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Use of Sentinel Lymph Node Dissection after Neoadjuvant Chemotherapy in Patients with node-Positive Breast Cancer at Diagnosis: Practice Patterns of American Society of Breast Surgeons Members

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Abstract

Background—The accuracy of sentinel lymph node dissection (SLND) in clinically node-positive patients who receive neoadjuvant chemotherapy has been investigated in clinical trials. This survey was designed to assess familiarity and impact of these trial findings into practice.

Methods—American Society of Breast Surgeons members were invited by e-mail to complete an anonymous online survey. 642 members responded (21% of 3090 eligible members). Results were summarized as proportions based on the number of responses to each question.

Results—Respondents indicated knowledge of the Z1071 (86%), SENTINA (57%), and SN-FNAC (39%) trials. The published false negative rates (FNR) of the trials were correctly reported by 53% (336/638) of respondents. Before the trials, 45% (285/636) offered SLND compared to 85% (543/638) after the trials. In the 556 respondents who reported knowledge of at least one trial, 310 (56%) currently offer SLND to >50% of patients, 175 (31%) offer to <50%, and 70 (13%) routinely perform axillary lymph node dissection. Respondents who reported knowledge of the trials but did not change their practice to incorporate SLND (n=67) cited concerns over lack of outcome data (64%), worries about FNR (42%), lack of resources (34%), or objections from radiation oncologists (25%), medical oncologists (18%), or other surgeons (8%).

Conclusions—The publication of trials evaluating SLND in clinically node positive patients has resulted in changes in practice. Concerns over the FNR and lack of outcome data limit incorporation of SLND into practice by some surgeons.

The presence of nodal metastases often guides treatment decisions in breast cancer. Many patients with clinically node-positive breast cancer receive neoadjuvant chemotherapy which can eradicate nodal disease in 40–75% of patients.[1–5] Despite high rates of nodal pathologic complete response, standard practice has been to perform axillary lymph node dissection

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(ALND) upon completion of chemotherapy. While it is unlikely that performing extensive axillary surgery in patients without residual disease confers oncologic benefit, identifying patients who may not require ALND has been challenging. Initial reports addressing the use of sentinel lymph node dissection (SLND) after chemotherapy reported false negative rates (FNR) ranging from 5–30%. However, these were largely retrospective studies without standardized surgical techniques, therefore difficult to interpret.[6–11]

Prospective trials evaluating the accuracy of SLND after neoadjuvant chemotherapy in clinically node-positive patients have been completed. The American College of Surgeons Oncology Group (ACOSOG) Z1071 trial reported a FNR of 12.6% for SLND in patients with cN1 disease who had at least 2 sentinel lymph nodes (SLN) removed.[12] While the trial did not meet its prespecified success threshold of 10%, subgroup analyses revealed that technical aspects of SLND could lower the FNR.[12–14] The European SENTinel NeoAdjuvant (SENTINA) trial and the Canadian Sentinel Node Biopsy Following Neoadjuvant Chemotherapy (SN FNAC) trial, corroborated these findings.[15,16] Techniques such as use of dual tracers (blue dye and radioisotope) and removal of >2 SLNs were shown to lower the FNR in all three trials. Additional factors were assessed in some of the trials including the use of ultrasound to assess nodal response, placing clips to mark nodes with biopsy-confirmed disease prior to chemotherapy and ensuring removal and evaluation after chemotherapy, as well as use of immunohistochemistry for pathologic evaluation.[13–15,17]

Since publication of these trials, some surgeons are offering SLND with the intent of omitting ALND if the pathology result is negative while others continue to routinely perform ALND. Amongst surgeons who have incorporated SLND into their practice, there is significant variation in techniques employed to minimize the FNR.[18–21] The goal of this study was to determine surgeon familiarity with the trials and to determine if and how they have incorporated the results into their practice. We also sought to identify barriers and issues that have contributed to lack of acceptance of the trial results, which might elucidate opportunities for future studies.

Methods

The study involved a survey of members of the American Society of Breast Surgeons (ASBrS) conducted over a 4 week period. ASBrS members were sent an email invitation with a web-based link to the 11-question, anonymous survey (Figure 1). Questions assessed practice environment, years in practice, and knowledge of trial data. The remaining questions focused on surgeon practice before and after publication of the trials, relative importance of patient and technical aspects, and barriers to implementation.

Responses were received from 642 (21%) of 3090 eligible members. Results were summarized as proportions based on the number of responses to each specific question. Statistical comparison was performed using chi-square tests with a significance level of 0.05. (SAS Enterprise Guide 5.1, Cary, NC). The study was approved by the ASBrS Research Committee and Board of Directors, and the MD Anderson Institutional Review Board.

