

Chapter 8
Radiotherapy of Breast

Radiotherapy plays an essential and critical role in the management of breast cancer, it is given for primary carcinoma of the breast to reduce the risk of loco-regional recurrence, and it has also been shown in many studies to improve survival in patients after mastectomy. In a general radiation oncology practice, breast cancer typically comprises approximately 25% of the total patient caseload. The role of radiotherapy after conservative surgery for DCIS remains complex and surrounded by considerable controversy. According to prospectively randomized trials, radiotherapy reduces subsequent breast recurrence in all patient groups irrespective of prognostic risk factors. That is not to say, however, that radiotherapy must be used for all patients with DCIS. In all cases, a realistic and balanced discussion of the relative risks and benefits of treatment options should be presented to the patient.

Clinical T1T2No lesions Breast-conserving surgery followed by radiation therapy to the intact breast is now clearly established as the most acceptable standard of care for the majority of women with early stage invasive breast cancer. Some patients may be treated by simple mastectomy, depending on the site and size of the tumour, the histological type, the grade and extent of in-situ change, and the size of the breast. Consideration of the cosmetic result and patient preference may determine the choice of treatment. Contraindications to conservative surgery and radiotherapy include multifocal breast tumours, extensive DCIS and patients with severe pre-existing cardiac or lung disease. After mastectomy, radiation to the chest wall is recommended for patients at high risk of local recurrence. i.e. if the primary tumour is more than 5 cm in diameter, of high-grade malignancy, involves the skin or axillary nodes, is incompletely excised, or there is tumour close to the excision margin. For inoperable T3 and T4 tumours, primary hormone therapy or chemotherapy may be given before loco-regional radiotherapy and possible subsequent surgery depending on systemic staging. T4d inflammatory carcinomas are treated with primary chemotherapy and radiotherapy.

Patients with operable tumours 3-4 cm or more in diameter have a higher local recurrence rate with conservative surgery and radiotherapy, and may therefore be offered primary chemotherapy. This strategy aims to produce sufficient tumour regression to avoid mastectomy in many patients, and data on its effect on local control and survival are awaited.

Lymph-node irradiation is unnecessary if an axillary dissection up to the lower border of the pectoralis minor (level 1) is negative, since involvement of other nodes is unlikely. If axillary nodes are involved, radiation may be given to the axilla and supraclavicular fossa. If a formal axillary clearance has been performed, subsequent axillary radiotherapy is associated with considerable morbidity but supraclavicular node irradiation alone may be given. For central or medial quadrant tumours, irradiation to the internal mammary nodes may be considered, but isolated local recurrence is rare and routine radiotherapy is not recommended. The role of sentinel node biopsy is currently under investigation, and may allow a policy of axillary dissection only in patients with a positive node biopsy.

Interstitial implants may be used:

- to give a boost to the site of excision following lumpectomy and external beam radiation as part of primary breast conservation therapy;
- to give a boost to residual tumour after external beam radiation for bulky inoperable disease;
- for salvage therapy for local recurrence.

With breast conservation, interstitial implantation may be considered to improve local control in patients with the following high-risk factors for recurrence:

- incomplete tumour excision;
- extensive intra-duct carcinoma in addition to invasive disease;
- patients under the age of 40 years;
- grade III tumours;
- tumours greater than 3 cm in diameter.

When a patient presents with bilateral tumours, treatment must be individualized according to the site and size of the lesions. Mastectomy may be appropriate in patients with large breasts because of the target volume which would be involved if radiotherapy were given.

Radiotherapy has a major role in the palliation of locally advanced fungating tumours and symptomatic metastases in sites such as bone, brain and skin.

Primary lymphoma of the breast is usually associated with diffuse histology and is treated by chemotherapy. Where local treatment is required for residual disease, this may be given to the breast by tangential fields as described below.

Planning technique

ASSESSMENT OF PRIMARY DISEASE

It is important for the radiotherapist to examine the patient pre-operatively. Breast examination includes inspection for nipple or skin retraction, discharge, ulceration or asymmetry, and palpation for site and size of the lump and fixation to adjacent structures. Glandular drainage areas are also assessed and TNM staging recorded on an accurate diagram. A photograph may be useful to show the exact position of the lesion. Mammography is performed to demonstrate the tumour and to detect multifocal or in-situ disease and bilateral involvement. Ultrasound is used to measure the lesion and guide fine-needle aspirate (FNA) cytology or core biopsy for histology.

