

ORIGINAL ARTICLE

Medicine Science 2025;14(1):183-8

The impact of oncoplastic surgery: A comparative analysis of racquet mammoplasty and conventional breast-conserving surgery

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Received 18 January 2025; Accepted 04 February 2025

Available online 01 March 2025 with doi: 10.5455/medscience.2025.01.011

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Abstract

This research evaluates the effectiveness of racquet mammoplasty versus conventional breast-conserving surgery (BCS) for upper-outer quadrant tumors, with an emphasis on oncological safety, cosmetic outcomes, and patient satisfaction. A retrospective analysis was conducted on 268 individuals treated surgically for upper-outer quadrant breast tumors between August 2021 and January 2024, and 210 participants met the inclusion criteria for the research. Information on patient characteristics and clinical parameters, such as gender, age, surgical method, and postoperative outcomes, was retrieved from the institutional database. Assessments were carried out at least six months after postoperative radiotherapy using the BREAST-Q questionnaire, specifically evaluating breast satisfaction, psychosocial well-being, and sexual well-being. The positive surgical margin rate was significantly lower in patients undergoing racquet mammoplasty compared to conventional BCS (5.6% vs. 21.7%; $p=0.001$). No statistically significant difference was observed in re-excision rates and recurrence rates ($p=0.858$ and $p=0.298$; respectively). BREAST-Q scores, including median breast satisfaction (84%; IQR: 82-88), psychosocial well-being (84%; IQR: 80-86) and sexual health (80%; IQR: 72-83.5%), were significantly higher, compared with conventional BCS ($p<0.001$, $p<0.001$ and $p<0.001$, respectively). Racquet mammoplasty appears to be a promising oncoplastic approach for the surgical treatment of upper-outer quadrant tumors. While it shows potential advantages in improving patient satisfaction compared to conventional BCS, further prospective randomized controlled trials are needed to validate and generalize these findings.

Keywords: Mammoplasty, breast cancer, breast-conserving surgery

Introduction

Breast cancer is one of the most prevalent malignancies in women, with significant advancements in survival rates due to early detection and multidisciplinary treatment strategies [1,2]. Breast-conserving surgery (BCS) was developed and has been widely implemented to preserve the integrity of breast tissue without compromising oncological safety [3,4]. Nevertheless, the aesthetic results of conventional BCS remain limited, particularly due to factors such as tumor location and size [5].

Oncoplastic surgical techniques have been devised to simultaneously ensure oncological safety and optimize aesthetic outcomes in breast cancer treatment. These techniques aim to maintain the breast's natural shape while excising malignant

tissue [6,7]. Oncoplastic surgery, particularly in cases involving large tumors, facilitates breast-conserving procedures with superior cosmetic results, thereby significantly contributing to the enhancement of patients' quality of life [8,9].

Racquet mammoplasty is a widely used oncoplastic method for surgically addressing tumors in the upper-outer quadrant of the breast. This method aims to preserve breast contour while allowing for extensive tumor resection. The racquet incision combined with the intraglandular flap technique is recognized as an effective approach for excising tumors in this region [10].

In this context, the racquet mammoplasty technique stands out as an innovative approach that enables extensive tumor resections while aiming to preserve breast contour. However, its impact on

CITATION

Ozgul H, Sakar B, Celik O, et al. The impact of oncoplastic surgery: A comparative analysis of racquet mammoplasty and conventional breast-conserving surgery. Med Science. 2025;14(1):183-8.



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oncological safety, aesthetic satisfaction, and complication rates compared to conventional BCS remains a subject of ongoing debate [11].

In upper-outer quadrant tumors, cosmetic issues following radiotherapy pose a significant challenge in surgical management. Through oncoplastic surgery, it is possible to achieve both tumor excision and axillary procedures, such as sentinel lymph node biopsy or axillary dissection, through a single incision. In contrast, conventional BCS often requires two separate incisions for these procedures. Therefore, our study aims to highlight the advantages of oncoplastic surgery in addressing these challenges.

This study seeks to evaluate the racquet mammoplasty technique in comparison to the conventional BCS approach for the treatment of upper-outer quadrant tumors. Specifically, it aims to assess the effects of both techniques on oncological safety, aesthetic outcomes, surgical complications, and patient satisfaction. This study aims to comprehensively elucidate the advantages and disadvantages of these two methods, thereby supporting existing literature and contributing to clinical practice.

