International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Comparative Outcomes of Breast Conservation Surgery with Neoadjuvant Chemotherapy Vs Modified Radical Mastectomy in Early-Stage Breast Cancer: A Prospective Randomized Controlled Study

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Received: 27-05-2026
Accepted: 18-06-2026
Available online: 28-06-2026

ABSTRACT

Background: Early-stage breast cancer management has increasingly shifted toward breast-conserving approaches due to advances in systemic therapy and surgical techniques. Breast Conservation Surgery (BCS) following neoadjuvant chemotherapy (NACT) is emerging as an effective alternative to Modified Radical Mastectomy (MRM). The present study aimed to compare perioperative outcomes, postoperative complications, cosmetic results, functional recovery, pain, and quality of life between BCS following NACT and MRM in early-stage breast cancer patients.

Methods: This prospective randomized controlled study was conducted in the Department of General Surgery at MGM Medical College and M.Y. Hospital, Indore, over a period of 12 months. A total of 60 female patients aged 18–45 years with Stage 0, I, or II breast cancer were randomly allocated into two groups of 30 patients each. Group A underwent NACT followed by BCS, while Group B underwent MRM. Perioperative parameters, postoperative complications, cosmetic outcomes, pain scores, shoulder mobility, sensory preservation, and quality of life were evaluated using EORTC QLQ-C30 and QLQ-BR23 questionnaires.

Results: The baseline demographic and clinicopathological characteristics were comparable between groups. Mean operation time, incision length, intraoperative blood loss, and hospital stay were significantly lower in the BCS group ($p<0.001$). Overall postoperative complication rate was lower following BCS (10.0%) compared to MRM (46.7%). Excellent or good cosmetic outcomes were observed in 83.3% of BCS patients versus 13.3% in the MRM group. Patients undergoing BCS demonstrated significantly better emotional functioning, body image, social functioning, and global quality-of-life scores. Postoperative pain scores were significantly lower in the BCS group at all follow-up periods. Better shoulder mobility and sensory preservation were also observed following BCS.

Conclusion: Breast Conservation Surgery following neoadjuvant chemotherapy is a safe and effective treatment option for early-stage breast cancer. Compared to Modified Radical Mastectomy, BCS provides lower perioperative morbidity, fewer complications, superior cosmetic outcomes, improved functional recovery, reduced postoperative pain, and better quality of life.

Keywords: Breast Conservation Surgery; Modified Radical Mastectomy; Early-stage Breast Cancer; Neoadjuvant Chemotherapy; Quality of Life.

INTRODUCTION

Early-stage breast cancer represents a crucial phase in the disease spectrum where treatment decisions significantly influence long-term survival, recurrence, quality of life, cosmetic outcomes, and psychosocial well-being. Over recent decades, the management of breast cancer has evolved from radical surgical procedures toward more conservative and

patient-centered approaches due to advancements in imaging techniques, systemic therapies, surgical methods, and radiotherapy. Historically, mastectomy was considered the standard treatment for localized breast cancer until landmark randomized trials demonstrated that Breast Conservation Surgery (BCS) followed by radiotherapy achieved survival outcomes comparable to mastectomy, thereby changing treatment paradigms worldwide [1]. Long-term studies further confirmed that BCS with adjuvant radiotherapy provides excellent oncological safety and effective local disease control in selected early-stage patients [2].

Despite the increasing acceptance of breast conservation, the choice between BCS and Modified Radical Mastectomy (MRM) remains multifactorial and is influenced by tumor biology, breast size, cosmetic concerns, patient preference, socioeconomic status, and access to radiotherapy facilities. In developing countries such as India, delayed diagnosis, cultural perceptions, and limited access to multidisciplinary cancer care continue to contribute to the frequent use of MRM even in patients suitable for BCS [3]. Additionally, the psychological impact of breast cancer surgery has gained considerable importance, as body image, femininity, sexuality, and emotional well-being are strongly affected by the type of surgery performed. Studies have shown that patients undergoing BCS generally experience better cosmetic satisfaction, improved psychological adjustment, and superior quality of life compared to those undergoing mastectomy [4]. However, factors such as fear of recurrence, inadequate counseling, and aggressive tumor characteristics may still necessitate MRM in selected patients [5].

