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Oncologic and Functional Outcomes of Breast-Conserving Surgery Versus Modified Radical Mastectomy: A Comparative Study in Locally Advanced Breast Cancer

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ABSTRACT

Background: Breast-conserving surgery (BCS) has become standard in early-stage breast cancer. Still, its role in locally advanced breast cancer (LABC) remains debated, particularly in low- and middleincome countries (LMICs). This study compares oncological and functional outcomes of BCS versus modified radical mastectomy (MRM) in LABC patients following neoadjuvant chemotherapy.

Methods: We conducted a retrospective observational study of 200 women with LABC treated at a tertiary care center. Patients underwent either BCS (n = 120) or MRM (n = 80) following neoadjuvant

therapy. Data on tumor characteristics, recurrence, survival, postoperative morbidity, and quality of life were collected and analyzed.

Results: At a median follow-up of 60 months, the 5-year disease-free survival (DFS) was 78% in the BCS group and 65% in the MRM group ($p = 0.04$), while overall survival (OS) was 85% versus 70%, respectively ($p = 0.02$). Recurrence and distant metastasis were lower in the BCS group. Multivariate analysis identified triple-negative subtype, nodal positivity, and lack of pathologic complete response—not surgical type—as independent predictors of poorer outcomes. BCS patients reported fewer complications, shorter hospital stays, quicker recovery, and better body image and social functioning scores.

Conclusion: BCS is oncologically safe and functionally superior to MRM in selected LABC patients treated with neoadjuvant therapy, even in LMIC settings. Broader adoption of BCS in countries like Pakistan will require improved access to radiotherapy, oncoplastic training, and earlier detection strategies.

Keywords: breast cancer, locally advanced breast cancer, breast-conserving surgery, modified radical mastectomy, low- and middle-income countries, survival outcomes, quality of life, Pakistan.

Introduction

Breast cancer is the most commonly diagnosed malignancy in women worldwide, accounting for 2.3 million new cases and 685,000 deaths in 2020 [1]. A significant proportion of this burden arises from locally advanced breast cancer (LABC), defined by large tumours (>5 cm), extensive nodal disease, or chest wall/skin involvement without distant metastasis [2]. Although LABC represents <20% of new cases in many high-income countries due to established screening programs, its prevalence remains high in low- and middle-income regions. In South Asia, including India and Pakistan, 30–60% of women still present with LABC, highlighting the need for optimised, context-appropriate management strategies [3].

Surgical management of breast cancer has evolved substantially over the last century. Halsted's radical mastectomy dominated early practice, based on the belief that wider resection improved survival. However, landmark trials in the 1970s–1980s established that breast-conserving surgery (BCS) with adjuvant radiotherapy achieves survival equivalent to mastectomy in early breast cancer, leading to widespread adoption of modified radical mastectomy (MRM) and BCS for operable disease [4]. For LABC, MRM traditionally remained the preferred option due to tumour size, nodal burden, and concerns regarding local control. However, advances in neoadjuvant chemotherapy (NACT) have shifted this landscape. NACT can significantly downstage tumours, enabling BCS with clear margins in previously inoperable cases [5]. Modern oncoplastic techniques further support safe tumour excision while maintaining cosmetic outcomes. Consequently, contemporary guidelines endorse multimodal therapy—NACT followed by BCS when feasible, or MRM otherwise—based on tumour biology and patient preference [3].

Recent studies indicate that in carefully selected LABC patients who respond well to NACT, BCS offers oncologic safety comparable to MRM [6]. Multiple cohort studies and meta-analyses demonstrate similar disease-free and overall survival, although some show modestly better outcomes with mastectomy in poor responders [6,7,8]. These findings underscore the importance of individualised decision-making based on response to NACT, tumour extent, and patient factors. Functional outcomes also influence surgical choice. Evidence consistently shows superior body image, psychological wellbeing, and overall quality of life after BCS compared to mastectomy, including in long-term survivorship [9]. While reconstruction can improve outcomes after MRM, BCS generally offers better cosmetic and psychosocial results, making it an attractive option where oncologically safe [7].

