Original Article Open Access

Archives Of Breast Cancer

DOI: 10.32768/abc.1568209473-652

Effect of Intercostobrachial Nerve Preservation During Axillary Dissection in Breast Cancer Surgery: A Prospective Cohort Study

Afsal Muhammed*[a], Kurian Cherian[a]

[a]*Department of Medicine and Surgery, Kerala University of Health Sciences, Thrissur, Kerala, India*

ARTICLE INFO

Received:
11 June 2025
Revised:
27 September 2025
Accepted:
9 February 2026

Keywords:
intercostobrachial nerve, axillary lymph nodes, breast neoplasms, postoperative complications, sensation disorders, pain, prospective studies

ABSTRACT

Background: The intercostobrachial nerve (ICBN), originating from the lateral cutaneous branch of the second intercostal nerve, innervates the axilla, lateral chest, and medial arm. Injury to the ICBN during axillary lymph node dissection (ALND) is associated with postoperative sensory disturbances. ICBN preservation is not routinely performed but may reduce pain and sensory disturbances in the ipsilateral arm. The objective is to determine the differences in postoperative clinical outcomes—specifically pain, paresthesia, and anesthesia of the ipsilateral arm—between patients who underwent ICBN preservation and those who did not, and to analyze anatomical variations of the ICBN within the study population.

Methods: This prospective cohort study was conducted at the Breast and Sarcoma Unit of the Regional Cancer Centre, Thiruvananthapuram, India, from January 2021 to March 2022. Evaluations were conducted preoperatively and on designated postoperative days for patients in both the ICBN preservation and no-preservation groups.

Results: Among the 147 patients who underwent axillary dissection, 29 (20%) had the ICBN preserved. At 180 days postoperatively, 86.2% of the patients in the ICBN preservation group were asymptomatic compared with 54.4% in the ICBN sectioned group. Sensory disturbance or pain was reported in only 13.8% of the ICBN preservation group vs 45.6% in the ICBN sectioned group. The incidence of pain, paresthesia, and anesthesia of the ipsilateral arm was significantly lower with ICBN preservation.

Conclusion: ICBN preservation during axillary dissection may reduce postoperative sensory disturbances in the superior medial region of the arm.

INTRODUCTION

Breast cancer is the most commonly diagnosed cancer worldwide, with an estimated 2.3 million new cases and 685 000 deaths in 2020, representing a significant global health burden. Advances in surgical management have shifted treatment from radical mastectomy to more conservative approaches, such as breast-conserving surgery and sentinel lymph node biopsy, especially for early-stage, node-negative disease.[1] However, axillary lymph node dissection (ALND) remains essential for patients with advanced-stage or node-positive breast cancer to accurately assess disease extent and guide therapy.[2]

Despite its clinical value, ALND is associated with several complications, including seroma, lymphedema, shoulder dysfunction, and sensory disturbances. One key contributor to postoperative morbidity is injury to the intercostobrachial nerve (ICBN), which can result in chronic pain, paresthesia, and numbness in the axilla and upper arm (Figure 1).[3] Recent large studies and meta-analyses indicate that preserving the ICBN during ALND significantly reduces the incidence of sensory disturbances and postoperative pain, thereby improving patient quality of life.[4]

***Address for correspondence:**
Afsal Muhammed,
Department of Medicine and Surgery, Kerala University of Health Sciences, Thrissur, Kerala, India
Email: drafsaloncosurgeon@gmail.com

