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ORIGINAL ARTICLE

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Single incision for oncologic breast conserving surgery and sentinel node biopsy in early stage breast cancer: A minimally invasive approach

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Abstract

Introduction: Breast conserving surgery (BCS) has a postoperative morbidity up to 30%. We report the feasibility of a single-incision approach for tumor excision and axillary sentinel node biopsy (SNB) sampling intended to minimize patient morbidity and complications.

Materials and Methods: A tertiary surgical oncology single surgeon database was retrospectively reviewed for all patients undergoing BCS and SNB between January 2013 and December 2015. The single-incision approach used a single breast incision to resect the tumor and the Lymphazurin-tagged SNB. The multi-incision group used a breast incision and a separate axillary incision.

Results: The single-incision approach was associated with shorter operative time (56 vs 64 minutes, $P = 0.026$). Sentinel node retrieval was achieved in 100% in both groups. The single-incision technique was used primarily in the upper outer quadrant (N = 41, 85.4%), but was also selectively applied in other quadrants (N = 5). There was no significant difference in complication rates between the two procedures ($P = 0.425$), and there were no instances of conversion from single-incision to standard BCS-SNB.

Conclusions: Minimally invasive breast conserving surgery is feasible for patients with early breast cancer located in the upper outer quadrants. This technique may reduce postoperative morbidity and improved cosmetic result.

KEYWORDS
breast cancer, breast conserving surgery, minimally invasive breast surgery

1 | INTRODUCTION

Oncologic Breast Conserving Surgery (BCS) has become the standard of care for early breast carcinoma, with equivalent rates of local control and overall survival and lower complication rates than mastectomy in large trials.[1–5] Similarly, sentinel lymph node biopsy (SNB) has been proven to be as effective as axillary node dissection for evaluating nodal involvement in large randomized control trials.[6] As such, current management of early invasive breast cancer includes BCS with SNB and adjuvant therapy as first line treatment for many patients.

While BCS represents a step toward minimally invasive oncologic surgery, it has potential for further refinement. The standard BCS with SNB approach yields 2 scars, which are often impractically close and associated with cutaneous devascularization and distortion of breast tissue that adversely affects cosmetic outcome. Several studies have shown that cosmetic results after breast cancer surgery

affect women, their body image, and sexual function and can have a significant negative effect on quality of life.[7–9]

The goal of this study was to evaluate the use of a novel single-incision approach for surgical resection of breast carcinoma, particularly focusing on oncologic efficacy for local control and surgical outcomes among patients treated with a single-incision approach.

2 | MATERIALS AND METHODS

2.1 | Study population and data sources

The study protocol was approved by the Emory University Institutional Review Board in compliance with the Health Insurance Portability and Accountability Act of 1996. A retrospective review of medical records of adult patients undergoing BCS with SLN for breast tumors treated by a single surgical oncologist at a tertiary academic multi-hospital National Cancer Institute-designated cancer center was performed. Sufficient follow-up was determined to be >2 months as this was a not a long-term outcomes analysis.

2.2 | Surgical methods

Patients with histologically proven breast tumors with mammographic evidence of localized disease were selected for this procedure. The patients were stratified into two cohorts based on operative approach: single-incision transaxillary BCS-SNB and conventional BCS-SNB that implies two separate incisions.

The single-incision transaxillary BCS approach begins with the patient in a supine position, slightly rotated away from the surgeon, and the ipsilateral arm extended over the head to expose the wire-localized tumor and axilla. SLN were identified using intraoperative periareolar injection of Lymphazurin dye. A single incision is made in the breast in proximity of the wire-localized tumor. Then, the delto-clavicular-pectoral fascia is opened from the breast using sharp dissection with electrocautery. The SNB are harvested from a single breast incision (Figure 1). Prior to incisional closure, the delto-clavicular-pectoral fascia is closed with a running absorbable suture. The conventional approach BCS used separate breast and axillary incisions for the tumor and lymph nodes, respectively.