Material and Methods

The research received approval from the Clinical Research Ethics Committee of Antalya Training and Research Hospital, University of Health Sciences (Ethics Committee number: 2024-385) and adhered to the principles outlined in the Declaration of Helsinki. Research and publication ethics were strictly adhered to throughout the study.

A retrospective analysis was conducted on 268 individuals treated with BCS for upper-outer quadrant breast tumors in our clinic between August 2021 and January 2024. All demographic and clinical data, including gender, age, surgical procedures, and postoperative outcomes, were obtained from the institutional database. Clinicopathological and prognostic data collected from the patients included age, tumor T and N stages, surgical method, resection status, surgical margin positivity, and local recurrence. All surgeries were performed at a single center by multiple surgeons with expertise in oncoplastic breast surgery.

In our clinic, adhering to the standard protocol, the BREAST-Q questionnaire was given to patients at least six months after surgery and radiotherapy. To ensure comprehensibility for the patients, a linguistically validated Turkish translation of the questionnaire from the original Swedish version was provided [12]. The BREAST-Q questionnaire serves as a patient-reported tool developed to assess satisfaction following breast reconstruction procedures. Its reconstruction section comprises several standalone scales, and the scales applied in this study included the following:

1. **Satisfaction with Breasts:** A 16-item scale assessing body image, focusing on breast shape, symmetry, tactile sensation, and appearance both in and out of clothing.
2. **Psychosocial Well-being:** A ten-question scale evaluating self-confidence in social interactions and the degree to

which individuals perceive themselves as equal or typical compared to other women.

3. **Sexual Health:** A concise, six-question scale designed to evaluate the influence of breast condition and surgical intervention on various aspects of sexual life.

The responses to each scale's items were compiled and converted into scores ranging from 0 to 100. Patient responses were analyzed using the standardized BREAST-Q scoring system and scoring module.

Patients with incomplete clinicopathological or follow-up data, multiple tumors within the same breast, inflammatory forms of breast cancer, distant metastatic disease, or positive surgical margins necessitating mastectomy were excluded from the study. Additionally, individuals with tumors situated in regions other than the upper-outer quadrant of the breast, those who experienced minor complications (e.g., infection, hematoma, seroma), were contraindicated for radiotherapy, underwent symmetrization surgery, did not actively participate in the survey, or provided incomplete survey responses were also excluded. Patients with minor complications, such as seroma or hematoma, were excluded from the study to minimize the potential impact of these complications on the cosmetic assessment outcomes.

The study population of 210 patients was categorized into two groups: one comprising individuals who underwent racquet mammoplasty and the other consisting of those treated with conventional BCS (Figure 1).

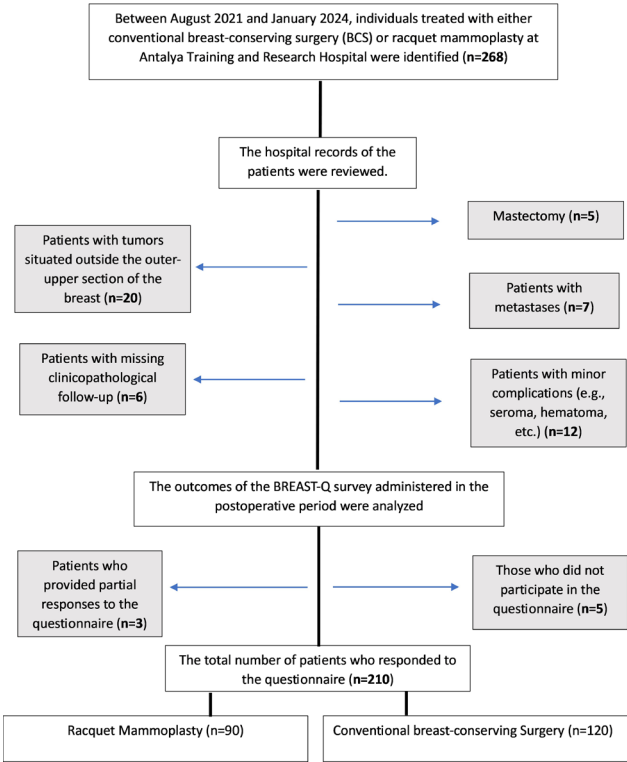


Figure 1. Flow-chart

Statistical Analysis

In this research, the association between clinical and pathological parameters of individuals treated with racquet mastoplasmy and conventional BCS was analyzed. Data analysis was carried out using Jamovi software version 2.6.2. Continuous data were presented as mean (standard derivation; SD) or median (interquartile range; IQR) and categorical data were presented as frequency (percentage; %). The Shapiro-Wilk test was utilized to evaluate the normality of data distribution. Parametric variables were evaluated by Student-t test, non-parametric variables by Mann-Whitney U test and categorical variables by Chi-square test. A p-value less than 0.05 is considered statistically significant.