Results

Overall Findings

Survey results for the 642 respondents are summarized in table 1. Practice type and duration as well as trial familiarity are summarized in figure 1. Respondents reported familiarity with ACOSOG Z1071 (85.5%, n=549), SENTINA (57.0%, n=366), and SN-FNAC (39.4%, n=253). Thirteen percent (n=86) reported that they were not familiar with any of the trials, 27.6% (n=177) were familiar with one trial, 22.7% (n=146) were familiar with two, and 36.3% (n=233) were familiar with all three trials. The FNR of SLND reported in the trials was correctly identified by 52.7% (n=336/638) of respondents. Before the trials were published, 17.3% (110/636) offered SLND with possible omission of ALND in most patients and 27.5% (175/636) offered it in selected patients. After the trials, 53.6% (342/638) offered it to > 50% of their patients and 31.5% (201/638) offered it to selected patients. When considering whether to offer SLND, over half of respondents considered the number of abnormal nodes seen on initial ultrasound (62.3%, 349/560), nodal response seen on ultrasound (61.8%, 346/560), and whether the patient would receive adjuvant radiotherapy (63.2%, 354/560).

Surgeons identified multiple technical features they considered critical to performance (table 1). Two-thirds (373/559) of respondents routinely place clips in lymph nodes with biopsy-proven metastases prior to the initiation of chemotherapy. A total of 386 participants described their practice of assessment of the clipped node intra-operatively. The clip is localized for removal by 71.5% (276/386) using a wire (73.2%, 202/276), radioactive seed (13.0%, 36/276), or other localization method (13.8%, 38/276). The remaining respondents stated that either they do not localize the clip but use x-ray to confirm removal (81.8%, 90/110) or use no clip assessment (18.2%, 20/110). (Figure 2)

There were 212 responses to the question assessing barriers to incorporation of SLND into practice. The primary concerns were lack of outcome data (52.8%, n=112), lack of resources (30.2%, n=64), resistance from medical oncology (26.4%, n=56) or radiation oncology (23.6%, n=50), and concerns about the FNR (20.8%, n=44).

Current Practice of Surgeons with Familiarity with Trials

Surgeons who reported knowledge of the trials were more likely to perform SLND currently (87.4%, 485/555) than those that did not know about the trials (69.2%, 54/78) (p<.0001). In order to assess how surgeons who have knowledge of the trials have decided to incorporate the data into practice, an analysis was performed limited to surgeons who reported familiarity with at least one trial categorized by their current practice (Table 2). Of 555 respondents familiar with a trial, 55.9% (n=310) offer SLND to > 50% of their patients with planned omission of ALND if SLNs are negative, 31.5% (n=175) to <50% of patients, and 12.6% (n=70) do not offer SLND to their patients with initial node-positive disease. Surgeons who reported knowledge of the trials but have not incorporated SLND into practice were more likely to identify the correct FNR of the trials (69.6%, 48/69) than those that offer SLND (57.4%, 278/484) although this did not reach statistical significance (p=0.07). A proportion of surgeons now incorporating SLND also offered SLND before

publication of the trials. In those now offering SLND in > 50% of patients, 24.4% (75/308) offered it to most patients before the trials and 27.6% (85/308) offered it in selected patients. Amongst surgeons currently using SLND in < 50% of cases, 5.2% (9/174) offered it to most patients before the trials and 38.5% (67/174) in selected patients (p<0.0001).

There were significant differences noted between the groups in regards to patient selection factors for SLND eligibility with surgeons offering SLND to <50% of patients reporting many factors utilized in their decision to offer SLND. Surgeons performing SLND in <50% of patients were more likely to consider number of abnormal nodes on ultrasound (79.4% vs 53.2%,p<0.0001), tumor subtype (47.4% vs. 29.0%, p<0.0001), patient age (55.4% vs. 33.9%, p<0.0001), plans for adjuvant radiotherapy (70.3% vs. 59.4%, p=0.02) and tumor size (26.3% vs. 17.4%, p=0.02) than surgeons offering SLND to the majority of their patients. Surgeons who reported knowledge of the trials but did not incorporate SLND (n=68) cited concerns over lack of outcome data (64.7%, n=44), worries about FNR (42.6%, n=29), lack of resources (33.8%, n=23), or objections from radiation oncologists (25%, n=17), medical oncologists (17.6%, n=12), or other surgeons (7.4%, n=5) (Table 3).