Examination of the surgical specimen should define the size, site and local extent of the primary lesion and the number and position of axillary nodes in the specimen. Histological review determines size, type of tumour, grade, assessment of excision margins, oestrogen-receptor status and lymph-node involvement. If the breast is preserved, the position of the tumour in relation to the surgical scar must be known and should be obtained from a surgical operative diagram,

Where inoperable primary tumours remain palpable after systemic therapy they can be assessed by palpation and ultrasound, marked on the skin and a photograph taken.

PATIENT POSITION

The patient is treated supine, and her position should remain the same during planning, simulation and treatment. The slope of the chest wall can be corrected by insertion of a triangular wedge or inclined plane under the head and shoulders for a simulator or simulator-CT localization (**Fig.1**). However, this technique is not CT compatible, and if three-dimensional CT planning is to be used, a supine position with both arms elevated and secured above the head is optimal for entering the CT scanner aperture. An immobilization device commercially available or custom made breast tilt boards with armrests that maintain the patient's daily position with the slope of the chest wall parallel to the table, often in combination with immobilization devices (e.g., alpha cradle, plastic molds), are typically used to reproduce daily positioning and minimize day-to-day set up errors. All patients should be aligned using a system of medial and lateral tattoos and laser lights. When tangential and lymph-node fields are used, careful consideration must be given to matching field edges to avoid inhomogeneity of dose distribution. Any junction between adjacent treatment fields is affected by normal respiration causing some patient movement, and verification should be carried out in each radiotherapy department when multiple diverging beams are used.

Other treatment positions have been used to improve the dosimetry in patients with large, pendulous breasts. A lateral decubitus position has been suggested by investigators at the Institut Curie. Irradiation in the prone position has been proposed, with reduction of dose in the high-dose region to 102% to 103% of the dose to the irradiated breast, as well as reduction of volume and dose to the underlying lung and heart and reduction of scattered dose to the contralateral breast. This technique is being increasingly employed and long-term follow-up data regarding outcomes and cosmesis are awaited.

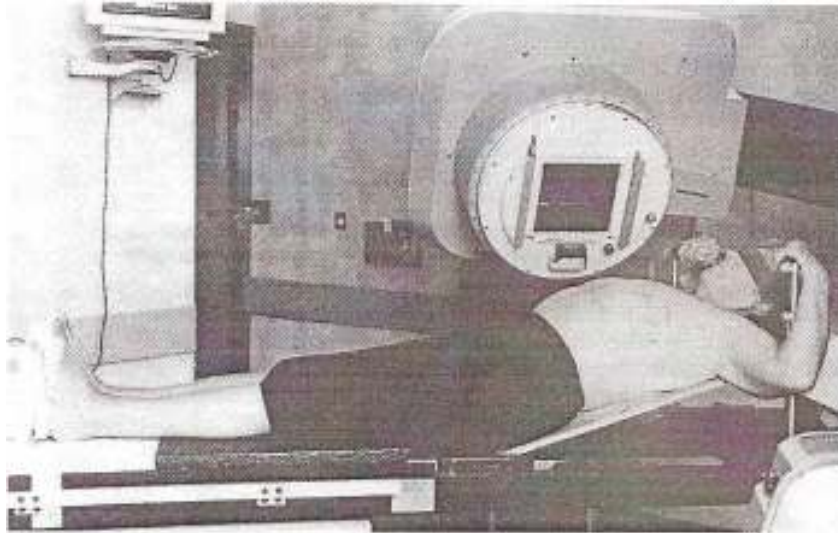


Figure 8.1.
Immobilization of a patient on an inclined plane with bilateral arm poles
and a footboard for simulation of an isocentric breast technique.

DEFINITION OF TARGET VOLUME

For this complex treatment several target volumes must be defined.

Breast

The entire breast is included in the target volume, with a 1 cm margin around palpable breast tissue. The aim is to treat down to the deep fascia, but not the underlying muscle, rib-cage, overlying skin or excision scar. The superior border covers as much breast tissue as possible and lies at about the level of the suprasternal notch medially, and just below the level of the abducted arm laterally. The inferior border lies 1 to 2 cm below the breast.

