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Analysis of Long-term Prognosis and Cosmetic Outcomes of Breast-conserving Surgery Combined with Sentinel Lymph Node Biopsy for Early-stage Breast Cancer

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Abstract: *Objective*: To investigate the long-term prognosis and postoperative cosmetic outcomes of breast-conserving surgery combined with sentinel lymph node biopsy in patients with early-stage breast cancer, providing a reference for the selection of clinical treatment plans. *Methods*: A retrospective analysis was conducted on the clinical data of 68 patients with early-stage breast cancer admitted from January 2022 to December 2025. Based on the surgical approach, patients were divided into an observation group (breast-conserving surgery + sentinel lymph node biopsy) and a control group (other surgical methods such as modified radical mastectomy/total mastectomy). Clinical and pathological characteristics, incidence of postoperative complications, follow-up prognosis, and satisfaction with cosmetic outcomes were compared between the two groups. *Results:* Among the 68 patients, 41 were in the observation group and 27 in the control group. The average age of patients in the observation group was (54.32 ± 8.15) years, while that in the control group was (62.45 ± 9.76) years. The average tumor size in the observation group was (1.86 ± 0.72) cm, compared to (3.21 ± 1.45) cm in the control group. The incidence of postoperative complications in the observation group was 9.76%, significantly lower than that in the control group at 33.33% ($P < 0.05$). The 6-month disease-free survival rate was 95.12% in the observation group and 88.89% in the control group, with no statistically significant difference between the two groups ($P > 0.05$). The excellent and good rate of cosmetic outcomes in the observation group was 87.80%, significantly higher than that in the control group at 29.63% ($P < 0.05$). *Conclusion:* Breast-conserving surgery combined with sentinel lymph node biopsy for early-stage breast cancer can achieve long-term prognostic outcomes comparable to those of traditional radical surgery, with the advantages of fewer postoperative complications and superior cosmetic results. This approach is worthy of clinical promotion and application, particularly for early-stage breast cancer patients who have a demand for preserving breast morphology.

Keywords: Early-stage breast cancer; Breast-conserving surgery; Sentinel lymph node biopsy; Long-term prognosis; Cosmetic results

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1. Introduction

Breast cancer is the most prevalent malignant tumor among women worldwide, with its incidence showing an annual increase and a trend toward younger age groups, posing a severe threat to women's physical and mental health as well as their quality of life [1]. With the widespread adoption of breast imaging techniques and the advancement of early cancer screening efforts, an increasing number of breast cancer patients are being diagnosed at an early stage, providing favorable conditions for precise clinical treatment and improved prognosis. The core of treating early-stage breast cancer lies in maximizing the preservation of patients' physical function and appearance integrity while achieving radical tumor resection, thereby enhancing postoperative quality of life. This has become an important concept in modern breast surgery [2]. Traditional radical mastectomy focuses on the extensive resection of breast tissue, chest wall fascia, and axillary lymph nodes. Although it can achieve the goal of radical tumor resection, the procedure is highly invasive, with a high incidence of postoperative complications. Moreover, the loss of the breast can have a severe negative impact on patients' psychological well-being, reducing their postoperative quality of life [3].

In recent years, the rapid development of minimally invasive surgical techniques has driven a transformation in breast cancer treatment modalities. Breast-conserving surgery combined with sentinel lymph node biopsy has gradually replaced some traditional surgical approaches as a preferred option for early-stage breast cancer treatment, owing to its advantages of minimal trauma, rapid recovery, and superior cosmetic results [4]. As the first-stop lymph nodes in the tumor drainage area, the metastatic status of sentinel lymph nodes can accurately reflect the overall metastatic situation of axillary lymph nodes. Sentinel lymph node biopsy can avoid complications such as lymphedema and nerve injury caused by blind axillary lymph node dissection, while providing a reliable basis for the formulation of subsequent treatment plans [5]. Currently, more clinical data are still needed to support the efficacy and cosmetic outcomes of breast-conserving surgery combined with sentinel lymph node biopsy, especially regarding the applicability and long-term prognostic stability in patients with different clinical and pathological characteristics, and a unified consensus has not yet been reached. Based on this, this study retrospectively analyzed the clinical data of 68 patients with early-stage breast cancer, comparing postoperative complications, long-term prognosis, and cosmetic outcomes between breast-conserving surgery combined with sentinel lymph node biopsy and traditional surgical procedures, in order to provide a reference for the rational selection of clinical treatment plans.

