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FROM THE DIVISION OF RADIATION ONCOLOGY AND THE DEPARTMENT OF BIOSTATISTICS, CITY OF HOPE NATIONAL MEDICAL CENTER, DUARTE, CALIFORNIA 91010, USA.

BREAST RETRACTION ASSESSMENT

Multiple variable analysis of factors responsible for cosmetic retraction in patients treated conservatively for stage I or II breast carcinoma

R. D. PEZNER, M. P. PATTERSON, L. R. HILL, N. L. VORA, K. R. DESAI and J. A. LIPSETT

Abstract

A method for objective evaluation of cosmetic outcome of patients treated conservatively for breast carcinoma allowed the location of the nipples on two coordinates. The method was applied in 41 patients, 5 to 41 months following the completion of radiation therapy. Multiple variable analysis revealed that extensiveness of resection of the primary breast tumor was the major factor associated with breast retraction. The only other factor of significance was patient age at diagnosis. Neither the radiation therapy parameters, the use of adjuvant chemotherapy, nor any other analyzed factor was found to be associated with cosmetic breast retraction.

The goal of a breast-preserving treatment for patients with stage I or II breast carcinoma is to provide both a cancer control rate at least equal to that of the standard breast cancer treatment, the modified radical mastectomy, and at the same time to provide a good cosmetic result. If a good cosmetic result cannot be achieved, a patient might be better off having a total mastectomy with the option of breast reconstruction. One cosmetic change which may occur is breast retraction. The treated breast may appear smaller and higher, and may feel more firm than the untreated breast. Breast retraction assessment (BRA) has previously been presented as a simple method of objectively measuring the amount of retraction of the treated breast in comparison to the untreated breast (5). In the present investigation a multiple-variable statistical analysis of treated patients was performed to determine what factors might be associated with retraction.

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Materials and Methods

Breast retraction assessment is performed using a measurement grid. A clear, acrylic sheet is supported vertically at chest height by a stand (Fig. 1). The sheet is marked as a grid at one cm intervals. The patient stands behind the grid, faces it, and is positioned so that her jugular notch and xyphoid are centered to the Y-axis which is at the midline. Y values increase positively in the inferior direction. The X-axis is at the top of the grid. X values increase from the midline laterally in both directions so that all values are positive. The nipple of each breast just barely touches the grid sheet. The observer locates the x- and y- coordinates for the nipple of each breast. BRA values are then calculated by simple vector geometry employing the Pythagorean theorem:

$$BRA = \sqrt{(X_R - X_L)^2 + (Y_R - Y_L)^2}$$

Example 1 (Fig. 2):

$$X_R = 10,\ Y_R = 20 \quad X_L = 10,\ Y_L = 19$$

$$BRA = \sqrt{(10-10)^2 + (20-19)^2}$$

$$= \sqrt{0 + (1)^2}$$

$$= 1.0 \text{ cm}$$

Example 2 (Fig. 3):

$$X_R = 11,\ Y_R = 18 \quad X_L = 8,\ Y_L = 22$$
$$BRA = \sqrt{(11-8)^2+(18-22)^2}$$
$$= \sqrt{(3)^2+(-4)^2}$$
$$= \sqrt{9+16} = 25$$
$$= 5.0 \text{ cm}$$

Patients. BRA was performed on 41 patients who had undergone conservative treatment for unilateral stage I or II breast carcinoma. Patients with bilateral simultaneous breast carcinoma or with a history of mastectomy for prior contralateral breast carcinoma were not evaluated. The patients ranged in age from 34 to 67 years. There were 11 patients who were pre- or perimenopausal while the remaining 30 were post-menopausal. Clinical stage (1) at presentation was T1N0 in 20 patients, T2N0 in 17, T1N1 in 1, and T2N1 in 3.

A wide range of conservative treatment approaches was employed. The primary tumor was surgically resected in all patients except one who was diagnosed by percutaneous needle aspiration cytology. Extensiveness of resection varied. For the purposes of analysis, we have defined extensive resection to mean that the pathologic specimen had a length and a width each greater than 8 cm, or that a single incision was employed to resect the primary tumor and the axillary nodes. Limited resections had a specimen with a length and/or width less than 8 cm, and separate incisions were employed to resect the primary and the axillary nodes. Axillary nodes were fully dissected in 34 patients, sampled in 3 patients, and not removed in 4.

Fifteen patients received adjuvant systemic chemotherapy. The first cycle was usually given before the start of radiation therapy This usually consisted of either L-phenylalanine mustard and 5-fluorouracil (5-FU) or cyclophosphamide, methotrexate and 5-FU. One patient also received adriamycin as part of a multi-agent treatment.

