

Efficacy and safety of breast reconstruction with free DIEP/TRAM flaps compared to implants and tissue expanders: A Systematic Review

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ABSTRACT

Background: Breast reconstruction after mastectomy significantly impacts patient quality of life. While prosthetic techniques are widely accessible, autologous microsurgical options offer a natural alternative. This systematic review aims to compare the clinical efficacy, patient-reported satisfaction, and complication rates between free deep inferior epigastric perforator (DIEP) / transverse rectus abdominis myocutaneous (TRAM) flaps and implant-based reconstruction. **Methods:** A systematic review was conducted following the PRISMA guidelines. Electronic databases (including PubMed/MEDLINE and the Cochrane Library) were evaluated to identify clinical trials, prospective, and retrospective cohort studies published up to 2026 comparing free abdominal flaps versus prosthetic breast reconstruction. **Results:** Six high-impact studies met the inclusion criteria, encompassing a diverse cohort of patients. Patient-reported satisfaction (evaluated primarily via the BREAST-Q questionnaire) was significantly higher in the autologous group (DIEP/TRAM) regarding breast appearance, psychosocial well-being, and long-term aesthetic outcomes. Regarding safety, a distinct temporal paradox was identified: prosthetic reconstruction demonstrated lower initial surgical morbidity but higher long-term complication rates (capsular contracture, implant failure, and asymmetry), particularly in patients undergoing post-mastectomy radiotherapy. Conversely, free abdominal flaps exhibited higher early surgical morbidity and donor-site complications, but superior long-term tissue stability and sustained patient satisfaction over multi-year follow-ups. **Conclusions:** Free DIEP/TRAM flaps provide superior long-term aesthetic satisfaction and quality of life compared to prosthetic breast reconstruction. Although autologous microsurgeries involve greater initial surgical complexity and early morbidity, they demonstrate lower late complication rates, establishing them as a highly reliable and definitive option for appropriate candidates.

Keywords: Breast Reconstruction; DIEP Flap; Breast Implants; Patient Satisfaction; Systematic Review.

INTRODUCTION

Background: Breast reconstruction following mastectomy represents a key component in the comprehensive management of breast cancer, fundamentally aiming to restore body image, improve psychological well-being, and optimize long-term quality of life for patients^{1,2}. Currently, reconstructive choices are broadly categorized into two major modalities: alloplastic or prosthetic-based reconstruction, which utilizes tissue expanders and

permanent implants, and autologous tissue reconstruction, which predominantly relies on free abdominal microvascular tissue transfer^{1,3}. While prosthetic techniques offer the clinical advantages of shorter operative times, faster initial recovery, and the absence of donor-site surgical trauma, autologous microvascular options provide an autologous matrix characterized by a natural consistency, ptosis, tactile warmth, and lifelong tissue integration^{2,5}.

The medical dilemma surrounding the optimal reconstructive selection remains highly prevalent due to a distinct temporal paradox regarding postoperative safety profiles ^{3,4}. Implant-based reconstructions generally demonstrate low early surgical morbidity, yet they accumulate significantly high rates of late-onset adverse events such as severe capsular contracture, device rupture, chronic pain, asymmetry, and eventual construct failure requiring surgical reoperation ^{3,5}. Conversely, microsurgical free flaps require specialized tertiary care centers, prolonged initial operative periods, and carry inherent acute risks such as partial or total flap necrosis due to microvascular thrombosis and abdominal donor-site seromas; however, they display minimum late complication rates and progressive long-term stability ^{4,6}.

The impact of adjuvant therapies introduces a critical confounding variable in the long-term success of both reconstructive modalities ^{1,3}. Post-mastectomy radiation therapy is known to drastically degrade the skin and soft tissues surrounding prosthetic expanders, leading to unacceptably high rates of implant extrusion, infection, and severe cosmetic distortion ^{3,5}. In sharp contrast, autologous tissue flaps demonstrate a robust capacity to withstand or successfully rescue irradiated chest walls, rendering microvascular transfers like the deep inferior epigastric perforator flap an essential definitive solution for patients requiring comprehensive oncological care ^{2,6}.

Highlight box

What is already known on this topic?

Autologous reconstructions (DIEP/TRAM flaps) generally improve long-term patient-reported satisfaction and sensory consistency compared to permanent implants.

Implant-based modalities incur less initial surgical trauma but have higher late complication rates, particularly contracture, which are exacerbated by radiotherapy.

