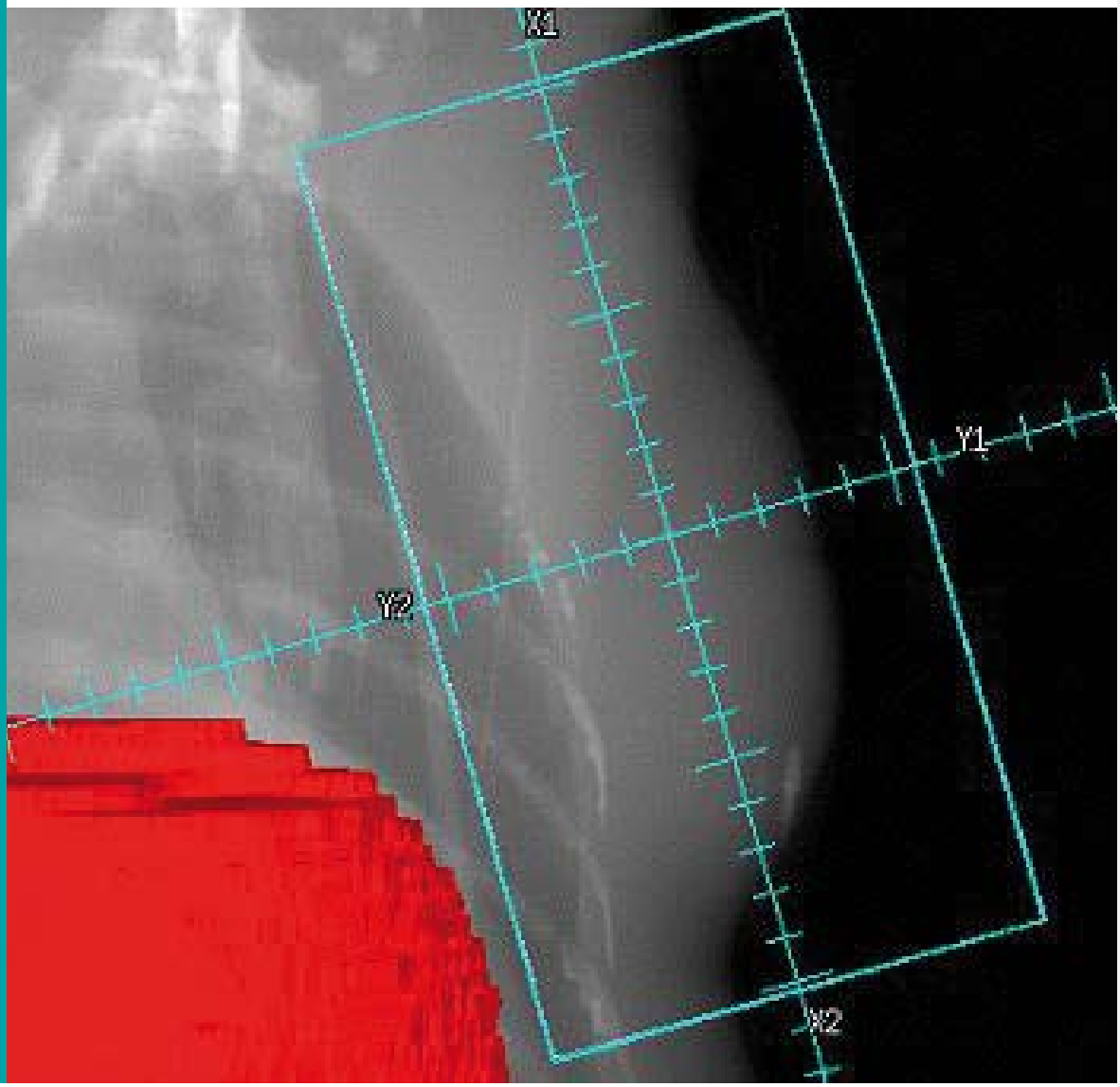
Case Study



Treatment of left-sided breast cancer using Active Breathing Coordinator™

Institution:	William Beaumont Hospital, USA
Patient:	54-year-old female
Diagnosis:	Left-sided breast cancer
Plan:	IMRT tangential fields
Respiratory motion management:	Active Breathing Coordinator™
Treatment:	45Gy in 25 fractions

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Treatment of left-sided breast cancer using Active Breathing Coordinator™

Radiation Oncologist: Larry Kestin, M.D.
Medical Physicist: Lisa Burgess, M.S. DABMP
Lead Radiation Therapist: Kerry Jeffries, R.T.T.

