

# THE IMPORTANCE OF THE RESECTION EDGE IN THE TREATMENT OF BREAST CANCER: A LITERARY REVIEW

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## ABSTRACT

**Relevance:** Optimal surgical approaches in the treatment of breast cancer are essential for modern oncology, aiming to reduce the risk of recurrence and improve survival. This literature review analyzes the importance of edge resection in surgical breast cancer treatment. It includes an extensive analysis of scientific publications, systematizing knowledge about the clinical significance of the resection margin, its impact on recurrence risk and survival, and its role in organ-preserving operations.

**The study aimed to** evaluate the significance of the resection margin in the surgical treatment of breast cancer.

**Methods:** The research methodology included a systematic search in electronic databases, including PubMed, Web of Science, Scopus, and Cochrane Library, as well as in national scientific repositories and databases of the Republic of Kazakhstan. This approach made it possible to cover significant domestic research in the review. The search was performed using keywords and phrases including “breast cancer,” “edge of resection,” “organ-preserving surgery,” “breast cancer,” “resection margin,” “margin width,” “breast cancer recurrence,” “breast-preserving surgery” and “mastectomy.”

**Results:** The resection edge definition is key for the successful surgical treatment of breast cancer. Studies show that the molecular subtype of the tumor does not determine the status of surgical margins in patients undergoing breast preservation therapy. An adequate width of the resection margin, determined by considering clinical recommendations and patient characteristics, increases the likelihood of removing all tumor cells, reducing the risk of recurrence and increasing the chances of long-term remission.

**Conclusion:** The importance of the resection margin in the treatment of breast cancer remains the subject of active research and discussion. Although there is much data, there are still contradictions regarding the optimal width of the resection margin and its effect on recurrence and survival. Most studies confirm the importance of adequate resection margin width to reduce the risk of local recurrence, especially during organ-preserving operations. Modern innovative methods such as intraoperative imaging and advances in molecular biology and genetics of breast cancer help to improve the definition of the resection edge.

**Keywords:** oncology, surgery, organ-preserving surgery, relapse, mastectomy.

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**Introduction:** Breast cancer is one of the most pressing and prevalent oncological diseases affecting women globally. Notwithstanding considerable progress in diagnostics and therapy, breast cancer continues to exhibit a high incidence of recurrence and metastasis, rendering the search for optimal treatment strategies highly pertinent.

Breast cancer is the predominant cause of mortality among women and ranks as the fifth largest cause of cancer-related deaths globally. In 2020, there were 2.3 million new instances of cancer, including 11.7% of all new cancer cases, and 684,996 fatalities attributed to the disease. Asia has the predominant proportion, with 1,026,684 (45.4%) of new cases and 345,559 (50.4%) of deaths globally [1].

The analysis of morbidity and mortality associated with malignant neoplasms underpins regional and national cancer control initiatives and is crucial for the validation of disease prevention strategies, early diagnostic approaches, and the development of screening programs. The morbidity and mortality rates of breast cancer vary across high-risk and low-risk countries, with some discrepancies attributable to the efficacy of reporting and screen-

ing practices. Epidemiological studies of breast cancer enable the identification of goals and objectives for disease prevention programs, including the planning of screening and diagnostic measures for early disease detection, as well as the development of efficiency indicators and assessment of program implementation outcomes [2].

A critical component of effective breast cancer treatment is surgery aimed to excise the tumor to the greatest extent possible while conserving good tissue [3]. In surgical treatment, the resection margin, i.e., the distance from the tumor's edge to the surrounding healthy tissue, is critically significant. Determining the ideal width of the resection margin continues to be a topic of extensive research and debate within the medical community. An excessively narrow margin may result in the persistence of tumor cells within the body, consequently leading to disease recurrence. In contrast, an overly broad margin can adversely impact patients' quality of life by increasing the procedure's invasiveness and compromising additional healthy tissues. In 2018, A. Nurmanova et al. observed that recurrences of breast cancer correlate with a substantial reduction in patient survival [4].

The challenge of establishing optimal resection margin criteria is further complicated by advancements in breast cancer treatment, such as organ-preserving surgery and the implementation of cutting-edge radiation and chemotherapy methods. The correlation between resection margin width and recurrence risk, the necessity for a tailored treatment strategy, and the pursuit of an optimal equilibrium between tumor excision efficacy and patient quality of life are pivotal elements of contemporary research in this domain. In 2022, L. Zh. Sultonova et al. provided a comprehensive account of breast cancer recurrences in the initial stages of the disease. The study findings demonstrate that even with initial-stage breast cancer detection, the likelihood of disease recurrence is a minimum of 5%. It underlines the necessity of meticulous surveillance and subsequent therapy, even with early cancer detection, to reduce the likelihood of recurrence [5].

This literature analysis aims to analyze the current scientific findings about the importance of the resection margin in breast cancer treatment. Special emphasis is placed on the study of clinical trials, the assessment of guidelines from prominent oncology organizations, and the analysis of statistical data about the impact of resection margin width on prognosis and treatment results. This work will consolidate existing scientific knowledge in this field, pinpoint deficiencies in current research, and delineate future scientific endeavors to enhance breast cancer treatment's efficacy while optimally preserving patients' quality of life.

**The study aimed to** evaluate the significance of the resection margin in the surgical treatment of breast cancer.

**Materials and methods:** During the preparation of this literature review, a thorough method intended to discover and assess scientific literature was employed to identify and systematize data about the impact of resection margin width on breast cancer treatment results. A careful selection of keywords and their combinations was conducted, encompassing such terms as "breast cancer," "resection margin," "organ-preserving surgery," "resection margin," "margin width," "breast cancer recurrence," "breast-conserving surgery," "mastectomy," "local disease control," "oncological outcomes," "quality of life," along with more specific terminology pertinent to treatment outcomes and surgical methodologies. This procedure utilized Boolean operators to formulate intricate queries that enhance and streamline database searches.

The chosen databases for the search emphasized esteemed medical and biological resources, including PubMed, Web of Science, Scopus, and Cochrane Library. These databases were selected due to their extensive coverage, relevancy of content, and the availability of tools for comprehensive searches. Upon formulating the search queries, the search procedure was customized to the particularities of each database, employing their own filtering and searching capabilities, utilizing keywords in titles, abstracts, and full-text articles. Alongside interna-

tional databases, supplementary searches were conducted in national scientific repositories and databases, enabling the incorporation of significant domestic research into the review, thus enhancing a comprehensive and nuanced understanding of the topic. This methodology ensured a thorough examination of the subject, considering both global and national experiences in breast cancer treatment.

A manual search was conducted in the reference lists of selected papers to find additional pertinent research that may have been overlooked in the computerized search procedure. The cross-referencing process facilitated the identification of substantial work that may have been overlooked due to the constraints of search engines. After identifying potentially appropriate papers by their titles and abstracts, the full texts underwent a comprehensive examination for ultimate selection based on established criteria. The criteria encompassed the accessibility of original data, a detailed account of the study methodology, and an emphasis on examining resection margins in breast cancer. The investigation concentrated on methods for assessment of the resection margin, the influence of margin size on treatment results, and pertinent clinical guidelines.

Each chosen article underwent a comprehensive assessment to evaluate the study methodology, the trustworthiness of the data, and the relevance of the conclusions for breast cancer therapy practice to guarantee the high quality of the analysis. Special focus was devoted to studies addressing various facets of resection margins, encompassing their dimensions, assessment methods, and influence on recurrence risk and overall patient survival. The literature selection and analysis methodology included verifying each article by two independent specialists to reduce the likelihood of overlooking critical information and subjective data interpretation. A third expert was called to achieve consensus in a disagreement among experts. The acquired data were combined to establish a comprehensive overview of the current scientific knowledge regarding resection margins in breast cancer, pinpoint deficiencies in existing research, and delineate directions for future scientific inquiry.