2. Materials and methods

2.1. Clinical data

A retrospective inclusion of 68 patients with early-stage breast cancer admitted to our hospital from January 2022 to December 2025 was conducted. All patients were pathologically diagnosed with breast cancer, with TNM staging of 0-IIA, and met the indications for surgical treatment. Patients with severe heart, liver, or kidney diseases, coagulation disorders, distant metastases, or incomplete follow-up data were excluded. The patients were divided into an observation group and a control group based on the surgical approach. The observation group underwent breast-conserving surgery combined with sentinel lymph node biopsy using blue dye tracing, while the control group underwent traditional surgical procedures such as modified radical mastectomy, total mastectomy, or extended radical mastectomy. The data on gender, body mass index, and clinical and pathological characteristics of the two groups of patients are detailed in **Table 1**.

Table 1. Comparison of clinical data between two groups of patients

Clinical Indicator	Observation Group (n = 41)	Control Group (n = 27)	Test Statistic (χ^2/t)	*P*-value
Gender (n, % Female)	41 (100.00%)	26 (96.30%)	1.032	> 0.05
Age (years, mean ± SD)	54.32 ± 8.15	62.45 ± 9.76	3.985	< 0.05
BMI (kg/m², mean ± SD)	23.45 ± 3.12	24.16 ± 3.57	0.921	> 0.05
Tumor Size (cm, mean ± SD)	1.86 ± 0.72	3.21 ± 1.45	5.237	< 0.05
Pathology Type (n, %)				
Invasive Ductal Carcinoma	35 (85.37%)	22 (81.48%)		
In Situ Carcinoma with Focal Invasion	4 (9.76%)	3 (11.11%)	2.154	> 0.05
Other Types	2 (4.87%)	2 (7.41%)		
TNM Stage (n, %)				
Stage 0	5 (12.20%)	2 (7.41%)		
Stage I	26 (63.41%)	13 (48.15%)	3.842	> 0.05
Stage II-IIIA	10 (24.39%)	12 (44.44%)		
Sentinel Lymph Node Metastasis (n, %)	8 (19.51%)	15 (55.56%)	10.236	< 0.05
Immunohistochemistry ER Positive (n, %)	30 (73.17%)	18 (66.67%)	0.387	> 0.05

2.2. Surgical methods

2.2.1. Observation group

Breast-conserving surgery combined with sentinel lymph node biopsy under blue dye tracing was performed. Before surgery, the tumor location was identified using color Doppler ultrasound or magnetic resonance imaging. An arc-shaped incision was made 1–2 cm outside the tumor margin, and the skin, subcutaneous tissue, and mammary gland were incised layer by layer. The tumor and surrounding normal glandular tissue were completely resected, and rapid pathological examination confirmed negative surgical margins. Subsequently, methylene blue dye was injected subcutaneously around the areola or in the quadrant where the tumor was located. After massaging the breast for 10-15 minutes, a small incision was made in the axillary fold to locate the dye-stained lymphatic vessels and sentinel lymph nodes. All stained lymph nodes and suspicious lymph nodes were completely resected and sent for pathological examination. After surgery, the residual mammary cavity was sutured and repaired, a drainage tube was placed, and the incision was closed layer by layer.

2.2.2. Control group

Depending on the patient's condition, modified radical mastectomy, total mastectomy, or extended radical mastectomy was selected. Modified radical mastectomy involved resection of the affected breast, pectoralis major fascia, and axillary lymph nodes; total mastectomy involved complete resection of the affected breast, with or without sentinel lymph node biopsy; extended radical mastectomy involved resection of the pectoralis minor muscle and subclavian lymph nodes in addition to the procedures performed in modified radical mastectomy. After surgery, a drainage tube was routinely placed, and the incision was bandaged under pressure.

2.3. Observation indicators

(1) Clinical and pathological indicators: Record the age, body mass index, tumor size, pathological type,

TNM staging, sentinel lymph node metastasis status, and immunohistochemical results of patients in both groups.

(2) Postoperative complications: Follow-up records were kept on the occurrence of complications such as postoperative wound infection, subcutaneous fluid accumulation, numbness, edema, and limited mobility of the affected limb.

(3) Long-term prognosis: Patients were followed up for 6 months after surgery, and the disease-free survival rate, local recurrence rate, and distant metastasis rate were recorded.

(4) Cosmetic outcomes: The cosmetic outcome evaluation criteria for the breast were used, dividing results into three grades: excellent, acceptable, and poor. Excellent: Symmetrical breast shape, inconspicuous incision scar, no obvious deformity, and patient satisfaction; Acceptable: Basically symmetrical breast shape, relatively conspicuous incision scar, mild deformity, and acceptable to the patient; Poor: Severely asymmetrical breast shape, obvious deformity, conspicuous incision scar, and patient dissatisfaction. The excellent rate = (number of excellent cases/total number of cases) × 100%.

2.4. Statistical methods

Data analysis was performed using SPSS 26.0 statistical software. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$), and comparisons between groups were made using the t-test. Count data were expressed as the number of cases (percentage) [n (%)], and comparisons between groups were made using the χ^2 test. A P-value < 0.05 indicated a statistically significant difference.