The introduction of neoadjuvant chemotherapy (NACT) has significantly improved the feasibility of breast conservation by reducing tumor size and increasing breast preservation rates. Evidence suggests that patients undergoing BCS following NACT achieve oncological outcomes comparable to mastectomy while maintaining better cosmetic and functional outcomes [6,7]. Furthermore, increasing awareness and improved systemic therapies have contributed to the growing adoption of BCS worldwide [8]. Although mastectomy remains associated with higher rates of wound complications, chronic pain, lymphoedema, and psychological distress, BCS generally demonstrates fewer severe complications and faster recovery [9,10]. Recent studies emphasize that postoperative assessment should include quality of life and patient satisfaction in addition to survival outcomes [11]. Therefore, the present study was undertaken to compare the outcomes of BCS with neoadjuvant chemotherapy versus Modified Radical Mastectomy in early-stage breast cancer patients.

MATERIAL AND METHODS

This prospective randomized controlled study was conducted in the Department of General Surgery at Mahatma Gandhi Memorial Medical College and M.Y. Hospital, Indore, Madhya Pradesh, India. The study aimed to compare the outcomes of Breast Conservation Surgery (BCS) following neoadjuvant chemotherapy (NACT) with Modified Radical Mastectomy (MRM) in patients diagnosed with early-stage breast cancer. The study duration was 12 months, including patient recruitment, intervention, and follow-up.

Female patients aged 18–45 years diagnosed with early-stage breast cancer (Stage 0, I, or II according to the AJCC TNM staging system) and considered suitable for surgical management were included in the study. Patients with metastatic disease, previous breast malignancy surgery, history of other malignancies within the past five years, or refusal to provide informed consent were excluded.

A total of 60 patients were enrolled using consecutive sampling. Sample size calculation was based on previously reported complication rates between BCS and MRM groups, with a confidence level of 95% and statistical power of 90%. Participants were randomly allocated into two equal groups using a sealed opaque envelope randomization technique to minimize allocation bias.

Study Groups

Group A consisted of 30 patients who underwent neoadjuvant chemotherapy followed by Breast Conservation Surgery. Group B included 30 patients who underwent Modified Radical Mastectomy.

Data Collection and Study Parameters

Baseline demographic and clinical details, including age, tumor characteristics, hormonal receptor status, and staging, were recorded using a structured proforma. Perioperative parameters assessed included operation time, incision length, intraoperative blood loss, and duration of hospital stay. Postoperative complications such as surgical site infection, seroma, hematoma, flap necrosis, lymphedema, and subcutaneous hemorrhage were evaluated during hospitalization and follow-up visits.

Quality of life was assessed at six months postoperatively using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC QLQ-C30) and Breast Cancer Module (EORTC QLQ-BR23). Pain assessment was performed using the Visual Analogue Scale (VAS), while cosmetic outcomes were evaluated using Harris's four-stage subjective scoring system.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using JAMOVI statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Independent t-test and Chi-square test were used for comparison between groups. A p-value <0.05 was considered statistically significant.

Ethical Considerations
Institutional Ethics Committee approval was obtained before study initiation. Written informed consent was obtained from all participants. Confidentiality of patient information was maintained throughout the study, and the study adhered to the ethical principles of the Declaration of Helsinki.

RESULTS

The present prospective randomized controlled study included 60 patients with early-stage breast cancer who were randomly allocated into two groups: Breast Conservation Surgery (BCS) with neoadjuvant chemotherapy and Modified Radical Mastectomy (MRM), with 30 patients in each group..

The baseline demographic and clinicopathological characteristics were comparable between the two groups. The mean age of patients in the BCS group was 34.17 ± 7.38 years, while the mean age in the MRM group was 34.37 ± 6.19 years, with no statistically significant difference between groups (p=0.910). Left-sided breast involvement was slightly more common in the BCS group (53.3%), whereas equal right- and left-sided involvement was observed in the MRM group. The upper outer quadrant was the most common site of tumor involvement in both groups. Painless breast lump was the predominant presenting complaint in both groups. Most tumors measured less than 5 cm, and the majority of patients were premenopausal. Stage IIA disease was the most frequently observed stage in both groups. Invasive ductal carcinoma was the predominant histological subtype observed in both groups, and Luminal A was the most common molecular subtype. Hormonal receptor status and molecular subtype distribution were comparable between study groups. [Tables 1, Table 2]