Impact of Trials on Surgeon Practice

Lastly, we evaluated surgeons who did not perform SLND before publication of the trials and reported knowledge of the trials to assess differences between those that decided to change their practice to incorporate SLND (78.1%, 246/315) compared to those that did not change their practice and continue to routinely perform ALND (21.9%, 69/315) (Table 3). There were no differences in regards to knowledge of specific trials or knowledge of the reported FNRs. Those that did not change their practice (and still routinely perform ALND) were more likely to show concern over the FNR (41.8%, 28/67) than those that now use SLND (13.6%, 8/59) (p=<.001). There were no significant differences regarding barriers to implementation.

Discussion

The publication of trials evaluating SLND in clinically node-positive patients who receive neoadjuvant chemotherapy has resulted in practice changes in a majority of surgeons who responded to the survey. While 45% of surgeons reported offering SLND with possible omission of ALND before the trials, 85% now offer it to at least some of their patients after chemotherapy. However, there is variation in patient selection and technical features thought to be critical for accuracy. There are also barriers to incorporation; primarily concerns over the lack of outcome data and reservations about the FNR.

One challenge of clinical trials is disseminating the data so that clinicians can determine if practice change is warranted. While 86% of respondents reported knowledge of ACOSOG Z1071, there was less awareness of the related SENTINA (57%) and SN FNAC (39%). However, even in respondents reporting knowledge of the trials, only 59% (326/553) accurately identified the FNR of SLND, the primary endpoint of the trials. Interestingly, those who knew of the trials but had decided not to change their practice to incorporate SLND were more likely to correctly identify the FNR. The majority (87%) of surgeons who knew about the trials now perform SLND in at least some patients. However, 69% of the

surgeons who were not familiar with the trials are also performing SLND pointing to routes of practice change other than direct knowledge of clinical trials.

Important lessons learned from these trials were that surgical technique impacts the accuracy of SLND. For instance, the use of dual tracers in ACOSOG Z1071 decreased the FNR from 20.3% to 10.8%.[12] Similar results were seen in SENTINA (16% to 8.6%)[16] and SN FNAC (16% to 5.2%).[15] In addition, retrieval of at least 3 SLNs lowered the FNR to 9% from 31% if one SLN was removed in ACOSOG Z1071.[12] In the SENTINA trial, the removal of one SLN resulted in a FNR of 24% which was reduced to 5% if 3 or more nodes were removed.[16] The SN FNAC trial corroborated this finding with a FNR of 18% with one SLN removed compared to 5% if at least 2 were removed.[15] More intense pathologic evaluation with immunohistochemistry (IHC) reduced the FNR from 12.6% to 8.7% in ACOSOG Z1071 and from 13.3% to 8.4% in the SN FNAC trial.[14,15] The investigators of the Z1071 trial have also recommended the use of axillary ultrasound after chemotherapy, noting that the FNR could have potentially been reduced to 9.8% if SLND had only been performed on patients with a normal axillary ultrasound at the completion of chemotherapy.[17] However, the SENTINA investigators concluded that the combination of palpation and axillary ultrasound after chemotherapy did not reliably assess response.[22] Our survey shows that surgeons recognize the limitations of the available ultrasound data as only half of respondents felt that ultrasound was critical. In contrast, surgeons recognize the importance of technical aspects such as use of dual tracer technique (86%) and removal of at least 2 SLNs (70%).

Additionally, data reported from the ACOSOG Z1071 trial demonstrated that placement of a clip in nodes with biopsy-proven metastases may be useful. In that study, 170 patients had a clip placed in the lymph node containing metastases at the time of initial biopsy. In the 107 patients where the clipped node was retrieved as a SLN, the FNR was 6.8% (95% CI 1.9–16.5%).[13] A recent study from our institution also showed utility in placing clips in lymph nodes with biopsy-proven metastases and ensuring removal of these nodes for evaluation. In our study, the FNR for SLND alone was 10.1% (95% CI 4.2–19.8). Evaluation of the clipped node alone had a FNR of 4.2% (95% CI 1.4–9.5).[23] When we assured removal of all SLNs and the clipped node, the FNR was reduced to 1.4% (95% CI 0.03–7.3). In 23% of patients, the clipped node was not a SLN. We have therefore proposed targeted axillary dissection, which entails the removal of SLNs as well as selective localization and removal of clipped nodes.[23,24] In this survey, 82% of surgeons stated that placing clips and ensuring removal was critical for the accuracy of SLND. The survey showed that 67% now routinely place clips in biopsied nodes and many selectively remove it with localization.