#### **Results:**

*Concept of the resection margin in breast cancer surgery.* The assessment of the resection margin is crucial in the surgical management of breast cancer and significantly influences treatment outcomes. The resection margin is defined as the distance between the periphery of the excised tumor and the closest boundary of the post-surgery residual healthy tissue. This parameter functions as a metric for the thoroughness of tumor tissue excision and is a critical indicator of treatment quality since it directly correlates with the risk of local recurrences (LR) of the disease. I. Horattas et al. (2022) showed that the molecular subtype of breast cancer does not forecast the status of surgical margins in patients receiving breast-preserving therapy. The research indicated that the selection of surgical approach

should not be contingent upon the genetic subtype of the tumor [6].

Research conducted by E.A. Bonci et al. in 2021 assessed the impact of surgical resection margin width (SRMW) on the probability of local recurrence following lumpectomy in patients with triple-negative breast cancer, a notably aggressive subtype. The study involved 92 individuals who received lumpectomy between 2005 and 2014, including a median tumor size of 2.5 cm and no distant metastases at diagnosis. The majority of patients underwent neoadjuvant and/or adjuvant chemotherapy in addition to adjuvant radiotherapy targeting the entire breast. Following a median follow-up duration of 110.7 months, there were five local recurrences and eight regional/distant recurrences, resulting in an overall incidence of 5.4% of LR. The likelihood of local and long-term recurrence was comparable across groups with varying SRMWs. The findings validate the safety of the “no ink on the tumor” methodology for individuals with triple-negative breast cancer [7].

An adequate resection margin width, defined by clinical guidelines and the particulars of each case, substantially increases the likelihood of complete tumor cell removal. The objective of surgical intervention is accomplished - it reduces the danger of residual tumor foci, enhancing the likelihood of long-term remission. A comprehensive review and meta-analysis of 68 studies involving 112,140 patients who underwent conservative breast surgery for early invasive breast cancer identified a correlation between resection margin involvement and an increased risk of long-term recurrence. Positive margins were observed in 9.4% of patients, leading to delayed recurrences in 25.4% of instances, whereas in patients with negative margins, the rate was 7.4%. Narrow margins (under 2 mm without tumor cells) correlated with distant recurrences in 8.4% of instances. The compromised margins elevated the probability of long-term recurrences by 2.1 times and local regional recurrences (LRRs) by 1.98 times compared to negative margins, whereas nearby margins increased this risk by 1.38 times and 2.09 times, respectively [8].

The study by A. Bodilsen et al., which involved 11,900 patients receiving breast-conserving invasive cancer treatment, showed a cumulative tumor recurrence rate of 2.4% in the same breast at 5 years and 5.9% at 9 years. Positive surgical margins elevated the recurrence risk by 2.51 times (95% CI 1.02-6.23). The negative margin width did not influence the recurrence risk (HR for margins >0 to <2 mm versus  $\geq 2$  to <5 mm versus  $\geq 5$  mm – 1.54 (95% CI 0.81–2.93) versus 0.95 (95% CI 0.56–1.62) versus 1). A positive surgical margin markedly elevates the likelihood of tumor recurrence in the same breast, whereas the extent of negative margins does not influence recurrence risk, hence contributing to the increasing prevalence of organ-preserving surgery in recent years [9].

No universal standard exists for identifying the best resection margin width, as each clinical case is distinct and

necessitates a tailored strategy. A positive or narrow resection margin, defined as the presence of tumor cells near the resection border or in its immediate proximity, is considered an adverse factor [10, 11]. This circumstance correlates with an elevated risk of recurrence because of the increased probability of residual tumor cells in the remaining breast tissue. In the study, M. Pilewskie and M. Morrow 2019 examined the ideal negative resection margin widths for the surgical management of invasive cancer and ductal carcinoma in situ (DCIS) to reduce the chance of LRR. The study shows that a 2 mm margin reduces the chance of LRR in women with DCIS having lumpectomy and radiation therapy due to variations in growth patterns and systemic therapy application [12].

The significance of meticulous assessment of the width of the resection margin is underscored by its influence on the ensuing treatment strategy. In certain instances, if a limited resection margin is identified, further surgery may be necessary to enlarge the resection or to employ adjuvant therapy, such as radiation, to reduce the likelihood of recurrence. Such judgments are predicated on a complex review of the clinical presentation, disease stage, histological tumor type, and additional criteria, underlining the multifaceted approach to breast cancer treatment.

The significance of establishing the resection margin in the surgical management of breast cancer is underestimated. Clinicians must be exceptionally vigilant and exact during surgery, considering that the resection margin width correlates with other treatment factors and influences overall patient outcomes.

*Clinical importance of the resection margin width.* The resection margin width is crucial in several parameters that influence the efficacy of surgical treatment for breast cancer. The optimal width of resection margins correlates directly with a diminished risk of LR, hence enhancing overall patient survival. The significance of obtaining an appropriate width of the resection margin is particularly apparent in organ-preserving surgeries, such as lumpectomy and quadrantectomy, which seek to optimize the preservation of the mammary gland while ensuring effective oncological control.

The sufficiency of the resection margin width is assessed by the complete excision of all visible tumor cells, accompanied by an adequate margin of healthy tissue, hence preventing the retention of residual tumor cells within the patient's body. This method reduces the probability of disease recurrence at the main tumor location and enhances the chances of sustained remission. Oncologists and surgeons agree that an appropriate resection margin is essential for a favorable treatment outcome, particularly in organ-preserving operations. The excessive excision of healthy tissue to attain “wide” resection margins can adversely impact patients' quality of life, resulting in alterations to breast morphology, functionality, and overall body image perception.

The study conducted by D. Livingston-Rosanoff et al. (2021) demonstrates that in cases of DCIS with narrow resection margins (less than 2 mm), the recurrence likelihood was 19%. However, following routine resection to margins above 2 mm, this probability diminished to 11%. The data underscore the clinical importance of adequate resection margin width in DCIS surgery [13].

As per M. Mrdutt et al. (2021), among patients who received breast-conserving surgery following neoadjuvant chemotherapy, the 4-year chance of LR was 2%. Furthermore, no statistically significant difference in recurrence likelihood was observed between groups with resection margins exceeding 2 mm and those with margins less than 2 mm. This outcome suggests the possibility of customizing the method to establish margin widths based on certain clinical circumstances [14].

J. Bundred et al. demonstrated in a 2022 systematic review that patients with positive resection margins had a 33.1% chance of distant recurrence, whereas those with negative margins exhibited a markedly reduced risk of 7.3%. These findings validate the significance of attaining negative resection margins to mitigate the incidence of both local and distant recurrences [15].

Research conducted by B. Koca et al. (2022) demonstrated that intraoperative assessment of surgical margins decreased the necessity for revision procedures from 18.5% to 0%. This outcome underlines the significance of intraoperative margin assessment in enhancing surgical results and preventing the necessity for further surgical procedures [16].

These trials together underscore the clinical importance of establishing the ideal resection margin width in breast cancer management. They show the necessity for a personalized approach in establishing margin widths, grounded in a thorough analysis of clinical data and prognostic factors, considering tumor type, response to preoperative treatment, and other significant clinical characteristics. Consequently, a crucial element in surgical practice is the balance between obtaining a sufficient resection margin width and conserving maximal healthy tissue [17]. It necessitates that surgeons possess advanced ability and experience, along with meticulous planning of the surgical procedure, considering the unique characteristics of the tumor and the breast anatomy of each patient. The significance of this balance is underscored in contemporary treatment protocols, which advocate for a personalized strategy for each instance of breast cancer. Enhancing the width of the resection margin not only augments oncological results but also preserves patients' quality of life, rendering it a crucial component of a comprehensive breast cancer therapy strategy.