The medial and lateral borders are determined by the site of the primary lesion and the size of the breast. The medial margin, if no internal mammary portal is used, should be at or 1 cm over the midline. If an internal mammary field is used, the medial tangential portal is located at the lateral margin of the internal mammary field. The lateral-posterior margin should be placed 2 cm beyond all palpable breast tissue, which is usually near the mid-axillary line. The inferior margin is drawn 2 to 3 cm below the inframammary fold.

In selected patients these margins can be reduced, provided that the cover of the tumour bed is not compromised, in order to minimize the treatment volume and/or amount of lung in the high dose zone. Irradiation of the rib-cage inferior to the inframammary fold is unnecessary unless the tumour bed encroaches on this margin or the breast is pendulous. The deep margin extends down to the deep fascia.

In patients treated with 6-MV or lower energy photons with wide tangential fields in whom separation is >22 cm there may be significant dose inhomogeneity in the breast; this may correlate with less satisfactory cosmetic results. This problem can be minimized by using higher energy photons (10 to 18 MV) to deliver all or a portion of the breast radiation (approximately 50%) as determined with treatment planning to maintain the inhomogeneity throughout the entire breast to 10% or less. If desired, the buildup of the beam may be modified with a “degrader.” Bolus should be avoided in conservatively managed patients. A variety of immobilizing devices or molds may be constructed to support the breast in the treatment position. A polyvinyl chloride, ring-shaped device, held by a strap, has been used around the breast to aid in positioning of patients with large, pendulous, or flaccid breasts. Skin reactions where material is in contact with the skin should be closely monitored.

Chest wall

The target volume includes the skin flaps. Posteriorly, the deep margin extends to the deep fascia, inevitably including underlying muscle and rib-cage. Part of the surgical scar may have to be excluded medially or laterally in order to reduce the dose to the underlying heart and lung to acceptable tolerance limits. This is achieved by allowing a maximum central lung distance of 2 cm on the simulator film.

Tumour bed

This volume must be chosen by taking into account the initial site and size of the tumour determined clinically, by photographic record and by mammography, the position of the surgical scar in relation to the tumour from a surgical diagram, the depth of the tumour in relation to skin and chest wall, and histopathological reports. Surgical clips may help to locate the tumour bed if their exact relationship to the tumour is known. A 2 cm margin is allowed around this estimated clinical target volume, with a deep margin extending to the underlying muscle fascia, giving a PTV of 7-9 cm in diameter at the skin surface (i.e. electron applicator 8-10 cm in diameter).

Lymph nodes

The lymphatic drainage to the axillary and supraclavicular nodes forms an irregular volume lying anteriorly at its upper border in the supraclavicular fossa, and extending more posteriorly at the lower border to include all groups of axillary nodes. After positive axillary-node sampling, the entire target volume may be treated in continuity. However, after a positive complete axillary clearance, the supraclavicular lymph nodes alone may be treated using the technique described below, in order to avoid unnecessary morbidity.

The internal mammary nodes lie 2-3 cm lateral and deep to the mid-line.

Since they cannot be treated satisfactorily with the breast target volume, and the incidence of clinical involvement is low, they are only treated in high-risk patients with large central or medial quadrant tumours with involved axillary lymph nodes.

Field arrangements

All fields should be treated with the patient in the same supine position as described above.

Breast technique

The patient lies supine with appropriate immobilization, and her position is aligned using laser lights. The borders of the target volume are marked on the skin with the centre points of the medial and lateral fields defined. Two reference tattoos are made at medial and lateral field centres, and a third one is made on the opposite side of the body, corresponding to the lateral field centre, to prevent rotation. Using the simulator, an isocentric technique is planned. The maximum depth of lung included in the tangential field is 2-3 cm (the central lung distance is usually less than 2 cm) as defined by simulation, simulator-CT or CT scanning (**Fig. 2**). The amount of lung included in the irradiated volume is greatly influenced by the portals used.

