Pectoral Fascia Preservation Versus Resection in Modified Radical Mastectomy

Mohammed Abdo Etman, MD; Alaa Abd Elazeem Elsisi, MD; M. Ashraf Balbaa, MD; Abdallah Salaheldin Abdallah, MD; Mohamed K. Alhanafy, MD
Surgery Department, Faculty of Medicine, Menoufia University, Egypt

Introduction: The modified radical mastectomy (MRM) is a common surgical option for carefully selected patients with breast cancer, but the necessity of pectoral fascia (PF) resection during the procedure has been debated.

Aim of work: To evaluate the impact of pectoral fascia preservation versus resection on surgical outcomes, complications, and recurrence rates in patients undergoing modified radical mastectomy.

Patients and methods: We have conducted a retrospective review of patients who underwent MRM at the Department of General Surgery, Menoufia University Hospital between January 2014 and December 2019. Patients were divided into two groups: Group A (PF preservation, n=61) and Group B (PF excision, n=72). After propensity score matching, there were 44 patients in each group with homogeneous patients and tumor characteristics.

Results: After matching, patients of both groups had similar demographics. Intraoperative blood loss was significantly higher in the PF excision group (220.4±26.2 mL vs. 255±29.8 mL; P<0.001) and similarly total seroma volume (495.3±209.3 mL vs. 805.1±385.7 mL; P<0.001), which was in favor of PF preservation. However, there were no significant differences in recurrence rates or postoperative complications such as seroma formation, skin necrosis, or surgical site infection.

Conclusions: Pectoral fascia preservation during MRM resulted in reduced intraoperative blood loss and seroma formation without compromising oncological outcomes. These findings suggest that PF preservation may be a viable option in MRM, offering a less invasive alternative with potentially improved postoperative recovery.

Key words: Pectoral fascia, modified radical mastectomy, breast cancer, seroma formation, recurrence.

Introduction

Modified radical mastectomy is a well-established surgical procedure primarily used for the treatment of breast cancer. The procedure involves the excision of the whole breast tissues, nipple-areola complex (NAC), and level I and II axillary lymph nodes, aiming to ensure the best possible oncological outcome.[1] In recent years, the role of the pectoral fascia in the success of this surgery has been debated. The pectoral fascia, a layer of connective tissue enveloping the pectoralis muscle, plays a significant role in breast tissue support and surgical integrity. The decision to preserve or excise the pectoral fascia during modified radical mastectomy has remained a debatable issue in breast cancer surgery.[2]

Historically, the pectoral fascia was routinely excised during modified radical mastectomy, primarily due to the belief that it could harbor cancerous cells, leading to higher local recurrence rates if left intact. However, this approach can lead to increased postoperative complications such as seroma formation, prolonged recovery, and higher rates of muscular atrophy.[3] Conversely, the preservation of the pectoral fascia is thought to minimize these complications by providing greater structural support, potentially enhancing cosmetic outcomes, and reducing the incidence of seromas and other postoperative complications. However, it is unclear whether preservation of the pectoral fascia adversely affects oncological outcomes, specifically recurrence rates.[4]

Recent studies have attempted to compare the two approaches, but the results remain inconsistent. Some studies suggest no significant difference in survival or recurrence rates between patients with pectoral fascia preservation and those with excision, while others argue that excision of the pectoral fascia may improve the completeness of cancer removal in certain clinical settings.[5,6] Moreover, the influence of pectoral fascia preservation on factors like intraoperative blood loss, operative time, and postoperative complications has not been comprehensively addressed.[7]

A particularly critical factor in evaluating the benefit of pectoral fascia preservation is the postoperative recovery process, which includes aspects like hospital length of stay, time to drain removal, and overall recovery of the affected upper extremity function.[8] With recent advancements in surgical techniques and improved adjuvant therapies, it is essential to re-evaluate the impact of pectoral fascia preservation on long-term oncological outcomes and postoperative quality of life.[9] Therefore, our study aims to evaluate the impact of pectoral fascia preservation versus resection on surgical outcomes, complications, and recurrence rates in patients undergoing modified radical mastectomy.