2.3 | Study variables and outcomes

Pre- and postoperative clinic notes, operative notes, imaging, and pathology reports were reviewed for patient sociodemographic, clinical, pathologic, and surgical information. Patients were staged according to the American Joint Commission on Cancer (AJCC) Seventh Edition classifications.

The primary outcomes of interest were tumor characteristics and adequacy of tumor resection, as defined by negative margins and lymph node biopsy. Secondary outcomes of interest included perioperative surgical factors, postoperative complications, and cosmetic result as documented in the clinic note at the follow-up clinic visit.

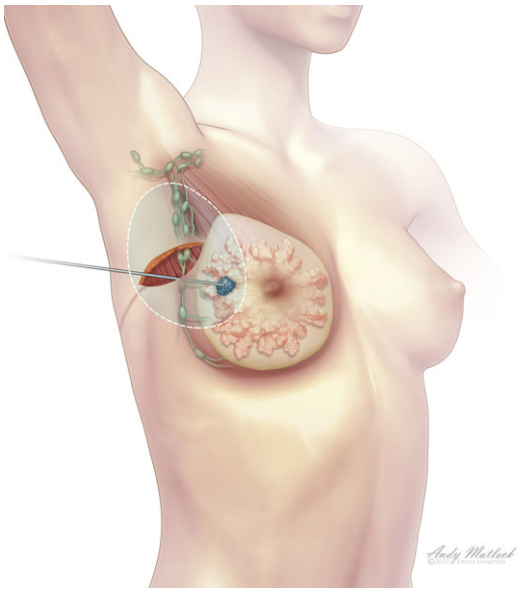

FIGURE 1 Single-incision breast conserving surgery that allows excision of the tumor and axillary sentinel nodes [Color figure can be viewed at wileyonlinelibrary.com]

2.4 | Data and statistical analysis

All data processing and statistical analysis were conducted using SPSS v22 (Armonk, NY, USA). Data are presented as frequency and percentage for categorical variables and median/IQR or mean/standard deviation for continuous variables. Categorical variables were compared with chi-square test or Fisher's exact test. Continuous variables were compared with two-tailed independent samples *t* test or Mann-Whitney *U* test. Univariable logistic regression analysis was performed to assess the association of relevant patient variables with each of the primary and secondary end points. Statistical significance was assessed at the alpha 0.05 level with correction for multiple comparisons where appropriate.

3 | RESULTS

During the three consecutive years study period, 110 BCS-SNB cases were identified; the sociodemographic, clinico-pathologic, and surgical treatment characteristics of the sample are shown in Table 1. The median age at diagnosis was 66 years (range: 29-91 years). Of these, 64 tumors (59%) occurred in the upper outer quadrant. The vast majority of the tumors (98%) were not palpable and required wire localization in Breast Imaging before surgery. Wire localization was performed with either mammographic (53%) or sonographic guidance (46%).

3.1 | Single-incision vs conventional BCS-SNB

There were 48 patients in the single-incision group and 62 in the multi-incision group. The oncologic efficacy characteristics of the two cohorts are described in Table 2. The single-incision technique

TABLE 1 Characteristics of breast conserving surgery patients (N = 110), 2013-2015

Patient sociodemographic and clinical characteristics	
Age (median, IQR)	63.4 [54.11, 70.70]
Race	
White	36 (32.7%)
Black	67 (60.9%)
Other/Unspecified	7 (6.4%)
Family history of breast cancer, N (%)	34 (30.9%)
Breast carcinoma subtype	
Invasive ductal	91 (82.7%)
Ductal, in situ	11 (10.0%)
Invasive lobular	6 (5.5%)
Invasive mucinous	2 (1.8%)
Breast quadrant	
Upper outer	64 (58.1%)
Upper inner	22 (20.0%)
Lower outer	18 (16.4%)
Lower inner	5 (4.6%)
Subareolar	1 (0.9%)
Wire localization	
Mammographic	58 (52.7%)
Ultrasound	50 (45.5%)
None	2 (1.8%)
AJCC clinical stage	
0	11 (10.0)
1A	53 (48.2%)
1B	3 (2.7%)
2A	23 (20.9%)
2B	7 (6.4%)
3A	5 (4.5%)
Complete neoadjuvant pathologic response	8 (7.3%)
Hormone receptor status	
Estrogen receptor positive	94 (85.5%)
Progesterone receptor positive	79 (71.8%)
Her2 receptor positive	13 (11.8%)
Triple receptor negative	11 (10.0%)