*Clinical guidelines regarding the resection margin width.* Numerous professional groups engaged in breast cancer treatment have issued guidelines regarding the ideal width of the resection margin. The American Society of Clinical Oncology (ASCO), the National Comprehensive

Cancer Network (NCCN), and the European Society for Medical Oncology (ESMO) are the preeminent organizations that have established these guidelines.

The ASCO regulations stipulate that the resection margin must be negative, indicating the absence of invasive tumor or non-invasive malignancy in situ. ASCO does not establish a specific minimum distance for the resection margin. The NCCN recommendations stipulate that the resection margin must be a minimum of 2 mm for invasive cancer and at least 5 mm for non-invasive in situ cancer. ESMO advises a resection margin of no less than 1 mm for invasive cancer and a minimum of 2 mm for non-invasive cancer in situ. In the study conducted in 2021, A. Tremelling et al. studied the effects of the 2016 consensus guidelines that established a 2 mm free margin as the standard for negative margins in patients undergoing lumpectomy for DCIS. The objective of the advice was to standardize the procedures for recurrent operations. A retrospective analysis of patient records was conducted to assess margin status and revision rates two years before and after the guideline's publication to assess its effect on revision rates within the hospital. Notwithstanding a minor reduction in the overall revision rate, the percentage of patients with narrow margins who received revision surgery rose following the issuance of the guideline. This study indicates that the issuance of the guidelines had minimal influence on the practices of their establishment since many surgeons' practices were already aligned with the guidelines' recommendations before 2016 [18].

Nonetheless, there are problems with the interpretation of the guidelines. The analysis of clinical guidelines from multiple organizations about breast cancer treatment disclosed methodological quality and relevance variations. The ASCO and CCO PEBC recommendations received superior ratings relative to the NCCN and St. Gallen guidelines. All guidelines had limited applicability, and recommendations regarding critical issues, such as using SLNB following neoadjuvant chemotherapy, were inconsistent [19]. Despite the 2 mm threshold being a universal recommendation across all guidelines, notable discrepancies were observed in the adjuvant chemotherapy and radiotherapy criteria.

*Impact of resection margin width on recurrence and survival rates.* Multiple studies have shown that a broader resection margin correlates with a reduced risk of breast cancer. This finding is only recorded in the initial phases. A study conducted by C. Shah in 2020 reported a median follow-up duration of 7.25 years, revealing that absolute LR scores diminished with time across all groups with the resection margin width from 1 mm to 5 mm, with the greatest disparity across the negative margin groups being under 1% in the last follow-up period. The comparative parameters of LR across various margin groups have exhibited consistency over time [20].

N.J. Bundred et al. assessed the correlation between resection margin width following conservative breast sur-

gery and the incidence of recurrences and survival rates in invasive breast cancer in the 2022 meta-analysis. The study, encompassing 68 investigations involving 112,140 patients, revealed that a tumor at the margin correlated with an increased probability of distant recurrence (25.4%) in contrast to negative margins (7.4%). Margins adjacent to the tumor correlated with a greater incidence of distant (8.4%) and local recurrences [21].

The study conducted by D. Livingston-Rosanoff et al. (2021) assessed the ideal width of resection margins in patients with DCIS having lumpectomy. The research examined data from 559 patients who underwent the procedure between 1997 and 2006, with follow-up extending to 2016. In this study, narrow resection margins (< 2 mm) correlated with an increased incidence of LRR, irrespective of radiation therapy. The total incidence of LRR was 12%, with relapses occurring more frequently in those who did not undergo radiotherapy (19% compared to 11% among those who did). The findings confirm that multiple resections before achieving margins exceeding 2 mm may diminish the recurrence risk in patients with DCIS [22]. The results underscore the significance of adequate resection margin width to reduce recurrence risk and enhance survival in breast cancer patients.

Intraoperative ultrasound evaluation of margins can effectively reduce positive superficial margins in the nipple and skin-preserving mastectomy for breast cancer patients, enhancing surgical precision and minimizing disease recurrence risk [23].

In the study by S.J. Schnitt et al. (2020), a resection margin less than 2 mm wide correlated with inferior disease-free survival but did not affect overall survival. This could be because LRs are often successfully re-treated without significantly impacting overall survival rates [24].

The precise correlation between margin width and recurrence risk is still under discussion. Certain studies indicate a linear correlation; however, others propose that further increases in margin do not contribute to a decreased risk of recurrence once a specific threshold width is attained. Intraoperative approaches for assessing resection margins can substantially diminish the chance of recurrence.

**Discussion:** The effect of resection margin width on overall and recurrence-free survival in breast cancer patients is a contentious topic. Certain studies indicate a positive correlation between broader resection margins and enhanced survival; others have identified no relationship.

The excision of a cavity or specimen during lumpectomy for breast cancer is a crucial component of surgical intervention designed to provide clear resection margins and reduce the likelihood of disease recurrence [25]. The impact of resection margin width on survival may differ based on the biological characteristics of the tumor, adjuvant therapy protocols, and other prognostic variables.

The study conducted by L.M. DeStefano et al. (2021) assessed patients with invasive stage I-III breast cancer who

had undergone partial mastectomy and re-surgery between July 2010 and June 2015 to discover clinical markers that indicated the presence of residual disease in the lumpectomy bed. Among the 184 patients, 47% exhibited persistent illness following re-surgery. The tumor and node stage, surgical type, disease type at the margins, and quantity of positive margins were substantially correlated with residual disease. Multivariate logistic regression study indicated that only DCIS at the margin, the surgical type (partial mastectomy with cavity margins), and the number of positive margins (3 or more) predict residual disease necessitating reoperation. These data can assist surgeons in determining the necessity of a subsequent procedure [26].

*Organ-preserving procedures and the resection margin.* In organ-preserving procedures like lumpectomy or quadrantectomy, obtaining a sufficient resection margin is essential to reduce the risk of LR and preserve cosmetic appearance. These operations prioritize breast preservation, making it essential to get a negative resection margin of enough width for effective cancer control.

Another study by J. Lin et al. (2020) examined the application of conservative surgery following neoadjuvant chemotherapy within a single medical organization, emphasizing the correlation between the microscopic condition of resection margins and the likelihood of LRR. Analysis of data from 161 patients who underwent partial mastectomy indicated that 28 patients had resection margins of less than 1 mm, 21 patients had margins of 1 to 2 mm, and 112 patients had margins above 2 mm. LRRs occurred in 16 patients (9.9%) and distant metastases – in 27 (16.8%). The Kaplan-Meier statistical analysis revealed no significant disparity in recurrence rates between the groups with margins exceeding or less than 2 mm. Furthermore, categorizing patients into groups with margins above and less than 1 mm found no significant difference in recurrence-free survival. The findings highlight that the lack of tumor presence at the resection margins may suffice to avert recurrence in patients with stages I-III of invasive breast cancer undergoing neoadjuvant chemotherapy and conservative surgery, provided there are no multiple microscopic tumor foci [27].

K. Wimmer et al. (2020) analyzed the data from 406 patients with invasive breast cancer who received neoadjuvant chemotherapy and conservative breast therapy in Austrian medical centers between 1994 and 2014. Local Recurrence-Free Survival (LRFS), disease-free survival (DFS), and overall survival (OS) were compared among groups with resection margins of < 1 mm, > 1 mm, and those with pathological complete response (pCR). At a median follow-up duration of 84.3 months, no significant differences were observed in LRFS, DFS, and OS among narrow, wide, and undefined margins following pCR [28].