Patients and methods

Study design

This retrospective study was conducted at Menoufia University Hospitals on patients who were candidates for modified radical mastectomy

DOI: 10.21608/asjs.2025.389638.1205

from January 2014 to December 2019. Patients were divided into two groups: Group A, Patients who had pectoralis fascia preservation, and Group B, patients who had pectoralis fascia excision. A total of 133 patients were enrolled: 61 patients in the PF preservation group and 72 patients in the PF excision group. Propensity score matching was applied to reduce the selection bias, and we used age, BMI, ASA classification (American Society of Anesthesiologists), tumor subtype, and tumor stage as covariates. After matching, we had 44 patients in either group with homogenous patients or tumor characteristics.

Sample size

The sample size was calculated based on prior literature, using a two-tailed independent samples t-test with a power of 80% and a significance level (Alpha) of 0.05. The minimum required sample size was estimated to be 42 patients per group. To account for potential dropouts or incomplete data, a total of 88 patients were enrolled, with 44 patients allocated to each group after propensity score matching.

Eligibility criteria

The inclusion criteria were female patients 18-75 years diagnosed with breast cancer and eligible for MRM and not candidates for breast-conserving surgery. We had several indications for MRM, such as multicentric cancers and bilateral cancers with strong family history or positive genetic predisposition (BRCA1, BRCA 2, TP53, etc.), locally advanced breast cancers with heavy axillary lymph node infiltration, Contraindications to irradiation, and the patient's desire for MRM and later breast reconstruction. Additionally, patients had to have tumors at least 5mm away from the pectoralis fascia. Exclusion criteria included the presence of recurrent or metastatic tumors. Further exclusions were uncontrolled comorbidities such as severe cardiovascular or autoimmune diseases.

Preoperative assessments

Preoperative assessments included detailed medical histories, with a focus on factors such as the patient's age, parity, comorbid conditions, and previous surgeries. Physical examinations included assessments of the chest, heart, and abdominal systems. Imaging studies included breast ultrasound, mammography, and, when necessary, MRI, performed to assess tumor characteristics and relationships to the pectoralis fascia.

Surgical procedure

The surgical procedure followed standard Modified Radical Mastectomy protocols. In Group A, the pectoralis fascia was preserved over the pectoralis major muscle **(Fig. 1)**, while in Group B, the pectoral fascia was excised along with the surrounding tissues as part of the surgical procedure **(Fig. 2).**

Fig 1: Pectoral fascia preservation.

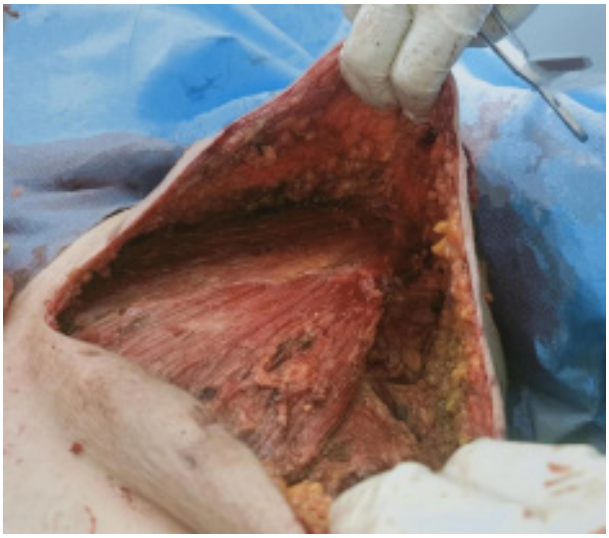

Fig 2: Pectoral fascia excision.

The postoperative data of the patients were reviewed for any complications, with a specific focus on drain output, the formation of seromas, and the development of any wound-related issues, such as skin or flap necrosis.

Perioperative outcomes

The primary outcome of the study was to compare the safety outcomes between the two groups, such as operative time, blood loss, and the presence of seromas. Secondary outcomes included the incidence of postoperative complications (E.g., infection, flap necrosis), the length of hospital stay, and the time taken for drain removal. In addition, we followed up all patients at regular intervals every 6 months for 5 years to assess recurrence through clinical examination and imaging. The impact of pectoral fascia preservation or excision on subsequent oncological management, such as the

need for chemotherapy or radiotherapy, was also recorded.

Ethical approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB) and the ethics committee at the Faculty of Medicine, Menoufia University (IRB 3-2023SURG5-2).