3. Results

3.1. Comparison of the incidence of postoperative complications between the two groups

The incidence of postoperative complications in the observation group was significantly lower than that in the control group, with a statistically significant difference ($P < 0.05$). See **Table 2** for details.

Table 2. Comparison of the incidence of postoperative complications between the two groups [n (%)]

Complication Type	Observation Group (n = 41)	Control Group (n = 27)	Total Incidence (%)	χ^2	*P*-value
Limb Numbness	3 (7.32%)	6 (22.22%)			
Limb Edema	0 (0.00%)	2 (7.41%)			
Incision Scar/Pain	1 (2.44%)	1 (3.70%)			
Flap Necrosis	0 (0.00%)	1 (3.70%)			
Limited Mobility	0 (0.00%)	1 (3.70%)			
No Complications	37 (90.24%)	16 (59.26%)			
Overall Complication Rate	4 (9.76%)	9 (33.33%)	19.12	6.843	< 0.05

3.2. Comparison of long-term prognosis between the two groups

After a 6-month postoperative follow-up, the observation group had a disease-free survival rate of 95.12%, a local recurrence rate of 2.44%, and a distant metastasis rate of 2.44%. The control group had a disease-free survival rate of 88.89%, a local recurrence rate of 7.41%, and a distant metastasis rate of 3.70%. There were no statistically significant differences in disease-free survival rate, local recurrence rate, or distant metastasis rate between the two

groups ($P > 0.05$). See **Table 3** for details.

Table 3. Comparison of long-term prognosis between the two groups [n (%)]

Prognostic Indicator	Observation Group (n = 41)	Control Group (n = 27)	χ^2	*P*-value
Disease-Free Survival (n, %)	39 (95.12%)	24 (88.89%)	1.452	> 0.05
Local Recurrence (n, %)	1 (2.44%)	2 (7.41%)	0.987	> 0.05
Distant Metastasis (n, %)	1 (2.44%)	1 (3.70%)	0.154	> 0.05
Death (n, %)	1 (2.44%)	0 (0.00%)	0.763	> 0.05

3.3. Comparison of postoperative cosmetic outcomes between the two groups

The excellent and good rate of postoperative cosmetic outcomes in the observation group was significantly higher than that in the control group, with a statistically significant difference ($P < 0.05$). See **Table 4** for details.

Table 4. Comparison of postoperative cosmetic outcomes between the two groups [n (%)]

Cosmetic Outcome Grade	Observation Group (n = 41)	Control Group (n = 27)	Excellent/Good Rate (%)	χ^2	*P*-value
Excellent/Good	36 (87.80%)	8 (29.63%)			
Fair	4 (9.76%)	10 (37.04%)			
Poor	1 (2.44%)	9 (33.33%)			
Total	41 (100.00%)	27 (100.00%)	64.71	32.657	< 0.05

4. Discussion

The primary treatment for early-stage breast cancer is surgery. Although traditional radical mastectomy can effectively remove tumor tissue, it involves significant surgical trauma, resulting in breast loss, which severely affects patients' physical appearance and mental health, and also leads to a relatively high incidence of postoperative complications. With the advancement of medical technology and the increasing demand for quality of life among patients, breast-conserving surgery combined with sentinel lymph node biopsy has gradually emerged as a crucial treatment option for early-stage breast cancer. This surgical approach not only ensures therapeutic efficacy but also maximizes the preservation of breast morphology, thereby improving patients' postoperative quality of life.

In this study, the incidence of postoperative complications in the observation group was significantly lower than that in the control group, highlighting the minimally invasive advantages of breast-conserving surgery combined with sentinel lymph node biopsy. Traditional radical mastectomy involves extensive resection of breast tissue, chest wall fascia, and axillary lymph nodes, which not only disrupts the axillary lymphatic drainage system but may also damage the thoracodorsal nerve and long thoracic nerve, which innervate the upper extremities, leading to complications such as numbness, edema, and limited mobility in the affected limb. In contrast, breast-conserving surgery involves the resection of only the tumor and a small amount of surrounding normal tissue, while sentinel lymph node biopsy precisely identifies and removes the lymph nodes in the drainage area, avoiding blind axillary lymph node dissection and significantly reducing damage to the lymphatic circulation and surrounding nerves. This finding is consistent with the research conclusions of Yu Hao et al. [6], who reported that

patients undergoing breast-conserving surgery combined with sentinel lymph node biopsy experienced a more than 20% reduction in the incidence of postoperative complications compared to those undergoing traditional surgery, along with a shorter recovery time from complications.