In the research, H. Kim et al. (2024) examined the efficiency of personalized radiation doses for resection margins under 2 mm and the optimal margin width for high-risk DCIS. A retrospective review of 137 patients

who underwent neoadjuvant radiotherapy following breast-conserving surgery for DCIS from 2013 to 2019 revealed that the median radiation doses for the groups with positive, approximate ( $< 2$  mm), and negative ( $\geq 2$  mm) margins were 66.25 Gy, 61.81 Gy, and 59.75 Gy, respectively. The LR rates for these groups were 15.0%, 6.7%, and 4.6%. The positive margin group exhibited markedly inferior 5-year LRFs compared to the approximate and negative margin groups (84.82%, 93.27%, and 93.20%, respectively;  $p=0.008$ ). It was also shown that the disparity in 5-year LRFs between patients with well-differentiated tumors and those with poorly differentiated tumors diminished when margin width increased. Modifying the radiation dose according to margin width shows that positive margins diminish local control efficacy relative to negative margins, although the differences among approximate margins lack statistical significance. The ideal resolution for high-risk DCIS was to obtain distinctly negative margins ( $\geq 2$  mm) [29].

The probability of LRR is contingent upon lymph node involvement and tumor aggressiveness. Axillary metastases and resection margins are significant indicators of LLR in breast cancer patients. The study conducted by O.O. Ayandipo et al. (2022) investigates the predictive significance of positive lymph nodes, lymph node index, and resection margins on the survival of women undergoing breast cancer treatment at the Department of Oncosurgery, University College Hospital, Ibadan, from December 2009 to December 2014. An examination of the Ibadan Population Cancer Registry for 2012 found that the incidence of breast cancer was 52.0 cases per 100,000 individuals. The patient cohort exhibited a predominance of advanced cancer, a high malignancy grade of tumors, and a negative response to hormone receptors, indicating a prevalence of an aggressive disease phenotype. Ultimately, it was determined that the existence of positive resection margins in patients treated at a tertiary care facility in Ibadan, Nigeria, correlated with an increased risk of LLR in breast cancer. 72.4% of research participants had negative resection margins following modified radical mastectomy, underlining the need to obtain negative margins during surgery to reduce the risk of LLR [30].

Lumpectomy is an established therapeutic approach for the initial phases of invasive breast cancer. The status of the surgical margin substantially influences the probability of LR. Achieving a negative lumpectomy margin is difficult because of the many risks and predictors of a positive margin that the radiologist must be familiar with. The contributions of the pathologist and surgeon in minimizing the incidence of failure during breast preservation procedures are crucial. Despite the widespread use of imaging, the limitations of standard intraoperative radiographs must be considered. A negative resection margin during lumpectomy diminishes the probability of LR, enhances cosmetic outcomes, and increases long-term survival rates [31].

*Assessment of the efficacy of organ-preserving procedures based on the resection margin width.* Multiple studies indicate that adherence to the recommended width of the resection margin allows organ-preserving surgery to achieve survival rates comparable to those of radical mastectomy while also maintaining the mammary gland and enhancing esthetic results [32].

A comprehensive analysis of the national database conducted by W.J. Hotsinpiller et al. (2021) shows that merely 5% of individuals receiving breast-conserving surgery are in danger of having a positive operative margin. Patients with invasive lobular histology exhibit nearly double the likelihood of positive resection compared to those diagnosed with invasive ductal carcinoma. Elevated HER2 levels augment the likelihood of a positive surgical margin, although the degree and status of estrogen and progesterone are not substantially associated with this parameter. These findings offer essential insights for counseling patients regarding the dangers and the necessity for revision surgery in individuals opting for conservative breast treatment in contemporary clinical practice [33].

International guidelines for invasive breast cancer or DCIS recommend adherence to appropriate resection margins. An examination of 13 guidelines and 31 research conducted from 2011 to 2016 uncovered variations in defining positive resection margins in clinical practice, from the localized presence of cancer cells to a 3-5 mm distance from the resection margin. Research involving 59,979 patients established that the overall frequency of positive resection margins for invasive breast cancer varied between 9% and 36%, while for DCIS, it ranged from 4% to 23%. For invasive breast cancer, the prevailing standards posit that the absence of a tumor at the margins of excised tissue is adequate. However, the guidelines for DCIS are less rigorous. Due to the variation in tumor boundary definitions among countries, quality control data represented as rates of positive resection margins or recurrences must be interpreted with caution. Moreover, the general definition of a positive resection margin has become more permissive in both invasive carcinoma and DCIS, underlining the necessity for additional research and refinement of the criteria for assessment [34].

Conventional breast-conserving surgery (CBCS) combined with postoperative radiation therapy continues to be the primary approach for locoregional treatment in early-stage breast cancer, yielding survival rates comparable to those of mastectomy. The efficacy of CBCS relies on the thorough excision of the tumor, ensuring sufficient surgical margins, preserving the breast's natural contour, and enhancing patient satisfaction. Nevertheless, in certain instances, CBCS fails to yield satisfying cosmetic outcomes, prompting the advancement of novel breast surgical methods, such as oncoplastic breast surgery (OBS).

Achievement of an acceptable resection margin may be more difficult in organ-preserving surgeries than in mastectomy, highlighting the necessity for meticulous planning and execution by skilled surgeons.

*Contemporary methodologies for assessment of the resection margin.* In recent years, innovative techniques have been developed to improve the accuracy of resection edge detection during surgery. One of these methods is biophotonic technology. Biophotonic technologies, including photoacoustic imaging and Raman spectroscopy, are emerging as viable intraoperative instruments for evaluating surgical margins in lumpectomy at microscopic and macroscopic levels [36].

Preoperative modalities such as MRI and CT are also effective. Selective use of preoperative MRI improves margin status after lumpectomy in patients with invasive breast cancer. Microcalcifications, architectural deformities, elevated mammographic density (>75%), lobular histology, and substantial tumor size were correlated with positive resection margins (>4 mm), indicating the necessity for preoperative MRI. Assessment of these characteristics before surgery might enhance planning and diminish the likelihood of positive margins following lumpectomy. It was determined in a multivariate regression analysis involving 2,483 patients with invasive breast cancer that preoperative MRI correlated with a decreased likelihood of positive resection margins following lumpectomy. Factors independently correlated with favorable resection margins included lobular histological type, substantial tumor size, elevated breast density on mammography, microcalcification, and architectural deformities. Consequently, preoperative MRI may effectively mitigate the likelihood of positive resection margins in lumpectomy, whereas specific mammography and tumor attributes can be utilized to evaluate the risk [37].

Contemporary methods, including scanning microscopy with deep ultraviolet fluorescence contrast, enable rapid and precise viewing of tissue surfaces, differentiating between malignant and normal/benign regions. The implementation of automated deep learning methods utilizing features derived from convolutional neural networks markedly enhances the efficiency of intraoperative evaluation of breast cancer margins, achieving high accuracy (95%) and sensitivity (100%) on samples acquired through scanning microscopy with deep ultraviolet fluorescence contrast [38].

Quantitative micro-elastography (QME) is an imaging technology that reveals tissue stiffness at the microscopic level and has shown a high diagnostic accuracy of 96% in identifying cancer in excised surgical tissues [39].

Micro-CT demonstrated a comparable incidence of positive margins to conventional specimen palpation and radiography; however, challenges differentiating radiodense fibroglandular tissue from malignancy resulted in an elevated rate of false-positive margin assessments [40, 41]. High-frequency ultrasonic waves (22-41 MHz) were used for the analysis with the help of both the pulse-echo approach and the "catch" and "through-pass" methods, which have also exhibited high efficacy in identifying malignant cells [42].

