AHOT | Acta Haematologica Oncologica Turcica

Acta Haematol Oncol Turc 2025;58(3):206-211

Original Article

DOI: 10.4274/ahot.galenos.2025.2025-8-3

Use of a Collagen-Laminin-Based Dermal Matrix Combined with Resveratrol Microparticles (Dermalix) for Wound Complications After Breast Surgery

Simay Akyüz[1], Betülay Kılıç[2], Kemal İpek[3], Hikmet Erhan Güven[4], İbrahim Burak Bahçecioğlu[5], Müjdat Turan[6], Ebru Esen[7], Şevket Barış Morkavuk[5], Melih Akıncı[4], Kerim Bora Yılmaz[6], Mehmet Ali Gülçelik[5]

[1]*University of Health Sciences Türkiye, Gülhane Faculty of Nursing, Department of Oncology Nursing, Ankara, Türkiye*
[2]*University of Health Sciences Türkiye, Gülhane Faculty of Nursing, Department of Internal Medicine Nursing, Ankara, Türkiye*
[3]*Ankara Provincial Health Directorate Public Hospitals Services Directorate, Ankara, Türkiye*
[4]*University of Health Sciences Türkiye, Ankara Etlik City Hospital, Department of General Surgery, Ankara, Türkiye*
[5]*University of Health Sciences Türkiye, Gülhane Research and Training Hospital, Department of Surgical Oncology, Ankara, Türkiye*
[6]*University of Health Sciences Türkiye, Gülhane Research and Training Hospital, Department of General Surgery, Ankara, Türkiye.*
[7]*İstinye University Hospital, Bahçeşehir Liv Hospital, Department of General Surgery, İstanbul, Türkiye*

ABSTRACT

Aim: Wound complications after breast surgery may adversely affect the healing process and delay the initiation of adjuvant therapy. Despite appropriate surgical technique and postoperative care, wound complications can still occur following breast operations. To evaluate the role of a collagen-laminin-based dermal matrix combined with resveratrol microparticles in the management of wound complications after breast surgery.

Methods: This study was conducted in the Surgical Department of a Training and Research Hospital between March 2021 and March 2022, and included 15 patients who underwent breast surgery. Inclusion criteria were: (a) prior breast surgery; (b) postoperative wound complication; (c) presence of granulation tissue; (d) a microbiologically culture-negative wound; and (e) use of a collagen-laminin-based dermal matrix combined with resveratrol microparticles during wound care.

Results: The mean age of the patients was 52.67±8.61 years. All were female. Wound complications occurred after breast cancer surgery in 73.4% of patients, while in 26.6% they were related to other surgical indications. Consecutive applications resulted in a statistically significant mean reduction in wound dimensions (p=0.012). Collagen-laminin-based dermal matrix combined with resveratrol microparticles showed a maximal effect by day 8 (after two consecutive applications), producing a marked decrease in wound size. No studies have evaluated the role of a collagen-laminin-based dermal matrix combined with resveratrol microparticles in wound complications after breast surgery. This study is the first to evaluate the therapeutic role of a collagen-laminin-based dermal matrix combined with resveratrol microparticles in wound complications after breast surgery. A characteristic feature of our study is that the patient population predominantly comprises individuals with wound complications following breast cancer surgery.

Conclusion: Collagen-laminin-based dermal matrix combined with resveratrol microparticles may have a role in the ambulatory management of granulating wound complications with microbiologically clean wound beds following breast surgery. Larger multicenter randomized controlled trials are needed.

Keywords: Breast surgery, wound complication, dermalix

Address for Correspondence: Simay Akyüz PhD., RN., University of Health Sciences Türkiye, Gülhane Faculty of Nursing, Department of Oncology Nursing, Ankara, Türkiye

E-mail: simayakyuz@gmail.com **ORCID ID:** orcid.org/0000-0002-0464-8934

Received: 28.08.2025 **Accepted:** 05.11.2025 **Epub:** 12.11.2025 **Publication Date:** 12.12.2025

Cite this article as: Akyüz S, Kılıç B, İpek K, et al. Use of a collagen-laminin-based dermal matrix combined with resveratrol microparticles (Dermalix) for wound complications after breast surgery. Acta Haematol Oncol Turc. 2025;58(3):206-211

Introduction

Breast surgery is among the most commonly performed surgical procedures and is undertaken for a variety of indications. These procedures include breast-conserving surgery, modified radical mastectomy, and simple mastectomy [1].