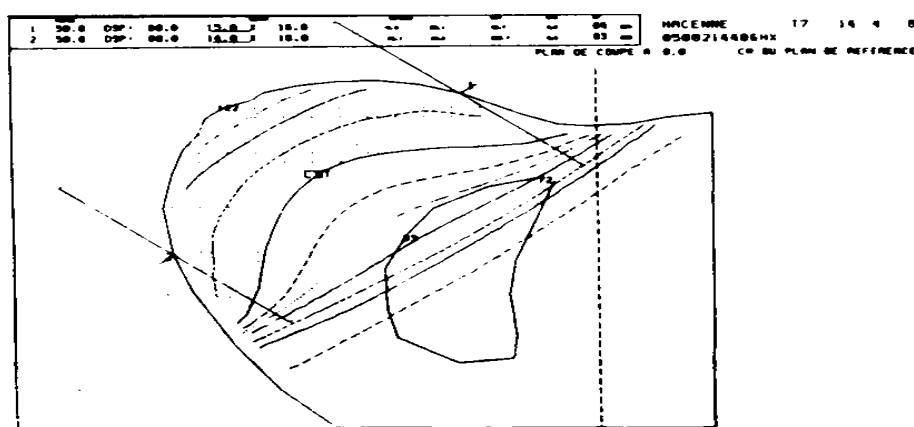


Figure 8.2.

Isodose of the breast on the axis tangential field, including internal mammary chain

The anterior border of the field in free air should be at least 1 cm from the skin surface (to ensure a satisfactory dose distribution). A transverse cross-section of the patient is taken through the centre of the planning target volume using an external contour or computerized tomography. Beam divergence into the lung at the posterior border of the field can be reduced by using either independent collimators to block the posterior half of the beam, or a 5° gantry tilt to align the opposing posterior field borders.

A dose distribution is prepared across the target volume using a wedge as compensator to ensure dose inhomogeneity of no more than ± 5 per cent (Fig. 4). Lung correction employing a correction factor within the range 0.2-0.3 may be used when calculating the dose distribution. Where the breast is large, outlines are taken through the centre of the volume and 5-8 cm above and below the centre; the simulator-CT facility is ideally suited to collecting these data. Dose distributions are produced at these three levels in order to check homogeneity and prepare tissue compensators if necessary.

Chest wall technique

Two tangential fields arranged as for the breast can be used. Bolus is usually only needed when treating recurrent disease, in order to maximize the dose to the skin. An alternative technique is to use a single anterior electron field of appropriate energy for the thickness of the chest wall determined by ultrasound or CT (usually 8-15 MeV).

Alignment of the Tangential Beam with the Chest Wall Contour

The anterior chest wall slopes downward from the mid-chest to the neck. To make the posterior edge of the tangential beam follow this downward-sloping contour, the collimator of the tangential beam may be rotated, or the patient placed on a slant so that the slope of the chest wall is parallel to the table. An alternative is to make the deep posterior edge of the tangential beam follow the chest wall contour by means of a rotating beam splitter mounted on a tray without rotation of the collimator or using multileaf collimation. In this way, the superior edge of the tangential beam remains in the true vertical and matches perfectly the vertical inferior edge of the supraclavicular field if used.

ANTERIOR FIELD

The irregular three-dimensional target volume of the breast and regional lymph nodes makes it technically difficult to deliver an equal and adequate dose to all areas and to spare the lungs, heart and brachial plexus.

The tangential fields used to treat the breast or chest wall are planned as described above. For irradiation to the supraclavicular nodes only, a single anterior field is used with the patient in exactly the same position. The superior border extends at least 3 cm above the medial end of the clavicle, but leaving a margin of skin clear superiorly in order to reduce reaction. Medially the border is placed 1 cm lateral to the mid-line to avoid the larynx and spinal cord. The lateral border lies at the junction of the medial two-thirds and the lateral one-third of the clavicle. The inferior border is at the lower border of the clavicle.

If the axillary lymph nodes and supraclavicular fossa are to be included in the target volume, then the inferior border of the anterior field is extended caudally to match with the tangential field, with shielding of the apex of the lung where appropriate. The lateral border extends to the outer border of the head of the humerus, with lead shielding of the acromio-clavicular joint and the head of the humerus (**Fig. 3**).

