

Date: 23rd September-2026

THE IMPORTANCE OF SENTINEL LYMPH NODES BIOPSY IN EARLY-
STAGE OF BREAST CANCER

Yusupbekov A.A.¹

Almurodova D.M.²

Malikova L.N.³

Ikromova G.N.⁴

¹Prof.MD head of department of oncology, oncohematology and Radiation oncology.
Tashkent State Medical University, Tashkent, Uzbekistan.

0000-0002-7747-0989

²PhD.Associate professor of department of oncology, oncohematology and Radiation
oncology.

Tashkent State Medical University, Tashkent, Uzbekistan.

dilbardoc@mail.ru 0009-0002-4147-9460

³Master of department of oncology, oncohematology and Radiation oncology.

Tashkent State Medical University, Tashkent, Uzbekistan.

malikovalaylo99@gmail.com 0009-0002-5678-1849

⁴Master of department of oncology, oncohematology and Radiation oncology.

Tashkent State Medical University, Tashkent, Uzbekistan.

guliikromova0720@gmail.com 0009-0005-9988-2713

Abstract: Sentinel lymph node biopsy is a safe and reliable procedure for the initial staging of breast cancer. Over the past decade, growing evidence has supported its use, and it is now regarded as the standard of care for evaluating metastatic spread to the axillary lymph nodes. Axillary lymph node involvement is still an important predictor of recurrence and survival in breast cancer. Axillary staging was classically done by axillary lymph node dissection (ALND), but the introduction of sentinel lymph node biopsy (SLNB) has led to a progressive and continuing de-escalation in its use.

Keywords: Sentinel Lymph Node, Breast Cancer, Axillary lymph node dissection, Neoadjuvant chemotherapy, Node positive, Macrometastasis, Micrometastasis

Introduction: In women with early-stage breast cancer, the condition of the axillary lymph nodes remains one of the strongest predictors of prognosis. Sentinel lymph node biopsy (SLNB) is now widely accepted as the standard method for determining metastatic involvement in the lymphatic basin. The sentinel node is generally the first lymph node to receive drainage from a specific anatomical site and serves as the key immune barrier for that region.(1) Because of its relatively low false-negative rate of 5–10% and high sensitivity of 90–95% in identifying nodal metastases, SLNB has become a minimally invasive yet dependable technique. This approach has revolutionized the surgical treatment of early breast cancer. Nonetheless, research is still ongoing to define its role in challenging scenarios



Date: 23rdSeptember-2026

such as after neoadjuvant therapy, to gain insights into host–tumor immune interactions, and to refine detection using novel agents for more accurate identification of metastatic nodes.(2)

1. Definition of sentinel node and sentinel lymph node biopsy

The concept of lymphatic drainage mapping originated in the 1950s. By the 1970s, researchers observed that certain lymph nodes received drainage earlier than others and labeled these the ‘sentinel nodes.’ In 1992, Donald Morton first described lymphatic mapping for cutaneous melanoma using blue dye to identify the sentinel node. The following year, Krag and colleagues introduced the use of radiotracer injection with a gamma probe for sentinel node mapping in breast cancer. On a molecular level, sentinel node status is influenced by antigen-presenting cells and their capacity to capture macromolecular tracers. Today, sentinel lymph node biopsy (SLNB) has largely replaced axillary lymph node dissection (ALND) for staging clinically node-negative axillae, owing to its high accuracy, reduced invasiveness, and lower morbidity.(table 1)(2). Sentinel lymph node biopsy (SLNB) is a procedure in which the sentinel node is located, excised, and examined to assess the presence of tumor cells. In breast cancer patients at low risk of nodal involvement, SLNB accurately predicts axillary status in about 95% of cases, leaving an estimated 5% chance of incorrectly classifying axillary disease as node-negative [4]. Accordingly, lymphatic mapping with SLNB is regarded as an appropriate alternative to systematic ALND in patients with early-stage breast cancer who present with clinically negative axillary lymph nodes [5]. Outcomes in terms of overall survival (OS), disease-free survival (DFS), and regional disease control have been shown to be statistically comparable between SLNB and ALND [6]. However, ALND continues to represent the standard of care for patients with clinically positive axillary nodes undergoing primary surgical treatment [5]. SLNB is a procedure that is still evolving and lacks full standardisation. Ongoing debates continue regarding both the technique and its appropriate indications and contraindications [15]. Table 1 (Ref. [16–24]) provides a summary of the current indications and contraindications, with an additional column outlining those that were previously considered contraindications. It should be emphasised that there is no clinical evidence supporting the use of SLNB in patients with a history of plastic breast surgery or prior breast/axillary radiotherapy; this guidance is based solely on expert opinion.