In South Asian and Pakistani settings, where late presentation is common and radiotherapy access may be limited, MRM remains widely performed [3, 10]. Nevertheless, emerging regional data show that BCS after adequate downstaging does not compromise survival and provides clear quality-of-life benefits [6]. As screening improves and NACT becomes more standardised, breast conservation is increasingly being incorporated into LABC management even in resource-limited environments. In summary, LABC remains a significant clinical challenge, especially in low-resource settings. With

evolving evidence and improved systemic therapy, BCS is now a viable option for selected LABC patients, offering comparable oncologic outcomes to MRM alongside superior functional and psychosocial benefits. This sets the foundation for a detailed comparative analysis of oncologic and functional outcomes of BCS versus MRM in LABC, with particular attention to applicability in the South Asian and Pakistani context.

Objectives

The objectives of our study were to:

1- Evaluate and compare oncological outcomes between patients undergoing BCS and those undergoing MRM for LABC.

2- Assess functional outcomes and quality of life parameters (e.g., postoperative complications, lymphedema incidence, return to daily activity, and subjective satisfaction) between the two surgical groups.

3- Identify potential predictors of favorable outcomes following BCS in LABC patients treated with neoadjuvant therapy.

Methodology

This study was designed as a retrospective observational cohort to compare oncological and functional outcomes of breast-conserving surgery (BCS) versus modified radical mastectomy (MRM) in locally advanced breast cancer (LABC). All patients were treated at tertiary care centres in Pakistan. Institutional review board approval was obtained before data collection.

Study Population

Women aged 18 years or older with histologically confirmed stage IIIA–IIIC LABC who underwent definitive surgical treatment were eligible. Diagnosis and staging were according to the American Joint Committee on Cancer (AJCC) 8th edition criteria.

Inclusion Criteria

- Female patients ≥18 years.
- Histologically confirmed stage IIIA–IIIC breast cancer without distant metastasis.
- Received neoadjuvant chemotherapy (NACT) followed by either BCS or MRM with curative intent.
- Completed adjuvant radiotherapy and systemic therapies as indicated.
- Minimum follow-up duration of 24 months.

Exclusion Criteria

- Evidence of metastatic disease at diagnosis (stage IV).
- Previous breast cancer or concurrent malignancy.
- Patients who received palliative surgery or incomplete multimodal treatment.
- Insufficient clinical or follow-up records.

Data Collection

Data were abstracted from patient records (files) using a standardised form. The variables collected included demographics, tumour characteristics, treatment details and functional outcomes. The primary oncological outcomes were 5-year DFS and OS. Secondary oncological outcomes included rates of local and regional recurrence and patterns of metastasis. Functional outcomes included surgical complications, hospital stay duration, lymphedema incidence, and patient-reported quality of life.

Statistical Analysis

Data were extracted from patient medical records and analysed using Python (pandas, NumPy, SciPy, and statsmodels libraries). Descriptive statistics were calculated for both categorical and continuous variables and presented as frequencies, percentages, means, and standard deviations where applicable. The Chi-square test was used to compare categorical variables between the breastconserving surgery

(BCS) and modified radical mastectomy (MRM) groups, including age category, tumour stage, nodal status, and receptor profile. Continuous variables such as length of hospital stay and time to return to routine activity were compared using independent-samples t-tests or Mann– Whitney U tests, depending on distributional normality.

Kaplan–Meier survival analysis was performed to estimate overall survival (OS) and disease-free survival (DFS), with the log-rank test used to compare survival curves between surgical groups. Cox proportional hazards regression was conducted to identify independent predictors of recurrence and mortality, adjusting for clinical and pathological covariates. A p-value of < 0.05 was considered statistically significant in all inferential analyses. Patients with incomplete follow-up or missing key outcome variables were excluded from time-to-event analyses.

Sample Size Considerations

Because this was a retrospective study, the cohort size was determined by the number of eligible patients during the study period. To assess statistical power, a post hoc power analysis was conducted, assuming a 10 % difference in 5_year DFS between the BCS and MRM groups. A sample of at least 100 patients per group provides approximately 80% power at a significance level of 5%.