N (%); median [interquartile range].

was used primarily in the upper outer quadrant (N = 41, 85.4%), but was also applied in upper inner (N = 4), lower outer, lower inner, and subareolar (N = 1 each). The single-incision approach was associated with a trend toward higher rates of negative margins (95.2% vs 85.6%, $P = 0.181$). Sentinel lymph nodes were successfully obtained in 100% of patients from both treatment groups, with a median of two and three SNBs acquired in the single incision and standard approach, respectively. There were no instances of conversion from the single-incision to double incision approach.

The surgical outcomes of the two procedures are described in Table 2. In the single-incision group, 85% of the cancers were located in the upper outer quadrant of the breast. There was no significant difference in complication rates between the two procedures ($P = 0.425$). The most common complications were wound seromas and superficial soft tissue infections in both cohorts; one patient in the single-incision cohort required a percutaneous interventional drain to be placed due to abscess. No episodes of lymphedema, arm motor, or sensory changes were found. The single-incision BCS was associated with a significantly shorter operative duration (56 vs 64 minutes, $P = 0.026$). The single-incision approach was successfully combined with other surgical adjuncts, including oncoplastic reconstruction,[7] axillary node dissection,[7] and Contura brachytherapy spacer insertion.[9] There was no statistically significant difference in oncologic re-excision to achieve negative margins, although the single-incision group had a nominally lower incidence of re-excision (4.2% vs 8.1%). No patients required completion mastectomy in either cohort.

All patients were seen postoperatively within 2-3 weeks after surgery in clinic. At the time of the first postoperative, visit the pathology results were reviewed. Based upon the results, Oncotype DX was obtained in 37 patients: 17 single incision (35%) and 20 standard (32%) patients to eventually dictate the need of adjuvant therapy.

4 | DISCUSSION

This single-center case series demonstrates excellent oncologic, functional, and cosmetic outcomes using a single-incision approach for minimally invasive breast conserving surgery with lymph node sampling. The single-incision approach was associated with shorter operative time and statistical trend toward a higher negative margin rate than standard BCS-SNB, 100% SLN retrieval, equivalent surgical outcomes, and the ability to be combined with several surgical adjuncts. As nearly 60% of all breast tumors are located in the UOQ, this approach is highly generalizable and uses easily identified anatomic landmarks that can be modified based on patient factors. Furthermore, this single-incision approach shows excellent versatility, with the ability to be combined with several different oncologic and reconstructive adjuvants. With the confirmation of oncologic and surgical efficacy, future areas of study will include long-term evaluation of patient oncologic, functional, and cosmetic outcomes following the single-incision approach.

The single-incision approach was associated with and a trend toward greater local control with higher rate of negative oncologic margins. BCT is associated with a 30%-60% rate of additional excision procedures for residual positive oncologic margins[10,11]; these reoperations can increase the risk of wound complications, delay adjuvant chemoradiation therapy, and result in worse esthetic outcomes.[10,11] A study at University of Michigan revealed that nearly half of women required re-excision lumpectomy, and 10% required mastectomy following initial attempt at BCS[12]; the authors postulated that this may also increase patient anxiety and negatively impact the patient-surgeon relationship. The single-incision approach was also associated with a 100% SLN retrieval rate, a rate higher