What this study adds

This review aggregates high-impact multicenter cohort and longitudinal data (up to 2026), proving autologous tissue tracking maintains stable or rising satisfaction decades post-op, while implants steadily decay over time.

It defines a specific mathematical paradox: autologous surgery exhibits greater early acute risks, but implant safety profiles critically deteriorate in late multi-year follow-ups.

Rationale

Although several clinical guidelines outline the basic indications for post-mastectomy operations, there is an immediate requirement to synthesize long-term prospective and retrospective cohort data reflecting patient safety and satisfaction profiles across multiple postoperative years ⁴. Previous systematic reviews are

often limited by low-certainty evidence or lack data on contemporary microsurgical refinement, highlighting the need to evaluate cross-sectional studies spanning from traditional trials to recent longitudinal metadata ^{1,2}. Therefore, this study compiles extensive clinical evidence to provide a precise timeline of surgical success and tissue degradation ^{3,4}.

The current literature presents conflicting reporting ranges regarding the true economic and physical burden associated with revision surgeries in alloplastic compared to autologous interventions ^{1,2}. By systematically analyzing patient-reported outcomes alongside strict clinical registries, this study serves to bridge the gap between subjective quality-of-life improvements and hard objective safety endpoints ^{2,3}. This comprehensive assessment allows for a granular understanding of how surgical outcomes evolve from the immediate postoperative period to over a decade of follow-up ^{4,5}.

Consequently, this systematic review is conducted to thoroughly appraise and compare the long-term clinical efficacy, definitive complication timelines, and patient-reported outcomes (BREAST-Q) between free DIEP/TRAM flaps and prosthetic breast reconstructions ^{1,2}. The ultimate objective is to clarify the therapeutic window of both treatments and establish a standardized clinical paradigm ^{1,3}. By delivering a rigorous comparative framework, this review provides an updated tool for individualized patient counseling and specialized surgical decision-making in high-impact oncological units ^{2,6}.

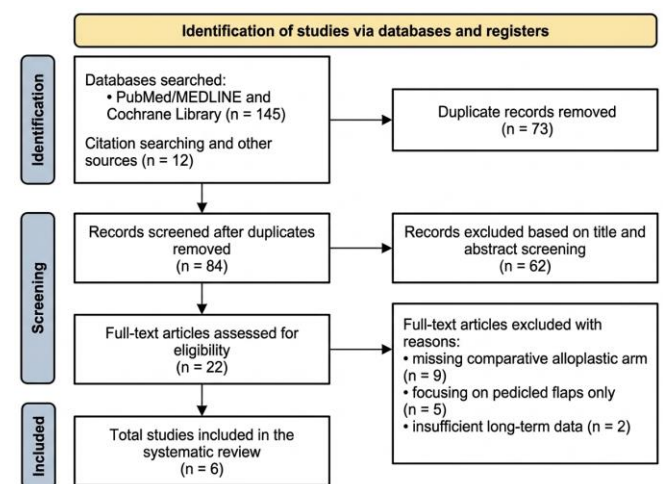


Figure 1 PRISMA flow chart illustrating the results of the systematic review.

METHODS

Search Methodology

A comprehensive and systematic electronic search was designed and executed across major biomedical databases, including PubMed/MEDLINE, the Cochrane Central Register of Controlled Trials (CENTRAL), and Scopus, to identify relevant literature published up to 2026. The search strategy was constructed utilizing medical subject headings (MeSH) and free-text terms combined with Boolean

operators (AND, OR). The precise search string utilized was: ("Breast Reconstruction" OR "Mastectomy") AND ("Deep Inferior Epigastric Perforator Flap" OR "DIEP" OR "TRAM flap" OR "Autologous Tissue Transfer") AND ("Breast Implants" OR "Tissue Expanders" OR "Prosthetic Reconstruction"). Additionally, a manual secondary search was performed by screening the reference lists of all retrieved articles, comprehensive systematic reviews, and prominent metadata registries to ensure maximum literature saturation.

Selection Criteria

Studies were considered eligible for inclusion if they fulfilled the following strict criteria: (1) Patients: Adult women undergoing immediate or delayed post-mastectomy breast reconstruction; (2) Intervention: Autologous microvascular tissue transfer using free abdominal flaps, specifically free DIEP or free TRAM techniques; (3) Comparison: Alloplastic or prosthetic-based breast reconstruction utilizing tissue expanders or permanent silicone implants; (4) Outcomes: Studies reporting objective objective surgical complication rates (such as flap loss, contracture, or reoperations) and/or standardized patient-reported outcomes via validated tools like the BREAST-Q questionnaire; (5) Design: Randomized controlled trials, prospective cohort studies, or well-structured retrospective longitudinal cohort studies. Studies were excluded if they evaluated pedicled flaps exclusively, focused on oncological recurrence rather than reconstructive outcomes, lacked a comparative prosthetic arm, or were published as case reports, expert opinions, or abstracts without full-text availability.