Breast cancer is one of the principal indications for breast surgery; it is the most frequent malignancy in women, accounting for 23.8% of cancers in women [2]. Incidence rates of breast cancer in Türkiye are consistent with global statistics [3].

Although postoperative complication rates after breast surgery are generally low, morbidity rates reported in the literature vary widely, from 2% to 50%. The most commonly observed complications are infection, seroma formation, and hemorrhage [4]. Wound complications after breast surgery are of particular concern: the incidence of mastectomy-flap necrosis, nipple necrosis, wound dehiscence, and delayed wound healing has been reported to range from 6% to 30% [5].

Wound complications that develop after breast surgery may adversely affect the healing process and give rise to important clinical problems. Despite appropriate surgical technique and postoperative care, such complications can still occur. Failure to manage wound complications in accordance with established wound-care principles may increase the risk of infection, delay the initiation of adjuvant therapy, and ultimately impair patients' quality of life [6-8].

Consequently, effective management of wound complications requires alternative wound-care approaches capable of closing tissue defects and accelerating healing. Biomaterials that actively participate in the repair process are classified as bioactive wound dressings. Composed of natural extracellular matrix components, these materials provide structural support for tissue repair owing to their biocompatibility. Such biomaterials may include polymers such as collagen, hyaluronic acid, chitosan, and alginate.

A collagen-laminin-based dermal matrix loaded with resveratrol -containing microparticles is an innovative wound dressing consisting of dipalmitoylphosphatidylcholine (DPPC)-based microparticles incorporated into a three-dimensional porous collagen-laminin scaffold [9]. The composite formulation includes a glycosaminoglycan derivative (hyaluronic acid), collagen/gelatin to provide hydrophilicity and a three-dimensional porous architecture, laminin as a cell-binding protein, DPPC (a phospholipid abundant in cell membranes), and resveratrol, which has antioxidant properties [10].

The aim of this study was to evaluate the role of a collagen-laminin-based dermal matrix combined with resveratrol microparticles in the management of wound complications following breast surgery.

Methods

Study Setting and Design

This retrospective analysis was conducted in the Surgical Oncology Clinic of a Training and Research Hospital between March 2021 and March 2022. The study population comprised all patients who underwent breast surgery during the study period. The sample consisted of 15 patients who developed postoperative wound complications and were treated with a collagen-laminin-based dermal matrix combined with resveratrol collagen-laminin-based dermal matrix combined with resveratrol microparticles (Dermalix®).

Patient Selection Criteria

Inclusion criteria were:

- Underwent breast surgery,
- Developed a postoperative wound complication,
- Microbiologically culture-negative wound,
- Dermalix® used during the wound-care process.

Exclusion criteria were:

- Primary wound healing after breast surgery,
- Development of other postoperative complications that could affect wound management (e.g., Seroma, abscess).

Data Collection

Data were obtained from the hospital information system and wound-care records using a data collection form prepared by the investigators. For each patient, demographic information, type of surgical procedure, characteristics of the wound complication, and the healing course were recorded.

Collagen-Laminin-Based Dermal Matrix Combined with Resveratrol Microparticles Application and Wound-care Protocol

In patients with postoperative tissue defects or non-healing wounds, Dermalix® application was initiated after confirming negative culture results and the establishment of granulation tissue.

Application protocol:

1. Application of an antiseptic to the dressing area,
2. Gentle debridement to remove biofilm layers,
3. Wound cleansing followed by measurement of wound dimensions,
4. Placement of the Dermalix® dressing tailored to the wound size and positioned on the wound bed,
5. Placement of a secondary absorbent dressing or gauze over Dermalix® to control exudate and completion of the dressing.