Patient history and diagnosis

A 54-year-old woman presented with recently diagnosed ductal carcinoma in situ (DCIS) of the left breast. In July 02 the patient underwent a routine screening mammogram, which revealed suspicious clusters of microcalcifications on both the right and left breast – addtional views were taken to confirm the suspicious nature of these calcifications. During August 02 stereotactic guided core biopsies of the suspicious calcifications were taken from both the left and right breast. On the right breast there was no evidence of malignancy but on the left breast there was a 2mm focus of grade 1 DCIS involving one of 31 cores.

A lumpectomy was performed in September 02. Pathology from a 7.3 x 6.0 x 2.5cm sample showed a 4mm in maximum dimension DCIS. All surgical margins were free of involvement by at least 5mm. It was found to be a nuclear grade 2 tumor and no axillary lymph nodes were dissected. Stage 0 Tis N0 M0. The histopathologic grade was grade 2 and the histopathologic type was ductal carcinoma in situ, cribiform type.

Rationale for Active Breathing Coordinator™

An initial free breathing (FB) CT scan indicated that the heart could not be excluded from the tangential field without compromising the breast target coverage. Applying a moderate deep inspiration breath hold (mDIBH) reduced the cardiac volume included in the field and the associated normal tissue toxicity.

Patient training

The initial patient training session included detailed explanation of the procedure and the opportunity for the patient to ask questions. An informed consent form was signed as defined by the institutional human investigational committee. The breath hold threshold level chosen was 2.2L, with Active Breathing Coordinator™ set at inspiration. This mDIBH level represented 75 to 80% of the patient's maximum inspiratory capacity. The patient could comfortably maintain repeated breath holds of 25 seconds. Appointment time required: 45 minutes.

CT scanning

After training was completed the patient proceeded to the CT scanner where scans were acquired of the entire thorax in both FB, with the Active Breathing Coordinator™ tubing in place and at mDIBH. The mDIBH scan required two breath holds of approximately 20 to 25 seconds. The FB scan provided information that helped with daily treatment set-up. Appointment time required: approximately 30 minutes.

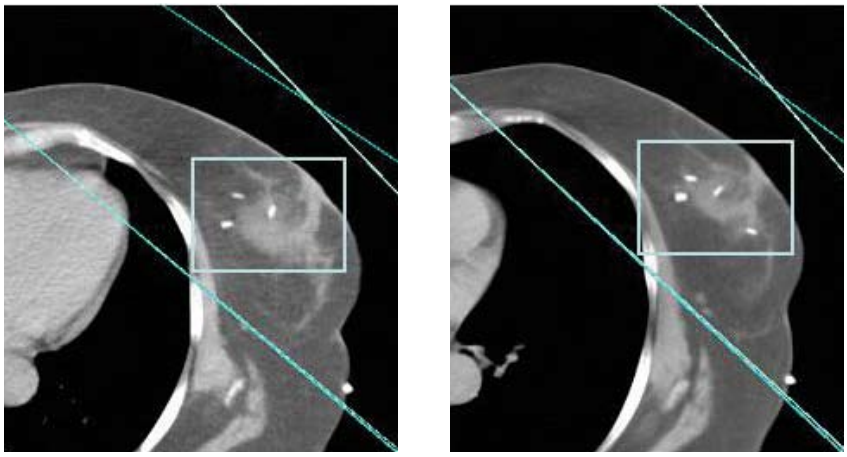

Figure 1: CT images (left) FB (right) mDIBH

Treatment planning

Planning was completed using an Philips Pinnacle® V6.0 workstation. A step-and-shoot IMRT plan was generated as per our standard departmental procedure [2].

Energy:	6MV
No. segments medial:	5
No. segments lateral:	5
Dose:	45Gy in 25 fractions

Tangential treatment was followed by an electron boost of 16Gy in eight fractions. Active Breathing Coordinator was not used for the electron boost.