Table 1. Current indications and contraindications for SLNB of the breast.

Indications	Contraindications	Other indications (Past contraindications)
Infiltrative carcinoma T1, T2 or T3, cN0 (clinically and echographically negative) [16]	Breast cancer with N1–N2	Multifocal or multicentric tumours [17]
Intraductal or in situ carcinoma if: - indication of mastectomy - high risk of infiltration (high histological grade or comedonecrosis; ≥ 3 cm; associated with a palpable or nodular lesion)	Inflammatory Carcinoma (T4d) [16]	Previous tumourectomy Previous plastic mammary surgery Previous breast or axilla radiotherapy Mammary recurrence after previous conservative surgery with SLNB [18] Before or after neoadjuvant treatment in cN0 patients [19–22] Pregnant, puerperal or lactating woman [23, 24] - Use of minimal possible dose, the same day of surgery - Vital colourants still contraindicated - Stop breastfeeding for 24 h T4b breast carcinoma in selected cases with focal changes

Date: 23rd September-2026

3. The SLNB technique in breast cancer

Several techniques are used to localize sentinel nodes (SNs) during surgery. Two of the most frequently applied methods are the use of vital dyes (such as Iso-sulfan Blue or Patent Blue) and radioactive colloids (typically technetium-labeled albumin). These approaches are not mutually exclusive and can be combined to enhance accuracy, depending on local availability as well as the experience and preferences of the surgical team [7]. When the blue dye technique is employed, 2–5 mL of dye is injected around the periphery of the tumor, taking care to avoid intratumoral injection or deposition into a seroma cavity following breast biopsy, as both may result in mapping failure (1-pic.). [8]. The interval between injection and axillary incision typically ranges from 3 to 8 minutes, depending on the patient's body habitus and tumor location. Gentle breast massage is often carried out at the injection site until the incision is made, with the aim of facilitating dye migration to the sentinel nodes (2-pic). [9]. The axillary fascia is approached via an inferior axillary incision, and all lymph nodes visibly stained blue, as well as those at the termination of a blue lymphatic channel, are excised and labeled as sentinel nodes.(3-pic). Any suspicious palpable nodes are also removed. The most frequent technical errors include neglecting to excise the node located at the end of a blue lymphatic channel and failing to recognize the blue node closest to the tumor [8]. The success rate of lymphatic mapping is notably greater when radioactive colloid is used compared to blue dye alone [8]. This method offers key benefits, including creating an individualized anatomical map of lymphatic drainage, enabling detection of both axillary and extra-axillary sentinel nodes, and helping determine the most suitable site for surgical incision [7]. A sensitive hand-held gamma probe is used to detect the nodes, after which a small skin incision is made in the operating room over the presumed nodal region. The probe then directs the surgeon to the targeted lymphatic nodes [8].



1-picture: the process of injection; 2-picture: dye migration; 3-picture: recognizing the blue nodes.

4. Staging the axilla after a negative SLNB

Date: 23rd September-2026

In recent years, axillary surgery has been increasingly recognized as a staging and prognostic tool rather than solely a therapeutic procedure. The reduction in the extent of axillary surgery has been influenced by several factors, including the introduction of screening mammography, advances in adjuvant and systemic therapies, the use of radiotherapy, and the growing importance of biological markers [11, 12]. Axillary recurrence following SLNB is considered uncommon [13]. A systematic review by Van der Ploeg et al. [12] reported an axillary recurrence rate of only 0.3% in SLNB-negative patients, while other studies suggest this figure may rise to 1.5% after 5 years [5]. Importantly, both the ALMANAC [13] and NSABP B-32 [6] trials showed no statistically significant differences in overall survival (OS), disease-free survival (DFS), or regional control when comparing SLNB alone with ALND in patients with negative SLNB results. With a detection rate of 98% and a predictive accuracy of 97.5% for sentinel nodes, evidence strongly supports that ALND is unnecessary in patients without sentinel node involvement [15]. Currently, SLNB is the standard approach for axillary staging in clinically node-negative (cN0) breast cancer [1], as axillary recurrence after a negative SLNB is extremely rare (0.3%), adding ALND does not improve DFS or OS, and SLNB carries significantly lower morbidity compared to ALND [15,16].

