GUIDELINES
FOR RADIOTHERAPY IN EARLY BREAST CANCER

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Guidelines for Breast Radiotherapy in Early Breast Cancer
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All patients should be considered for invitation to enter clinical trials where eligible.

Indications

DCIS

Management of DCIS remains a matter of some debate. The following is a guide only and the final decision is at the discretion of the responsible clinicians.

Treat patients according to risk of recurrence (the Van Nuys Score may be used to assist decision making).

Low risk patients

Tumour size less than or equal to 15mm + low grade lesions + margins >10mm

-Wide local excision only

High risk patients

Patients with more than one of the following features - tumour size >4cm, high grade histology, <1mm margin.

-Mastectomy only

All other patients

Wide local excision and post operative radiotherapy. Technique and dose as for invasive cancer following breast conserving therapy.
Invasive breast cancer

Radiotherapy after breast conserving surgery (BCS)

There are currently no low risk groups identified in whom breast radiotherapy may be omitted following BCS. Therefore outside a clinical trial, radiotherapy is indicated in all patients treated with BCS.

Post mastectomy

Definite indications for chest wall radiotherapy post mastectomy are:

- 4 or more involved axillary lymph nodes
- tumour size of 5cm or greater
- involved excision margins
- the presence of 2 or more of the following minor risk factors
  - 1-3 involved axillary lymph nodes
  - Grade 3
  - lymphovascular invasion

The role of post mastectomy radiotherapy in patients with 1-3 involved axillary lymph nodes remains unclear. Radiotherapy may be considered outside a trial on an individual patient basis taking into consideration other risk factors for local recurrence such as young age.

Management of regional lymph nodes

Axilla

The axilla is not normally irradiated in the following circumstances:

1. N0 axilla, post axillary node clearance/ non directed axillary sample.

2. T1a/T1b low grade tumours with NX axilla (insufficient axillary sample or no axillary surgery).

3. Following level 2 or 3 axillary clearance (following axillary clearance with 4 or more nodes positive, the upper axilla will be included in the supraclavicular fossa field).
Following a sentinel lymph node biopsy where only isolated tumour cell have been identified.

Using a hypofractionated weekly regime for palliation of local disease.

Axillary radiotherapy may be considered in the following situations:

1. Positive axilla following the sampling of less than 4 lymph nodes.
2. Axillary micrometastases as an alternative to ANC or observation.
3. Positive sentinel lymph node biopsy as an alternative to axillary clearance.
4. NX axilla with moderate/high risk tumours eg less than 4 lymph nodes from a non directed sample but all negative.

Supraclavicular fossa

Supraclavicular fossa normally irradiated if 4 or more axillary lymph nodes are positive.

Internal Mammary Chain

Not routinely treated.

Treatment planning and delivery

Immobilisation

Patient should be immobilised in a stable, supine position using the current approved device (QUEST board at the time of writing). The patient’s head should be straight, and the shoulder of the arm of the affected side only should be abducted to approximately 90 degrees with the elbow flexed and rotated backwards. The arm is supported at the elbow and wrist. For 3 field techniques treating nodal drainage areas, a chin strap is used to improve immobilisation.
Simulation

CT planning is used to minimise the dose to heart and lung and optimise dose homogeneity throughout the treatment volume. The central lung distance should not normally exceed 2cm. The irradiation of large volumes of heart should be avoided by keeping the distance from the posterior edge of the field to the anterior border of the heart to less than 1.5cm. Although, it is not normal practice to outline the critical structures and thus produce DVH’s, the following dose constraints for organs at risk have been recommended for the IMPORT HIGH trial and are included here for reference:
• The volume of ipsilateral lung receiving 18 Gy should be less than 15%
• The volume of contralateral lung receiving 2.5 Gy should be less than 15%
• The volume of heart receiving 13 Gy should be less than 10%
• The mean dose to the contralateral breast should be less than 1 Gy

A digital reconstructed image is produced of the lateral treatment field to verify the above parameters. With informed patient consent, reference marks, essential for accurate treatment may be “tattooed” at the time of scan.

Definition of target volumes

Clinical target volume (CTV)

Intact breast
The whole of the breast tissue and including the soft tissues down to the deep fascia but not including the overlying skin or underlying muscle and ribcage.

Chest wall
The skin flaps from 5mm below the skin surface, including the soft tissues down to the deep fascia, but not including the underlying muscle and ribcage.
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Medial supraclavicular fossa

Contents of the medial SCF.

Axilla

Contents of the axilla.

SCF+axilla

Contents of the SCF and axilla.

Planning target volume (PTV) and field borders

Breast/Chest wall

CTV + 1cm margin.
The field borders are as follows:
Medial - the midline.
Lateral - 1 cm below the breast plate or to the mid-axillary line.
Superiorly - the second intercostal space at the level of the Angle of Louis.
Inferiorly - 1 to 2cm below the inferior extent of breast tissue (estimated for chest wall irradiation).