Statistical analysis

Statistical analysis was performed using SPSS Statistics, version 20 (IBM SPSS, Armonk, NY, USA). Continuous data were summarized using means and standard deviations, while categorical data were expressed as frequencies and percentages. The independent t-test or the Mann-Whitney U test were used to compare continuous variables, while Fisher's exact test or chi-square tests compared the categorical variables. P value < 0.05 was considered statistically significant.

Results

Patient demographics and clinical data

A total of 133 patients were enrolled in our study: 61 patients in the PF preservation group and 72 patients in the PF excision group **(Table 1).**

Propensity score matching was applied to reduce the selection bias. Age, BMI, ASA classification, tumor pathology, and stage were covariates. After matching, we had 44 patients in either group with homogenous patients or tumor characteristics **(Table 2).**

Perioperative outcomes

Intraoperative blood loss was significantly lower in the preservation group (220.3±26.2 mL vs. 255±29.8 mL, P<0.001). The operating time was longer in the PF excision group (81.2±7.22 vs. 92.1± 7.3 and P value 0.21). The total volume of postoperative seroma was significantly lower in the preservation group (495.3±209.3 mL vs. 805.1±385.7 mL, P< 0.001). Time to drain removal was shorter in the preservation group (7.2±0.6 days vs. 12.3±1.0 days, P=0.01). Patients in both groups had comparable results regarding the length of hospital stay (2±1.05 vs. 1.5±1.74 and P=0.22) **(Table 3).**

Long-term oncological outcomes

At five years, chest wall recurrence was observed in 2 patients (4.5%) in the preservation group and 1 patient (2.3%) in the excision group (HR: 0.75, 95% CI: 0.12–4.85, p=0.82). Regional breast recurrence was recorded in 1 patient (2.3%) in the preservation group and 2 patients (4.5%) in the excision group (HR: 1.45, 95% CI: 0.22–9.35, p=0.67). Distant recurrence occurred in 9 patients (20.5%) in the preservation group and 8 patients (18.2%) in the excision group (HR: 0.92, 95% CI: 0.38–2.21, p=0.87) **(Table 4).**

The cumulative breast cancer-specific five-year survival was analyzed for all patients and showed comparable results in either group **(Fig. 3).**

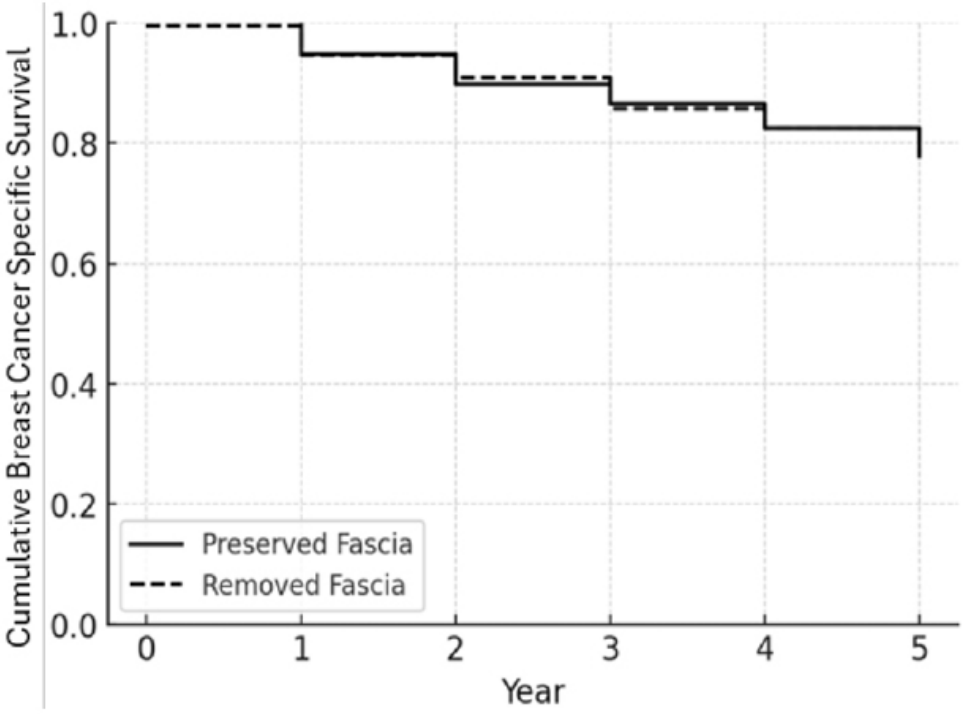

Fig 3: The cumulative 5-year breast cancer-specific survival.