This survey also confirmed barriers to acceptance of the trial data and incorporation of SLND in these patients in clinical practice. The primary concerns were hesitation about the FNR and lack of outcomes data. With a FNR of 12.6%, the ACOSOG Z1017 trial did not meet its threshold of 10%.[12] This has prompted many to question whether SLND should be incorporated into practice based on a negative trial. While the techniques mentioned above decreased the FNR, conclusions must be based on subgroup analyses which have insufficient power to be definitive. There is currently no data to know the true FNR when all of the optimal technical factors are used. In addition, there is no outcome data available to assess

the oncologic safety of omission of ALND after nodal conversion. Finally other than limiting to patients with clinical N1 disease, there is limited data to guide surgeons in selecting which patients would be appropriate candidates. Surgeons with knowledge of the trials that currently offer SLND selectively were more likely to consider tumor subtype, patient age, and the number of abnormal nodes in their decision to offer SLND then those that offer SLND routinely.

The primary limitations to this study are related to sampling. Only ASBrS members were invited to complete this survey. Given membership in this breast-specific organization, members are more likely to be familiar with breast cancer trials. Because it was a voluntary study with a 21% response rate, there is selection bias for the surgeons that chose to participate. It is likely that a survey of national practice patterns might show a different level of incorporation into practice. However, the surgical management of breast cancer patients is increasingly ascribed to surgeons with a breast focus, surgeons likely to be members of ASBrS. One publication based on the American Board of Surgery recertification data estimated that 90% of breast cancer surgery was performed by 25% of practicing surgeons.[25] As with any survey, answers had to be categorized and may not accurately assess nuances associated with practice decisions. Lastly, the goal of this survey was to assess practice patterns, but the scope does not allow for recommendations on the use of SLND or the optimal technique if performed.

In conclusion, the majority of surgeons responding to the survey report familiarity with the recently published trials evaluating the use of SLND for axillary staging in clinically node-positive breast cancer patients who receive neoadjuvant chemotherapy. These trials have resulted in practice changes, although many surgeons have chosen to incorporate the results in a selective manner. There remain concerns over the FNR and of the lack of oncologic outcome data which could present opportunity for future study.

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Appendix 1 – Survey sent to American Society of Breast Surgeons membership

1. Which best describes your clinical practice?

   Private practice general or oncologic surgeon who performs breast surgeries

   Private practice breast-only surgeon

   Academic general or oncologic surgeon who performs breast surgeries

   Academic breast-only surgeon

   I do not provide clinical care

2. How long have you been in clinical practice?

0 to 5 years

5 to 10 years

10 to 15 years

15 to 20 years

Greater than 20 years

3. Are you familiar with these recent multi-institutional trials evaluating the accuracy of sentinel lymph node biopsy in clinically node positive breast cancer patients who receive neoadjuvant therapy? Please check all trials with which you are familiar:

Yes, I am familiar with the ACOSOG Z1071 trial results

Yes, I am familiar with the SENTINA trial results

Yes, I am familiar with the SN FNAC trial results

No, I am not familiar with any of these trial result

4. The ACOSOG Z1071, SENTINA and SN FNAC trials all enrolled patients with clinically node positive breast cancer who received neoadjuvant chemotherapy then went on to SLND with planned completion ALND in order to determine the false negative rate of SLND. For patients who presented with clinical N1 (cN1) disease and had their SLN(s) examined by hematoxylin and eosin staining, the false negative rates in all of these studies was:

Less than 5%

5% – 9%

10%–15%

>15%

I am not familiar with these trial results

5. Before publication of these trial results, did you perform SLND on clinically node positive patients after neoadjuvant chemotherapy with the intent to omit axillary lymph node dissection (ALND) if no residual disease was identified in the SLN(s)?

Most of the time

In select patients

No, my standard practice was to perform ALND

6. What is your current practice in regards to surgical management of clinically node positive patients (cN1) who receive neoadjuvant chemotherapy?

In the majority of patients (>50%), I perform SLND with the intent of omitting ALND if no disease is identified in the SLN(s)

In a select group of patients (<50%), I perform SLND with the intent of omitting ALND if no residual disease is identified in the SLN(s)

My standard practice is to perform ALND in all patients (Skip to question 11)

7. The aim of the following question is to determine which clinicopathologic features impact your pre-operative decision in determining whether a patient is appropriate for SLND and consideration of omission of ALND if no metastases are seen in the SLN(s) after neoadjuvant therapy. Please check all variables that you consider when determining eligibility for SLND in these patients: (Please check all that apply)

Primary tumor size

Number of abnormal axillary lymph nodes seen on US performed at the time of diagnosis before initiation of neoadjuvant chemotherapy