**Table 2. Axillary local recurrence and relative survival in
SN micrometastases, macrometastases with or without
ALND. Patients: National Cancer Database (1998–2006).
Adapted from Bilimoria et al. [46].**

Surgery and micro/ macrometastasis	Axillary local recurrence (5 years)	Relative survival (5 years)
SN micrometastases		
SLNB	0.4%	99%
SLNB + ALND	0.2%	97.8%
SN macrometastases		
SLNB	1.0%	89.9%
SLNB + ALND	1.1%	89.1%

5. Overview of management after a positive SLNB

Axillary lymph node metastases remain one of the key prognostic indicators in breast cancer. For many years, ALND was the standard approach to evaluate axillary involvement, providing accurate information about the presence of clinically significant disease. However, while ALND can improve local disease control and reduce recurrence, complete removal of axillary nodes disrupts anatomy and often leads to complications such as interstitial fibrosis and lymphedema-conditions that significantly impair quality of life. SLNB was developed to maintain the prognostic value of axillary assessment while minimizing the morbidity associated with ALND. Validation studies of SLNB demonstrated a concordance rate of 97.5% between sentinel node status and overall axillary involvement, and 95% in cases where the axilla was disease-free. Traditionally, patients with a positive sentinel node (SN) would undergo ALND to further evaluate nodal involvement. However, more recent clinical trials have shown that ALND offers no survival advantage for patients with limited axillary

Date: 23rd September-2026



disease. It is important to note that in 30%–50% of SN-positive cases, the disease is confined to the sentinel node alone, with no additional nodal spread [1]. Furthermore, axillary recurrence is rare, occurring in fewer than 2% of cases across most studies. In a large retrospective analysis of 97,314 SN-positive patients, Bilimoria et al. [15] found that 23% with SN macrometastases (pN1) and 55% with SN micrometastases (pN1mi) did not undergo ALND, while 22% did. After adjusting for differences in pathology and adjuvant treatments among centers, outcomes showed no differences in axillary recurrence rates or 5-year relative survival between patients who had ALND and those who did not, for both pN1 and pN1mi disease (Table 2, Ref. [17]). About 38% of sentinel node–positive patients over the age of 50 are now spared from undergoing a full axillary dissection [7]. Furthermore, the 2014 American Society of Clinical Oncology (ASCO) guidelines advise against ALND in cases with one or two sentinel node metastases, provided the patient is receiving breast-conserving surgery (BCS) with whole-breast radiotherapy and, if indicated, systemic therapy [10].

Conclusions: In summary, SLNB is now regarded as the optimal technique for axillary staging in breast cancer, enabling treatment tailored to recurrence risk while offering strong evidence of lower morbidity compared with more extensive surgical approaches. The key points of current understanding can be outlined as follows:

1. Axillary lymph node metastases remain one of the most important prognostic indicators in breast cancer.
2. For patients with early-stage breast cancer and clinically negative axillary nodes, SLNB is the standard approach for axillary evaluation, with overall survival (OS), disease-free survival (DFS), and regional control outcomes comparable to those of ALND.
3. SLNB accurately reflects axillary status in 95% of cases, with a false-negative rate of approximately 5%.
4. Axillary recurrence following SLNB is uncommon, reported at 0.3% to 1.5% within 5 years.
5. ALND may be safely omitted in patients with early-stage breast cancer who present with micrometastases detected on SLNB.