Table 1: Patients' demographics before Propensity score matching

Variable	Pectoralis fascia preservation (n= 61)	Pectoralis fascia excision (n= 72)	P-value
Age (Mean±SD)	52.3±3.5	59.1± 4.5	0.23
BMI	27.8±3.4	23±4.1	0.15
Pathology			
Invasive ductal carcinoma	54 (88.5)	63 (87.5)	0.16
Invasive lobular carcinoma	5 (8.2)	8 (11.1)	
Paget's disease of the breast	2 (3.3)	1 (1.4)	
Stage			
Stage I	5 (8.2)	6 (8.3)	0.023*
Stage II	35 (57.4)	36 (50)	
Stage III	21 (34.4)	30 (41.7)	
No. of lymph nodes (Mean ± SD)	14.2±5.1	15.2±4.5	0.31
Luminal classification			
Luminal A	36 (59)	40 (55.6)	0.62
Luminal B	23 (37.7)	29 (40.3)	
Triple negative	2 (3.3)	3 (4.1)	
ASA classification			
I	41 (67.2)	45 (62.5)	0.01*
II	17 (27.9)	21 (29.2)	
III	3 (4.9)	6 (8.3)	

Table 2: Patients' demographic and clinical data after propensity score matching

Variable	Pectoralis Fascia Preservation (n=44)	Pectoralis Fascia Excision (n=44)	P-value
Age (Mean ± SD)	50.1±3.7	53.2±4.7	0.24
BMI	23.8±4.1	24.3±4.5	0.36
ASA classification			
I	29 (65.9)	27 (61.4)	0.33
II	11 (25)	14 (31.8)	
III	4 (9.1)	3 (6.8)	
Pathology			
Invasive Ductal Carcinoma	40 (90.9)	41 (93.2)	0.85 (b)
Invasive Lobular Carcinoma	3 (6.8)	2 (4.5)	
Paget's Disease of the Breast	1 (2.3)	1 (2.3)	
Stage			
Stage I	3 (6.8)	0 (0)	0.32
Stage II	24 (54.6)	26 (59.1)	
Stage III	17 (38.6)	18 (40.9)	
No. of lymph nodes (Mean ± SD)	14.6 ± 4.4	16.9 ± 5.6	0.41 (a)
Luminal classification			
Luminal A	26 (59.1)	25 (56.8)	0.51
Luminal B	18 (40.9)	17 (38.6)	
Triple negative	0 (0)	2 (4.6)	
Adjuvant therapy			
Hormonal Therapy	24 (54.5)	25 (56.8)	0.96 (b)
Chemotherapy	18 (40.9)	19 (43.2)	0.21
Radiotherapy	17 (38.6)	20 (45.5)	0.74 (b)
Neoadjuvant Therapy	17 (38.6)	18 (40.9)	0.61

a = Mann-Whitney U test; b = Fisher exact test.

Table 3: Perioperative outcomes

Variable	Pectoralis fascia preservation (n=44)	Pectoralis fascia excision (n=44)	P-value
Intraoperative blood loss (ml)	220.3±26.2	255±29.8	< 0.001*
Operative time (Minute)	81.2±7.22	92.1±7.3	0.21
Total volume of seroma (ml)	495.3±209.3	805.1±385.7	< 0.001*
Time to drain removal (Days)	7.2±0.6	12.3±1.0	0.01*
Hospital length of stay (Days)	2± 1.05	1.5±1.74	0.22
Postoperative complications			
Seroma	4 (9.1)	6 (13.6)	0.23
Hematoma	1 (2.3)	2 (4.6)	0.61
Wound/ Flap necrosis	1 (2.3)	0 (0)	0.33
Surgical site infection	2 (4.6)	1 (2.3)	0.21

*Data are presented as mean ± SD; *Mann-Whitney U test. Statistical significance at P < 0.05.