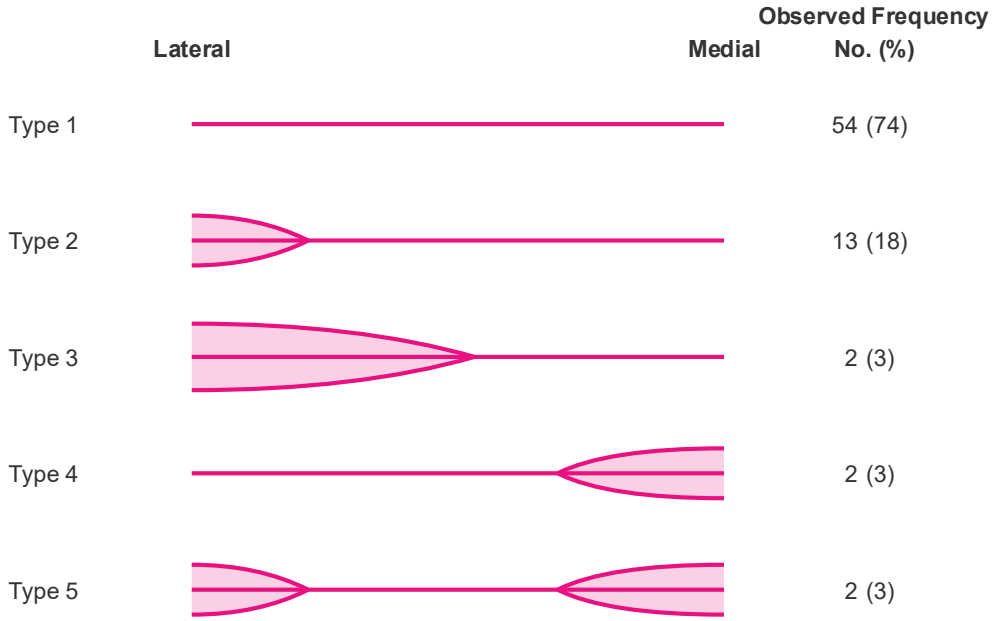

Figure 1. Various Types of Intercostobrachial Nerve[5]

Early breast cancer encompasses stages I and II, which are characterized by small tumors (T0–T2) with limited or no spread to the lymph nodes (N0–N1), as well as large operable breast cancers (T3N0). Locally advanced breast cancer (LABC) includes stage IIIA–C and refers to tumors that are larger and have spread to the regional lymph nodes, without distant metastasis. LABC includes a heterogeneous group of tumors, usually larger than 5 cm, involving the skin, along with regional nodal metastasis (axillary, supraclavicular, infraclavicular, and internal mammary nodes).[6] Inflammatory carcinoma is also included in this stage. Stage IV is classified as metastatic breast cancer. Early-stage breast cancer can be managed through the standard approach, which involves surgery followed by additional treatment. However, in certain cases of early breast cancer with aggressive characteristics, as well as in large operable breast cancers, neoadjuvant chemotherapy (NACT) may be preferred to enable breast conservation. NACT is also considered a standard treatment procedure for patients with LABC.[7]

Advancements in molecular biology have led to the molecular classification of breast cancer, aiding in decision-making for systemic therapy and prognosis. The 4 main molecular subtypes are luminal A, luminal B, *ERBB2* (formerly HER2) overexpression, and basal-like triple-negative breast cancer (TNBC).[8] The molecular subtypes of breast cancer provide valuable information for determining treatment options and predicting prognosis. Estrogen receptor (ER)/progesterone receptor (PR)–positive tumors are generally considered to have favorable biology, whereas *ERBB2*-positive and TNBC tumors are considered to have more aggressive biology. According to the Nottingham Modification of the Bloom-Richardson grading system (Figure 2), the histological grade of the tumor is determined by evaluating 3 key morphological features: tumor differentiation (extent of tubule formation), nuclear pleomorphism, and proliferative activity (mitotic count).[9]

NACT is the standard treatment for LABC.[10] It is used for the management of early-stage cancer and is also preferred for large operable cases where breast conservation is desired. It has the potential to eliminate micro metastatic disease effectively. Moreover, it aids in determining systemic therapy associated with the residual disease.[11] ALND has traditionally been recommended for patients with positive lymph nodes, particularly those with 3 or more involved nodes or larger tumors (T3).[6] However, recent studies such as ACOSOG Z0011 have shown that ALND may not be necessary in all cases of lymph node positivity. For selected patients undergoing breast-conserving surgery with limited nodal involvement treated with radiation therapy and systemic therapy, sentinel lymph node biopsy alone may suffice.[12] This shift reflects a growing emphasis on minimizing surgical morbidity without compromising oncological outcomes.

The objective of this study is to compare postoperative clinical outcomes, specifically pain, paresthesia, and anesthesia, in patients undergoing ALND with and without ICBN preservation and to document anatomical differences of the ICBN in the study population. The preservation of ICBN is not

standard practice during axillary dissection. We hypothesized that the incidence of pain, paresthesia, and anesthesia of the ipsilateral arm would be significantly lower with ICBN preservation. Because preservation of ICBN and its clinical outcomes have not been studied widely, the aim of the present research is to investigate ICBN preservation and postoperative clinical outcomes.