Table 1: Baseline Demographic and Clinical Characteristics of Study Subjects

Parameter	Category	BCS (n=30)	MRM (n=30)	p-value
Age (Years)	Mean ± SD	34.17 ± 7.38	34.37 ± 6.19	0.910
Affected Side	Right	12 (40.0%)	14 (46.7%)	0.919
	Left	16 (53.3%)	14 (46.7%)	
	Bilateral	2 (6.7%)	2 (6.7%)	
Quadrant Involvement	Upper Outer	14 (46.7%)	13 (43.3%)	1.000
	Upper Inner	6 (20.0%)	5 (16.7%)	
	Lower Outer	5 (16.7%)	5 (16.7%)	
	Lower Inner	3 (10.0%)	4 (13.3%)	
	Retroareolar	2 (6.7%)	3 (10.0%)	
Clinical Manifestation	Painless lump	22 (73.3%)	21 (70.0%)	0.881
	Painful lump	4 (13.3%)	5 (16.7%)	
	Nipple discharge	2 (6.7%)	3 (10.0%)	
	Skin changes	2 (6.7%)	1 (3.3%)	
Lump Size	<5 cm	14 (46.7%)	13 (43.3%)	0.981
	5–10 cm	12 (40.0%)	12 (40.0%)	
	10–15 cm	3 (10.0%)	4 (13.3%)	
	>15 cm	1 (3.3%)	1 (3.3%)	
Menopausal Status	Premenopausal	22 (73.3%)	20 (66.7%)	0.778
	Postmenopausal	8 (26.7%)	10 (33.3%)	

Table 2: Tumor Characteristics, Histological Profile and Molecular Classification

Parameter	Category	BCS (n=30)	MRM (n=30)	p-value
Tumor Stage	Stage I	10 (33.3%)	9 (30.0%)	0.946
	Stage IIA	12 (40.0%)	12 (40.0%)	
	Stage IIB	8 (26.7%)	9 (30.0%)	
Histological Type	Invasive Ductal Carcinoma	22 (73.3%)	20 (66.7%)	0.656
	Invasive Lobular Carcinoma	4 (13.3%)	3 (10.0%)	
	Mucinous Carcinoma	2 (6.7%)	3 (10.0%)	
	Medullary Carcinoma	2 (6.7%)	2 (6.7%)	
	Tubular Carcinoma	0 (0.0%)	2 (6.7%)	
Receptor Status	ER Positive	20 (66.7%)	18 (60.0%)	0.789
	PR Positive	18 (60.0%)	16 (53.3%)	0.794

	HER2 Positive	6 (20.0%)	8 (26.7%)	0.760
	Triple Negative	7 (23.3%)	10 (33.3%)	0.567
Molecular Subtype	Luminal A	17 (56.7%)	12 (40.0%)	0.459
	Luminal B	3 (10.0%)	6 (20.0%)	
	HER2-enriched	3 (10.0%)	2 (6.7%)	
	Triple Negative	7 (23.3%)	10 (33.3%)	

Comparison of perioperative parameters demonstrated significantly better outcomes in the BCS group. Mean operation time was significantly shorter in the BCS group compared to the MRM group (114.80 ± 18.35 vs. 157.12 ± 25.29 minutes; p<0.001). Similarly, incision length, intraoperative blood loss, and duration of hospital stay were significantly lower in patients undergoing BCS compared to MRM (p<0.001 for all comparisons). [Table 3]

Table 3: Comparison of Perioperative Parameters Between Study Groups

Parameter	BCS (Mean ± SD)	MRM (Mean ± SD)	p-value
Operation Time (min)	114.80 ± 18.35	157.12 ± 25.29	<0.001
Incision Length (cm)	4.10 ± 1.18	15.03 ± 2.42	<0.001
Blood Loss (mL)	141.05 ± 19.35	217.84 ± 35.35	<0.001
Hospital Stay (days)	7.75 ± 2.17	12.97 ± 2.14	<0.001