Dressing changes were performed every four days. At each dressing change, the wound area was measured, photographed, and documented. Patients were followed on an outpatient basis until complete epithelialization of the wound.

Ethical Considerations

Institutional approval was obtained from the University of Health Sciences Türkiye, Gülhane Scientific Research Ethics Committee (decision no: 2025-283, date: 03.06.2025).

Statistical Analysis

Statistical analysis were performed using IBM Statistical Package for the Social Sciences statistics for Windows, version 24.0 (IBM Corp., Armonk, NY, USA; released 2016). Descriptive statistics are presented as numbers (percentages), means, and standard deviations. The suitability of the data for a normal distribution was assessed by examining the skewness and kurtosis coefficients. Repeatedmeasures analysis of variance was used for comparisons across time points, and p values <0.05 p values <0.05 were considered statistically significant.

Results

The mean age of the patients included in the study was 52.67±8.61 years; all were female. An analysis of the surgical procedures performed on patients who developed wound complications revealed that 46.6% underwent oncoplastic breast surgery, 26.6% mastectomy, and 26.6% biopsy. Among the patients who had oncoplastic breast surgery, 42.8% underwent a subcutaneous mastectomy with implants, while 57.2% received level 2 glandular flaps. In the cohort of patients who underwent mastectomy, 75% had modified radical mastectomy and 25% had simple mastectomy. Additionally, localization of the wound typically occurred at the incision line and was accompanied by evisceration. Following wound bed preparation, the mean number of applications of a collagen laminin-based dermal matrix with resveratrol microparticles (Dermalix®) was 2.47±0.91, and the mean time to epithelialization was 15.33±5.43 days. Patient characteristics are summarized in Table 1.

Wound monitoring was performed on 15 samples. Because some patients improved during the study, the number of samples decreased to 12 on day 8, 6 on day 12, and 2 on day 16. The average wound size in 15 patients before application of Dermalix® was 7.87±9.21 cm^2; it decreased to 5.53±7.87 cm^2 (change -2.34±2.70) on day 4, 2.70±4.90 cm^2 (change -5.08±5.01) on day 8, 2.08±2.46 cm^2 (change -10.53±9.84) on day 12, and 1.45±1.76 cm^2 (change -21.30±16.87) on day 16.

Due to because of epithelialization-related inequalities imbalances in the data set, patients who were measured on days 4 and 8 were included in the analysis. Variance analysis of variance performed on repeated measurements showed that the wound healing process observed measured on days 4 and 8, based onrelative to initial wound sizes, exhibited a statistically significant improvement patternpattern of improvement (p=0.012). The mean reduction in wound size in sequential applicationswith sequential applications was found to be statistically significantwas statistically significant, and the cumulative effect of the wound healing process was observed to be maximalthe cumulative effect of wound healing peaked on day 8. In measurements taken on day 12, the difference in wound size compared to baseline reachedthe change in wound size from baseline was 10.53±9.84 cm^2 in six patients. In the final stage of treatment (day 16), the average wound size decreased

Table 1. Patient and wound characteristics following breast surgery

Characteristics	Mean ± SD	
Age	52.67±8.61	
Average number of dressing applications	2.47±0.91	
Wound measurement		
Pre-application measurement (n=15)	7.87±9.21	
First post-application measurement (n=15)	5.53±7.87	
Second post-application measurement (n=12)	2.70±4.90	
Third post-application measurement (n=6)	2.08±2.46	
Fourth post-application measurement (n=2)	1.45±1.76	
Time to epithelialization (days)	15.33±5.43	
	Number (n)	**Percentage (%)**
Diagnosis		
Breast cancer	11	73.4
Other	4	26.6
Surgical procedure		
Oncoplastic breast surgery	7	46.8
Mastectomy	4	26.6
Biopsy	4	26.6
Wound location		
Incision line	15	100.0
Number of wound dressing applications		
1	2	13.3
2	6	40.0
3	5	33.3
4	2	13.3

SD: Standard deviation

to 1.45±1.76 cm^2, and a total improvement of 21.30±16.87 cm^2 was achieved compared towith baseline. The characteristics of the wound healing process are presented in Table 2.