Status of axillary lymph nodes seen on US performed preoperatively after completion of neoadjuvant chemotherapy

Tumor subtype (Hormone receptor positive, HER2 positive, triple negative)

Patient age

Planned postoperative radiation

I do not consider any of these variables in my decision

8. The following question is to understand technical aspects that you consider crucial to the accuracy of SLND in clinically node positive patients who receive neoadjuvant chemotherapy. I believe that the following components must be in place for SLND results to be accurate:

Dual tracer technique (i.e. blue dye and radioisotope)	Yes	No
Removal of ≥ 2 SLNs	Yes	No
Removal of ≥ 3 SLNs	Yes	No
The biopsied node has a clip placed at the time of diagnosis and removal of the clipped node at surgery is confirmed	Yes	No
Immunohistochemistry is performed to confirm no residual metastasis	Yes	No
Preoperative ultrasonography following neoadjuvant chemotherapy showing normalization of nodes	Yes	No

9. Do you routinely have a clip placed in axillary nodes with biopsy-proven metastases? (If your answer is *no*, please skip to question #11.) Yes No

10. If a clip is placed in the biopsied node, how is this clipped node handled intra-operatively?

We place clips but do not assess for their removal at surgery

I do not selectively remove the clipped node, but I perform an x-ray of the nodes to confirm clip removal

I localize clipped nodes with wire/needle localization

I localize clipped nodes with I^{125} seeds

I localize clipped nodes with a method other than wire or seed localization

We do not place clips in nodes

11. 11. If you do not rely on SLND to stage clinically node positive patients after neoadjuvant chemotherapy, what has limited your use of this technique? (Please check all that apply)

I do not feel the reported false negative rates for SLND are low enough to accurately assess axillary nodes after neoadjuvant chemotherapy

I do not feel that we have adequate data regarding the long-term, oncologic outcomes when ALND is omitted in these patients

I feel that SLND may be appropriate in some patients, but my institution does not have the resources that I feel are essential to accuracy of the technique (such as clip placement in biopsied nodes, or inability to localize clipped nodes)

I feel that SLND may be appropriate in some patients, but medical oncologists in my institution do not feel this is appropriate

I feel that SLND may be appropriate in some patients, but radiation oncologists in my institution do not feel this is appropriate

I feel that SLND may be appropriate in some patients, but other surgeons in my practice do not feel this is appropriate

My institution is currently collecting internal data to determine the FNR of SLND in our institution

I use SLND in this population with omission of ALND when no metastases are identified

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Synopsis

Trials have evaluated the accuracy of SLND in clinically node-positive patients after chemotherapy. This survey of American Society of Breast Surgeons members reports that 45% (285/636) offered SLND before the trials compared to 85% (543/638) after the trials.