METHODS

Study design and participants

This was a prospective cohort study on the effect of ICBN preservation during axillary dissection in breast cancer surgeries. Patients diagnosed with breast carcinoma in the Department of Surgical Oncology at the Regional Cancer Centre, Thiruvananthapuram, India, constituted the study population.

Eligibility criteria

All patients diagnosed with carcinoma of the breast who underwent ALND as part of their surgical management during the study period were eligible for inclusion. Patients with recurrent breast cancer, prior axillary surgery, or preexisting neurological deficits in the ipsilateral upper limb were excluded. All eligible patients were consecutively enrolled and categorized into 2 groups based on whether the ICBN was preserved or sacrificed during ALND.

Sample size

The sample size was calculated based on assumed proportions of 0.60 in group 1 and 0.30 in group 2, derived from a previous study.[13] With a 1:4 allocation ratio, 80% power, and a 5% α error, the required sample size was determined to be 130 participants. This included 26 patients in the ICBN preservation group and 104 in the nonpreservation group.

Outcome measurement

All consenting patients who underwent axillary dissection were evaluated both preoperatively and postoperatively for sensory disturbances of the upper medial arm. Subjective evaluation involved questioning patients about symptoms of sensory disturbance, including pain, paresthesia, and anesthesia in the ipsilateral upper medial arm. Objective evaluation consisted of sensory testing, which included assessment of touch sensation using a cotton ball at 1 cm below the axillary hairline and pinprick sensation tested with a 10-g monofilament at the same site. Additionally, the area of sensory dullness was measured as the distance from the axillary hairline to the first point of decreased sensation (A) and from the axillary hairline to the olecranon process of the ulna (B), with the A/B ratio calculated to quantify sensory loss. These assessments were conducted on the preoperative day and on postoperative days 1, 18, 60, and 180.

Variable measurement

The primary outcome was the incidence and severity of postoperative sensory disturbances—including numbness, pain, and paresthesia—in the upper limb at 180 days postoperation. The main exposure variable was whether the ICBN was preserved or sacrificed during axillary dissection. Additional predictors included ICBN preservation status, nodal yield, anatomical variations of the ICBN, and surgery duration. Potential confounders considered were age, comorbidities, type and stage of breast cancer, and type of surgery performed (breast-conserving therapy vs mastectomy). Data sources for these variables included intraoperative records, pathology reports, and standardized clinical assessments.

Statistical analysis

Descriptive statistics, including means and standard deviations (SDs), were used to summarize the demographic and clinical characteristics of the study population. Analytical methods included the independent *t* test for comparing continuous variables between the ICBN preservation and nonpreservation groups, the χ^2 test for categorical variables, and analysis of variance (ANOVA) where applicable. A *P* value < 0.05 was considered statistically significant. All analyses were performed using SPSS software (IBM Corp).

RESULTS

A total of 147 patients were enrolled in the study.

Demographic analysis

Table 1 summarizes the baseline demographic and clinicopathological characteristics of the study participants. The majority of patients in both groups were aged 50 years or older, with a mean age of approximately 55 years. The distribution of nodal yield was similar between groups, with most patients having more than 10 lymph nodes retrieved. The percentages of patients undergoing breast-conserving surgery and mastectomy were comparable between the ICBN preserved and not preserved groups. Anatomical variation of the ICBN was predominantly medial in those where the nerve was preserved. The mean surgery time was longer in the ICBN preservation group, reflecting the additional dissection required; however, this difference did not reach statistical significance. Overall, the 2 groups were well matched in terms of baseline characteristics.