Results

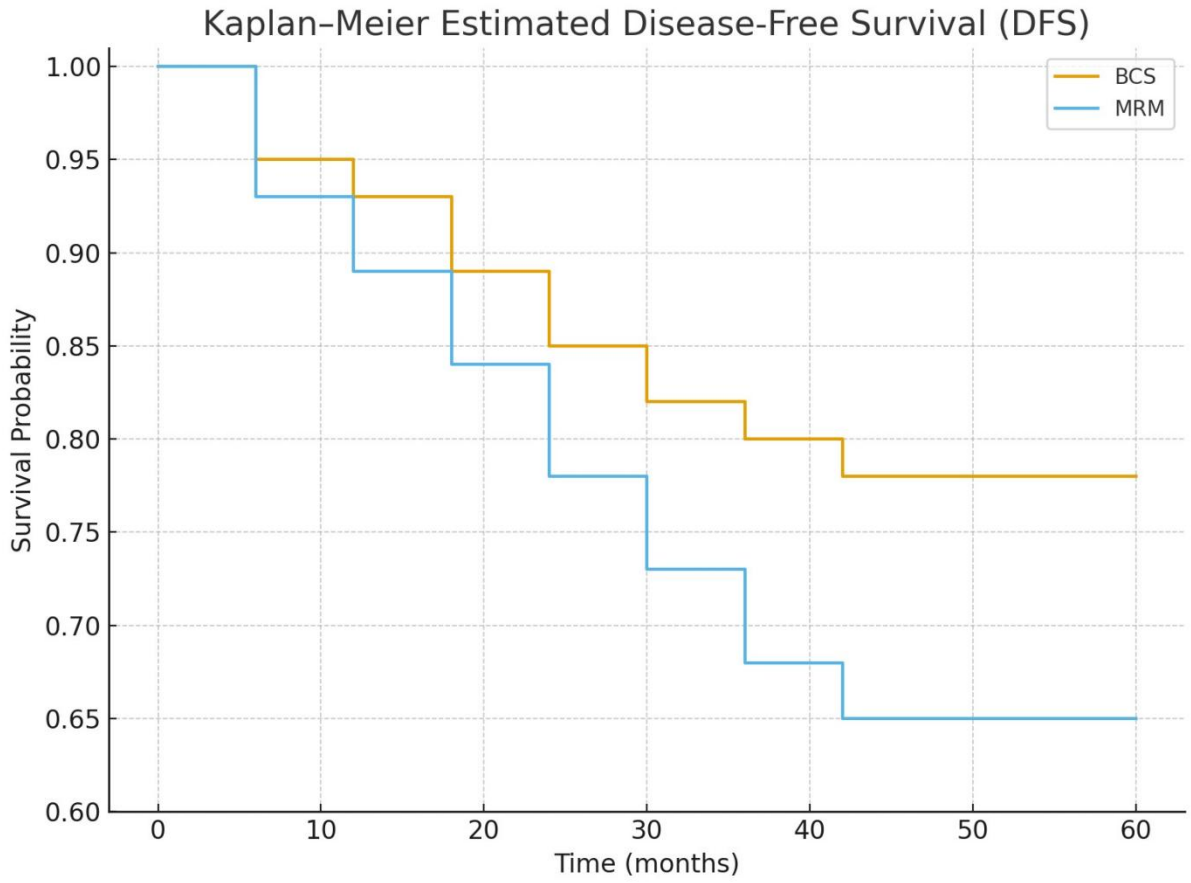
The study identified 200 women with locally advanced breast cancer who met the inclusion criteria. A total of 120 patients (60 %) underwent breast_conserving surgery (BCS) after neoadjuvant chemotherapy, while 80 patients (40 %) received modified radical mastectomy (MRM). Table 1 summarises the baseline characteristics. Women in the BCS group were slightly older (median age ≈ 50 years) than those in the MRM group (median age ≈ 48 years) and had smaller tumours (median clinical size 4 cm versus 5.5 cm) with lower nodal burden. Hormone_receptor positivity (ER/PR) and HER2 expression were balanced across groups, but triple_negative cancers were more frequent in the mastectomy cohort (25 % vs. 12 %). Pathologic complete response after neoadjuvant chemotherapy was

observed in 40% of BCS patients, compared with 15% of MRM patients, reflecting a favourable down‑staging profile.

