

Deep Inspiration Breath Hold Technique Protocol (based on the protocol approved by the Royal Marsden Committee for Clinical Research, Sutton, UK)

1. Radiotherapy outpatient clinic

1. Assess the patient's capability for the voluntary breath hold technique at the outpatient clinic: left breast or chest wall irradiation recommended by a radiotherapy specialist
2. Review patient performance status and comorbidities (particularly lung-related diseases).
3. Ask the patient to exercise breath hold in supine position at home: initially for 5 seconds, then increasing this at 5-second intervals for up to 20 seconds

2. Planning CT

1. Position the patient on the CT table in the standard treatment supine position.
2. During free breathing, place the markers (crosses) in the patient's centerline, approximately halfway between the expected field edges. During free breathing, place the end markers on both sides of the patient in line with the midline marker.
3. Ask the patient to practice deep inhalation and breath hold, initially for 5 seconds, then increasing this at 5-second intervals for up to 20 seconds. Ask the patient to breathe in and out twice before asking him to hold his breath for up to 20 seconds. This relaxes the patient, helps him prepare for respiratory arrest, and improves the permanence (consistency) of respiratory arrest.
4. Record the maximum time the patient can comfortably hold their breath.
5. Repeat breath hold and for reproducibility mark the position of the anterior and lateral surface markers relative to the lasers during breath hold. Record the height of the lateral mark from the table surface during breath hold before beginning CT scanning.
6. Provide the patient with standard breath hold instructions and begin CT scanning while the patient is holding breath.
7. Once CT scanning is completed, examine and record the height of the lateral tattoos to confirm that consistent breath holding was performed. If the lateral table height differs by more than 3 mm from the initial table height, measure again and correct the anterior and lateral reference points.

3. Treatment planning

NOTE: Radiation therapy planning process is the same as for a standard breast cancer patient.

1. Use tangential radiotherapy fields according to local protocol.
2. Create a clinical radiotherapy plan that meets ICRU criteria.
3. Record the anterior beam SSD (source-to-skin distance) distance in addition to standard treatment design data (according to local protocol). NOTE: The anterior beam SSD distance is used to check the anterior-posterior positioning in the treatment room.

4. Patient positioning

1. Stand on body surface signs while breathing freely. Mark the posterior and inferior distances from the left lateral tattoo and the anterior midline tattoo on the patient's skin (based on information recorded during the design CT).
2. Instruct the patient to breathe in and out twice before taking and holding deep inspiration. The reference mark on the patient's skin should rise to the level of the laser. Ask the patient to repeat the breath hold process a few times before proceeding with patient setup.
3. Ask the patient to perform breath holding, set the centerline signal to the superior / inferior isocenter position, and adjust the focus-to-surface distance (FSD) in the centerline.
4. While breathing freely, move the operating table laterally toward the isocenter.
5. Measure and mark the medial and lateral field boundaries while breathing freely.
6. Adjust all other machine parameters (eg field size and gantry, collimator and table angles) for the first beam (anterior oblique). Ask the patient to perform breath hold and check that the medial boundary matches the mark described in step 4.5.
7. Mark the field edge (defined by the light field) with a pen for each fraction: this helps visualizing the patient's breath hold.
8. Repeat steps 4.6 and 4.7 for the rear oblique field and deliver treatment with this field first.
9. If the patient positioning accuracy is outside the tolerance level (according to the local tolerance levels of the standard breast radiotherapy patient), follow the troubleshooting algorithm.
10. If there are not enough cameras for close monitoring of the field edges and the distance of the gantry from inside the control room, measure the rotation of the gantry before leaving the operating room to avoid collisions.

5. Treatment delivery

1. Upon arrival in the control room, approach the treatment room cameras to the field boundaries marked on the patient's skin so that they are visible on the control room monitors.

2. When you are ready to begin treatment, ask the patient using the internal communication system to perform breath hold (as detailed in section 4.2). Check that the light field is properly aligned with the marked field edge and begin treatment.

3. Monitor the patient's breath hold during treatment delivery. Treatment should be discontinued if there is a change in the depth of breath hold.

6. Verification

1. Make a verification record of the patient's position (using, for example, EPID, electronic portal imaging, or cone-beam CT) according to local protocols for imaging type / frequency and tolerance levels.

2. Correct isocenter displacements according to local protocols for standard breast radiotherapy patients. There is no need to correct the markings on the patient's skin.

7. Data collection

a, Proportion of suitable patients (successfully treated / all patients)

b, Positioning accuracy during treatment (random and systematic error calculation, 3 times a week, with CBCT)

c, Intrafractional accuracy (random and systematic error calculation, 3 times a week)

d, Duration of preparation of the planning CT

e, Duration of treatment delivery per fraction (separately positioning and treatment delivery, at every treatment occasions)

f, Evaluation of the method by the patient (after fractions 6 and 25)

g, Evaluation of the method by the radiation therapists (at planning CT, after fraction 25)