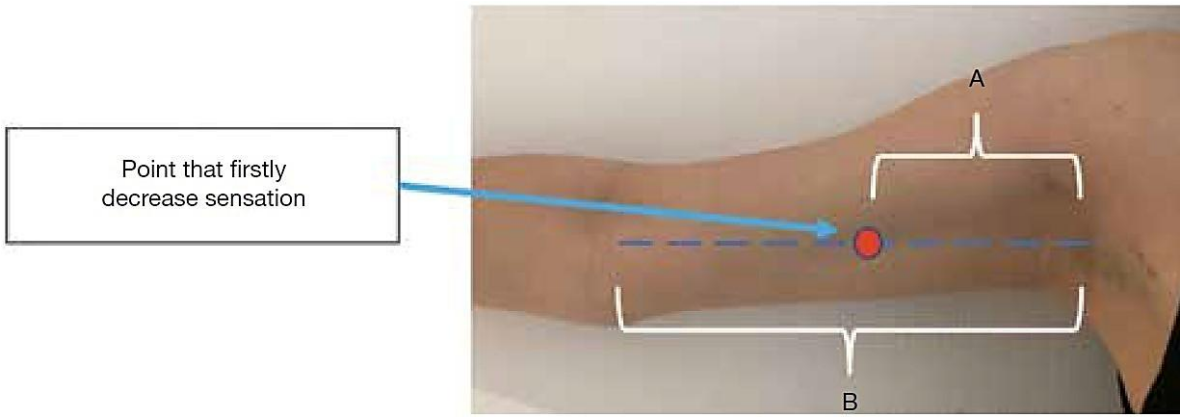

Figure 2. Measurement of A and B Values[14]

Table 1. Baseline Characteristics of Breast Cancer Patients Undergoing Axillary Dissection with (n = 29) or Without (n = 118) ICBN Preserved

Characteristic	ICBN Preserved (n = 29)	ICBN Not Preserved (n = 118)	Total (n = 147)
Age, y, mean (SD)	54.2 (8.6)	55.7 (9.1)	55.4 (9.0)
Age group, No. (%)			
<50 y	7 (24.1)	37 (31.4)	44 (29.9)
>50 y	22 (75.9)	81 (68.6)	103 (70.1)
Nodal yield, No. (%)			
<10 nodes	4 (13.8)	23 (19.5)	27 (18.4)
>10 nodes	25 (86.2)	95 (80.5)	120 (81.6)
Nodal yield, mean (SD)	12.7 (2.8)	13.1 (3.2)	13.0 (3.1)
Type of surgery, No. (%)			
Breast-conserving	13 (44.8)	54 (45.8)	67 (45.6)
Mastectomy	16 (55.2)	64 (54.2)	80 (54.4)
ICBN anatomical variation, No. (%)			
Medial	23 (79.3)	0	23 (15.6)
Lateral	6 (20.7)	0	6 (4.1)
Surgery time, min, mean (SD)	83.6 (11.7)	77.3 (12.9)	78.5 (12.7)

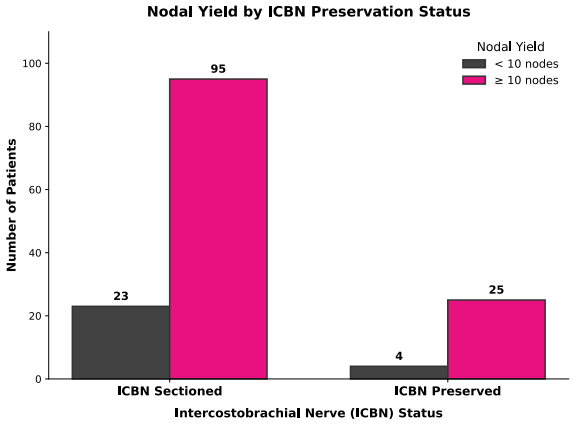

Figure 3. Nodal Yield Among the Groups

A significantly larger number of patients (118) experienced ICBN sectioning compared with 29 patients who had the nerve preserved.

Regarding nodal yield, among patients with the ICBN not preserved, 95 individuals had a nodal yield greater than 10, compared with 23 individuals with a yield below 10. In the group with the ICBN preserved, 25 yielded more than 10 nodes and 4 yielded fewer than 10 (Figure 3). This indicates a higher overall nodal yield in cases where the ICBN is not preserved.

Table 2. Comparison of Sensory Disturbance or Pain at 180 Days Postoperative Follow-up

Sensory disturbance or pain at 180 Days	ICBN not preserved (n = 114)	ICBN preserved (n = 29)	Total (n = 143)	*P* value[a]
No	62 (54.4%)	25 (86.2%)	87 (60.8%)	<0.001
Yes	52 (45.6%)	4 (13.8%)	56 (39.2%)	
Total	114 (100%)	29 (100%)	143 (100%)	

ICBN, intercostobrachial nerve.

[a]Calculated using the χ^2 test.

Table 2 presents the comparison of sensory disturbance or pain at 180 days postoperatively. A significantly higher proportion of patients in the ICBN preserved group were free of sensory disturbance or pain (86.2%) compared with the ICBN not preserved group (54.4%). Conversely, the

incidence of sensory disturbance or pain was markedly higher in the ICBN not preserved group (45.6%) than in the preserved group (13.8%) ($P < 0.001$).

