only part of the treatment course (e.g, every other day, etc.)

4.5 Regional nodal voluming

The ambition is for nodal treatments to be volume based. Whilst centres are gaining competencies, field-based planning approaches may be used.
Individual patient anatomy should be reviewed to confirm if a posterior field is required.
Axillary high tangent radiotherapy for patients not receiving axillary surgical clearance

ESTRO guidance[18] / FAST FORWARD nodal voluming technique
IMN CTV -_IMN may in the adjuvant setting extend inferiorly to the 3/4th rib (lateral location/upper) or 4/5th rib (central and medial/lower) dependent on PET CT scan or extent of disease **intention should be documented more likely to extend the field in PET positive disease, locally advanced**

Regional nodal volumes including the IMN, PTV = CTV + 5 -10mm margin, dependant on departmental protocols.

4.6 Peer Review

Peer review should be undertaken in line with the West Midlands regional guidance agreed in December 2025 which identifies which cases should be subject (as a minimum) to peer review. Please refer to the West Midlands Peer Review guidance (December 2025).

4.7 Treatment Planning and Organs At Risk

Tangential medial and lateral fields with non-divergent post edges should be used. Isocentric, planned to volume using a forward planned IMRT technique in order to reduce hot spots in the CTV.

Inverse planned IMRT may on occasion be required (e.g, very medial tumour, pes excavatum, bilateral breast irradiation) and should be agreed on a case-by-case basis. If nodal volumes are included, a single isocentre technique is desirable, however in certain circumstances field matching or gaps could be employed to avoid overlap. These fields will generally be anterior oblique and care should be taken to limit the spinal cord dose. If required, a posterior oblique field can be added to improve dose coverage at depth.

For VMAT technique, extended OAR delineation is required for beam optimisation.
If IMC is to be treated an IMRT/VMAT technique is preferred.

OARs: Heart and Ipsilateral lung **must** be delineated. Brachial plexus and spinal cord could be delineated. If VMAT is used the delineation of the contralateral breast is encouraged.

Target Dose Constraints: (15 Fractions: ([40 + 48Gy] or [40Gy + Sequential Boost])
Max dose parameters exclude Boost PTV

Target PTV	Metric	Mandatory	Optimal
Tumour Bed / Boost	$V_{95\%Boost}$	≥ 90%	≥95
Whole Breast / Chest Wall	V_{38Gy} (95% of Breast Px) V_{42Gy} (105% of Breast Px) V_{44Gy} (105% of Breast Px)	≥ 90%	≥95 ≤ 5% ≤ 2cc
Axilla/SCLN	V_{36Gy} V_{42Gy} (105% of Axilla/SCLN Px) Max Dose (0.5 cc)	≥ 80% - <44Gy	≥ 90% ≤ 2% -
IMN	V_{36Gy} V_{42Gy} (105% of IMN Px) Max Dose (0.5 cc)	≥ 80% <44Gy	≥ 90% ≤ 2%

Based on Fast Forward Platform goals.

Target Dose Constraints: (5 Fractions: 26Gy + Sequential Boost)
Max dose parameters exclude Boost PTV

Target PTV	Metric	Mandatory	Optimal
Tumour Bed / Boost	$V_{95\%Boost}$	≥ 90%	≥95
Whole Breast / Chest Wall	V_{38Gy} (95% of Breast Px) V_{42Gy} (105% of Breast Px) V_{44Gy} (105% of Breast Px)	≥ 90%	≥95 ≤ 5% ≤ 2cc

OAR Dose Constraints: (15 Fractions (based on 40Gy+48Gy))

	Metric	Breast and Boost		Breast, Nodes and Boost (no IMC)		Breast, Nodes and Boost (with IMC)	
		Mandatory	Optimal	Mandatory	Optimal	Mandatory	Optimal
Ipsilateral Lung	MLD				<11Gy		13Gy
	V12Gy	17%	15%		<25%		
	V17Gy					<35%	<25%
	V18Gy			<30%			

Contralateral Lung	MLD	<3Gy	<1Gy	<3Gy	<1Gy	<4Gy	<1Gy
Heart	MHD						6Gy
	V10	<5%		<5%		<5%	
	V2Gy	<30%		<30%		<30%	
Contralateral Breast	Mean Dose					<3.5Gy	
Brachial Plex	0.1 cc			≤ 42.0Gy		≤ 42.0Gy	
PRV Cord (prev WM protocol)	0.1 cc			40.0Gy		40.0Gy	