Table 4: Analysis of events that occurred at 5-year follow-up

	Preserved Facia	Removed Fascia	Hazard Rate Ratio (95% CI)	p-value
Number of patients	44	44	—	—
Chest wall recurrence	2	1	0.75 (0.12–4.85)	0.82
Regional breast recurrence	1	2	1.45 (0.22–9.35)	0.67
Distant recurrence	9	8	0.92 (0.38–2.21)	0.87
Contralateral breast cancer	0	0	—	—
Death (Breast-specific)	1	2	1.80 (0.29–11.3)	0.52
Death (All events)	3	4	1.25 (0.30–5.18)	0.76

Discussion

Modified radical mastectomy remains a cornerstone in the surgical management of breast cancer. The role of pectoralis fascia preservation versus excision during this procedure is a subject of ongoing debate.[10] Our study aims to evaluate the impact of pectoralis fascia preservation versus excision on the immediate postoperative outcomes rather than long-term oncological results.

The baseline characteristics of our study sample, including the distribution of pathology types and tumor stage, are comparable between the two groups, with no significant differences in tumor pathology or tumor stage. These findings align with previous studies, which suggest that the presence or absence of pectoral fascia has no major effect on the staging or pathology of breast cancer itself. As reported by Chen et al., pectoral fascia preservation does not appear to influence tumor characteristics or stage at diagnosis, which supports the decision to preserve or excise the fascia should be based on surgical considerations rather than disease factors.[5]

In our study, the pectoralis fascia preservation group demonstrated significantly less intraoperative blood loss (220.3±26.2 ml vs. 255±29.8 ml, P<0.001). Additionally, the preservation group required a shorter operative time (81.2±7.22 minutes vs. 92.1± 7.3minutes, P=0.21). Similarly, Mohamed et al. reported that preserving the pectoral fascia results in reduced blood loss and shorter surgical times.[11] This can be attributed to the fact that excision of the pectoral fascia involves more dissection and manipulation of surrounding tissues, which can contribute to increased blood loss and the need for a longer operation.

A striking finding in our study is the significant reduction in the total volume of seroma formation in the pectoral fascia preservation group (495.3±209.3 ml) compared to the excision group (805.1±385.7 ml, P<0.001). Moreover, patients in the PF group had a shorter time to drain removal (7.2±0.6 days vs. 12.3±1.0 days, P=0.01). Similarly, Suijker demonstrated that preservation of the pectoral fascia leads to a decrease in seroma formation and a shorter duration of drain placement.[4] The reduction in seroma formation can be attributed to the preservation of tissue support and vascular integrity provided by the pectoral fascia, which minimizes the dead space left behind after surgery.

In terms of hospital length of stay, our study found no significant difference between the preservation group (2±1.05 days) and the other group (1.5±1.74 days, P=0.22). Similarly, Blok et al., reported that pectoral fascia preservation reduces some postoperative complications, but it does not significantly alter the overall hospital stay.[12] Factors such as patient comorbidities, overall surgical recovery, and institutional protocols for postoperative care likely play a more substantial role in determining the length of hospitalization

than the specific surgical technique employed.

Our study showed that patients of both groups had comparable results in terms of postoperative oncological management, including the administration of hormonal therapy, chemotherapy, and radiotherapy, as well as the use of neoadjuvant therapy. Similarly, these studies found that the choice of pectoral fascia preservation or excision does not impact the need for adjuvant treatments.[11,13] Both studies indicated that systemic treatments and radiation are determined by the tumor's biological characteristics, stage, and nodal involvement rather than the surgical approach. Tondu also noted that adjuvant therapies are typically guided by pathological findings and oncological guidelines rather than the preservation of anatomical structures during surgery.[14]

Furthermore, the use of neoadjuvant therapy (38.6% in the preservation group vs. 40.9% in the excision group). Similarly, Rubio et al, suggested that the decision for neoadjuvant treatment is primarily guided by tumor size, stage, and receptor status rather than the type of surgical procedure performed.[15] The lack of difference in adjuvant and neoadjuvant treatments supports the conclusion that pectoralis fascia preservation does not influence the overall treatment strategy for breast cancer patients.