To limit the volume of heart and/or lung, it may not be possible to include the full lateral or medial extent of the mastectomy scar within the PTV when treating the chest wall.

Medial SCF

CTV+1cm margin.
The field borders are as follows:
Medial – ipsilateral edge of the vertebral bodies.
Lateral – lateral extent of the second rib.
Superior – at least 3cm above the head of the clavicle (ie to cover the SCF).
Inferior – matched to the tangential fields.

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Axilla and SCF field

CTV + 1cm margin
The field borders are as follows:
Medial – the ipsilateral edge of the vertebral bodies.
Lateral – the insertion of the Teres major into the humerus
Superior – at least 3cm above the head of the clavicle (ie to cover the SCF).
Inferior – matched to the tangential fields.

Field borders for the monobloc technique

Medial – midline (or a little beyond) to allow coverage of breast tissue inferiorly, after use of collimator rotation to ensure optimum axillary coverage.
Lateral – mid-axillary line (or a little posterior to mid-axillary line) to ensure all breast tissue is encompassed and the field border is behind the clavicle or covering axillary contents ()
Inferior – 1 to 2cm below the inferior extent of breast tissue (estimated for chest wall irradiation).
Superior – approximately two-thirds of the clavicle included ((if planned in the simulator) or sufficient to include level 3 axillary nodes (if CT planned with virtual simulation).

Dose prescription

Tangentials

Dose homogeneity should not vary by more than 12% in the central slice. Dose must be prescribed to the ICRU 50 reference point which lies at or near the centre of the target volume and which is half way between the lung surface and the skin surface on the perpendicular bisector of the posterior beam edge.
Anterior SCF/axilla field

The dose is prescribed to Dmax (100%). Where a posterior axillary boost is required, this is planned using the full CT data set.

Radiotherapy equipment

Megavoltage photons of 6MV energy are normally appropriate. Where patient separation is large and dose homogeneity is compromised, mixed beams of 6 and 10 MV energies may be considered.

Techniques

Breast/Chest wall only

Tangential pair.

Breast/chest wall + axilla (ie where treatment of the SCF is not indicated)

Extended tangentials pair (modified monobloc).

Breast/chest wall +SCF

3 field.
Tangential pair and anterior field to cover medial SCF.

Breast/chest wall + SCF+axilla

3 field.
Tangential pair and anterior field to cover SCF and axilla
Consider the addition of a fourth posterior axillary field in patients with a large axillary separation (ie greater than 14cm).

Bolus

Routine use of bolus following mastectomy is at the discretion of the responsible clinician.
Radiotherapy schedules

**Breast/chest wall only**

- 40Gy in 15 daily fractions.
- 50Gy in 25 daily fractions.
- 45Gy in 20 daily fractions.

**Breast/ chest wall + axilla (monobloc)**

- 45Gy in 20 daily fractions.

**Breast/chest wall + SCF**

- 40Gy in 15 daily fractions.
- 50Gy in 25 daily fractions.

**3/4 field breast/chest wall + axilla + SCF**

- 45Gy in 20 daily fractions prescribed to the intersection point.
- 50Gy in 25 daily fractions prescribed to the intersection point.

**Tumour bed boost**

**Patient Selection Criteria**

**Age**

Boost for all patients aged 50 years and younger. Omission in very low risk patients aged 50 and below up to individual clinician’s discretion.

**Excision margins**

All involved (<1mm) radial excision margins (although further surgery should always be considered initially as the management of choice). Involved posterior excision margins. Close margins (1-2mm) at individual clinician’s discretion.

**Other high risk features in women >50 years**

Individual clinician’s discretion.
Recommended dose/fractionation regimes

16Gy in 8 daily fractions
10Gy in 5 daily fractions
9Gy in 3 daily fractions

Volume definition

Tumour bed CTV (yellow) = the tumour bed includes the volume enclosed by the surgical clips plus changes in the surrounding tissue architecture on CT images. The posterior margin of the CTV should not extend beyond the deep fascia unless this is breached by the tumour. Radially, the CTV should not extend beyond the edges of the visible breast and the anterior extent of the CTV should be limited to 5mm below the skin surface. If a large seroma is present, drainage should be considered prior to the patient attending for planning CT.

PTV (blue) = CTV+5mm-10mm
Ideally a margin of 5mm should be used. This is only possible when regular on board imaging is employed and there is confidence in the reproducibility of the set up. However, in the absence of frequent imaging, significant breast swelling or a poorly co-operating patient, the margin should be 10mm and at present a 10mm margin is indicated with our current imaging protocols.