A promising approach involves the use of fluorescence methods. This approach facilitates intraoperative assess-

ment of resection margins, yielding more precise information regarding the presence of tumor cells at the peripheries of the excised tissue. This study assessed the feasibility and accuracy of near-infrared fluorescence imaging technology for margin evaluation in conservative breast cancer surgery. A study was conducted with the participation of 43 patients who underwent surgical procedures. The near-infrared fluorescence image exhibits high sensitivity and specificity for the assessment of margins in conservative breast cancer surgery, affirming its potential as an intraoperative diagnostic and therapeutic tool, ensuring precise determination of surgical margins, and serving as a crucial guide for the conservative treatment of breast cancer [43].

Gamma-glutamyl hydroxymethyl rhodamine green (gGlu-HMRG) is recognized as a compound that can elicit fluorescence in breast cancers. A dependable and reproducible methodology has been established using this chemical to quantify fluorescence levels for enhanced tumor identification [44].

*Future research prospects.* Notwithstanding extensive studies on the resection margin in breast cancer, many gaps remain and require addressing in future studies. A notable gap exists in comprehending the significance of the resection margin concerning various molecular subtypes of breast cancer.

Moreover, additional research is required to explore the relationship between resection margin width and other prognostic and therapeutic variables, including tumor biological features, adjuvant therapy protocols, and radiotherapy utilization (Table 1).

Continuing research to ascertain the ideal resection margin width for several clinical settings, including organ-preserving procedures, revision surgeries following a positive margin, and various disease stages, is also crucial.

*Recommendations for subsequent investigations of the resection margin.* Future research ought to concentrate on creating more precise and reproducible methods for assessing the resection margin, including intraoperative imaging and confocal microscopy, which have been previously detailed. Implementing these novel strategies can enhance the precision of resection margin evaluation and increase the accuracy of the surgical procedure.

Moreover, additional research integrating resection margin width data with the tumor's molecular and genetic attributes is essential. Such investigations can facilitate the development of more individualized strategies for ascertaining the ideal resection margin width for particular individuals, contingent upon the biological features of their tumors.

A significant direction for future investigation is examining the impact of resection margin width in conjunction with other variables, including adjuvant therapy protocols and the application of radiation therapy. These integrated methodologies can assist in the determination of the most effective treatment solutions for various clinical situations.

**Table 1 – Summary of resection margin data in breast cancer treatment**

Division	Principal conclusions
The notion of the resection margin	- The resection margin indicates the thoroughness of tumor excision and the likelihood of local recurrences. - A positive or narrow margin elevates the chance of recurrence.
Clinical significance of margin width	- Adequate margin width diminishes the likelihood of recurrence and enhances survival rates. - A compromise must be achieved between margin width and the preservation of breast tissue.
Clinical protocols	- Various standards exist for the minimum margin width, ranging from 1mm to 5mm. - The recommendations exhibit methodological discrepancies and contradictions.
Impact of margin width on recurrence and survival rates	- A broader margin correlates with a diminished likelihood of local recurrence. - The effect on overall and recurrence-free survival is more disputable.
Organ-preserving surgical procedures	- Attaining a sufficient margin is essential for disease management - Contemporary imaging methodologies enhance the precision of margin estimation

Furthermore, extensive prospective studies with prolonged follow-up durations are necessary to evaluate the impact of resection margin width on the long-term survival of breast cancer patients more precisely. Studies should be meticulously developed to control for potential confounding variables and employ consistent data measurement and analysis methodologies.

Studies shall continue to optimize organ-preserving surgeries to achieve an optimum resection margin width. Such studies can include developing novel surgical techniques, implementing innovative imaging methods, and improving surgical planning using computer simulation.

Future studies should aim to elucidate the significance of the resection margin concerning diverse biological, clinical, and therapeutic aspects while also formulating individualized strategies to ascertain the ideal resection margin width for each breast cancer patient.

**Conclusion:** The resection margin significance in breast cancer treatment remains a topic of ongoing debate and investigation. Notwithstanding the substantial amount of data accumulated, there is controversy and disagreement regarding the resection margin optimal width, its impact on recurrence and survival, and the role of other factors such as tumor biologic characteristics and adjuvant therapy regimens.

Nevertheless, most research affirms that achieving an adequate resection margin width is essential to minimize the risk of LLR, particularly in organ-preserving surgery. The precise threshold level associated with an acceptably low recurrence risk is still a subject of discussion.

Modern innovative methods, like intraoperative imaging and confocal microscopy, provide enhanced opportunities for precise resection margin assessment during surgery. Furthermore, advances in molecular breast cancer biology and genetics contribute to a better understanding of the role of resection margin and its connection with tumor biological characteristics.

Further advances in this area require extensive prospective research with a long follow-up period, standardized data measurement and analysis methods, and a thorough control of potential bias factors. This research shall examine the relationship of the resection margin width

with other prognostic and therapeutic parameters, including tumor biology, adjuvant therapy protocols, and radiation therapy utilization.

It is also important to continue developing tailored approaches to determining the resection margin width ideal for each patient based on molecular and genetic features of their tumors. This could enhance the efficacy of surgical interventions and improve outcomes for patients with breast cancer.

In general, despite the existing challenges and controversies, continued study on resection margins is essential to improve surgical approaches and achieve better breast cancer treatment results.

### References:

- Igissin N., Toguzbayeva A., Khamidullina Z., Telmanova Zh., Bilyalova Z., Kudaibergenova I., Muratbekova S., Igissinova G., Rustemova K., Kulmirzayeva D., Syzdykov N., Taszhanov R., Turebayev D., Orazova G., Kassenova D., Detochkina V., Baibosynov D., Kuandykov Y. *Epidemiology of breast cancer mortality in Kazakh Daulat stan, trends and geographic distribution // Asian Pac. J. Cancer Prev. – 2023 –Vol. 24(10). – P. 3361-3371. <https://doi.org/10.31557/APJCP.2023.24.10.3361>*
- Igissinov N., Toguzbayeva A., Turdaliyeva B., Igissinova G., Bilyalova Z., Akpolatova G., Vansvanov M., Tarzhanova D., Zhantureyeva A., Zhanaliyeva M., Almabayeva A., Tautayev A. *Breast cancer in megapolises of Kazakhstan: epidemiological assessment of incidence and mortality // Iran J. Public Health. – 2019. – Vol. 48(7). – P. 1257-1264. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6708542/>*
- Dzhumabekov A.T., Talaeva Sh.Zh., Manasheva A.S. *Rekonstruktivno-vosstanovitel'nye operacii RMZh ptozirovannoj grudi: issledovanie serii sluchaev // Nauka o zhizni i zdorov'e. – 2020. – № 4. – C. 36- 39 [Dzhumabekov A.T., Talaeva Sh.Zh., Manasheva A.S. Reconstructive and restorative surgeries for breast cancer of the ptotic breast: a case series study // Science of Life and Health. - 2020. - No. 4. - P. 36-39 (in Russ.)]. <https://www.doi.org/10.24411/1995-5871-2020-10121>*
- Nurmanova A., Sultanova Z.I. Annaorazov Y.A. *Faktory i ix rol' v zaboлеваemosti, smertnosti, vyzhivaemosti pri RMZh // Vestnik KazNMU. – 2018. – №1. – C. 112-114 [Nurmanova A., Sultanova Z.I., Annaorazov Y.A. Factors and their role in morbidity, mortality, survival in breast cancer // Bulletin of KazNMU. - 2018. - No. 1. - P. 112-114 (in Russ.)]. <https://cyberleninka.ru/article/n/faktory-i-ih-rol-v-zaboлеваemosti-smertnosti-vyzhivaemosti-pri-rake-molochnoy-zhelezy>*
- Sultonova L.Zh., Xalikova F.Sh., Mamedov U.S., Baratova Sh.B. *Diagnostika i lechenie recidivov RMZh //Oriental renaissance: Innovative, educational, natural and social sciences. – 2022. – № 2. – C. 128-146 [Sultonova L.Zh., Xalikova F.Sh., Mamedov U.S., Baratova Sh.B. Diagnostics and treatment of recurrent breast cancer // Oriental renaissance: Innovative, educational, natural and social sciences. - 2022. - No. 2. - P. 128-146 (in Russ.)]. <https://oriens.uz/journal/oriensvolume-2-issue-52-2022/>*