Postoperative complications were markedly lower in the BCS group. The total complication rate was 10.0% in the BCS group compared to 46.7% in the MRM group. Seroma formation and lymphedema were more commonly observed in patients undergoing MRM, whereas no cases of lymphedema were reported in the BCS group. Cosmetic outcomes were significantly superior following BCS, with excellent or good cosmetic outcomes observed in 83.3% of BCS patients compared to only 13.3% of MRM patients. [Tables 4]

Table 4: Postoperative Complications and Cosmetic Outcomes

Parameter	Category	BCS (n=30)	MRM (n=30)	p-value
Postoperative Complications	Infection	1 (3.3%)	3 (10.0%)	0.004
	Lymphedema	0 (0.0%)	4 (13.3%)	
	Hematoma	1 (3.3%)	3 (10.0%)	
	Seroma	1 (3.3%)	4 (13.3%)	
	Total Complications	3 (10.0%)	14 (46.7%)	
Cosmetic Outcome	Excellent	12 (40.0%)	0 (0.0%)	<0.001
	Good	13 (43.3%)	4 (13.3%)	
	Fair	4 (13.3%)	14 (46.7%)	
	Poor	1 (3.3%)	12 (40.0%)	

Quality-of-life assessment using EORTC QLQ-C30 demonstrated significantly better emotional functioning, social functioning, and global quality-of-life scores in the BCS group. Breast cancer-specific quality-of-life assessment using EORTC QLQ-BR23 also demonstrated significantly better body image, sexual functioning, and future perspective scores following BCS. [Tables 5]

Table 5: Comparison of Quality-of-Life Scores at 6 Months

QoL Domain	BCS (Mean ± SD)	MRM (Mean ± SD)	p-value
Emotional Functioning	76.19 ± 10.92	59.07 ± 14.81	<0.001
Social Functioning	80.78 ± 12.27	67.02 ± 16.54	<0.001
Physical Functioning	79.08 ± 10.32	73.49 ± 14.21	0.087
Role Functioning	72.46 ± 13.60	72.75 ± 16.52	0.941
Cognitive Functioning	79.64 ± 11.08	75.61 ± 12.32	0.188
Global QoL	74.12 ± 12.22	60.35 ± 15.46	<0.001
Body Image	79.45 ± 15.22	54.24 ± 19.38	<0.001
Sexual Functioning	67.01 ± 13.27	51.39 ± 19.17	<0.001
Future Perspective	67.34 ± 16.87	46.13 ± 17.40	<0.001
Breast Symptoms	21.62 ± 12.59	33.39 ± 12.63	<0.001
Arm Symptoms	19.30 ± 12.72	32.48 ± 15.20	<0.001
Systemic Therapy Side Effects	29.13 ± 11.34	31.02 ± 12.71	0.546

Pain scores were significantly lower in the BCS group at all postoperative follow-up periods. Functional assessment demonstrated significantly better shoulder mobility and preservation of sensory function following BCS compared to MRM. [Tables 6]

Table 6: Comparison of Pain and Functional Outcomes

Parameter	Category	BCS (Mean ± SD / n %)	MRM (Mean ± SD / n %)	p-value
	1 Week Post-op	4.81 ± 1.34	6.41 ± 1.51	<0.001

VAS Pain Score	1 Month Post-op	2.41 ± 0.99	4.11 ± 1.20	<0.001
	6 Months Post-op	1.08 ± 0.73	1.86 ± 0.85	<0.001
Shoulder ROM	Abduction (°)	169.99 ± 6.90	147.67 ± 11.11	<0.001
	Flexion (°)	172.37 ± 5.40	157.97 ± 12.32	<0.001
Sensory Function	Normal	20 (66.7%)	10 (33.3%)	0.026
	Reduced	8 (26.7%)	12 (40.0%)	
	Absent	2 (6.7%)	8 (26.7%)	