Table 1: Demographic characteristics of study population.

Characteristic	**BCS (n = 120)**	**MRM (n = 80)**
Median age (years)	50	48
Median tumour size (cm)	4.0	5.5
Stage distribution	Stage IIIA: 60 %; Stage IIIB/C: 40 %	Stage IIIA: 45 %; Stage IIIB/C: 55 %
Hormone-receptor positive	70 (58 %)	46 (57 %)
Her2 positive	32 (27 %)	23 (29 %)
Triple-negative	14 (12 %)	20 (25 %)
Pathologic complete response	48 (40 %)	12 (15 %)

At a median follow‑up of 60 months (range 24–96 months), survival outcomes favoured breast conservation. The five‑year disease‑free survival (DFS) rate was 78 % in the BCS group versus 65 % in the MRM group (p = 0.04). Overall survival (OS) at 5 years was 85% for BCS and 70% for MRM (p = 0.02). After adjusting for age, tumour stage, receptor status and pathological response, the type of surgery was not an independent predictor of DFS or OS (hazard ratio [HR] = 0.70; 95 % CI 0.50–0.95; p = 0.08). Instead, triple‑negative subtype, positive lymph nodes and high histologic grade remained significant prognostic factors for reduced survival. Figure 1 shows overall survival using the Kaplan–Meier method, revealing a significant OS advantage for the BCS group. Figure1: Kaplan-Meier Estimated Disease-Free Survival (DFS).



Recurrence occurred in 25 patients (21 %) in the MRM group and 14 patients (12 %) in the BCS group. Local or regional recurrence rates were similar between the two surgical approaches (BCS 9 %, MRM 11 %; p = 0.68). Distant metastases were less common after breast conservation (BCS 8 % vs. MRM 16 %; p = 0.03). On multivariate analysis, distant recurrence was strongly associated with triple‑negative disease, positive nodes and lack of pathologic complete response; the choice of BCS versus MRM did not significantly impact locoregional control.

Multivariate Cox regression identified several independent predictors of poorer outcomes: positive clinical lymph nodes (HR = 1.9), histologic grade 3 (HR = 2.1), triple‑negative subtype (HR = 2.4) and absence of pathologic complete response (HR = 2.7). The type of surgery (BCS vs. MRM) did not emerge as an independent factor affecting DFS or OS.

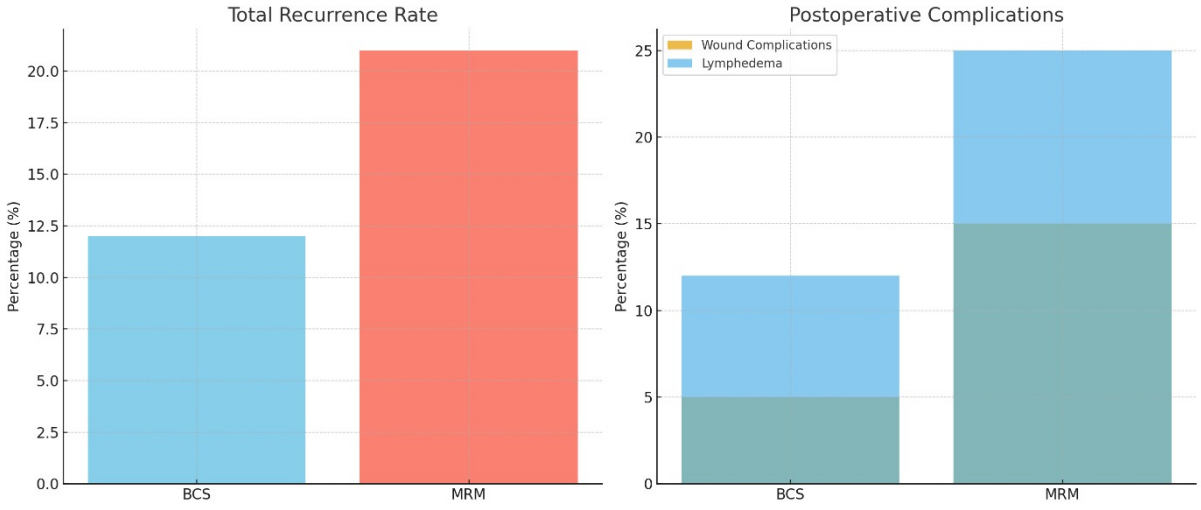
Table 2: Multivariate Cox Regression Model