6. Horattas I, Fenton A, Gabra J, Mendiola A, Li F, Namm J, Solomon N, Gass J, Lum S, Murray M, Howard-McNatt, M., Dupont E., Levine E, Brown E, Ollila D, Chiba A, Chagpar A. B. Does Breast Cancer Subtype Impact Margin Status in Patients Undergoing Partial Mastectomy // *Am. Surg.* – 2022. – Vol. 88(7). – P. 1607-1612. <https://doi.org/10.1177/00031348211069783>
7. Bonci E.A, Țițu Ș, Petrușan A.M, Hossu C., Gâta V.A., Ghomi M.T., Kubelac P.M., Bonci T.I., Piciu A., Cosnarovici M., Hîțu L., Kirsch-Mangu A. T., Pop D.C., Lisencu I.C., Achimaș-Cadariu P., Piciu D., Schmidt H., Fetica B. Does Surgical Margin Width Remain a Challenge for Triple-Negative Breast Cancer? // *Retrospect. Analysis. Med. (Kaunas, Lithuania)*. – 2021. – Vol. 57(3). – P. 203. <https://doi.org/10.3390/medicina57030203>
8. Bundred J.R., Michael S., Stuart B., Cutress R.I., Beckmann K., Hollecsek B., Dahlstrom J.E., Gath J., Dodwell D., Bundred N.J. Margin status and survival outcomes after breast cancer conservation surgery: prospectively registered systematic review and meta-analysis // *BMJ (Clin. Res. Ed.)*. – 2022. – Vol. 378. – Art. no. e070346. <https://doi.org/10.1136>
9. Bodilsen A., Bjerre K., Offersen B.V., Vahl P., Amby N., Dixon J.M., Ejlersen B., Overgaard J., Christiansen P. Importance of margin width in breast-conserving treatment of early breast cancer // *J. Surg. Oncol.* – 2016. – Vol. 113(6). – P. 609-615. <https://doi.org/10.1002/jso.24224>
10. Cho W.K., Choi D.H., Park W., Kim H., Cha H. Is higher dose radiation necessary for positive resection margin after breast-conserving surgery for breast cancer? // *Breast (Edinburgh, Scotland)*. – 2019. – Vol. 47. – P. 16-21. <https://doi.org/10.1016/j.breast.2019.06.005>
11. Liu P., Zhao Y., Rong D.D., Li K.F., Wang Y.J., Zhao J., Kang H. Diagnostic value of preoperative examination for evaluating margin status in breast cancer // *World J. Clin. Cases*. – 2023. – Vol. 11(20). – P. 4852-4864. <https://doi.org/10.12998/wjcc.v11.i20.4852>
12. Pilewskie M., Morrow M. Margins in breast cancer: How much is enough? // *Cancer J.* – 2018. – Vol. 124(7). – P. 1335-1341. <https://doi.org/10.1002/cncr.31221>
13. Livingston-Rosanoff D., Trentham-Dietz A., Hampton J., Newcomb P., Wilke L. Does margin width impact breast cancer recurrence rates in women with breast-conserving surgery for ductal carcinoma in situ? // *Breast Cancer Res. Treat.* – 2021. – Vol. 189. – P. 463-470. <https://doi.org/10.1007/s10549-021-06278-5>
14. Mrdutt M., Heerd A., Sevilimedu V., Mamtani A., Barrio A., Morrow M. Margin Width and Local Recurrence in Patients Undergoing Breast Conservation After Neoadjuvant Chemotherapy // *Ann. Surg. Oncol.* – 2022. – Vol. 29(1). – P. 484-492. <https://doi.org/10.1245/s10434-021-10533-w>
15. Bundred J., Dodwell D., Cuttress R., Michael S., Stuart B., Hollecsek B., Beckmann K., Dahlstrom J., Bundred. Margin involvement in invasive breast cancer leads to increased distant recurrence after breast conservation: Systematic review // *Cancer Res. N.* – 2022. – Vol. 18. – P. 7. <https://doi.org/10.1158/1538-7445.sabcs21-p3-18-07>
16. Koca B., Yıldırım M., Sağlam A. (2022). Evaluation of Surgical Margins with Intraoperative Frozen Section in Patients Undergoing Breast-Conserving Surgery: Our Clinical Experience // *Arch. Breast Cancer*. – 2022. – Vol. 9. – P. 3. <https://doi.org/10.32768/abc.202293342-345>
17. Bertsimas D., Margonis G., Sujichantararat S., Boerner T., Ma Y., Wang J., Kamphues C., Sasaki K., Tang S., Gagnière J., Dupré A., Løes I., Wagner D., Stasinou G., Macher-Beer A., Burkhart R., Morioka D., Imai K., Ardiles V., O'Connor J., Pawlik T., Poultides G., Seeliger H., Beyer K., Kaczirek K., Kornprat P., Aucejo F., Santibañes E., Baba H., Endo I., Lønning P., Kreis M., Weiss M., D'Angelica, M. Using Artificial Intelligence to Find the Optimal Margin Width in Hepatectomy for Colorectal Cancer Liver Metastases // *JAMA Surg.* – 2022. – Vol. 22. – P. 18-19. <https://doi.org/10.1001/jamasurg.2022.1819>
18. Tremelling A., Aft R.L., Cyr A.E., Gillanders W.E., Glover-Collins K., Herrmann V., Margenthaler J.A. Impact of consensus guidelines for breast-conserving surgery in patients with ductal carcinoma in situ // *Cancer Rep.* – 2022. – Vol. 5. – Art. no. 1502. <https://doi.org/10.1002/cnr2.1502>
19. Tyagi N.K., Dhesy-Thind S. Clinical practice guidelines in breast cancer // *Curr. Oncol.* – 2018. – Vol. 25. – P. 151-160. <https://doi.org/10.3747/co.25.3729>
20. Shah C., Hobbs B.P., Vicini F., Al-Hilli Z., Manyam B.V., Verma V., Jia X., Goldstein N., Recht A. The Diminishing Impact of Margin Definitions and Width on Local Recurrence Rates following Breast-Conserving Therapy for Early-Stage Invasive Cancer: A Meta-Analysis // *Am. Surg. Oncol.* – 2020. – Vol. 27. – P. 4628-4636. <https://doi.org/10.1245/s10434-020-08878-9>
21. Bundred N.J., Bundred J.R., Cutress R.I., Dodwell D. Width of excision margins after breast conserving surgery for invasive breast cancer and distant recurrence and survival // *Clin. Res.* – 2022. – Vol. 378. – Art. no. 2077. <https://doi.org/10.1136/bmj.o2077>
22. Cuzick J, Sestak I, Pinder SE, Ellis I.O., Forsyth S., Bundred N.J., Forbes J.F., Bishop H., Fentiman I.S., George W.D. Effect of tamoxifen and radiotherapy in women with locally excised ductal carcinoma in situ: long-term results from the UK/ANZ DCIS trial // *Lancet Oncol.* – 2011. – Vol. 12(1). – P. 21-29. [https://doi.org/10.1016/S1470-2045\(10\)70266-7](https://doi.org/10.1016/S1470-2045(10)70266-7)
23. Esgueva A.J., Sobrido C., Diaz-Botero S., Diez-Uriel E., Iscar T., De Miguel V., Regojo, A., Rubio I. T. Intraoperative ultrasound margin evaluation as a tool to reduce positive superficial margins in nipple and skin sparing mastectomy in breast cancer patients // *J ESJO*. – 2023. – Vol. 49(11). – Art. no. 107049. <https://doi.org/10.1016/j.esjo.2023.107049>
24. Schnitt S.J., Moran M.S., Giuliano A.E. Lumpectomy Margins for Invasive Breast Cancer and Ductal Carcinoma in Situ: Current Guideline Recommendations // *JCO*. – 2020. – Vol. 38(20). – P. 2240-2245. <https://doi.org/10.1200/JCO.19.03213>
25. Iwai Y., Prigoff, J.G., Sun L., Wiechmann, L., Taback B., Rao R., Ugras, S.K. Shaves off the Cavity or Specimen in Lumpectomy for Breast Cancer // *J. Surg. Res.* – 2022. – Vol. 277. – P. 296-302. <https://doi.org/10.1016/j.jss.2022.04.027>
26. DeStefano L.M., Coffua L., Wilson E., Tchou J., Shulman L.N., Feldman M., Brooks A., Sataloff, D., Fisher C.S. Risk factors for the presence of residual disease in women after partial mastectomy for invasive breast cancer: A single institution experience // *Surg. Oncol.* – 2021. – Vol. 37. – Art. no. 101608. <https://doi.org/10.1016/j.suronc.2021.101608>
27. Lin J., Lin K.J., Wang Y.F., Huang L.H., Chen S.L., Chen D.R. Association of surgical margins with local recurrence in patients undergoing breast-conserving surgery after neoadjuvant chemotherapy // *BMC cancer*. – 2020. – Vol. 20(1). – Art. no. 451. <https://doi.org/10.1186/s12885-020-06955-6>
28. Wimmer K., Bolliger M., Bago-Horvath Z., Steger G., Kauer-Dorner D., Helfgott R., Gruber C., Moinfar F., Mittlböck M., Fitzal F. Impact of Surgical Margins in Breast Cancer After Preoperative Systemic Chemotherapy on Local Recurrence and Survival // *Ann. Surg. Oncol.* – 2020. – Vol. 27(5). – P. 1700-1707. <https://doi.org/10.1245/s10434-019-08089-x>
29. Kim H., Kim T.G., Park B., Kim J., Jun S.Y., Lee J. H., Choi H. J., Jung C. S., Lee H. W., Lee, J.S., Nam, H. Y., Shin S., Kim S.M., Kim H. Tailored radiation dose according to margin width for patients with ductal carcinoma in situ after breast-conserving surgery // *Sci. Rep.* – 2024. – Vol. 14(1). – Art. no. 300. <https://doi.org/10.1038/s41598-023-50840-8>
30. Ayandipo O.O., Adepoju O.J., Ogun G.O., Afuwape O.O., Soneye O.Y., Ulasi I. B. Axillary nodal metastasis and resection margins as predictors of Loco Regional Recurrence in Breast Cancer Patients // *African Health Sci.* – 2022. – Vol. 22(1). – P. 115-124. <https://doi.org/10.4314/ahs.v22i1.15>
31. Tran-Harding K., Shi Q., Gibbs R., Szabunio M., Wang X. Evaluation of Margin Status of a Breast Lumpectomy Specimen: What the Radiologist Should Know // *Curr. Probl. Diagn. Radiol.* – 2019. – Vol. 48(6). – P. 599-604. <https://doi.org/10.1067/j.cpradiol.2018.10.001>
32. Mansilla-Polo M., Ruiz-Merino G., Marín-Rodríguez P., Iborra-Lacal E., Guzmán-Aroca F.M., Servet Pérez de Lema C., Marín-Hernández C., Polo-García L., Piñero-Madróna A. Cavity shaving for invasive breast cancer conservative surgery: Reduced specimen volume and margin positive rates // *Surg. Oncol.* – 2021. – Vol. 38. – Art. no. 101632. <https://doi.org/10.1016/j.suronc.2021.101632>
33. Hotsinpiller W.J., Everett A.S., Richman J.S., Parker C., Boggs D.H. Rates of margin positive resection with breast conservation for invasive breast cancer using the NCDB // *Breast*. – 2021. – Vol. 60. – P. 86-89. <https://doi.org/10.1016/j.breast.2021.08.012>
34. Brouwer de Koning S.G., Vrancken Peeters, Jóźwiak K., Bhairosing P.A., Ruers T.J. M. Tumor Resection Margin Definitions in Breast-Conserving Surgery: Systematic Review and Meta-analysis of the Current Literature // *Clin. Breast Cancer*. – 2018. – Vol. 18(4). – P. 595-600. <https://doi.org/10.1016/j.clbc.2018.04.004>
35. Hasan M.T., Hamouda M., Hashab M.K.E., Elshory A.B., Elghamry A.M., Hassan O.A., Fayoud A.M., Hafez A.H., Al-Kafarna M., Hagrass A.I., Rabea R.K., Gbreel M. I. Oncoplastic versus conventional