Results

The study included 210 participants with a median (IQR) age of 55 (47-60) years. Among the surgical techniques, 90 patients (42.9%) undergoing racquet mastoplasmy and 120 patients (57.1%) undergoing conventional BCS. In terms of tumor stage, 43 patients (20.5%) were classified as stage 1A, 67 patients (31.9%) as stage 2A, 74 patients (35.2%) as stage 2B and 26 patients (12.4%) as stage 3A. The median (IQR) satisfaction with breast, psychological well-being and sexual health scores were 72 (58-96), 68 (52-95) and 62 (52-92), respectively.

In our study, a comparison was made between racquet mastoplasmy (n=90) and conventional BCS (n=120). The median age for racquet mastoplasmy was found to be 54.5 years (IQR: 47–58), and for conventional BCS, it was 56 years (IQR: 46.8–60) (p=0.083). The median pathological tumor size was identified as 15 mm (IQR: 10–25) for racquet mastoplasmy and 15 mm (IQR: 8–22) for conventional BCS (p=0.574). In terms of tumor stage, we observed that 18 patients (20%) who underwent racket mastoplasmy and 25 patients (20.8%) who underwent conventional BCS were classified as stage 1A. Additionally, 25 patients (27.8%) and 42 patients (35%) were categorized as stage 2A, 39 patients (43.3%) and 35 patients (29.2%) as stage 2B, and 8 patients (8.9%) and 18 patients (15%) as stage 3A, respectively (p=0.149). Pathological margin positivity was noted in 5 patients (5.6%) who underwent racquet mastoplasmy and in 26 patients (21.7%) who underwent conventional BCS, with a statistically significant difference observed between the two groups (p=0.001). Recurrence was observed in 2 patients (2.2%) who underwent racquet mastoplasmy and in 6 patients (5%) who underwent conventional BCS (p=0.298). Re-excision was required in 5 patients (5.6%) who underwent racquet mastoplasmy and in 6 patients (5%) who underwent conventional BCS (p=0.858) (Table 1).

Table 1. Demographic and other data between the racquet mastoplasmy and BCS

Variables	Racquet mastoplasmy (n=90)	Conventional BCS (n=120)	P value
Age, year	54.5 (47-58)	56 (46.8-60)	0.083
Pathological tumor size, mm	15 (10-25)	15 (8-22)	0.574
Stage	1A	18 (20%)	0.149
	2A	25 (27.8%)	
	2B	39 (43.3%)	
	3A	8 (8.9%)	
Pathological margin positivity	Negative	85 (94.4%)	0.001*
	Positive	5 (5.6%)	
Recurrence	Negative	88 (97.8%)	0.298
	Positive	2 (2.2%)	
Re-excision	Negative	85 (94.4%)	0.858
	Positive	5 (5.6%)	

BCS: breast-conserving surgery; variables are presented as median (IQR) or n (%); variables are compared with chi-square and Mann-Whitney U test; P<0.05 is statistically significant

When comparing BREAST-Q scores between racquet mastoplasmy and conventional BCS, statistically significant differences were identified in terms of breast satisfaction, psychosocial well-being, and sexual health (p<0.001). In the racquet mastoplasmy group, the median breast satisfaction score [84% (IQR: 82–88)] was found to be significantly higher compared to the conventional conventional BCS group [67.5%

(IQR: 63.8–69.3)]. Similarly, psychosocial well-being scores were observed to be notably higher in the racquet mastoplasmy group [84 (IQR: 80–86)] compared to the conventional BCS group [62% (IQR: 60–66)]. Additionally, sexual well-being scores in the racquet mastoplasmy group [80% (IQR: 72–83.5)] were significantly higher than those in the BCS group [56% (IQR: 54–60)] (Table 2).