Regarding postoperative morbidity, patients of both groups exhibited similar results for skin necrosis (P=0.33) and surgical site infection (P=0.21). However, the PF excision group had more cases with postoperative seroma (13.6% vs. 9.1%) and postoperative hematoma (4.6% vs. 2.3%), but it didn't reach any statistical significance. Likewise, Lo Torto et al, reported a lower risk of postoperative complications, such as skin necrosis and surgical site infection, in patients with preserved pectoral fascia.[16] The preservation of the pectoral fascia appears to contribute to better wound healing and reduced complications by maintaining the integrity of the underlying tissue structure and blood supply.

This study assures that in operable breast cancers that do not involve pectoral fascia, the PF preservation or excision didn't affect the regional, chest wall, or distant recurrences. The 5-year breast cancer-specific survival was comparable in both groups (97.7% in group A vs. 95.5% in group B, and P=0.52). It was not established that patients who had pectoral fascia removal had a lower local recurrence rate.

The chest-wall recurrence has been shown to be associated with an increased risk of distant metastases and breast cancer specific death. After modified radical mastectomy, the development of lymph node metastases has a significant impact on locoregional recurrence.[17,18] The locoregional recurrence rate is reduced by postoperative adjuvant radiation,[19] and its effect is increased when paired with chemotherapy.[20] In our study, the use of adjuvant chemotherapy and radiation therapy, as well as the prevalence of lymph node metastases, were similar in both groups.

All breast cancers are systemic from the beginning, according to Bernhard Fisher, and changing the local treatment plan won't affect the result.[21] Numerous randomized trials comparing mastectomy and breast-conserving therapy's survival outcomes made this fact clear.[22] The choice of adjuvant therapy will be influenced by the surgical removal of the tumor, which should be curative.

The strength of this study lies in its well-matched cohort of patients. Propensity score matching was used to reduce the selection bias and to create homogenous groups with comparable baseline patients and tumor characteristics. The comprehensive assessment of recurrence rates, postoperative morbidity, and oncological treatment strategies provides valuable insights into the clinical implications of pectoralis fascia preservation. However, the retrospective nature of this study, small sample size and shorter follow-up period might represent inherent limitations. Further randomized controlled trials with larger cohorts and extended follow-up periods are needed to address these limitations.

Conclusion

Pectoral fascia preservation during MRM resulted in reduced intraoperative blood loss and seroma formation without compromising the longterm oncological outcomes. These findings suggest that PF preservation may be a viable option in MRM, offering a less invasive alternative with potentially improved postoperative recovery. Further larger sample and randomized controlled trials are still required to validate these findings. Ultimately, the choice between fascia preservation and excision should be guided by individual patient factors, surgical considerations, and clinical judgment rather than concerns about recurrence or treatment outcomes.

References

1. Marinkovic M, Djordjevic N, Djordjevic L, Ignjatovic N, Djordjevic M, Karanikolic V: Assessment of the quality of life in breast cancer depending on the surgical treatment. ***Supportive Care in Cancer.*** 2021; 29: 3257-3266.

2. Bland KI: Topographic anatomical relationships of the breast, chest wall, axilla, and related sites of metastases. ***Oncoplastic Breast Surgery Techniques for the General Surgeon.*** 2020; 35-69.

3. Jatoi I, Benson J, Sbitany H, Jatoi I, Benson J, Sbitany H: Surgery for breast cancer. ***Atlas of***

Breast Surgery. 2020; 69-86.

4. Suijker J, Blok YL, de Vries R, van den Tol MP, Krekel NM: Pectoral fascia preservation in oncological mastectomy to reduce complications and improve reconstructions: A systematic review. ***Plastic and Reconstructive Surgery–Global Open.*** 2020; 8(3): e2700.

5. Chen AX, Li XX, Guo ZY, Ge J, Yu Y, et al: Preservation of the pectoralis major fascia has no impact on the long-term oncologic outcomes of patients with breast cancer treated with conservative mastectomy and immediate breast reconstruction: A propensity score matching analysis. ***Journal of Plastic, Reconstructive & Aesthetic Surgery.*** 2023; 86: 231-238.

6. Billington A, Dayicioglu D, Smith P, Kiluk J: Review of procedures for reconstruction of soft tissue chest wall defects following advanced breast malignancies. ***Cancer Control***. 2019; 26(1): 1073274819827284.