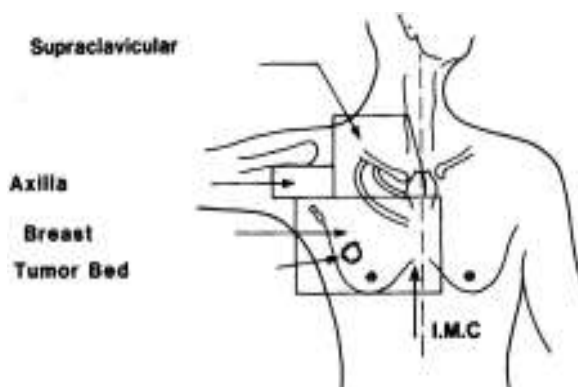


Figure 8.3
Technique of breast irradiation and doses

Various techniques have been developed for matching the inferior border of the supraclavicular field with the superior border of the tangential fields. A gap of 5-10 mm may be left between the fields at the skin. The superior divergence of the tangential beams can be eliminated by rotating the couch through an angle of approximately 5° so that the superior edge of the fields lies horizontal and matches the straight upper border of the target volume. This manoeuvre increases the divergence inferiorly, but this is not usually clinically important. Divergence may then be removed from the inferior border of the anterior nodal field by moving the gantry a few degrees following a 90° couch rotation. Despite these two manoeuvres to remove divergence, matching at a skin junction is not perfect at depth, and movement of the patient due to respiration leads to inhomogeneity at the match line. Independent collimators can be used to produce half-beam blocking at the inferior border of the supraclavicular field and the superior border of the tangential field (**Fig. 4**).

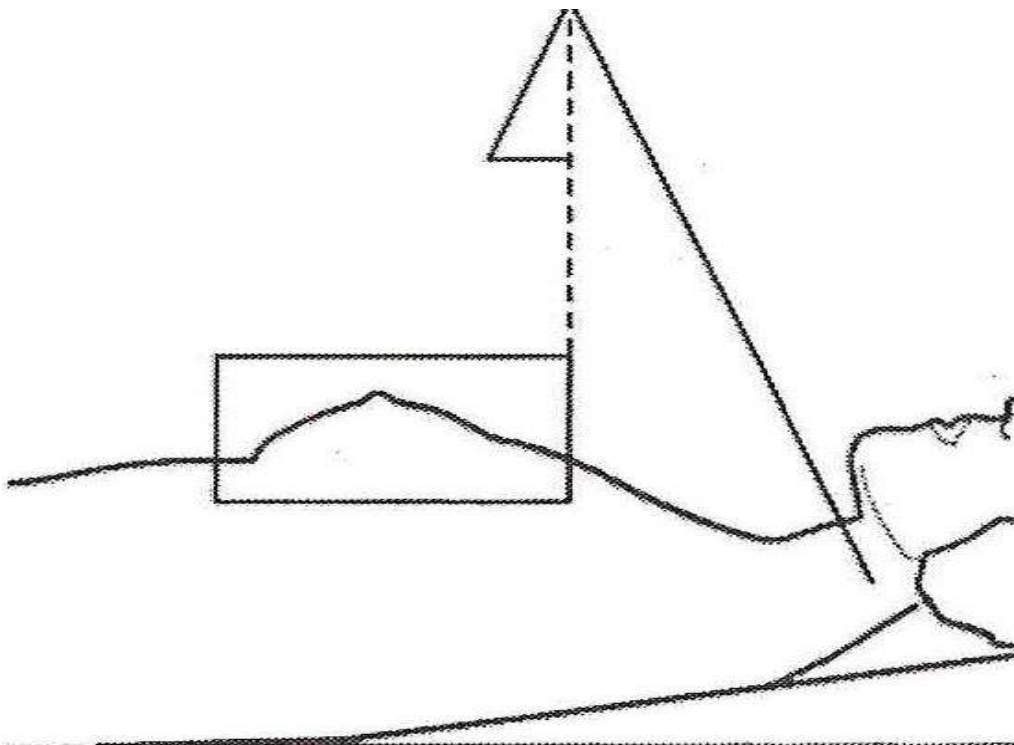


Fig.4 Diagram showing the matching of superior border of tangential fields and inferior border of supraclavicular field using independent collimators.

ADDITIONAL AXILLARY FIELD

A single anterior field encompassing the planning target volume is recommended for adjuvant radiotherapy to supraclavicular and axillary lymph nodes. For advanced, palpable axillary disease, an additional posterior axillary field may be needed to ensure an adequate dose to the axillary nodes. When the axillary separation exceeds 15 cm, the mid-plane close to the axilla for a single anterior field falls below 80 per cent for 6-MV photons. An adequate mid-plane dose to the axilla can be achieved using a posterior axillary field treated every day, and weighted according to the separation in the axilla (e.g. for 16-18 cm, 1:10 weighting of posterior axilla: anterior SCF field applied doses). However, the hot spot at D_{max} (2 cm below the anterior skin surface) increases for larger separations to 110 per cent. Care must be taken to stay within the tolerance range of the brachial plexus, and a dose distribution should be produced for each patient when this technique is used. The

posterior axillary field is defined by palpating the apex of the axilla and aligning the infra-medial margin along the upper border of the rib-cage (**Fig. 5**).