Discussion

This study found that the use of a collagen-laminin-based dermal matrix combined with resveratrol microparticles for the management of tissue defects following breast surgery may contribute to wound epithelialization. The findings show that, in wounds characterized by granulation tissue formation and a microbiologically negative wound bed, sequential use of the wound dressing produces maximal effect by day 8 (after two applications), resulting in a significant reduction in wound size.

The severity and prevalence of postoperative complications associated with breast surgery are variable and significantly related to the surgical procedure. Surgical complications may occur in the breast, at the lumpectomy or mastectomy site, or in the axillary region [4]. According to a meta-analysis investigating the effect of wound-related postoperative complications on oncological outcomes, which included 1,418 breast cancer patients, wound complications were occurred in 26.9% of patients, and the time to adjuvant therapy was statistically significantly longer in patients with wound complications, with delays ranging from an average of 1.18 to 16.21 days [6]. The importance of wound complications stems from their causing delays in adjuvant therapy among patients with breast cancer. The vast majority of patients who experienced complications also reported significant stress and anxiety [7,11]. This situation can also lead to prolonged hospital stays, increased risk of hospital-acquired infection, and higher healthcare costs. Considering these risks, effective wound management protocols are an absolute necessity. In our study sample, the reduction in wound size from the first to the last measurement, the average number of days to epithelialization, the ability to provide outpatient follow-up, and follow-ups performed by wound care professionals highlight the importance of effective wound management and wound-care product selection. Considering the negative effects on patients and healthcare services of complications following breast surgery, as reported in the literature, the correct selection of products can contribute to healing.

There is no single ideal product for the management of wound complications [12]. Given the wide range of wound-care products available, selecting a product suitable for the wound-bed characteristics and supportive of healing is critically important.

Wound care nurses and wound care specialists play an important role in this process. These professionals provide guidance on determining the type and cause of the wound, planning treatment and care goals, and managing difficult symptoms and complications. They also make important contributions to identifying factors that support wound healing through a holistic approach that includes consideration of the impacts of wounds on psychological well-being and quality of life [13]. To meet these needs, new-generation wound-care, enabled by technological developments, offer promising alternatives. One such alternative is a collagen-laminin-based dermal matrix combined with resveratrol microparticles, which we used in our research for wound management. Classified in the current literature as bioactive, these wound dressings can influence wound healing through various physiological mechanisms. These products, enriched with hyaluronic acid, honey, collagen, alginates, and polymers containing polyhexamethylene biguanide, chitin, and chitosan derivatives, create a suitable microenvironment for wound healing by providing pH regulation, moisture homeostasis, oxygen permeability, and exudate management [14]. Studies show that resveratrol stimulates collagen synthesis and fibroblast activation with its antioxidant properties, thereby supporting cellular proliferation [15]. Extracellular matrix components such as glycosaminoglycans and fibrous proteins are reported to facilitate cell migration, adhesion, and new tissue formation [9,16]. In this context, the developed collagen-laminin-based dermal matrix combined with a resveratrol microparticle formulation is reported to contain laminin, which plays a role in cell adhesion; collagen, which provides structural support; and hyaluronic acid, a glycosaminoglycan derivative; the lipid DPPC forms the microparticle structural component. In vitro studies have demonstrated that these components exhibit synergistic effects in tissue repair [10].