Table 3 presents the comparison of sensory loss measurements (A value, B value, and A/B ratio) between the ICBN sectioned and ICBN preserved groups. Across all follow-up periods, the A value and A/B ratio were significantly higher in the ICBN sectioned group compared with the preserved group ($P < 0.001$), indicating a greater area and proportion of sensory loss when the nerve was sacrificed. In contrast, the B value, representing arm length, showed no significant difference between groups at any time point ($P > 0.05$).

Table 3. Comparison of A, B, and A/B Values Between Breast Cancer Patients With (n = 29) and Without (n = 114) ICBN Preservation During Axillary Dissection

Day of testing	Variable	ICBN cut, mean (SD)	ICBN preserved, mean (SD)	*P* value[a]
Postop Day 1	A value	6.576 (0.851)	0.621 (1.590)	<0.001
	B value	19.466 (1.231)	19.483 (1.184)	0.95
	A/B value	0.339 (0.049)	0.032 (0.081)	<0.001
Postop Day 18	A value	6.657 (0.919)	1.038 (1.969)	<0.001
	B value	19.482 (1.217)	19.500 (1.175)	0.95
	A/B value	0.343 (0.050)	0.052 (0.097)	<0.001
Postop Day 60	A value	6.700 (0.863)	0.962 (1.865)	<0.001
	B value	19.446 (1.199)	19.423 (1.137)	0.93
	A/B value	0.346 (0.050)	0.049 (0.096)	<0.001
Postop Day 180	A value	6.088 (0.739)	1.207 (2.059)	<0.001
	B value	19.442 (1.217)	19.483 (1.184)	0.87
	A/B value	0.314 (0.041)	0.061 (0.103)	<0.001

ICBN, intercostobrachial nerve; Postop, postoperative. [a]Calculated using *t* test.

Table 4 presents the analysis of surgery time. The mean surgery time for the ICBN preservation group was 83.6 (11.7) minutes, compared with 77.3 (12.9) minutes for the nonpreservation group, resulting in a mean difference of 6.3 minutes. This difference was not statistically significant ($P = 0.05$).

Table 4. Surgery time in breast cancer patients undergoing axillary dissection with (n = 29) or without (n = 118) ICBN preservation

ICBN preservation	No.	Mean	SD	*P* value
Yes	29	83.6	11.7	0.05
No	118	77.3	12.9	

ICBN, intercostobrachial nerve.

DISCUSSION

In a study reviewing 30 observational studies involving 19 813 patients,[15] it was concluded that ALND is related to a 21% high risk for persistent postsurgical pain (PPSP). There is evidence that the preservation of ICBN minimizes the incidence of PPSP associated with axillary clearance.

A single-center, small-scale randomized controlled study involving 309 patients[16] assessed the effect of ICBN preservation vs sacrifice during breast cancer surgery. The findings indicated that division of the ICBN was associated with a higher risk of postoperative sensory deficits. Additionally, nerve preservation was found to increase operative time by approximately 5 minutes. In a similar context, Taira et al[17] reported that preserving the ICBN significantly reduced the area of hypoesthesia over time when compared with nerve division, although it did not have a significant effect on health-related quality of life. Similarly, a meta-analysis by Warrier *et al.*[18] confirmed that ICBN preservation decreases sensory disturbances such as hypoesthesia and anesthesia, reinforcing its clinical relevance.

If the entirety of the observed effect of axillary dissection on PPSP is attributable to the lack of ICBN preservation, the potential absolute reduction in PPSP rates would be substantial. Additionally, nerve-sparing techniques do not require specialized equipment, suggesting that implementation on a larger scale would be highly feasible. In this study, preoperative sensory evaluations showed no significant differences between the 2 groups. However, on the first postoperative day, there was a significant difference observed in the objective sensory testing. Interestingly, when patients were asked about any sensory abnormalities in the ipsilateral upper arm as part of the subjective evaluation, they did not report any abnormalities. This lack of subjective perception could be attributed to postoperative pain, which may have masked or overshadowed any sensory changes that were present. While the subjective evaluation did not show any significant differences between the groups, there was a significant difference observed during objective evaluations using cotton wool and a 10-g monofilament.