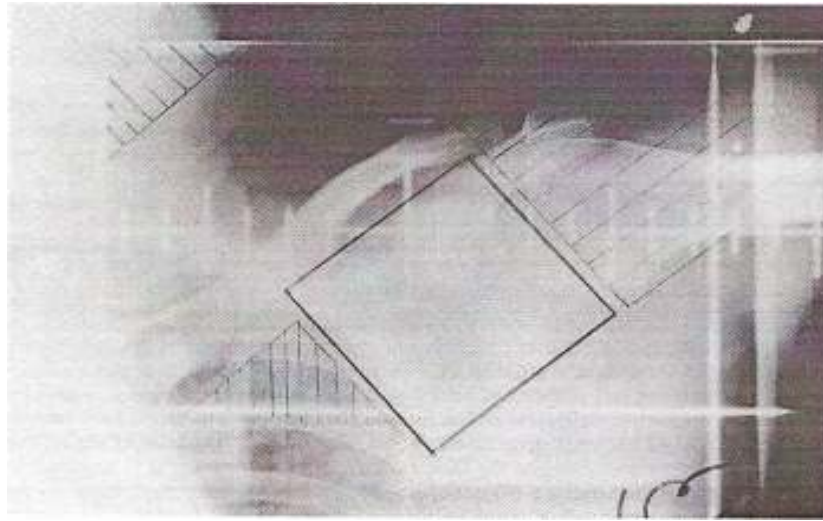


Fig. 5. Posterior axillary field with shielding of acromio-clavicular joint and upper humerus, apex of lung and chin to anterior field.

Single Isocentre, Breast and Nodal Technique

A technique can be used where a single isocentre is set up at depth on the match-line of the anterior nodal and tangential fields. The gantry is set up to treat the tangential fields by blocking the beam superior to the central axis and thereby shielding the nodal field. When the supraclavicular/axillary field is treated, the inferior part of the beam is blocked. This technique requires asymmetric collimators and good immobilization of the patient so that the isocentre does not move during the entire treatment. It is assumed that the effects of respiration are random. The technique requires large field sizes (a 40 X 40cm field produces a maximum tangential field length of 20cm). Special wedges may be needed for the maximum field length or the tangential half of the beam only. This technique can be time-consuming to simulate, and its accuracy depends on precise abutment of the jaws, as an under- or overlap of 1 mm can lead to significant inhomogeneity of dose.

INTERNAL MAMMARY NODE FIELD

The benefit of irradiation of the internal mammary lymph nodes is an unresolved issue because clinical failures at this site are very rare and the majority of patients at risk receive adjuvant therapy. Megavoltage anterior fields are no longer used to treat internal mammary lymph nodes because of the exit dose to the heart. For medial-quadrant disease, the tumor bed may lie so close to the internal mammary nodes that it is impossible to treat both target volumes homogeneously. Treatment may then have to be given to the primary tumor alone by moving the tangential field further across the mid-line on to the contralateral side. Alternatively, an electron field of electron energy 12-16 MeV can be used to treat the internal mammary nodes with a match to adjacent tangential fields. Care must be taken to ensure homogeneity of dose to the primary tumor bed, and attempts must be made to calculate the dose distribution at the electron-photon interface.

The medial border of the internal mammary field is the midline. The lateral border is usually 5 to 6 cm lateral to the midline. The superior border abuts the inferior border of the supraclavicular field and the inferior border is at the xiphoid or higher. If only the internal mammary lymph nodes are to be treated, the superior border of the field is at the first intercostal space (superior border of the head of the clavicle).

The dose is calculated at a point 4 to 5 cm beneath the skin surface (depending on the thickness of anterior chest wall and ideally based on CT scan localization).

CT treatment planning is useful for irradiation of the internal mammary lymph nodes. Although the lymph nodes are most often not visible, the internal mammary vessels can be clearly seen and contoured on axial CT slices. This anatomic region can then be visualized in treatment field design and in dosimetry planning.