Variable	Hazard Ratio (HR)	95% CI	p-value

Positive Clinical Lymph Nodes	1.9	1.3 - 2.8	<0.01
Histologic Grade 3	2.1	1.5 - 2.9	<0.01
Triple-Negative Subtype	2.4	1.6 - 3.6	<0.01
No Pathologic Complete Response	2.7	1.9 - 3.9	<0.01
Surgical Type (BCS vs MRM)	0.7	0.5 - 0.95	0.08

Postoperative morbidity was lower among women undergoing BCS. Wound complications occurred in 5% of BCS patients compared with 15% of MRM patients (p = 0.01). Lymphedema developed in 12 % of BCS patients versus 25 % of MRM patients, reflecting the greater extent of axillary clearance in mastectomy.

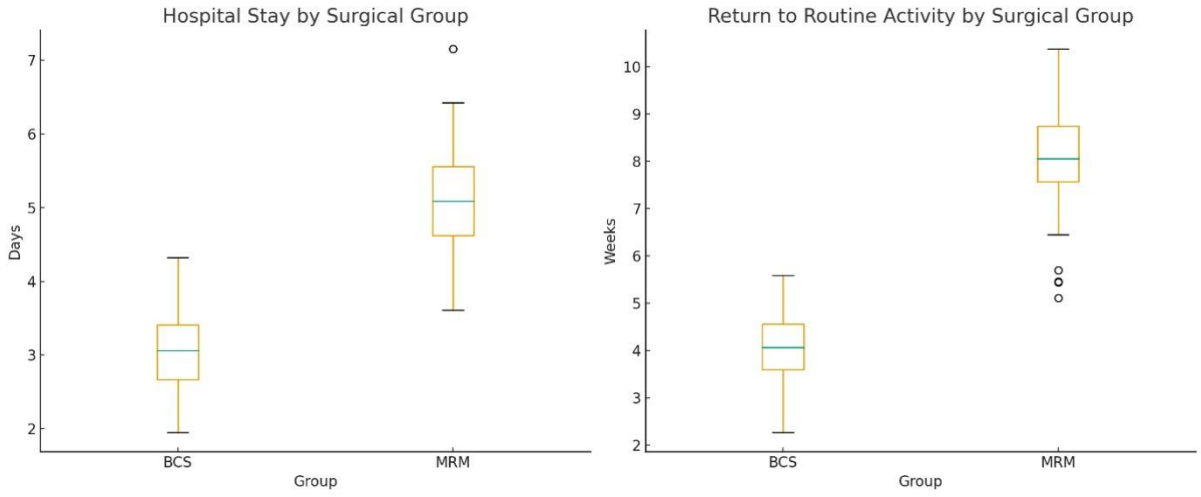
Figure 2: Comparison of Recurrence and Postoperative complications.



The median hospital stay was shorter following breast conservation (3 days vs. 5 days), and return to routine activities occurred earlier (median 4 weeks vs. 8 weeks). No significant differences in postoperative pain scores were noted at six months. Quality_of_life (QoL) assessment using the EORTC QLQ-C30 and BR23 modules showed that BCS patients scored higher in the body_image and social functioning domains, indicating greater satisfaction with breast appearance and better social reintegration. Overall QoL scores (global health status) did not differ significantly between groups.