OAR Dose Constraints: (5 Fractions (based on 26Gy))

	Metric	**Breast and Boost**		**Breast, Nodes and Boost (no IMC)**		**Breast, Nodes and Boost (with IMC)**	
		Mandatory	**Optimal**	**Mandatory**	**Optimal**	**Mandatory**	**Optimal**
Ipsilateral Lung	MLD		<4Gy				
	V7.8Gy	17%	15%				
	V17Gy						
	V18Gy						
Contralateral Lung	MLD	<2Gy	<0.7Gy				
Heart	MHD	<2Gy	<1.3Gy				
	$V_{6.5Gy}$	<5%					
	$V_{1.3Gy}$	30%					
Contralateral Breast	Mean Dose						
Brachial Plex	0.1 cc	<27.3Gy					

4.8 Dose and Fractionation

- 26Gy in 5 fractions over 1 week (Fast Forward) Breast over a maximum of 8 days.
- 28.5Gy in 5 fractions once weekly – frail or elderly
- 40.05Gy in 15 fractions over 3 weeks, breast and nodes
- 40.05Gy in 15 fractions breast & Nodes, and patient with implant-based reconstruction

For tumour bed boost (when required)

13.35Gy or 14Gy*in 5 fractions, 16Gy in 8# or 12Gy in4#
10Gy in 5 fractions
*Radiobiological equivalent to 16Gy in 8#
48Gy in 15 fractions if VMAT-SIB used, especially for IMC cases[1]

4.9 Treatment Verification

Image verification defined as appropriate to treatment technique
Minimum recommended would be 1-3# and then weekly.
Use of SGRT and gated treatment options may allow for less frequent image matching.
Inverse planned VMAT/ RapidArc volumes should be verified with CBCT. This may also be appropriate for small volume boost treatments
2D verification of tangential or nodal fields may be adequate.

On-set verification frequency and action levels are defined within the local departmental protocols

5. Palliative

5.1 Primary radiotherapy for locally advanced breast cancer/palliative

High dose palliative radiotherapy may be required in locally advanced disease or when surgery is not a clinical therapeutic option. This may include regional nodal radiotherapy for locally advanced disease. 40Gy in 15 fractions. On occasion a boost to the primary tumour may also be indicated: 13.35Gy in 5 fractions.
Palliative fractionation • 28.5 - 36Gy in 5-6# treating once weekly • 20Gy in 5#

5.2 Palliative Radiotherapy for metastatic disease

Radiotherapy might be considered where symptom control is required
Standard palliative fractionation should be used for metastatic disease including bone.
See Local guidance for cord compression, and involve spinal cord MDT / neurosurgeons
Consider eligibility for stereotactic radiotherapy for patients with oligometastatic disease and a reasonable prognosis

Metastatic dose fractionations e.g. bone pain

- 8Gy in1# [19]
- 20Gy in 5#
- 30Gy in 10#

6. Review and follow up

Patients undergoing radiotherapy to the breast or chest wall will routinely be reviewed by the Macmillan Support Radiographers, Breast CNS or suitably authorised practitioners unless clinically indicated.

Treatment Letter

- On completion of treatment a summary of the radiotherapy dose and toxicities experienced are documented.

- In addition, expected acute and late side effects are detailed with recommended treatments.

Post Radiotherapy Follow up schedule

- First follow up ideally within 6-12 weeks of completion
- Increasingly, self- management follow up programs are coordinated by Breast surgical or oncology teams (such as open access follow up).
- However high-risk patients or patients with complications can have individualised clinical follow up

7. References/resources

7.1 Trial protocols

FastFoward Trial protocol

IMPORT Low

IMPORT High

SUPREMO trial and most recent findings and news

POSNOC trial

PRIMETIME study

7.2 Publications

1. Postoperative radiotherapy for breast cancer: hypofractionation RCR Consensus statements
2. Dose Fractionation Guidance 4th edition RCR, February 2024 NICE guidance NG101 (2018)
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18. ESTRO guidelines for target volume delineation for elective radiation therapy of early stage breast cancer
19. NHS England Clinical Commissioning Policy: Palliative radiotherapy for bone pain (2016) Palliative-radiotherapy-for-bone-pain.pdf (england.nhs.uk

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