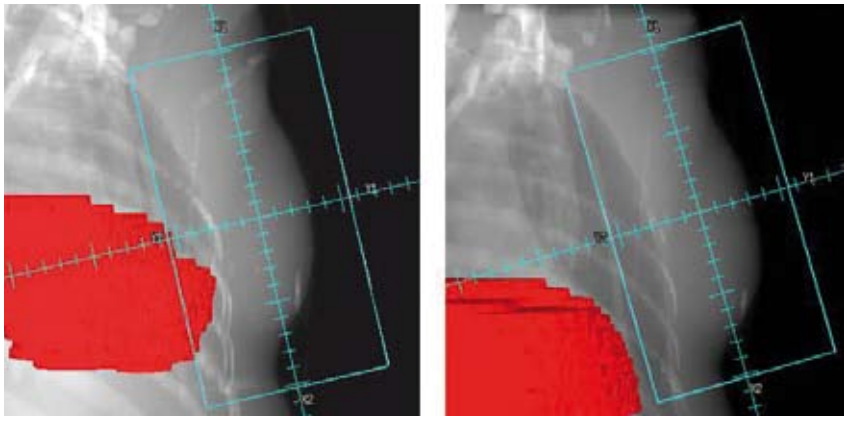

Figure 2: DRR (left) FB (right) mDIBH

Verification simulation

The purpose of this visit was to verify planned parameters, produce hardcopy images and place reference tattoos on the patient's skin. During this session the majority of patient positioning was completed in FB using data acquired from the FB scan. Minor adjustments were made in mDIBH to set the correct position, which required only short breath holds of five to 10 seconds. Appointment time required 45 minutes.

Treatment using Active Breathing Coordinator™

The patient was immobilized in a personalized alpha cradle. Daily set-up positioning was mainly completed in FB with only one five second breath hold, utilized daily to set the anterior SSD. Once per week the medial and lateral tangential SSDs were checked at mDIBH, although all other days only FB checks were completed.

Number of breath holds required for patient treatment:

No. of breath holds medial:	Two (duration: 23 seconds and 22 seconds)
No. of breath holds lateral:	Two (duration: 22 seconds and 21 seconds)

(continued overleaf)

Two electronic portal images (EPI) were acquired of each beam, totalling = four EPI per treatment fraction. No standardized correction procedure is utilized in our department for breast patients. Corrections were employed as a result of physician review. Off-line analysis of EPIs was completed for research purposes [3]. This was completed with an in-house treatment verification tool and used the ribs and chest wall for template matching purposes. Appointment time required 20 minutes.

Outcome and follow-up

Comparison with FB. The Active Breathing Coordinator™ plan was compared with a plan generated on the initial FB scan [1].

	Free breathing	Breath hold
Heart V30	2.7%	0.0%
Maximum heart distance	2.0cm	0.0cm
Lung V20	12.2%	10.2%
Maximum lung distance	2.5cm	2.7cm

Although the maximum lung distance included in the radiation field is greater for the Active Breathing Coordinator™ plan, the lung V20 is less when compared with the FB plan. This is due to the large increase in absolute lung volume with the mDIBH technique. Although there is more lung visualized in the field for Active Breathing Coordinator™ treatment, the percentage of the total lung volume being irradiated to the 20Gy level is less.

Conclusions

Similar to our common experience, no problems were encountered during the treatment course. The patient was comfortable and maintained the breath holds for each session as required. Active Breathing Coordinator™ in our clinic has been well accepted by both patients and staff.

Clinical papers:

1. *Remouchamps V.M., Letts N., Vicini F.A., Sharpe M.B., Kestin L.L., Chen PY, Martinez AA, Wong JW. Initial clinical experience with moderate deep inspiration breath hold using an active breathing control device in the treatment of patients with left-sided breast cancer using external beam radiation therapy. International Journal of Radiation Oncology Biology Physics, 01 July 2003 (Vol. 56, Issue 3, Pages 704-715).*
2. *Vicini FA, Sharpe MB, Kestin LL, Martinez AA, Mitchell CK, Wallace MF, Matter R, Wong JW. Optimizing breast cancer treatment efficacy with intensity modulated radiotherapy, International Journal of Radiation Oncology Biology Physics 01 December 2002 (Vol. 54, Issue 5, Pages 1336-1344).*
3. *Letts N, Remouchamps VM, Martinez AA, Vicini FA, Wong JW. Set-up inaccuracies in breast irradiation: a comparison of free breathing and active breathing control (ABC) treatment using Electronic Portal Images (EPI), International Journal of Radiation Oncology Biology Physics, 01 October 2003 (Vol. 57, Issue 2 (Supplement), Page S309).*