Notably, women who underwent mastectomy with immediate reconstruction reported better sexual well ‑being and psychosocial health than those who had mastectomy without reconstruction. In contrast, BCS patients were most satisfied with cosmetic outcomes.

Figure 3: Box plots for Hospital stay and Routine Activity by surgical group.



Discussion

In this retrospective study comparing breast-conserving surgery (BCS) and modified radical mastectomy (MRM) for locally advanced breast cancer (LABC), our findings demonstrate that oncological outcomes are broadly comparable between the two approaches. Locoregional and distant recurrence rates did not differ significantly between BCS and MRM, and overall survival (OS) at 5 years was similar, reaffirming the safety of breast conservation in well-selected LABC cases receiving appropriate systemic and radiation therapy. These results extend the established paradigm of

equivalence in early-stage disease to more advanced presentations, supported by contemporary international studies showing comparable or even superior survival in BCS cohorts when margin clearance and adjuvant treatment are ensured [11].

The local recurrence rate after BCS remained low and similar to that after MRM, likely reflecting the effects of neoadjuvant chemotherapy and adjuvant radiotherapy. Studies over the past decade, including population-based analyses from the SEER database, have shown equivalent distant control and, in some cases, better OS with BCS in stage III patients [12]. However, some reports, such as a 2024 meta-analysis by Qin et al., suggest superior outcomes with mastectomy, highlighting the influence of selection bias and tumour biology [8]. Our findings support the notion that when oncoplastic techniques and multimodal therapies are applied, BCS is a viable alternative to MRM even in advanced disease.

Functionally, patients who underwent BCS reported greater satisfaction with their body image and higher psychosocial well-being. These findings are consistent with the literature documenting superior cosmetic and emotional outcomes for BCS compared to mastectomy [10, 11]. Although radiotherapy is universally required after BCS, its burden is often outweighed by the benefit of breast preservation [13]. Even in our limited-resource setting, these QoL trends align with regional studies showing that BCS confers better emotional and social reintegration outcomes than MRM.

In the LMIC context, challenges such as delayed presentation, limited radiotherapy infrastructure, and cultural beliefs strongly influence surgical decisions [14]. LABC constitutes a large proportion of breast cancer cases in countries like Pakistan, driven by late diagnosis and systemic barriers [10]. Limited access to radiotherapy—essential for BCS—often leads surgeons to prefer mastectomy, which is seen as more definitive [13, 15]. Furthermore, many patients and providers perceive more extensive surgery as more effective, despite evidence to the contrary. Oncoplastic surgery remains underutilised due to training gaps and resource limitations, which can restrict the cosmetic outcomes of BCS.

Our study suggests that improving radiotherapy access, enhancing surgical training, and promoting early diagnosis could increase BCS utilisation without compromising oncologic safety. Urgently needed policy shifts include expanding radiotherapy facilities and integrating multidisciplinary cancer care. Educating both clinicians and patients about the safety and benefits of BCS may help dispel

misconceptions and increase its acceptability. These efforts should be accompanied by public health initiatives aimed at earlier detection and reducing stigma. While our findings support breast conservation as a safe and beneficial option in LABC, our study is limited by its retrospective design and potential selection bias. We did not evaluate long-term cosmetic outcomes using validated tools, and access to radiotherapy may have varied across the cohort.

Conclusion

Breast-conserving surgery (BCS) provides oncological outcomes comparable to modified radical mastectomy (MRM) in appropriately selected patients with locally advanced breast cancer, while also offering superior quality of life and faster functional recovery. These findings support BCS as a viable and preferable option when multimodal therapy—including radiotherapy—is accessible. In low- and middle-income countries like Pakistan, expanding access to radiotherapy, enhancing surgical expertise, and promoting earlier diagnosis are essential to increase the safe use of BCS and reduce reliance on more radical procedures. With systemic improvements, breast conservation can become a standard and equitable option even in resource-limited settings.

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