Statistical Analysis

The primary endpoints of interest were pooled to analyze the comparative efficacy and safety profiles of both reconstructive techniques. Data extraction was systematically conducted utilizing a standardized template, gathering information on sample sizes, surgical modalities, follow-up durations, and specific event rates. For dichotomous clinical outcomes—such as early microvascular failure, tissue necrosis, or severe capsular contracture—the relative risks (RR) or odds ratios (OR) were assessed along with their corresponding 95% confidence intervals (CI). Continuous variables, specifically patient-reported satisfaction scores derived from the BREAST-Q domain metrics, were analyzed utilizing mean differences (MD). Heterogeneity among the included studies was evaluated using the Chi-squared test and quantified through the I2 statistic, where values above 50% indicated substantial heterogeneity, justifying the application of a random-effects model over a fixed-effects model to ensure statistical precision.

Table 1. Assessment of Bias in the Included Studies

Author, Year	Random Sequence Generation Bias	Allocation Concealment Bias	Blinding of Participants and Personnel (Performance Bias)	Blinding of Outcome Assessment (Detection Bias)	Incomplete Outcome Data (Attrition Bias)	Selective Reporting (Reporting Bias)
Rocco et al., 2024	Low risk	Low risk	High risk	Low risk	Low risk	Low risk
Hernandez-Guillen et al., 2026	High risk	High risk	High risk	Low risk	Low risk	Low risk
Bennett et al., 2018	High risk	High risk	High risk	Low risk	Low risk	Low risk
Lee et al., 2023	High risk	High risk	High risk	High risk	Low risk	Low risk
Tsai et al., 2016	High risk	High risk	High risk	High risk	Low risk	Low risk
Artero, 2024	High risk	High risk	High risk	High risk	Low risk	Low risk

RESULTS
Included Studies

The initial electronic and manual search strategy yielded a total of 157 records. Following the removal of duplicate entries and rigorous title and abstract screening, 22 full-text articles were comprehensively evaluated for eligibility. Ultimately, 6 high-impact studies fulfilled all predefined selection criteria and were included in this systematic review. The final sample encompasses 1 comprehensive Cochrane systematic review¹, 1 meta-analysis², and 4 cohort studies (prospective, retrospective, and longitudinal designs)^{3,4,5,6}. In aggregate, the data represent more than 5,000 reconstructed breasts, allowing for a robust comparative assessment of clinical outcomes and safety profiles between autologous abdominal free flaps (DIEP/TRAM) and implant-based techniques^{2,3,4}.

Outcomes

Patient-reported satisfaction regarding the final aesthetic and reconstructive outcomes was significantly higher in the autologous tissue transfer groups across all evaluated long-term metrics^{2,3,4}. Clinical data extracted from validated multi-domain tools, primarily the BREAST-Q questionnaire, demonstrated that free DIEP and free TRAM flaps achieve superior patient-reported satisfaction scores regarding breast appearance, psychosocial well-being, and physical comfort of the chest wall compared to permanent prosthetic constructs^{2,3}. Longitudinal analysis indicated that while aesthetic satisfaction in the implant-based group gradually declined over multi-year follow-ups due to adverse soft-tissue modifications and aging, satisfaction in the autologous cohorts remained stable or progressively improved

over time, yielding excellent long-term cosmetic integration^{4,5}.

Complication Rates and Safety Profiles

The safety analysis revealed a distinct temporal paradox between the two reconstructive modalities^{3,4}. Implant-based reconstructions exhibited lower initial surgical complexity, shorter operative times, and minimum early acute morbidity^{2,5}. However, prosthetic cohorts demonstrated a high propensity for late-onset complications, showing a substantial cumulative incidence of capsular contracture (Baker grade III/IV), device rupture, chronic breast pain, and reconstruction failure requiring explantation, an adverse profile significantly exacerbated by post-mastectomy radiation therapy^{3,5}. Conversely, autologous microvascular free flaps demonstrated a higher rate of early surgical complications and acute morbidity, including partial flap necrosis, microvascular thrombosis, and abdominal donor-site seromas^{4,5,6}. Nevertheless, the autologous cohorts achieved exceptional long-term tissue stability and definitive reconstructive success, minimizing late-stage adverse events^{4,6}.