TABLE 2 Characteristics of single incision vs standard two-incision breast conserving surgery

	Single incision N = 48 (43.6%)	Standard BCS N = 62 (56.4%)	Chi-Square	Likelihood ratio [95% CI]	*P*-value
Patient Age, median [IQR]	63.4 [54.5, 68.9]	63.4 [53.6, 72.7]			0.804
Location in upper outer quadrant vs other quadrant	41 (85.4%)	23 (37.1%)	25.962	2.303 [1.631, 3.250]	<0.001**
Surgical efficacy					
Negative tumor margins (no tumor at the ink)	40/42 (95.2%)	45/52 (86.5%)	2.031	0.472 (0.136, 1.637]	0.181
Clip in sample	45/45 (100.0%)	56/56 (100.0%)	0.150	1.021 [0.920, 1.134]	1.000
Invasive largest dimension, cm median [IQR]	1.10 [0.25, 2.07]	1.30 [0.65, 2.3]			0.552
DCIS only	5 (10.4%)	6 (9.7%)	0.016	1.076 [0.349, 3.317]	1.000
Gross specimen volume (cm^3) median [IQR]	188 [133, 353.5]	160.5 [93.75, 242.25]			0.216
SLN identified	40/40 (100%)	52/52 (100%)	—	—	—
SLN identified, median [IQR]	2 [2, 3]	3 [2, 4]			0.050**
Axillary node dissection, N (%)	8 (16.7%)	10 (16.1%)	0.006	1.017 [0.648, 1.596]	1.000
Nodes identified in axillary dissection, median [IQR]	16 [11.3, 17.8]	15 [5.8, 32.8]			0.893
LN positive	7 (14.6%)	14 (22.6%)	1.120	0.646 [0.283, 1.474]	0.590
Patient outcomes					
BCS operative duration (min), median [IQR]	56.0 [46.5, 73.3]	64.0 [54.5, 75.5]			0.026**
Intraoperative Jackson-Pratt axillary drain placement	9 (18.8%)	14 (22.6%)	0.624	0.906 [0.621, 1.323]	0.646
Complication			1.220		0.543
Infection	4 (8.3%)	2 (3.2%)			
Noninfectious wound complication	6 (12.5%)	5 (8.1%)			
Reoperation	2 (4.2%)	5 (8.1%)	0.690	0.775 [0.470, 1.277]	0.466
Clavien-Dindo complication					
0	35 (72.8%)	49 (79.0%)	3.861		0.425
1	7 (14.6%)	4 (6.5%)			
2	3 (6.3%)	4 (6.5%)			
3A	1 (2.1%)	0 (0.0%)			
Operation			6.013		0.049**
BCS	41 (85.4%)	58 (93.5%)			
BCS + Bilateral	0 (0.0%)	2 (3.2%)			
BCS + Oncoplastic	7 (14.6%)	2 (3.2%)			
Contura Spacer	11 (22.9%)	14 (22.6%)	0.002	1.008 [0.680, 1.496]	1.000
IORT	0 (0.0%)	2 (3.2%)	1.577	0.556 [0.469, 0.658]	0.504

**corresponds to a statistical *P*-value <0.05.
N (%); median [interquartile range].

than both the AC0SOG Z0010 trial (98.6%)[13] and NSABP B32 trial (97%).[14] While there were no cases requiring conversion of the single-incision approach to the standard BCS-SNB approach, the placement of the initial single-incision approach would pose no limitation if conversion was required for greater axillary exposure. Similarly, in the event that re-excision surgery is oncologically required, this can be undertaken without difficulty.

The utility of the single-incision BCS approach has increased in the era of ACOSOG Z0011 trial application, as the character of SLB replaces completion axillary dissection for patients with limited SLN metastatic breast cancer.[15] Following partial mastectomy with complete axillary dissection, the risk of skin-pectoral adherence deformity and lateral nipple-areolar migration. However, our data and institutional experience show that single-incision partial mastectomy with complete axillary node dissection is feasible, as 16% of the single-incision cohort received an axillary dissection. For patients with a clinically positive axillary node examination with a planned axillary dissection, the single-incision approach should be performed only by surgeons with experience and comfort with the single-incision technique.