Radiation therapy was employed to treat the entire breast by opposed tangential fields in all 41 patients. ^{60}Co teletherapy was used in 38 cases, the 10 MeV photon beam of a Clinac-18 in 2, and a 4 MeV photon beam in one. Wedges were employed as tissue compensators in 39 patients. Bolus was employed to the entire breast for part of treatment for 2 patients, and to the surgical scar only in 2 patients. Minimum dose in the whole breast based upon computer dosimetry was 45 to 51 Gy, delivered at 1.8 to 2.0 Gy per fraction.

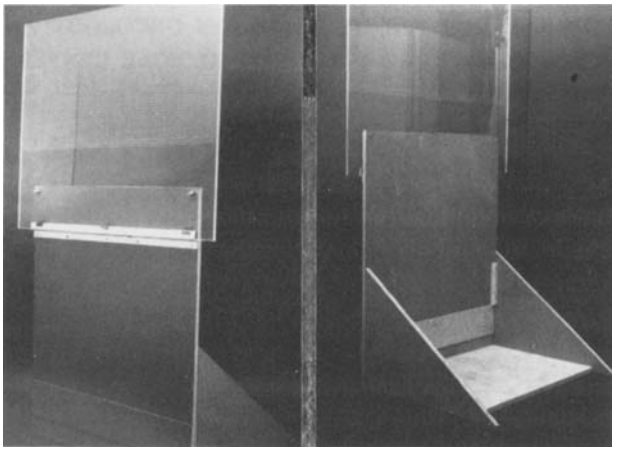

Fig. 1. Breast retraction assessment measurement grid.

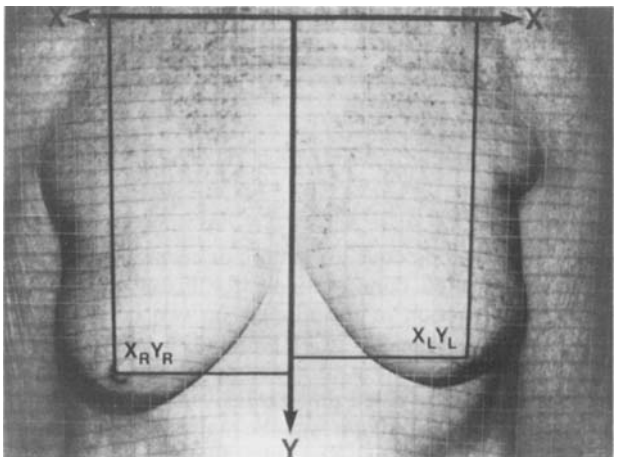

Fig. 2. Example 1: Patient with carcinoma of left breast treated by limited tumor resection, axillary node dissection, radiation therapy to the breast and regional nodes and interstitial ^{192}Ir implant radiation boost to primary site.

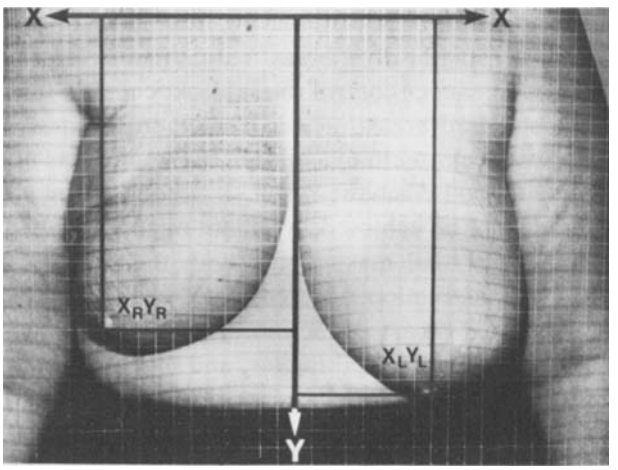

Fig. 3. Example 2: Patient with carcinoma of the right breast treated by limited tumor resection, axillary node dissection and radiation therapy to only the breast and without primary site radiation boost.

Table

BRA meaurements as related to extensiveness of primary breast tumor resection

Breast resection	No. of cases	Average BRA ±SD (cm)	Range (cm)	
Extensive	13	4.9±2.0	2.8–8.5	p<0.001
Limited	28	2.7±1.5	0.0–5.2	

The primary tumor bed received a local radiation boost in 24 patients. Interstitial ^{192}Ir implant was employed in 15, electron beam in 7, both implant and electron beam in one and ^{60}Co teletherapy in one. Total boost dose ranged from 5 to 30 Gy, with 19 receiving 15 to 25 Gy. The primary tumor bed site received a boost in those cases where tumor excision margins were not considered clear by the strict pathologic criteria of the N. S. A. B. P. protocol B-06 (2).