REFERENCES:

- [1] Atalay C. New concepts in axillary management of breast cancer. *World J Clin Oncol.* 2014; 5: 895–900.
- [2] Benítez A, Cortés M, Bajén M, Gasén AR, Sabaté A. Ganglio centinela, ROLL y SNOLL en cáncer de mama. In: Soriano A, Martín J, García A, (eds). *Medicina nuclear en la práctica clínica* (pp. 571–584). 2nd ed. Grupo Aula Médica: Madrid; 2012.
- [3] Bilimoria KY, Bentrem DJ, Hansen NM, Bethke KP, Rademaker AW, Ko CY, et al. Comparison of sentinel lymph node biopsy alone and completion axillary lymph node dissection for node-positive breast cancer. *J Clin Oncol.* 2009; 27: 2946–2953.

Date: 23rd September-2026

[4] Cabanas RM. An approach for the treatment of penile carcinoma. *Cancer*. 1977; 39: 456–466.

[5] Harlow SP, Weaver DL. Sentinel lymph node in breast cancer: Techniques. 2016. Available at: UpToDate. (Accessed: 1 December 2016).

[6] Kell MR, Burke JP, Barry M, Morrow M. Outcome of axillary staging in early breast cancer: a meta-analysis. *Breast Cancer Res Treat*. 2010; 120: 441–447.

[7] Kim T, Giuliano AE, Lyman GH. Lymphatic mapping and sentinel lymph node biopsy in early-stage breast carcinoma: a meta-analysis. *Cancer*. 2006; 106: 4–16.

[8] Krag DN, Weaver DL, Alex JC, Fairbank JT. Surgical resection and radiolocalization of the sentinel lymph node in breast cancer using a gamma probe. *J Surg Oncol*. 1993; 62: 335–340.

[9] Krag DN, Anderson SJ, Julian TB, Brown AM, Harlow SP, Costantino JP, et al. Sentinel-lymph-node resection compared with conventional axillary-lymph-node dissection in clinically node-negative patients with breast cancer: overall survival findings from the NSABP B-32 randomised phase 3 trial. *Lancet Oncol*. 2010; 11: 927–933.

[10] Lyman GH, Giuliano AE, Somerfield MR, Benson AB, Bodurka DC, Burstein HJ, et al. American Society of Clinical Oncology guideline recommendations for sentinel lymph node biopsy in early-stage breast cancer. *J Clin Oncol*. 2005; 23: 7703–7720.

[11] Lyman GH, Temin S, Edge SB, Newman LA, Turner RR, Weaver DL, et al. Sentinel lymph node biopsy for patients with early-stage breast cancer: American Society of Clinical Oncology Clinical Practice Guideline Update. *J Clin Oncol*. 2014; 32: 1365–1383.

[12] Magnoni F, Veronesi P. Sentinel node biopsy in conservative surgery for breast cancer: a changing role in clinical practice. *Minerva Chir*. 2020; 75: 386–391.

[13] Mansel RE, Fallowfield L, Kissin M, Goyal A, Newcombe RG, Dixon JM, et al. Randomized multicenter trial of sentinel node biopsy versus standard axillary treatment in operable breast cancer: the ALMANAC Trial. *J Natl Cancer Inst*. 2006; 98: 599–609.

[14] Naik AM, Fey J, Gemignani M, Heerdt A, Montgomery L, Petrek J, et al. The risk of axillary relapse after sentinel lymph node biopsy for breast cancer is comparable with that of axillary lymph node dissection. *Ann Surg*. 2004; 240: 462–471.

[15] Riogi B, Sripadam R, Barker D, Harris O, Innes H, Chagla L. Management of the axilla following neoadjuvant chemotherapy for breast cancer: a change in practice. *Surgeon*. 2021; 19: 1–7.

[16] Schwartz GF, Giuliano AE, Veronesi U. Proceedings of the consensus conference on the role of sentinel lymph node biopsy in carcinoma of the breast, April 19–22, 2001, Philadelphia, Pennsylvania. *Cancer*. 2002; 94: 2542–2551.

[17] Veronesi U, Paganelli G, Viale G, Luini A, Zurrida S, Galimberti V, et al. A randomized comparison of sentinel-node biopsy with routine axillary dissection in breast cancer. *N Engl J Med*. 2003; 349: 546–553.