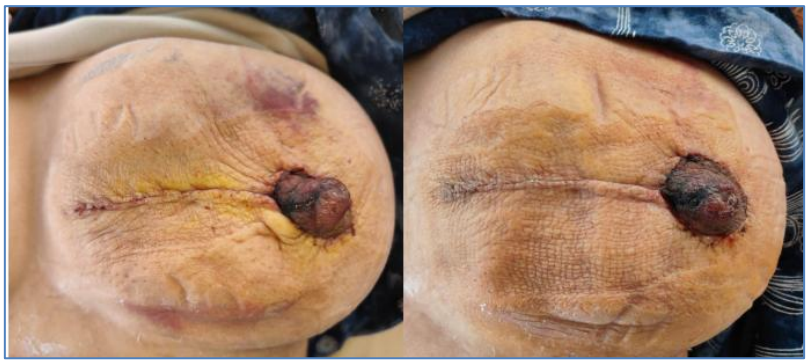

Figure 1: An early postoperative appearance with mild edema and intact wound, maintaining breast symmetry post BCS. Follow-up image demonstrating well-healed scar and acceptable cosmetic result

Figure 2: Intraoperative images depict wide excision with exposure of pectoralis muscle. Postoperative image shows sutured wound

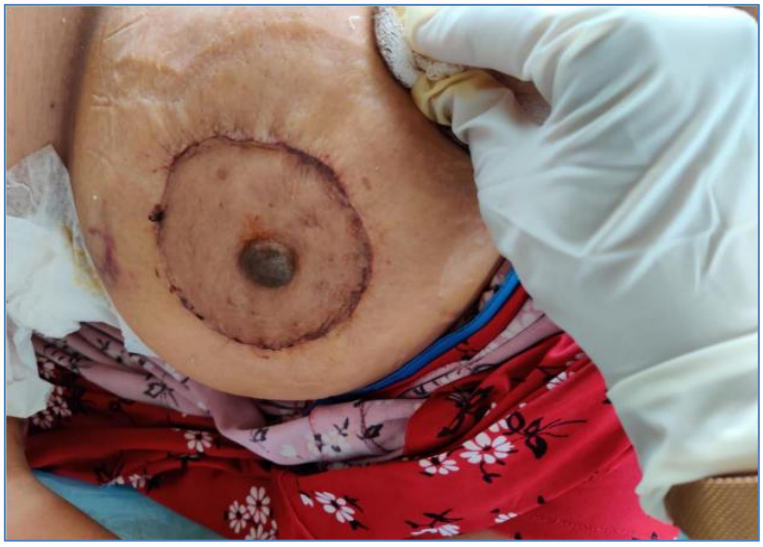

Figure 3: Postoperative image showing preserved nipple–areola complex (NAC) in BC

Figure 4: Bilateral postoperative result demonstrating symmetrical breast contour and preserved NACs

DISCUSSION

The present prospective randomized controlled study compared the outcomes of Breast Conservation Surgery (BCS) following neoadjuvant chemotherapy (NACT) with Modified Radical Mastectomy (MRM) in patients with early-stage breast cancer. The study evaluated perioperative outcomes, postoperative complications, cosmetic results, pain, shoulder mobility, sensory preservation, and quality of life. The findings demonstrated that BCS following NACT was associated with significantly better perioperative and patient-centered outcomes compared to MRM while maintaining oncological safety in selected patients. Both groups were comparable at baseline with no significant differences in age, tumour stage, histological type, receptor status, molecular subtype, tumour size, menopausal status, or clinical presentation.

The mean age was 34.17 ± 7.38 years in the BCS group and 34.37 ± 6.19 years in the MRM group, with no statistically significant difference. Similar age comparability was reported by Akbari et al. [90]. Tumour characteristics were also similarly distributed between groups. The upper outer quadrant was the most common site of tumour involvement, invasive ductal carcinoma was the predominant histological subtype, and Luminal A was the most frequent molecular subtype. Boughey et al. [12] highlighted the importance of tumour biology and molecular subtype in successful breast conservation following neoadjuvant chemotherapy. The comparable tumour characteristics in the present study indicate that the superior outcomes observed with BCS were not related to biologically favorable disease.

Perioperative parameters significantly favored the BCS group. Mean operation time, incision length, intraoperative blood loss, and hospital stay were significantly lower following BCS compared to MRM. Similar findings were reported by Joty et al. [13], who observed lower surgical morbidity with breast-conserving procedures. The smaller incision size and reduced blood loss reflect the minimally invasive nature of BCS. Bowen et al. [14] also demonstrated that neoadjuvant chemotherapy does not significantly increase postoperative morbidity, suggesting that the higher perioperative burden in MRM is mainly related to the extent of surgery.