Other groups have described similar single-incision approaches, including the transmammary axillary nodal evaluation (TANE procedure), consisting of a single mammary incision with transmammary axillary evaluation,[16,17] as well as the single axillary incision with transaxillary breast tumor resection.[18] We have identified several practical advantages to the single-incision approach as described.

FIGURE 2 Postoperative cosmetic outcomes of a patient with left breast tumor localized at 1 o'clock position in the left upper outer quadrant. A single incision was used for the breast cancer and the retrieval of three axillary sentinel node [Color figure can be viewed at wileyonlinelibrary.com]

First, this approach halves the number of incisions required for the dissections, minimizing pain from cutaneous nerve disruption. This incision removes any incisions from the axilla, which reduces the risk of cicatricial skin contraction that may affect arm mobility. Up to 1/3 of postoperative BCS-SNB patients report axillary symptoms interfering with daily life,[19] including pain, numbness, paresthesia, reduced range of motion.[13,20–22] SNB with standard axillary incision is associated with a 5%-8% rate of long-term postoperative lymphedema,[6,23] and minimizing disruption of axillary lymphatic and vascular channels with minimally invasive node sampling may further reduce this complication. It has been our institutional experience to close the delto-clavicular-pectoral fascia with a running absorbable suture to improve wound healing and cosmesis—first, to minimize potential space for seroma formation and decrease communication between the breast and axilla, and second, to decrease skin and subcutaneous tissue migration associated with disrupted fascial connections.

The single-incision approach also removes the incision from the breast and allows the incision to be "hidden" in a cosmetically favorable position away from the primary cosmetic breast (Figure 2). Likewise, this approach also increases the distance between the incision and the radiation bed for BCT. Radiation in BCT is associated with telangiectasia, sclerosis, cutaneous atrophy, and fibrosis,[24,25] each of which may contribute to wound complications and poor cosmetic outcome when applied in close proximity to the healing breast incision. The removal of a cutaneous incision is also a benefit given the high proportion of African-American patients (60%) in our Atlanta-based center, as Black race is associated with a 20-fold higher incidence of keloid and hypertrophic scar formation than Caucasians.[26]

Critical evidence-based analysis of the single-incision approach allows for refinement of the procedure. Intraoperative drain placement was lower in the single-incision group, despite the presence of a single dissection cavity connecting the breast to the axilla and a larger median gross tissue sample size (188 vs 160.5 cc). This may contribute to the trend toward higher rates of wound complications with the single-incision approach (20.8% vs 11.3%), although this did not reach statistical significance.

The limitations of this study should be noted. The academic tertiary cancer center setting of this study and availability of skilled mammographers for wire localization based on incisional planning may not be generalizable to community-based practices. Furthermore, this study was designed solely as a pilot to evaluate oncologic and surgical efficacy. Specific measures of patient satisfaction were not collected with a patient questionnaire about cosmetic results. A follow-up study is planned with prospective quantitative collection of pre- and postoperative patient functional, satisfaction, and cosmetic results that will be used to quantify patient benefit from the single-incision approach and better educate patients on surgical approaches. There was potential for selection bias based on upper outer quadrant predominance of the single-incision groups in this retrospective study; however, the fact that a single surgeon performed resection for all the patients in both cohorts is a strength of the study and eliminates some variability. In conclusion, we describe a single-incision approach for resection of breast tumors with excellent oncologic, functional, and cosmetic outcomes. We highly support the use of this effective and safe technique in the treatment of select breast tumors to improve patient cosmetic results.

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CONFLICT OF INTEREST

The authors of this manuscript have no conflicts of interest to disclose.

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