Bilateral Breast Irradiation

Where bilateral breast irradiation is indicated a combination of two- and three-field techniques is used, with particular care to prevent overlap of the tangential fields in the mid-line by leaving an appropriate gap. When a second primary tumour is diagnosed in a contralateral breast and radiotherapy is required, it is important to reconstruct any previous radiotherapy treatment to the original side in order to ensure that there is no risk of overlap, particularly in the mid-line and supraclavicular region. Doses to underlying spinal cord should be estimated.

Irradiation of Tumor Bed (Boost to Tumor Site)

The need for a boost to the tumor bed following lumpectomy and whole breast radiation remains an area of debate. In the earlier years of breast-conserving surgery, status of the surgical margins was not always assessed. Recent retrospective data suggest that patients with known negative margins have high local control rates with no boost following whole breast irradiation.

Before the widespread availability of electron beam therapy, interstitial brachytherapy or cone-down photon boost was popular. Currently, most institutions prefer electron beam boost because of its relative ease in setup, outpatient setting, lower cost, decreased time demands on the physician, and excellent results compared with Ir192 implants.

Electron Boosts

The patient is positioned with the arm toward the head to flatten the breast contour, and may be rolled so that the tumor bed is parallel to the table and the accelerator head can point straight down onto the target volume. An electron energy is selected that covers the target volume depth (usual range is 9 to 16 Me V electrons), based on review of the physical examination, mammogram, ultrasound, CT, or other imaging used to ascertain the location and depth of the tumor or metallic surgical clips. The 90% prescription isodose line is limited to the chest wall to decrease dose to the lung. The clinical setup for electron boost involves marking the projection of the postlumpectomy volume on the skin and adding 2 to 3 cm in all directions.

Accurate target volume definition is critical with any boost technique. Methods vary from simple and unsophisticated to complex and expensive, such as ultrasound and CT definition of the target volume. The accuracy of using the scar to define the lumpectomy cavity has been questioned.

Surgical clips are ideal for the localization of the tumor bed. The surgical clip method requires the cooperation of the surgical team. Despite the fact that it would theoretically take an infinite number of clips to define every extension of a typical lumpectomy cavity, in practice six clips suffice (superficial, deep, medial, lateral, cephalad, and caudal).

CT-guided portal design should be done in the treatment position. This technique gives good definition of the depth of the chest wall, and has been shown to be similar to ultrasound in delineating the lumpectomy cavity. Delineation of the biopsy cavity becomes more difficult with increased interval from surgery. The combination of surgical clips with a treatment planning CT scan to define the lumpectomy site for electron boost is most ideal. In the absence of surgical clips, the CT scan evaluation of the biopsy cavity and/or postsurgical changes, in combination with clinical information including mammography findings, scar location, operative reports, and patient input, will provide accurate information regarding placement of the field and energy of the electron boost.

Three-Dimensional Conformal or Intensity-Modulated Radiation Therapy

Standard opposed tangential fields with appropriate use of wedges to optimize dose homogeneity remain the most commonly employed method for delivery of whole breast irradiation. A number of publications have explored the potential advantages of 3D conformal radiation therapy (3DCRT) or intensity-modulated radiation therapy (IMRT) to treat patients with breast cancer. Theoretically, 3DCRT involves a reduction in the volume of normal tissues receiving a high dose, with an increase in dose to the target volume that includes the tumor and a limited amount of normal tissue. IMRT potentially can further improve the dose distribution between the target

and non-target tissue, but may also increase the volume of tissue exposed to lower doses of radiation. As suggested, this may increase the risk of second malignancies, and one must carefully weigh the potential gains and limitations of advanced planning techniques. It is important to recognize that the term IMRT has been used in various ways to describe breast cancer treatment. In some studies, IMRT is described as a method of three-dimensional dose compensation without a change in the gantry angles of predesigned tangential fields. In such instances, dose distribution has been improved, but the fields are not more conformal. Accordingly, low dose to other organs is not an issue. For others, IMRT attempts to improve conformality of the high-dose region by using multiple field angles that increase the volume of normal tissues that receive low radiation doses.

Accelerated Partial Breast Irradiation

The current standard of care for women with invasive breast cancer remains whole breast irradiation following breast-conserving surgery. With the notable exception of selected elderly women, omission of radiation therapy has now been proven in numerous randomized trials and meta-analysis to compromise local control, and to a lesser extent breast cancer-related mortality. For some women, the 6-week course of daily radiation with its associated time and travel issues is not feasible. In response to this, a wide variety of accelerated forms of treatment have been developed and proven safe and effective in short-term studies.