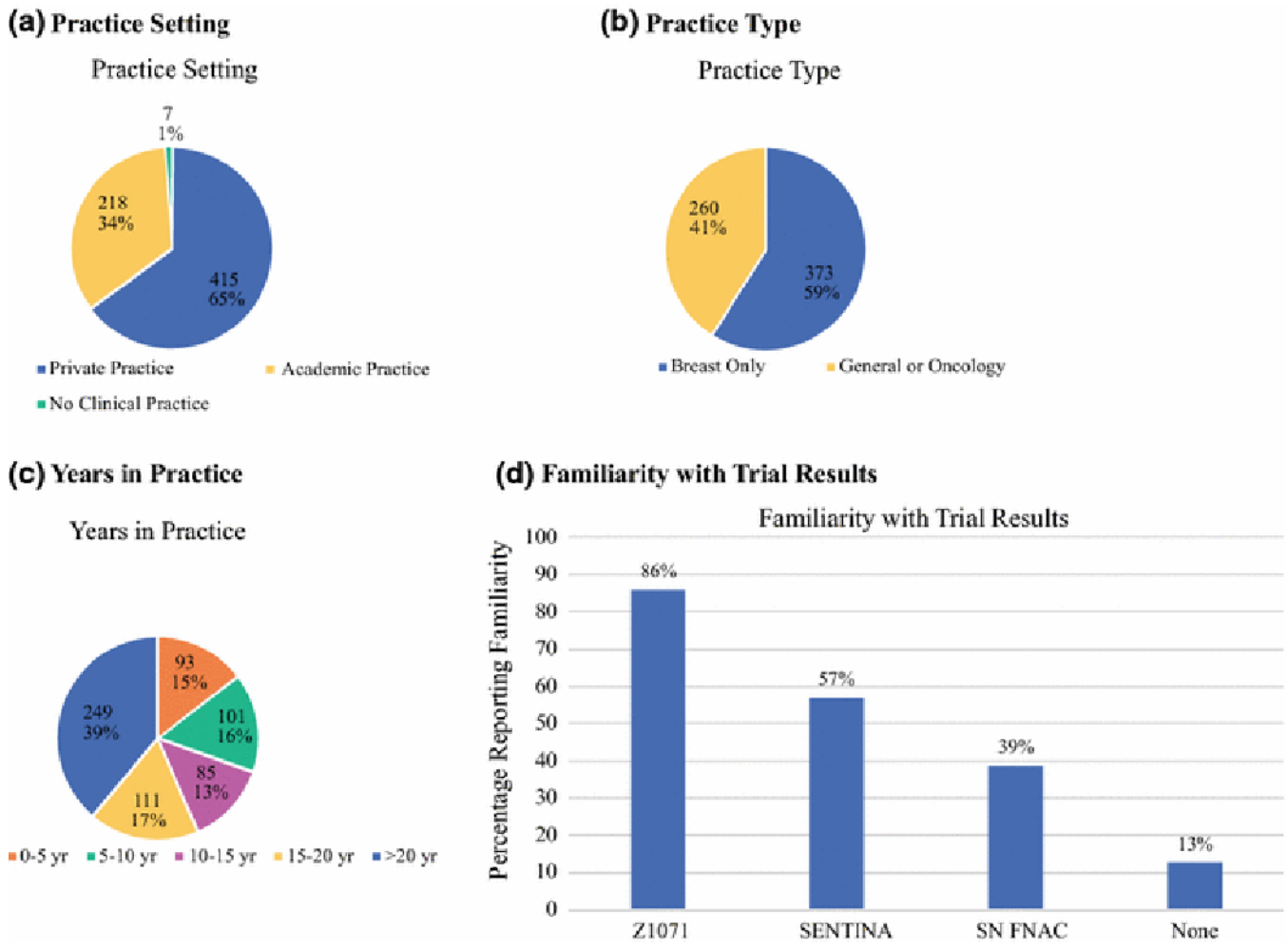

Figure 1.