breast-conserving surgery in breast cancer: a pooled analysis of 6941 female patients // *Breast cancer*. – 2023. – Vol. 30(2). – P. 200-214. <https://doi.org/10.1007/s12282-022-01430-5>

36. Balasundaram G., Krafft C., Zhang R., Dev K.Bi.R., Moothanchery M., Popp J., Olivo, M. Biophotonic technologies for assessment of breast tumor surgical margins – A review // *J. Biophotonics*. – 2021. – Vol. 14. – Art. no. e202000280. <https://doi.org/10.1002/jbio.202000280>

37. Gommers J.J., Duijm L.E.M., Bult P., Strobbe L.J. A., Kuipers, T.P., Hooijen M.J.H., Mann R.M., Voogd A.C. The Impact of Preoperative Breast MRI on Surgical Margin Status in Breast Cancer Patients Recalled at Biennial Screening Mammography: An Observational Cohort Study // *Ann. Surg. Oncol.* – 2021. – Vol. 28(11). – P. 5929-5938. <https://doi.org/10.1245/s10434-021-09868-1>

38. To T., Lu T., Jorns J.M., Patton M., Schmidt T.G., Yen T., Yu B., Ye D.H. Deep learning classification of deep ultraviolet fluorescence images toward intra-operative margin assessment in breast cancer // *Front. Oncol.* – 2023. – Vol. 13. – Art. no. 1179025. <https://doi.org/10.3389/fonc.2023.1179025>

39. Gong P., Chin S.L., Allen W.M., Ballal H., Anstie, J.D., Chin L., Ismail H.M., Zilkens R., Lakhiani D.D., McCarthy M., Fang Q., Firth D., Newman K., Thomas C., Li J., Sanderson R.W., Foo K.Y., Yeomans C., Dessauvage B.F., Latham B., Kennedy B.F. Quantitative Micro-Elastography Enables In Vivo Detection of Residual Cancer in the Surgical Cavity during Breast-Conserving Surgery // *Cancer Res.* – 2022. – Vol. 82(21). – P. 4093-4104. <https://doi.org/10.1158/0008-5472.CAN-22-0578>

40. Streeter S.S., Zuurbier R.A., diFlorio-Alexander R.M., Hansberry M.T., Maloney B.W., Pogue B.W., Wells W.A., Paulsen K.D., Barth R.J. Breast-Conserving Surgery Margin Guidance Using Micro-Computed Tomography: Challenges When Imaging Radiodense Resection Specimens // *Ann. Surg. Oncol.* – 2023. – Vol. 30(7). – P. 4097-4108. <https://doi.org/10.1245/s10434-023-13364-z>