Clinical studies support these theoretical foundations. Gokce et al. [17] reported that a collagen-laminin dermal matrix impregnated with resveratrol-loaded hyaluronic acid-DPPC microparticles accelerated the wound healing process in a diabetic environment. In another study, Çetinkalp et al. [10] compared standard wound care with standard wound care combined with a collagen-laminin-based dermal matrix and resveratrol microparticles for 4 weeks in patients with diabetic foot wounds. At the end of the study, the wound closure rates were 57.82% in the dressing group and 26.63% in the standard care group. Statistical analyses showed that a collagen-laminin-based dermal matrix combined with resveratrol microparticles promoted rapid wound healing and reduced parameters of oxidative stress [10]. In line with

Table 2. Wound healing measurement results

	Initial wound size	Day 4 wound size	Day 8 wound size	Wilks' lambda distribution	F	p
Wound size	7.87±9.21	5.53±7.87	2.70±4.90	0.476	8.330	**0.012**
Difference compared to the beginning	-	-2.34±2.7	-5.08±5.01			

Analysis of variance in repeated measurements

these findings, the current literature supports the use of this wound dressing as a effective therapeutic agent in diabetic wound healing and in colonic anastomotic dehiscence [9,10,17]. No studies have evaluated the role of a collagen-laminin-based dermal matrix combined with resveratrol microparticles in wound complications following breast surgery. This study is the first to evaluate the therapeutic role of collagen laminin-based dermal matrix combined with resveratrol microparticles in wound complications after breast surgery. A characteristic feature of our study is that the patient population consists predominantly of cases with wound complications after breast cancer surgery.

The findings suggest that a collagen-laminin-based dermal matrix combined with resveratrol microparticles may have an alternative role in the management of wound complications after breast surgery, with clinical advantages such as shortening the time to start adjuvant therapy, enabling outpatient follow-up, and accelerating epithelialization. Furthermore, our study emphasizes the importance of specific wound-bed conditions to achieve the optimal effect of a collagen- and laminin-based dermal matrix combined with resveratrol microparticles. Specifically, this wound dressing was found to be effective in wound beds where granulation tissue was present and microbiological contamination was eliminated. Objective measurements showed that sequential applications of a collagen-laminin-based dermal matrix combined with resveratrol microparticles resulted in a statistically significant reduction in wound size on day 8 (after two consecutive applications). This finding suggests that the dressing has a cumulative effect on wound healing over time and that a clean, granulated wound bed is critical for optimal results. Similarly, the literature reports that wound bed preparation and control of microbial load increase the effectiveness of wound care [18].

Study Limitations

However, our study has some methodological limitations. The single-center design and relatively small sample size, along with substantial attrition over time, limit the generalizability of the results. Furthermore, the availability of the product and lack of coverage by reimbursement schemes may limit patient access in clinical practice and increase costs. These limitations indicate the need for future multicenter randomized controlled trials with larger sample sizes.

Conclusion

This study is the first to evaluate the role of a collagen-laminin-based dermal matrix combined with resveratrol microparticles in wound complications following breast surgery. sequential collagen-laminin-based dermal matrix combined with application of resveratrol microparticles in granulated, microbiologically clean wound beds showed the maximal effect on day 8, resulting in a significant reduction in wound size. With its clinical advantages such as minimizing delays to adjuvant treatment and enabling outpatient follow-up, this dressing may serve as an alternative in the management of wound complications following breast surgery. Due to the single-center design and limited sample size, multicenter randomized controlled trials are needed.

Ethics

Ethics Committee Approval: Institutional approval was obtained from the University of Health Sciences Türkiye, Gülhane Scientific Research Ethics Committee (decision no: 2025-283, date: 03.06.2025).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.A., K.İ., K.B.Y., M.A.G., Concept: S.A., H.E.G., İ.B.B., M.T., E.E., Ş.B.M., M.A., K.B.Y., M.A.G., Design: S.A., K.İ., H.E.G., İ.B.B., M.T., E.E., Ş.B.M., M.A., K.B.Y., M.A.G., Data Collection or Processing: S.A., K.İ., Analysis or Interpretation: S.A., B.K., Literature Search: S.A., B.K., İ.B.B., M.T., E.E., Ş.B.M., M.A., K.B.Y., M.A.G., Writing: S.A., B.K., H.E.G., M.A., M.A.G.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial suppor.

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