Characteristics of Survey Respondents

(a) Practice Setting

(b) Practice Type

(c) Years ibn Practice

(d) Practice Type

(e) Familiarity with Trial Results

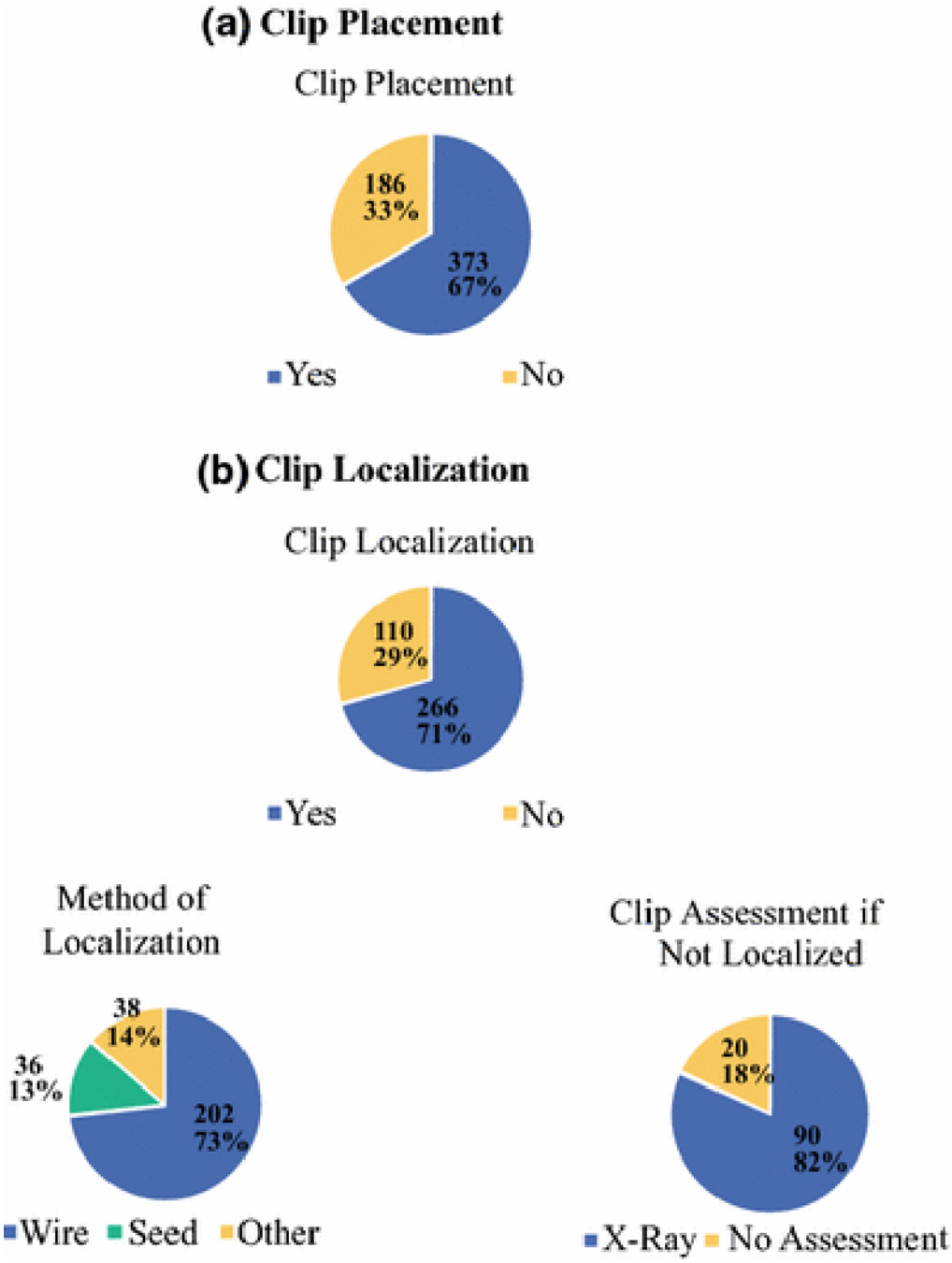

Figure 2.
Use of Clips in Biopsied Lymph Nodes
(a) Clip Placement
(b) Clip Localization

Table 1

Survey results in all respondents

Total Respondents	**N=642**		
The FNR of SLND is:	638 Responses		
<5%	42 (7%)		
5–9%	155 (24%)		
10–15%	336 (53%)		
>15%	25 (4%)		
Not familiar with the trial results	80 (13%)		
Use of SLND alone before publication of trials:	636 Responses		
Most of the time	110 (17%)		
In select patients	175 (28%)		
No	351 (55%)		
Currently offer SLND with possible omission of ALND:	638 Responses		
In the majority (>50%)	342 (54%)		
In select patients (<50%)	201 (32%)		
Perform ALND in all patients	95 (15%)		
Features considered in determining if eligible for SLND:	560 Responses		
Tumor size	116 (21%)		
Number of abnormal axillary nodes on ultrasound at diagnosis	349 (62%)		
Status of nodes on ultrasound after completing chemotherapy	346 (62%)		
Tumor subtype	200 (36%)		
Patient age	235 (42%)		
Planned postoperative radiation	354 (63%)		
Do not consider any of these	43 (8%)		
Technical aspects considered critical for SLND:	Yes	No	No Response
Dual tracer	481 (86%)	77 (14%)	84
Removal of ≥ 2 SLN	332 (70%)	139 (30%)	171
Removal of ≥3 SLN	292 (61%)	184 (39%)	166
Placing clip to mark biopsied node and ensured removal	435 (82%)	97 (18%)	110
Immunohistochemistry	247 (50%)	247 (50%)	148
Normalization of nodes on ultrasound	247 (49%)	258 (51%)	137
Routinely place clips to mark biopsied nodes:	559 Responses		
Yes	373 (67%)		
No	186 (33%)		
Intra-operative handling when clips are placed:	386 Responses		
Wire localization	202 (52%)		
Seed localization	36 (9%)		
Other localization technique	38 (10%)		

Total Respondents	**N=642**
X-ray to confirm removal but no localization	90 (23%)
No assessment for clipped node	20 (5%)
Reasons SLND is not used:	212 Responses
Concerns about false negative rate	44 (21%)
Lack of oncologic outcome data	112 (53%)
Do not have the institutional resources required	64 (30%)
Resistance from medical oncologists	56 (26%)
Resistance from radiation oncologists	50 (24%)
Resistance from other surgeons	32 (15%)
Institution is collecting data	15 (7%)

Table 2

Surgeons who reported knowledge of at least one trial characterized by their current practice