In terms of long-term prognosis, there were no significant differences in the 6-month disease-free survival rate, local recurrence rate, or distant metastasis rate between the two groups, indicating that the tumor control efficacy of breast-conserving surgery combined with sentinel lymph node biopsy is not inferior to that of traditional radical mastectomy. The core support for this conclusion lies in the radical resection of the tumor through breast-conserving surgery—in this study, the observation group ensured negative surgical margins, with precise preoperative localization of the tumor extent using color Doppler ultrasound and magnetic resonance imaging. Postoperatively, standardized adjuvant therapies (chemotherapy, radiotherapy, endocrine therapy, etc.) were administered based on the patient's pathological characteristics, effectively controlling the risk of local recurrence. Meanwhile, the precise assessment of lymph node metastasis through sentinel lymph node biopsy provided a reliable basis for formulating subsequent treatment plans, avoiding overtreatment or undertreatment. It is important to note that although no prognostic differences were observed during the 6-month follow-up in this study, some research indicates that the 5-year and 10-year survival rates after breast-conserving surgery combined with standardized radiotherapy are comparable to those of traditional radical surgery [7]. Therefore, extending the follow-up period in future studies is necessary to further validate the long-term efficacy and stability of this surgical approach.

The significant aesthetic advantage is one of the core competitive strengths of breast-conserving surgery combined with sentinel lymph node biopsy. The breast, as a vital physical symbol for women, has its morphological integrity directly influencing patients' postoperative self-identity and mental health. The breast loss caused by traditional radical surgery often leads to psychological issues such as inferiority and anxiety in patients, even affecting family relationships and social activities. In contrast, breast-conserving surgery preserves the natural breast morphology to the greatest extent possible through techniques such as curved incision design and breast cavity repair, with concealed incision scars. Combined with postoperative rehabilitation care, it achieves a favorable cosmetic outcome. In this study, the excellent and good cosmetic outcome rate of 87.80% in the observation group not only reflects the standardization of surgical procedures but also underscores the improvement in patients' quality of life. Patients satisfied with their cosmetic outcomes exhibit more stable psychological states postoperatively and demonstrate higher rehabilitation compliance, forming a virtuous cycle that further enhances long-term prognosis.

From a clinical application perspective, the promotion of breast-conserving surgery combined with sentinel lymph node biopsy necessitates strict adherence to indications. In this study, patients in the observation group had smaller average tumor sizes, were younger, and exhibited lower rates of sentinel lymph node metastasis, suggesting that this procedure is more suitable for early-stage breast cancer patients with TNM stages 0-I, tumor diameters ≤3 cm, and no extensive lymph node metastasis, particularly in young patients with a desire to preserve breast morphology [8]. For patients with larger tumor volumes, multifocal lesions, positive surgical margins, or extensive lymph node metastasis, traditional radical or extended radical surgery should remain the priority to ensure complete tumor eradication [9]. Additionally, preoperative assessment of patients' immunohistochemical results is crucial; for patients positive for estrogen receptor (ER) and progesterone receptor (PR), postoperative endocrine therapy can further reduce recurrence risk, providing supplementary assurance for the safety of breast-conserving surgery [10].

The findings of this study indicate that patients in the observation group had a lower average age, smaller average tumor size, and lower rate of sentinel lymph node metastasis compared to the control group, which is closely related to the indications for breast-conserving surgery. This procedure is more suitable for young patients with smaller tumor volumes, earlier stages, and no obvious lymph node metastasis. In terms of postoperative complications, the overall incidence rate in the observation group was 9.76%, significantly lower than the 33.33% in the control group. This is primarily because breast-conserving surgery involves a small incision, eliminating the need for extensive resection of breast tissue and axillary lymph nodes, resulting in minimal damage to the axillary lymphatic drainage system and upper limb nerves, thereby reducing the occurrence of complications such as numbness, edema, and restricted mobility in the affected limb.

This study has certain limitations: Firstly, it is a retrospective study with a relatively limited sample size, which may introduce selection bias. Secondly, the follow-up period was short, lasting only six months, and the long-term prognostic effects still require further verification through extended follow-up. Thirdly, the evaluation of cosmetic outcomes was subjective, lacking objective quantitative indicators. Future research should involve large-sample, prospective studies incorporating objective cosmetic evaluation metrics to further explore the long-term efficacy and cosmetic outcomes of breast-conserving surgery combined with sentinel lymph node biopsy, providing more reliable evidence for clinical treatment.

5. Conclusion

In conclusion, breast-conserving surgery combined with sentinel lymph node biopsy for early-stage breast cancer offers advantages such as minimal trauma, fewer postoperative complications, and excellent cosmetic outcomes, with long-term prognosis comparable to that of traditional radical surgery, making it worthy of clinical promotion and application. In clinical practice, it is essential to strictly adhere to surgical indications, thoroughly evaluate the patient's condition before surgery, and strengthen postoperative follow-up and rehabilitation guidance to further enhance treatment outcomes and improve patients' quality of life.

Disclosure statement

The author declares no conflict of interest.

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