7. Yang X, Lin Q, Wang Q: The impact of breast-conserving surgery and modified radical mastectomy on postoperative wound complications in patients with early breast cancer. ***International Wound Journal.*** 2024; 21(2): e14685.

8. Naik, M: To study the factors influencing seroma formation after modified radical mastectomy/ breast conservative surgery In: ***Mch Vims Ballari (Master's thesis, Rajiv Gandhi University of Health Sciences (India)).*** 2019.

9. El-Jebaoui J: Evaluation of the enhanced recovery after surgery (ERAS) protocol for Rapid recovery after breast reconstruction surgery using a deep inferior epigastric perforator (DIEP) flap. ***Papyrus.*** 2024.

10. Golara A, Kozłowski M, Lubikowski J, Cymbaluk-Płoska A: Types of breast cancer surgery and breast reconstruction. ***Cancers.*** 2024; 16(18): 3212.

11. Mohamed HA, Mansy OM, Elkammash SH, Hokkam EN, Ramadan AA: Oncological safety of pectoralis fascia preservation in modified radical mastectomy. ***Suez Canal University Medical Journal.*** 2022; 25(4): 61-69.

12. Blok YL, Suijker J, van den Tol MP, van der Pol CC, Mureau MA, van der Hage JA, Krekel NM: Preservation of the pectoral fascia in mastectomy with immediate reconstruction: A nationwide survey. ***Journal of Surgical Research***. 2023; 284: 101-105.

13. Citgez B, Yigit B, Bas, S: Oncoplastic and reconstructive breast surgery: A comprehensive review. ***Cureus.*** 2022; 14(1).

14. Tondu T, Hubens G, Tjalma WA, Thiessen FE, Vrints I, Van Thielen J, Verhoeven V: Breast reconstruction after nipple-sparing mastectomy in the large and/or ptotic breast: A systematic review of indications, techniques, and outcomes. ***Journal of Plastic, Reconstructive & Aesthetic Surgery.*** 2020; 73(3): 469-485.

15. Rubio IT, Sobrido C: Neoadjuvant approach in patients with early breast cancer: Patient assessment, staging, and planning. ***The Breast.*** 2022; 62: S17-S24.

16. Lo Torto F, Turriziani G, Donato C, Marcasciano M, Redi U, Greco M, Ribuffo D: Deep sternal wound infection following cardiac surgery: A comparison of the monolateral with the bilateral pectoralis major flaps. ***International Wound Journal***. 2020; 17(3): 683-691.

17. Varzaru VB, Popescu R, Vlad DC, Vlad CS, Moatar AE, Rempen A, Cobec IM. Predictors of recurrence and overall survival in breast cancer patients undergoing neoadjuvant chemotherapy and surgery: A comprehensive statistical analysis. ***Cancers.*** 2025;17(6):924.

18. Kim H, Lee SB, Nam SJ, Lee ES, Park BW, Park HY, et al: Survival of breast-conserving surgery plus radiotherapy versus total mastectomy in early breast cancer. ***Annals of Surgical Oncology.*** 2021; 1: 1-9.

19. Overgaard M, Nielsen HM, Tramm T, Højris I, Grantzau TL, et al: Postmastectomy radiotherapy in high-risk breast cancer patients given adjuvant systemic therapy. A 30-year long-term report from the Danish breast cancer cooperative group DBCG 82bc trial. ***Radiotherapy and Oncology.*** 2022; 170: 4-13.

20. Fisher B: Breast cancer management-alternative to radical mastectomy. ***N Engl J Med.*** 1979; 301: 326–328.

21. ElSherif A, Armanyous S, Al-Hilli Z, Valente SA: Mastectomy options for the treatment of ipsilateral breast cancer recurrence after lumpectomy. ***The American Journal of Surgery.*** 2022; 223(3): 447-451.

22. De la Cruz Ku G, Karamchandani M, Chambergo-Michilot D, Narvaez-Rojas AR, Jonczyk M, Príncipe-Meneses FS, Posawatz D, Nardello S, Chatterjee A. Does breast-conserving surgery with radiotherapy have a better survival than mastectomy? A meta-analysis of more than 1,500,000 patients. ***Annals of Surgical Oncology.*** 2022; 29(10): 6163-6188.