	Offer SLND in >50% of Patients N=310	Offer SLND in <50% of Patients N=175	Still Do ALND N= 70	P Value
Respondents familiar with:				
Z1071	306 (99%)	174 (99%)	69 (99%)	0.7
SENTINA	207 (67%)	108 (62%)	50 (71%)	0.3
SN FNAC	148 (48%)	74 (42%)	31 (44%)	0.5
The FNR of SLND is:	309 Responses	175 Responses	69 Responses	
<5%	28 (9%)	7 (4%)	1 (1%)	**0.03**
5–9%	91 (29%)	43 (25%)	13 (19%)	
10–15%	171 (55%)	107 (61%)	48 (70%)	
>15%	9 (3%)	11 (6%)	5 (7%)	
Not familiar with this data	10 (3%)	7 (4%)	2 (3%)	
Use of SLND alone before trials:	308 Responses	174 Responses	70 Responses	
Most of the time	75 (24%)	9 (5%)	0	<**0.000**
In select patients	85 (28%)	67 (39%)	1 (1%)	**1**
No	148 (48%)	98 (56%)	69 (99%)	
Features considered in determining if eligible for SLND:	310 Responses	175 Responses	10 Responses	
Tumor size	54 (17%)	46 (26%)	2 (20%)	0.07
Number of abnormal nodes on US	165 (53%)	139 (79%)	7 (70%)	<**0.0001**
Ultrasound after completing NAC	197 (64%)	114 (65%)	4 (40%)	0.3
Tumor subtype	90 (29%)	83 (47%)	2 (20%)	**0.0001**
Patient age	105 (34%)	97 (55%)	4 (40%)	**<0.0001**
Plans for adjuvant radiation	184 (59%)	123 (70%)	6 (60%)	0.06
Do not consider any of these	31 (10%)	3 (2%)	2 (20%)	**0.001**
Technical aspects considered critical:	310 Responses	175 Responses	11 Responses	
Dual tracer	367/307 (87%)	156/174 (90%)	8/11 (73%)	0.2
Removal of ≥2 SLNs	186/257 (72%)	103/147 (70%)	5/9 (56%)	0.5
Removal of ≥3 SLNs	166/265 (63%)	97/147 (66%)	7/11 (64%)	0.8
Placing clip and ensuring removal	244/296 (82%)	139/165 (84%)	10/11 (91%)	0.7
Immunohistochemistry	126/268 (47%)	85/157 (54%)	8/10 (80%)	0.06
Normalization of nodes on ultrasound	135/279 (48%)	90/159 (57%)	3/11 (27%)	0.07
Reasons SLND is not used:	25 Responses	80 Responses	68 Responses	
Concerns about false negative rate	1 (4%)	10 (13%)	29 (43%)	**<0.001**
Lack of oncologic outcome data	8 (32%)	41 (51%)	44 (65%)	0.02
Do not have institutional resources	4 (16%)	24 (30%)	23 (34%)	0.2
Resistance from medical oncologists	8 (32%)	20 (25%)	12 (18%)	0.3
Resistance from radiation oncologists	9 (36%)	16 (20%)	17 (25%)	0.3

	Offer SLND in >50% of Patients N=310	Offer SLND in <50% of Patients N=175	Still Do ALND N= 70	P Value
Resistance from other surgeons	7 (28%)	15 (19%)	5 (7%)	**0.03**
Institution is collecting data	1 (4%)	9 (11%)	5 (7%)	0.5

Table 3

Analysis limited to surgeons who did not perform SLND before the trials and reported knowledge of the trials. This is a comparison of those that changed their practice to incorporate SLND after the trials to those that did not change their practice (and still routinely do ALND)

	Changed Practice to Use SLND N=246	Did Not Change Practice (Still do ALND) N=69	P Value
Familiar With Trials:			
Z1071	245 (100%)	68 (99%)	1.0
SENTINA	175 (71%)	49 (71%)	1.0
SN FNAC	120 (49%)	30 (44%)	0.4
The FNR of SLND is:	245 Responses	68 Responses	
<5%	11 (5%)	1 (2%)	0.3
5–9%	63 (26%)	13 (19%)	
10–15%	159 (65%)	47 (69%)	
>15%	8 (3%)	5 (7%)	
Not familiar with data	4 (2%)	2 (3%)	
Reasons SLND is not used:	59 Responses	67 Responses	
Concerns about false negative rate	8 (14%)	28 (42%)	**<0.001**
Lack of oncologic outcome data	29 (49%)	43 (64%)	0.1
Do not have institutional resources	14 (24%)	23 (34%)	0.2
Resistance from medical oncologists	12 (20%)	12 (18%)	0.7
Resistance from radiation oncologists	13 (22%)	17 (25%)	0.7
Resistance from other surgeons	11 (19%)	5 (8%)	0.1
Institution is collecting data	4 (7%)	4 (6%)	0.9