Regional lymph nodes were irradiated in 22 patients. This usually involved one or two anterior fields to treat the ipsilateral supraclavicular and internal mammary nodes. The full axilla was treated in 12 patients. This involved enlargement of the anterior field and addition of a posterior field to fully encompass the axilla. Total doses to the regional nodes ranged from 36 to 66 Gy, with 18 patients receiving 45 to 51 Gy. Fraction size was 1.7 to 2.0 Gy per day.

BRA evaluation was performed 5 to 41 months following the end of radiation therapy (mean 17 months). All patients signed informed consent before participating in this study. For each patient, BRA measurements were performed three times with the patient's arms at her sides. The measurements were averaged and BRA was calculated.

Multiple variable analysis was performed using step-wise linear regression to evaluate the following factors: primary tumour size (T1 versus T2), tumor location (inner quadrant versus central or outer quadrant), age at diagnosis, weight (less than versus more than 68 kg), bra cup size, history of thyroid surgery, extensiveness of primary tumor surgery, axillary surgery (full dissection versus sampling or no axillary surgery), adjuvant chemotherapy, daily radiation fraction size (1.7–1.8 Gy versus 2.00 Gy), use of regional nodal radiation fields, use of radiation therapy to the full axilla, and use of a local radiation boost to the primary tumor bed site.

Results

BRA values for patients with stage I or II breast carcinoma ranged from 0 to 8.5 cm, with a mean of 3.4 cm. In comparison, BRA values for a group of 29 control patients who did not have and were never treated for breast carcinoma ranged from 0 to 3.1 cm with a mean of 1.2 cm (5).

Multiple variable analysis revealed that extensiveness of primary tumor resection was the primary factor which statistically was most highly related to breast retraction (Table 1). Patients with extensive resection had a mean BRA of 4.9 cm with a range of 2.8 to 8.5 cm, while patients with limited resection had a mean BRA of 2.7 cm with a range of 0.0 to 5.2 cm ($p<0.001$). Neither the radiation therapy parameters nor the use of adjuvant chemotherapy were related to breast retraction.

The only other factor found to be associated with retraction was patient age at time of diagnosis. Age entered as a second step once extensiveness of surgery was taken into account. BRA values increased positively with increasing age ($p<0.02$). Once age was taken into account, no other factors gave additional significant prediction. Attempts to break the population into age groups (e.g. less than 60 years old versus more than 60 years old) failed to give statistically signficant results.

Discussion

Several authors have analyzed the cosmetic outcome for patients with early stage breast carcinoma. This usually involved one or more investigators making a judgement as to whether cosmetic changes were absent, mild, moderate or severe. HARRIS & LEVENE (4) employed such a scale to conclude that breast retraction was related to the total radiation dose. DANOFF & GOODMAN (3) used a similar scale to reach the conclusion that patients receiving adjuvant chemotherapy were more likely to suffer greater retraction than those who did not receive chemotherapy. Others have based their evaluation upon how much of the treated breast developed cosmetic changes. RAY & FISH (6) used such a scale to reach the conclusion that chemotherapy had a negative impact on breast cosmesis.

The scoring of such scales is subject to observer bias. We have found them to be of little value in the critical analysis of factors responsible for cosmetic outcome. Moreover, there are several cosmetic

changes which may occur. Besides breast retraction, patients may develop breast edema, hyperpigmentation, telangiectasia, depigmentation, areolar and nipple changes, shoulder stiffness and arm lymphedema. It would not be correct to assume that all cosmetic changes may be due to just the same causes. Each cosmetic change must be analyzed separately for its own set of related factors. The analysis employed should be as free as possible of subjective observer bias.

Breast retraction assessment is a simple tool which objectively and quantitatively analyzes only retraction. It can be employed to compare the cosmetic outcome of various breast-preserving approaches performed at different institutions.

The underlying assumption of BRA measurements is that the goal of breast-preserving cancer treatment is to minimize changes caused by treatment. While some patients may prefer the retraction of their treated breast because it may appear more 'youthful', we believe that patient satisfaction is best achieved by producing as little deformity as possible.

Our multiple variable analysis revealed that extensiveness of primary tumor surgery was the major factor related to breast retraction. Chemotherapy and radiation therapy, as delivered to our patients, did not play a significant role. Patient age did appear to play a minor role in retraction, but breast size, as determined by bra cup size, did not.

We plan to continue our studies by increasing the size of the group of patients analyzed, and performing serial evaluations over time to determine if other factors may play a role in retraction in patients treated conservatively for stage I and II breast carcinoma.

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