Selection of suitability for photon or electron boosts

All local surgeons to clip the tumour cavity.
All patients for boosts to be scanned and the action sheet should be completed accordingly.
It is anticipated that to enable boosts to be given at the satellite centre without the oversight of the supervising consultant, the boost should be planned at the same time as phase 1 (i.e. electron or photon) and this should be in the phase 1 position (normally on the Quest board) to ensure reproducibility.
The boost volume (as defined above) is outlined by the clinician or a suitably qualified radiographer (as agreed by the individual consultant). An informed choice of electron or photon boost may then be made on the
depth and position of the tumour bed as identified on the planning scan bearing in mind the following:

- 4 cm is considered the depth beyond which it may be difficult to achieve adequate coverage with electrons and thus consideration should be given to a photon boost.
- A consistent set-up will be difficult for electron boosts in lateral or inframammary positions especially in larger breasts and so photon boosts may be indicated for these subjects.

**Electron boosts planning**

1. Outlining and margining to be completed by the clinician or radiographer as above. Electron energy to be decided at the time of the phase 1 virtual simulation.
2. At virtual simulation, the beam is placed to cover the PTV by breast planning radiographer on Prosoma to achieve close approximation to skin apposition. To reduce the risk of errors due to misalignment of rectangular/square fields, circular fields are strongly recommended. However, at present there are no circular beams in Prosoma and thus the nearest sized square should be used to denote field position. It may not always be appropriate to use circles e.g. if a circular field includes the nipple unnecessarily when it would be possible to avoid with a rectangular/square field.
3. Moves from the origin parameters for the electron beam to be recorded and printed. Projection of field onto the “golden lady” with all treatment parameters applied looking from the treatment angle to be printed.
4. Approved electronically by clinician.

**Electron boost verification**

For the pilot study, patients attend for a simulator visit, just before the start of phase 2 for verification, mark up and the recording of a digital image. However, it is intended that no verification or skin marks should be necessary once the Varian pilot is completed.

**Electron boosts treatment**

1. For treatment, the patient will be in the phase 1 position on the Quest board. Correct patient orientation will be achieved by using
the back pointing gantry angle and moves will then be made from the origin to the electron field isocentre.
2. All electron treatment parameters will then be applied and the light beam projection on the patient’s skin will be checked with the golden lady print out.

**Photon boosts planning**

1. Clinician or designated planning radiographer to outline the boost CTV/PTV.
2. Check that the virtually simulated tangentials cover the boost CTV and PTV and confirm the dose for phase 1 and phase 2.
3. The whole breast treatment is planned first, ensuring adequate, homogeneous coverage of the boost PTV. This plan saved as *phase 1*.
4. The boost volume is then planned. The aim is to cover the boost volume with 95% of the combined dose, with a homogeneous dose across the phase 2 PTV, while minimising contribution of dose to the breast tissue outside the boost PTV from the phase 2. The plan showing the tangents with the photon boost is called the *combined plan*.
5. The phase 1 contribution is removed from the combined plan and this is saved as the *phase 2* plan.
6. Multiple slices of *the combined plan* (showing the absolute dose) are printed out for the clinician to study the distribution.
7. The normalisation slices of *phase 1* and *phase 2* showing relative dose are printed out for prescribing.
8. To prescribe:
   - Use the *combined plan* in absolute dose to see the distribution through the breast.
   - Prescribe the whole breast dose on the *phase 1* normalisation slice print-out.
   - Prescribe the boost volume dose on the *phase 2* normalisation slice print-out.

**Timing of radiotherapy**

In patients not receiving chemotherapy, radiotherapy should be started within 12 weeks of the date of surgery.
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In patients receiving CMF alone, radiotherapy may be given concurrently with chemotherapy.

In patients receiving Epirubicin-CMF, radiotherapy may be given concurrently with the CMF component but there should be a gap of a minimum of 3-4 weeks between the last epirubicin infusion and the start of radiotherapy.

In patients receiving regimes containing anthracyclines or taxanes throughout eg AC, FEC-taxotere, radiotherapy should be given on completion of chemotherapy, with a minimum delay of 3 weeks to the start of radiotherapy and ideally within 6 weeks of completing chemotherapy.

Sequencing of radiotherapy and trastuzumab is at the discretion of the responsible clinician.

Palliative Radiotherapy to the Breast

May be considered for patients with inoperable disease especially where there are associated symptoms eg pain, fungation, bleeding.
Planning is on an individual basis.

Palliative regimes include:

36Gy in 6 weekly fractions of 6Gy per week. Patient should be reviewed on a weekly basis.

39Gy in 13 fractions over a fortnight.

45Gy in 12 fractions, 3 fractions per week.
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References:


3. Adjuvant radiotherapy and chemotherapy in node-positive premenopausal women with breast cancer. Ragaz et al. NEJM 1997; 337: 949-955