These findings suggest that there may be subtle sensory changes in the preservation group that were

detectable through objective testing but were not subjectively perceived by the patients. The presence of postoperative pain might have influenced the patients' subjective experience and their ability to accurately report sensory abnormalities. During the postoperative period, specifically on day 18, a significant number of patients in the ICBN sacrificed group reported sensory abnormalities characterized by decreased sensation or anesthesia in the ipsilateral upper medial arm. This observation was consistent with the objective testing using cotton wool and a 10-g monofilament. Patients became more conscious of these sensory changes once the surgical pain subsided, allowing them to better perceive the paresthesia and anesthesia. In contrast, all patients in the ICBN preservation group had preserved sensory function as demonstrated by objective testing. These differences between the 2 groups were statistically significant. Supporting evidence from randomized clinical trials reinforces the feasibility of preserving ICBN without significantly extending surgical time or compromising lymph node clearance. Chirappapha et al[14] found that preservation improved physical function and reduced sensory disturbances without increasing surgical complexity. Salama *et al.*[19] also reported that ultrasonic dissection techniques facilitated ICBN preservation while ensuring effective lymphatic sealing. These findings suggest that nerve-sparing techniques are practical and beneficial.

A similar trend was observed on postoperative day 60, with some patients in the ICBN preservation group exhibiting a response to the 10-g monofilament but not to the cotton wool stimulus. This discrepancy was more pronounced on postoperative day 180, potentially due to the completion of adjuvant radiation therapy approximately 6 months after surgery. The effect of radiation therapy might have altered the fine touch sensation in the ipsilateral upper medial arm. However, the patients in the preservation group still had preserved pain sensation as indicated by the 10-g monofilament. Overall, the majority of patients who had ICBN preservation demonstrated preserved sensory function based on both subjective and objective evaluations, and these differences were statistically significant when compared with those who had their ICBN sectioned during surgery. These findings emphasize the benefits of ICBN preservation in maintaining postoperative sensory function. It is important to consider the potential long-term effects of adjuvant treatments such as radiation therapy on sensory outcomes and further investigate the clinical implications of these findings.

A study by Torresan *et al.*[13] aligns with these findings. This prospective, randomized, double-blind intervention was conducted at the State University of Campinas in Brazil from January 1999 to July 2000. A total of 85 patients were divided into 2 groups based on whether the ICBN was preserved. All surgeries were performed by the same surgeons using a consistent technique. Postoperative assessments were carried out at 2 days, 40 days, and 3 months.

In the arm, pain sensitivity was evaluated using a questionnaire for subjective evaluation as well as a neurological examination for objective evaluation. The present study found that preserving the ICBN was associated with a noteworthy reduction in pain sensitivity, as assessed both subjectively and objectively. The subjective evaluation after 3 months revealed that 61% of the patients in the ICBN preservation group were asymptomatic, compared with 28.6% in the nerve section group ($P < 0.01$). Similarly, in the objective evaluation, 53.7% of patients in the ICBN preservation group had a normal neurological examination, compared with only 16.7% in the nerve section group ($P < 0.01$). Additionally, a randomized clinical trial by Melhem *et al.*[20] showed that ICBN preservation significantly reduced paresthesia and chronic pain at 6 months postoperatively.

The study did not observe any significant difference in the total duration of surgery ($P = 0.76$) or the number of dissected nodes between the 2 groups ($P = 0.59$). This suggests that preserving the ICBN during the surgical procedure was feasible without affecting the surgical time or the extent of lymph node dissection. The present study showed that the group of patients who had the ICBN preserved had a higher proportion of asymptomatic individuals and a lower incidence of sensory disturbances or pain compared with the group where the ICBN was sectioned. These differences were statistically significant and were observed in all postoperative evaluations. The objective neurologic examination of the arm also revealed a similar pattern of sensitivity differences between the 2 groups.

Although preserving the ICBN extended surgical time slightly—by a mean of 6.3 minutes—this difference was not statistically significant. Anatomical evidence from existing studies,[21,22] involving a total of 1567 axillae, indicates that the ICBN is present in 98.4% of individuals and typically originates from fibers at the T2 spinal level (90.6%). The nerve exhibits 2 common branching patterns: a single trunk in 47.0% of cases and a bifurcating pattern in 42.2%. In cases with a bifurcating pattern, the division is usually unequal (63.4%). Although fewer in number, most preserved ICBNs were single nerves. Consistent with these findings, a meta-analysis by Al-Dardery et al[4] confirmed that the ICBN is present in 98.4% of individuals, typically

originates from T2 fibers, and most commonly follows either a single trunk or bifurcating pattern.