Table 2. Comparison of BREAST-Q score data between the Racquet mammoplasty and BCS

	Racquet mammoplasty (n=90)	Conventional BCS (n=120)	P value
Satisfaction with breasts, %	84 (82-88)	67.5 (63.8-69.3)	<0.001*
Psychosocial well-being, %	84 (80-86)	62 (60-66)	<0.001*
Sexual health, %	80 (72-83.5)	56 (54-60)	<0.001*

BCS: breast-conserving surgery; vales are presented as median (IQR); vales are compared with Mann-Whitney U test; P<0.05 is statistically significant

Discussion

Breast cancer surgery necessitates an approach that ensures oncological safety while simultaneously enhancing patients' quality of life. Among breast-conserving treatment options, conventional BCS has been a longstanding and widely adopted surgical technique. However, with the growing focus on aesthetic and functional outcomes, oncoplastic breast-conserving surgery (OBCS) has become increasingly prominent. OBCS combines oncological principles with plastic surgery techniques to optimize aesthetic outcomes while maintaining oncological safety [13-15]. In this study, we demonstrated that racquet mammoplasty, an OBCS technique specifically employed for tumors located in the upper-outer quadrant of the breast, exhibits comparable postoperative complication rates to conventional BCS. Moreover, based on the BREAST-Q satisfaction survey, racquet mammoplasty achieved significantly superior breast satisfaction outcomes compared to conventional BCS.

In breast cancer treatment, oncoplastic surgical techniques are suggested to facilitate the achievement of wider resection margins [14]. A review of the literature reveals that a study by Crown et al. demonstrated that OBCS significantly reduces re-excision rates [16]. Similarly, a meta-analysis conducted by Hasan et al. in 2023, which included 6941 patients, found that oncoplastic surgery is associated with lower rates of positive surgical margins compared to conventional BCS [17]. In our study, the rate of positive surgical margins in the OBCS group was found to be lower compared to the conventional BCS group, consistent with the literature. However, no statistically significant variation was observed between the two groups regarding the requirement for re-excision. It should be noted that the scope of our study was confined to patients with tumors situated in the outer-upper region of the breast. Therefore, we believe that larger and more comprehensive studies are needed to draw more definitive conclusions.

The extended follow-up findings of OBCS have demonstrated its oncological efficacy, showing lower recurrence rates [15,18]. However, in a study conducted by Rietjens et al., no notable variation in recurrence rates was identified between OBCS and conventional BCS following a mean follow-up period of 74 months [19]. Similarly, in our study, no statistically significant difference in recurrence rates was observed between the two groups after a mean follow-up of 27 months. The comparable re-excision requirements observed in our study may reflect the

lack of a significant difference in recurrence rates between the groups. However, considering both the literature and the findings of our study, it is suggested that long-term follow-up studies are necessary to obtain more definitive and reliable results regarding recurrence rates.

In our study, although the positive surgical margin rate was lower in the racket mammoplasty group, there was no significant difference in re-excision rates. This outcome may be attributed to the management strategy for patients with positive surgical margins due to DCIS. High-grade lesions were treated with reoperation, while other cases were managed with radiotherapy. This approach aligns with current treatment protocols in the literature and underscores the importance of individualized management strategies in such scenarios [20].

The BREAST-Q questionnaire is a well-established and extensively used instrument for evaluating patient satisfaction and quality of life after breast surgery. Its reliability and validity have been well-documented in the literature. Liu et al. highlighted the effectiveness of BREAST-Q in evaluating patient perspectives in oncoplastic breast surgery, while Stolpner et al. validated its clinical application, affirming it as a reliable assessment instrument [21,22]. Recent literature includes various studies that have investigated the effect of OBCS versus conventional BCS on patient satisfaction and quality of life through the use of the BREAST-Q questionnaire. Hernanz et al., for example, reported no significant differences in quality of life or aesthetic satisfaction between OBCS and conventional BCS as evaluated by BREAST-Q [23]. However, the comparison of racquet mammoplasty, a specific OBCS technique, with conventional breast-conserving surgery remains limited in the existing studies. Xu et al. demonstrated that racquet mammoplasty in early-stage breast cancer could result in higher postoperative breast satisfaction and reduced positive surgical margin rates compared to conventional BCS [24]. Similarly, Acar et al. reported on the cosmetic outcomes of a patient undergoing racquet mammoplasty, emphasizing that OBCS could be a preferable option for larger tumors [25].

In a study by Rose et al., patients treated with oncoplastic breast-conserving surgery (OBCS) reported statistically significant better outcomes in the domain of "Psychosocial Well-being" compared to those treated with conventional BCS. Nevertheless, no notable differences were found between the two groups in the areas of "Breast Satisfaction" and "Sexual Health." [26].