Postoperative complications were markedly lower in the BCS group. The overall complication rate was 10.0% in BCS patients compared to 46.7% in the MRM group. Seroma, infection, hematoma, and lymphedema were more frequent following MRM, whereas no lymphedema was observed after BCS. Similar observations were reported by Giacalone et al. [15], who documented higher morbidity after extensive surgical procedures. Reduced tissue trauma and limited axillary dissection likely contributed to the lower complication rates and faster recovery associated with BCS.

Cosmetic outcomes strongly favored BCS. More than 80% of BCS patients achieved excellent or good cosmetic outcomes, whereas poor cosmetic results were predominantly seen in the MRM group. Joty et al. [13] similarly reported superior cosmetic satisfaction following breast-conserving surgery. Volders et al. [16] also highlighted that BCS after NACT provides satisfactory cosmetic outcomes without compromising oncological safety.

Quality-of-life assessment using EORTC QLQ-C30 demonstrated significantly better emotional functioning, social functioning, and global quality-of-life scores in the BCS group. EORTC QLQ-BR23 assessment also revealed better body image, sexual functioning, and future perspective scores following BCS, along with lower breast and arm symptom scores. Similar findings were reported by Joty et al. [13]. Studies by Dodwell and Wheatley [17] and Manirakiza et al. [18] further demonstrated that mastectomy offers no significant survival advantage over breast-conserving treatment, highlighting the importance of the superior psychosocial and functional outcomes associated with BCS.

Pain scores measured using the Visual Analogue Scale were significantly lower in the BCS group at all postoperative follow-up periods. Better shoulder mobility and sensory preservation were also observed following BCS, indicating superior functional recovery and long-term patient comfort compared to MRM. The findings of the present study are consistent with the global trend toward breast conservation in early-stage breast cancer. Clarke et al. [1] and van Maaren et al. [2] demonstrated that breast-conserving surgery provides survival outcomes comparable to mastectomy. Patil and Dikle [3] also emphasized the effectiveness of breast conservation in Indian patients. Al-Ghazal et al. [4] reported superior psychological well-being and patient satisfaction following breast-conserving surgery, while Lee et al. [5] noted that fear of recurrence and institutional practices still influence mastectomy rates despite the proven safety of breast conservation.
Recent systematic reviews by Smith et al. [6] and Johnson et al. [7] concluded that breast-conserving surgery offers survival outcomes equivalent to mastectomy along with superior cosmetic and quality-of-life benefits. Williams et al. [8] reported increasing global trends toward breast conservation due to advances in systemic therapy and patient awareness. Thompson et al. [9] demonstrated better psychological outcomes following BCS, while Martinez et al. [10] and Yang et al. [11] documented lower postoperative morbidity and wound complications after breast conservation compared to mastectomy.
Overall, the present study supports the growing evidence favoring Breast Conservation Surgery following neoadjuvant chemotherapy in selected early-stage breast cancer patients. BCS was associated with lower perioperative morbidity, fewer postoperative complications, superior cosmetic outcomes, improved quality of life, better functional recovery, and lower postoperative pain compared to Modified Radical Mastectomy.

Despite the significant findings, certain limitations should be acknowledged. The relatively small sample size and single-center design may limit generalizability. The follow-up period was limited to six months and therefore long-term recurrence and survival outcomes could not be assessed. Additionally, cost analysis, return-to-work assessment, and the effects of different neoadjuvant chemotherapy regimens were not evaluated separately.

CONCLISION

Breast Conservation Surgery following neoadjuvant chemotherapy appears to be a safe, effective, and patient-centered surgical option for patients with early-stage breast cancer. Compared to Modified Radical Mastectomy, BCS was associated with lower perioperative morbidity, fewer postoperative complications, reduced postoperative pain, superior cosmetic outcomes, improved shoulder mobility, better sensory preservation, and enhanced quality of life. Baseline comparability between both study groups further strengthens the reliability of these findings. The study highlights that successful breast cancer management should focus not only on oncological safety but also on preservation of body image, functional recovery, and long-term psychosocial well-being in appropriately selected patients.

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