However, it should be noted that the present study has some limitations. This study is a prospective observational study without randomization, which may introduce bias. Additionally, the surgeries were performed by 3 different surgeons, which could have resulted in variations in nodal yield and surgical duration, although these differences were not statistically significant. Also, subjective evaluation might not capture all sensory losses, particularly in older patients who may not report them. Furthermore, the present study did not have long-term follow-up data to assess the safety aspects of ICBN preservation regarding disease-free survival and overall survival.

These limitations should be considered when interpreting the results. Further research, ideally through a randomized clinical trial, is warranted to validate these findings and provide more comprehensive insights into the benefits and safety of ICBN preservation during axillary lymphadenectomy.

CONCLUSION

This study demonstrates that ICBN preservation during axillary lymphadenectomy is a feasible approach that positively affects postoperative outcomes by reducing variations in arm pain sensitivity. Importantly, this nerve preservation technique did not affect the total duration of the surgery or the number of dissected nodes. These findings suggest that preserving the ICBN is a viable approach that can potentially improve patients' clinical outcomes.

ETHICAL CONSIDERATIONS

This study was conducted in accordance with ethical principles for research involving human subjects. Informed consent was obtained from all participants, who were assured of their right to withdraw at any time. This study was approved by the Institutional Ethics Committee, Regional Cancer Centre, Thiruvananthapuram. Participant anonymity and confidentiality were maintained. The study protocol was reviewed and approved by an independent ethics committee, and provisions for participant compensation in the event of injury were included. Written informed consent for the publication of the images and data included in this manuscript was obtained from the patient prior to the study.

DATA AVAILABILITY

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

CONFLICT OF INTERESTS

The author reports that there is no conflict of interest.

FUNDING

None.

ACKNOWLEDGMENTS

None.

AI DISCLOSURE

No artificial intelligence (AI) technologies were used in the conception, design, data acquisition, analysis, or interpretation of this study. AI-assisted tools were utilized solely for limited language refinement to enhance the clarity and readability of the manuscript. All content remains the responsibility of the authors.

REFERENCES

1. Mustonen L, Aho T, Harno H, Sipilä R, Meretoja T, Kalso E. What makes surgical nerve injury painful? A 4-year to 9-year follow-up of patients with intercostobrachial nerve resection in women treated for breast cancer. *Pain* 2019;160(1):246, doi: 10.1097/j.pain.0000000000001398.
2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: a cancer journal for clinicians* 2021;71(3):209-49, doi: 10.3322/caac.21660.
3. Temple WJ, Ketcham AS. Preservation of the intercostobrachial nerve during axillary dissection for breast cancer. *The American Journal of Surgery* 1985;150(5):585-8, doi: 10.1016/0002-9610(85)90442-8.
4. Al-Dardery NM, Khaity AM, Albakri KA, Abdelsattar AT, Benmelouka AY, Lee T, et al. Preservation versus dissection of the intercostobrachial nerve for breast cancer surgeries: a systematic review and meta-analysis. *Ann Med Surg (Lond)* 2024;86(2):1003-11, doi: 10.1097/ms9.0000000000001622.
5. Khan A, Chakravorty A, Gui G. In vivo study of the surgical anatomy of the axilla. J*ournal of British Surgery* 2012;99(6):871-7, doi: 10.1002/bjs.8737.
6. Fowble B, Solin LJ, Schultz DJ, Goodman RL. Frequency, sites of relapse, and outcome of regional node failures following conservative surgery and radiation for early breast cancer. *International Journal of Radiation Oncology* Biology* Physics*