These approaches include multicatheter interstitial implants placed around the excision cavity, single balloon catheter that can be afterloaded with a central radiation source (MammoSite, Cytac Corporation, Marlborough, MA) which is placed into the excision cavity, external beam conformal partial breast irradiation, and intraoperative single-dose irradiation. Although these techniques vary considerably, they share the common strategy of delivering the radiation to a smaller volume of breast tissue around the lumpectomy site, using fewer larger fractions delivered over a shorter time. The rationale behind this approach is that the majority of breast relapses occur at or near the lumpectomy site.

Although the early results clearly demonstrate the feasibility and acceptable toxicity of accelerated partial breast irradiation, this approach has not yet been demonstrated in a randomized trial to be equivalent to whole breast irradiation. There are several ongoing randomized trials that will attempt to answer the question of whether this approach is equivalent to whole breast irradiation for selected patients.

Interstitial Implantation

For interstitial implantation, the distribution of sources to cover the target volume is chosen and a suitable perspex template used. Under general anaesthesia, rigid needles are passed through the breast and fixed at each end with a template (**Fig. 6**). Undue pressure on the templates should be avoided as this can cause severe scarring.

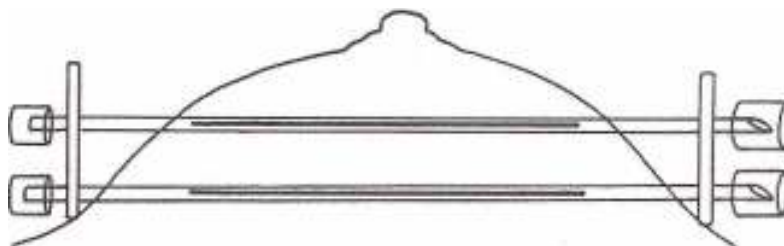


Fig. 6. Interstitial implant with rigid needles

The length of iridium wire loaded into a needle should position the end of the active wire 5-10 mm from the skin entry point. The superficial plane of wires should be approximately 1 cm below the skin surface. These measures ensure that the high dose rates around the wire do not cause telangiectasia or skin necrosis. For peripheral tumours or chest-wall recurrence where there is only sufficient tissue for a single-plane implant, a straight plastic tube technique can be used. Breast implants can be performed with remote afterloading; if this is done at a high dose rate, the treatment may need to be fractionated.

Implementation of plan

Patient alignment is checked using sagittal and coronal laser lights to medial and lateral tattoos. Tangential fields are treated isocentrically, and anterior and posterior nodal and electron fields are treated at the machine FSD. Appropriate shielding is applied to the anterior field. Beam films are taken on the treatment unit in order to check the borders of the tangential fields and to ensure that the central lung distance included does not exceed 2 cm.

Dose prescription**Breast and Chest Wall**

50 Gy in 25 fractions given in 5 weeks.

Using tangential fields, skin doses are adequate for the intact breast, but bolus may sometimes be required for chest-wall irradiation for recurrent disease.

Tumor Bed

10-15 Gy in 5 to 7 fractions to the 100 per cent isodose given in 7 to 9 days
or 20-25 Gy at the 85 per cent isodose given in 2 to 2.5 days by implant.

Residual Tumor

18-20 Gy given in 6 to 8 fractions
or 30-40 Gy at the 85 per cent isodose given in 3 to 4 days by implant.

Nodal irradiation

50 Gy in 25 fractions given in 5 weeks.

The dose from the anterior supraclavicular field is prescribed to the 100 per cent point (build-up depth) on the central axis. The dose received at the midaxillary plane from the anterior supraclavicular field is calculated using the axillary separation, and recorded.

If an additional contribution from a posterior axillary field is considered to be necessary to bring this dose up to 50 Gy, a dose distribution is essential. This additional dose should be given as small daily fractions, and the summated dose at the anterior bronchial plexus should be kept within the tolerance range according to guidance given.

Patient care

Patients are instructed to limit washing of the irradiated skin and to use aqueous cream to keep the skin moisturized. One per cent hydrocortisone cream may be used to relieve the discomfort of dry desquamation. If moist desquamation occurs, treatment is temporarily stopped and paraffin gauze or hydrogel applied until healing occurs. Tight-fitting clothes should be avoided as much as possible in order to reduce friction and abrasion of the skin. Loose cotton garments are recommended.