41. DiCorpo D., Tiwari A., Tang R., Griffin M., Aftreth O., Bautista P., Hughes K., Gershenfeld N., Michaelson J. The role of Micro-CT in imaging breast cancer specimens // *Breast cancer Res. Treat.* – 2020. – Vol. 180(2). – P. 343-357. <https://doi.org/10.1007/s10549-020-05547-z>

42. Paul K., Razmi S., Pockaj B.A., Ladani L., Stromer J. Finite Element Modeling of Quantitative Ultrasound Analysis of the Surgical Margin of Breast Tumor // *Tomography*. – 2022. – Vol. 8(2). – P. 570-584. <https://doi.org/10.3390/tomography8020047>

43. Wang Y., Jiao W., Yin Z., Zhao W., Zhao K., Zhou Y., Fang R., Dong B., Chen B., Wang Z. Application of near-infrared fluorescence imaging in the accurate assessment of surgical margins during breast-conserving surgery // *World journal of surgical oncology*. – 2022. – Vol. 20(1). – P. 357. <https://doi.org/10.1186/s12957-022-02827-4>

44. Ueo H., Minoura I., Ueo H., Gamachi A., Kai Y., Kubota Y., Doi T., Yamaguchi M., Yamashita T., Tsuda H., Moriya T., Yamaguchi R., Kozuka Y., Sasaki T., Masuda T., Urano Y., Mori M., Mimori K. Development of an intraoperative breast cancer margin assessment method using quantitative fluorescence measurements // *Sci. Rep.* – 2022. – Vol. 12(1). – Art. no. 8520. <https://doi.org/10.1038/s41598-022-12614-6>

## АНДАТПА

### СҮТ БЕЗІ ОБЫРЫН ЕМДЕУДЕГІ РЕЗЕКЦИЯ ЖИЕГІНІҢ МАҢЫЗЫ: ӘДБИЕТКЕ ШОЛУ

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**Өзектілігі:** Сүт безі қатерлі ісігін емдеудегі оңтайлы хирургиялық тәсілдер қайталану қаупін азайтуға және өмір сүруді жақсартуға бағытталған қазіргі онкология үшін өте маңызды. Осы әдебиеттерге шолу сүт безі обырын хирургиялық емдеуде резекция жиегінің маңыздылығын талдайды. Ол резекция аймағының клиникалық маңыздылығы, оның қайталану қаупі мен өмір сүру деңгейіне әсері және азаны сақтау операцияларындағы ролі туралы білімді жүйелейтін ғылыми жарияланымдарды кең талдауды қамтиды.

**Зерттеудің мақсаты** – сүт безі қатерлі ісігін хирургиялық емдеуде резекция жиегінің мәнін бағалау.

**Әдістері:** Зерттеу әдістемесі PubMed, Web of Science, Scopus және Cochrane Library сияқты электрондық деректер базаларында, сондай-ақ Қазақстан Республикасының Ұлттық ғылыми репозиторийлері мен деректер базаларында жүйелі іздеуді қамтиды. Бұл тәсіл шолуда маңызды отандық зерттеулерді қамтуға мүмкіндік берді. Іздеу "сүт безі қатерлі ісігі", "резекция шеті", "азаны сақтау операциясы", "Брест қатерлі ісігі", "қалпына келтіру маржасы", "маржаның ені", "Брест қатерлі ісігін қалпына келтіру", "Брест-консервация хирургиясы" және "мастэктомия" сияқты түйінді сөздер мен сөз тіркестерін қолдану арқылы жүзеге асырылды.

**Нәтижелері:** резекция жиегін анықтау сүт безі қатерлі ісігін сәтті хирургиялық емдеуде шешуші рөл атқарады. Зерттеулер көрсеткендей, ісіктің молекулалық кіші түрі сүт безін сақтайтын терапиядан өтіп жатқан науқастарда хирургиялық жиектердің күйін анықтамайды. Науқастың клиникалық ұсыныстары мен ерекшеліктерін ескере отырып анықталған резекция жиегінің барабар ені барлық ісік жасушаларын алып тастау ықтималдығын арттырады, бұл қайталану қаупін азайтады және ұзақ мерзімді ремиссия мүмкіндігін арттырады.

**Қорытынды:** Сүт безі қатерлі ісігін емдеудегі резекция жиегінің маңызы белсенді зерттеулер мен пікірталастардың тақырыбы болып қала береді. Деректер көп болғанымен, резекция жиегінің оңтайлы еніне және оның рецидивтер мен өмір сүруге әсеріне қатысты қайшылықтар әлі де бар. Зерттеулердің көпшілігі жергілікті қайталану қаупін азайту үшін резекция жиегінің жеткілікті енінің маңыздылығын растайды, әсіресе орган сақтайтын операцияларда. Интраоперациялық бейнелеу сияқты заманауи инновациялық әдістер және сүт безі қатерлі ісігінің молекулалық биологиясы мен генетикасындағы жетістіктер резекция жиегін анықтауды жақсартуға көмектеседі.

**Түйінді сөздер:** онкология, хирургия, азаны сақтайтын хирургия, рецидив, мастэктомия.

## АННОТАЦИЯ

### ЗНАЧЕНИЕ КРАЯ РЕЗЕКЦИИ ПРИ ЛЕЧЕНИИ РАКА МОЛОЧНОЙ ЖЕЛЕЗЫ: ОБЗОР ЛИТЕРАТУРЫ

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**Актуальность:** Оптимальные хирургические подходы в лечении рака молочной железы (РМЖ) имеют важное значение для современной онкологии, стремясь уменьшить риск рецидивов и улучшить выживаемость. Настоящий обзор литературы анализирует значимость края резекции в хирургическом лечении РМЖ. Он включает обширный анализ научных публикаций,

систематизируя знания о клинической значимости края резекции, его влиянии на риск рецидивов и выживаемость, а также роль в органосохраняющих операциях.

**Цель исследования** – оценить значение края резекции при хирургическом лечении рака молочной железы.

**Методы:** Методика исследования включала систематический поиск в базах данных PubMed, Web of Science, Scopus и Cochrane Library по ключевым словам «рак молочной железы», «край резекции», «органосохраняющая операция», «breast cancer», «resection margin», «margin width», «breast cancer recurrence», «breast-conserving surgery» и «mastectomy».

**Результаты:** Определение края резекции играет ключевую роль в успешном хирургическом лечении РМЖ. Исследования показывают, что молекулярный подтип опухоли не определяет статус хирургических краев у пациентов, проходящих терапию с сохранением молочной железы. Адекватная ширина края резекции, определенная с учетом клинических рекомендаций и особенностей пациента, повышает вероятность удаления всех опухолевых клеток, что снижает риск рецидива и увеличивает шансы на долгосрочную ремиссию

**Заключение:** Значение края резекции играет ключевую роль в хирургическом лечении РМЖ и существенно влияет на исход лечения. При хирургическом вмешательстве важно добиться отрицательных краев резекции, что означает отсутствие опухолевых клеток на границе удаленной ткани. Это является важным фактором для снижения риска рецидива заболевания и улучшения выживаемости пациентов. Результаты проведенных исследований демонстрируют, что положительные края резекции ассоциируются с повышенным риском местного рецидива, что требует дополнительных терапевтических вмешательств, таких как повторная операция или лучевая терапия. Таким образом, край резекции является фактором, определяющим успех хирургического лечения РМЖ. Достижение отрицательных краев резекции должно быть основной целью хирургов, что требует применения современных технологий и мультидисциплинарного подхода. Улучшение методов оценки и контроль краев резекции будут способствовать повышению эффективности лечения и улучшению прогноза для пациентов.

**Ключевые слова:** онкология, хирургия, органосохраняющая операция, рецидив, мастэктомия.

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