Similarly, Hauerslev et al. found that OBCS and BCS offered comparable outcomes in terms of locoregional morbidity, with both methods being highly accepted in terms of aesthetics and patient satisfaction [27]. Furthermore, a study by Altinel et al. demonstrated that the histopathological patterns of patients undergoing OBCS did not significantly affect quality of life or satisfaction [11]. These findings highlight the aesthetic and psychosocial benefits provided by OBCS, while also underscoring the need for further research into other quality-of-life domains to fully understand its impact.

The findings of our study demonstrate that racquet mammoplasty provides superior patient-reported outcomes compared to conventional BCS in terms of breast satisfaction, psychosocial well-being, and sexual health. The comparison of BREAST-Q scores revealed that the racquet mammoplasty group achieved statistically significantly higher scores in all domains compared to the conventional BCS group. Our results appear to be consistent with the data reported in the literature. Furthermore, these findings support the notion that oncoplastic surgery not only ensures oncological safety but also makes a significant contribution to improving patient satisfaction and quality of life. However, validating these findings in different patient populations, with various OBCS techniques, and through long-term follow-ups could be an important step toward the standardization of surgical strategies. Increasing the number of studies in this area within the literature may further contribute to the establishment of standardized surgical approaches.

In our study, patients who underwent racquet mammoplasty and conventional BCS exhibited a homogeneous distribution in terms of key demographic and clinical characteristics, such as age, pathological tumor size, and tumor stage. This homogeneity provides a significant advantage in ensuring comparability between the groups. The lack of statistically significant differences in age and tumor size, along with the fact that all tumors were located in the upper-outer quadrant, allowed for an unbiased evaluation of the outcomes of both techniques. However, the limited sample size may have posed challenges in detecting more subtle differences between subgroups. Nevertheless, achieving a homogeneous distribution is considered a major strength of our study, as it enhances the reliability and validity of the comparative analyses.

Another notable strength of our study is the use of a validated questionnaire, which allowed for objective evaluation without the need for external intervention. Additionally, the absence of surgical intervention on the contralateral breast in all patients enabled a direct comparison between the operated breast and the untouched breast in terms of natural shape and size. This allowed patients to assess whether the goal of preserving the natural structure of the breast had been achieved. An additional key strength of the study is the high response rate obtained, which enhances the reliability and representativeness of the results.

One of the primary limitations of this study is its retrospective design, which inherently carries the risk of information gaps and selection bias during data collection and patient selection. Future studies designed as prospective, randomized controlled trials are necessary to address these shortcomings and provide higher-level evidence.

Another limitation is the relatively short follow-up period (mean: 27 months), which may not fully capture long-term outcomes, particularly local recurrence rates, that are critical in breast cancer management. Studies with extended follow-up durations would offer more definitive insights into the oncological safety and long-term efficacy of the surgical techniques.

Additionally, although all surgeries were performed at a single center, they were carried out by multiple surgeons. This variability in surgical technique may introduce subtle differences in outcomes, which could not be fully accounted for in the current study.

The relatively small sample size is also a limitation, as it may limit the detection of more subtle differences between subgroups. While a homogeneous distribution was achieved between the groups, larger patient cohorts are essential for more robust comparisons, especially across different tumor localizations and surgical techniques.

Despite these limitations, our study highlights the effectiveness of racquet mammoplasty for upper-outer quadrant breast tumors. Further research is needed to evaluate other oncoplastic surgical techniques across broader patient populations and diverse tumor locations. Additionally, future studies focusing on long-term quality of life and psychosocial outcomes using comprehensive survey tools would significantly enhance the understanding of patient-reported outcomes in this field.

Conclusion

Racquet mammoplasty, as an oncoplastic surgical approach for upper-outer quadrant breast tumors, demonstrated superiority over conventional BCS in terms of both oncological safety and aesthetic outcomes. In our study, the frequency of positive surgical margins was notably reduced in the racquet mammoplasty group, whereas no variation was observed between the two groups concerning the need for re-excision. BREAST-Q questionnaire results revealed that patients who underwent racquet mammoplasty reported higher satisfaction rates in terms of breast satisfaction, psychosocial well-being, and sexual health compared to those who underwent conventional BCS. These findings highlight that oncoplastic surgery not only enhances oncological safety but also significantly contributes to better patient outcomes in terms of quality of life and aesthetic satisfaction. However, to confirm these findings and further explore the long-term impact of racquet mammoplasty, future studies with longer follow-up periods, larger sample sizes, and well-designed prospective randomized controlled trials are needed.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Ethical approval for the study was obtained from the Clinical Research Ethics Board (21/11/2024 approval number: 2024-385), and the study was conducted in accordance with the Helsinki Declaration.

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