1989;17(4):703-10, doi: 10.1016/0360-3016(89)90055-2.
7. Sun Y, Liao M, He L, Zhu C. Comparison of breast-conserving surgery with mastectomy in locally advanced breast cancer after good response to neoadjuvant chemotherapy: A PRISMA-compliant systematic review and meta-analysis. *Medicine* 2017;96(43), doi: 10.1097/MD.0000000000008367.
8. Yersal O, Barutca S. Biological subtypes of breast cancer: Prognostic and therapeutic implications. *World journal of clinical oncology* 2014;5(3):412, doi: 10.5306/wjco.v5.i3.412.
9. Chen AM, Meric-Bernstam F, Hunt KK, Thames HD, Oswald MJ, Outlaw ED, et al. Breast conservation after neoadjuvant chemotherapy: the MD Anderson cancer center experience. *Journal of Clinical Oncology* 2004;22(12):2303-12, doi: 10.1200/JCO.2004.09.062.
10. Bansal C, Singh U, Misra S, Sharma KL, Tiwari V, Srivastava A. Comparative evaluation of the modified Scarff-Bloom-Richardson grading system on breast carcinoma aspirates and histopathology. *Cytojournal* 2012;9, doi: 10.4103/1742-6413.92550.
11. Asselain B, Barlow W, Bartlett J, Bergh J, Bergsten-Nordström E, Bliss J, et al. Long-term outcomes for neoadjuvant versus adjuvant chemotherapy in early breast cancer: meta-analysis of individual patient data from ten randomised trials. *The Lancet Oncology* 2018;19(1):27-39, doi: 10.1016/S1470-2045(17)30777-5.
12. Ung O, Tan M, Chua B, Barraclough B. Complete axillary dissection: a technique that still has relevance in contemporary management of breast cancer. *ANZ journal of surgery* 2006;76(6):518-21, doi: 10.1111/j.1445-2197.2006.03765.x.
13. Torresan RZ, Cabello C, Conde DM, Brenelli HB. Impact of the preservation of the intercostobrachial nerve in axillary lymphadenectomy due to breast cancer. *The breast journal* 2003;9(5):389-92, doi: 10.1046/j.1524-4741.2003.09505.x.
14. Chirappapha P, Arunnart M, Lertsithichai P, Supsamutchai C, Sukarayothin T, Leesombatpaiboon M. Evaluation the effect of preserving intercostobrachial nerve in axillary dissection for breast cancer patient. *Gland Surgery* 2019;8(6):599, doi: 10.21037/gs.2019.10.06.
15. Waltho D, Rockwell G. Post–breast surgery pain syndrome: establishing a consensus for the definition of post-mastectomy pain syndrome to provide a standardized clinical and research approach—a review of the literature and discussion. *Canadian journal of surgery* 2016;59(5):342, doi: 10.1503/cjs.000716.
16. Johannsen M, Farver I, Beck N, Zachariae R. The efficacy of psychosocial intervention for pain in breast cancer patients and survivors: a systematic review and meta-analysis. *Breast Cancer Research and Treatment* 2013;138:675-90, doi: 10.1007/s10549-013-2503-4.
17. Taira N, Shimozuma K, Ohsumi S, Kuroi K, Shiroiwa T, Watanabe T, et al. Impact of preservation of the intercostobrachial nerve during axillary dissection on sensory change and health-related quality of life 2 years after breast cancer surgery. *Breast Cancer* 2014;21:183-90, doi: 10.1007/s12282-012-0374-x.
18. Warrier S, Hwang S, Koh CE, Shepherd H, Mak C, Carmalt H, et al. Preservation or division of the intercostobrachial nerve in axillary dissection for breast cancer: meta-analysis of randomised controlled trials. *The Breast* 2014;23(4):310-6, doi: 10.1016/j.breast.2014.01.014.
19. Salama AM, Nawar AM, Zayed ME, Essa MS. Evaluation of ultrasonic axillary dissection in preservation of intercostobrachial nerve and lymphatic sealing in breast cancer patients: randomized controlled trial. *Annals of Medicine and Surgery* 2020;60:255-60, doi: 10.1016/j.amsu.2020.10.059.
20. Melhem J, Amarin M, Odeh G, Al-Bustami N, Al-Lauzy H, Ayoub R. Intercostobrachial nerve (ICBN) preservation versus sacrifice in axillary dissection: randomized controlled trial. *American Journal of Clinical Oncology* 2021;44(5):206-9, doi: 10.1097/COC.0000000000000809.
21. Lin PP, Allison DC, Wainstock J, Miller KD, Dooley WC, Friedman N, et al. Impact of axillary lymph node dissection on the therapy of breast cancer patients. *Journal of clinical oncology* 1993;11(8):1536-44, doi: 10.1200/JCO.1993.11.8.1562.
22. Hladiuk M, Huchcroft S, Temple W, Schnurr BE. Arm function after axillary dissection for breast cancer: a pilot study to provide parameter estimates. *Journal of surgical oncology* 1992;50(1):47-52, doi: 10.1002/jso.2930500114.

How to Cite This Article

Muhammed A, Cherian K. Effect of Intercostobrachial Nerve Preservation During Axillary Dissection in Breast Cancer Surgery: A Prospective Cohort Study. Arch Breast Cancer. 2026; 13(2):136-43.
Available from: https://www.archbreastcancer.com/index.php/abc/article/view/1143