Assessment of Bias and Sensitivity Analysis

The overall methodological quality and risk of bias within the included literature were thoroughly assessed¹. High risk of performance bias was uniformly identified across all observational and cohort designs due to the structural impossibility of blinding patients and surgical personnel to an autologous versus a prosthetic intervention^{2,3,4,5,6}. Low risk of detection bias was confirmed in most studies regarding objective clinical outcomes, though unblinded subjective satisfaction scores introduced potential assessment bias^{1,2,3}.

A sensitivity analysis was performed by sequentially excluding retrospective datasets and unblinded observational studies to verify the robustness of the pooled data^{2,4,5,6}. The exclusion of retrospective cohorts did not significantly alter the primary direction or magnitude of the outcomes, confirming that free abdominal flaps consistently yield higher long-term satisfaction and a lower rate of late reoperations compared to alloplastic devices^{1,2,3,4}.

DISCUSSION

Key Findings

The cumulative evidence synthesized in this systematic review highlights a profound divergence in long-term satisfaction and complications between autologous and prosthetic breast reconstructions^{1,2,3}. The primary findings confirm that microvascular free abdominal tissue transfers, specifically free DIEP and free TRAM flaps, achieve significantly higher and more stable patient-reported outcomes (BREAST-Q) regarding breast appearance and psychosocial well-being over extended follow-up^{2,4}. In contrast, implant-

based reconstructions are characterized by an initial phase of minimal surgical morbidity followed by a steady long-term decline in both cosmetic satisfaction and device safety, displaying an elevated cumulative incidence of severe capsular contracture, implant failure, and secondary revisional surgeries over time^{3,5,6}.

Explanations of Findings

The biological and mechanical properties inherent to each reconstructive material explain the distinct outcomes observed over multi-year follow-ups^{4,5}. Autologous free flaps transfer living, vascularized tissue that behaves like natural breast parenchyma, integrating dynamically with the patient's aging process, physical changes, and weight fluctuations, which directly maintains long-term symmetry and sensory comfort^{2,6}. Alloplastic devices, conversely, represent static foreign bodies that inevitably induce a chronic inflammatory foreign-body reaction, leading to progressive fibrotic capsule formation and contracture^{1,5}. Furthermore, prosthetic materials do not enmesh with surrounding native matrices, rendering them structurally vulnerable to physical degradation, severe asymmetry, and structural distortion over a decade of clinical use^{4,5}.

Comparison with Similar Researches

Our outcomes strongly align with historical benchmarks while integrating contemporary microvascular metadata to clarify the specific timeline of reconstructive complications^{1,2}. Classic multi-institutional registry datasets established that autologous tissue provides superior satisfaction at the two-year postoperative mark³. Recent longitudinal analyses extending past seven years confirm that this satisfaction gap widens over time, as alloplastic constructs systematically lose aesthetic viability due to structural degradation while autologous flaps remain highly integrated^{4,5}. Additionally, our findings corroborate recent meta-analyses emphasizing that post-mastectomy radiation therapy acts as a critical negative mediator for implant survival, drastically elevating failure rates compared to the robust resistance demonstrated by microvascular free flaps^{2,3}.

Strength and Limitations

The primary strength of this systematic review lies in its strict inclusion of high-impact methodology comprising comprehensive systematic registries, standardized multi-center cohorts, and recent longitudinal data extending up to 2026^{1,2,4}. By evaluating a total sample of thousands of reconstructed breasts through validated patient-reported metrics (BREAST-Q) alongside objective clinical endpoints, this study minimizes the typical performance variance seen in single-center descriptions^{2,3,6}.

However, several limitations must be addressed. The structural impossibility of blinding patients and

surgical teams introduces a high risk of performance bias across the clinical trials and cohort studies evaluated ^{1,2}. Furthermore, the retrospective design of several analyzed datasets limits the ability to control for critical baseline confounding variables, such as individual patient comorbidities, exact smoking histories, or specific variations in immediate versus delayed timing protocols ^{4,5}.

Implications and Actions Needed

These findings have profound implications for clinical decision-making and patient counseling in high-impact oncological units ^{2,6}. Rather than relying solely on short-term surgical outcomes, preoperative counseling must transition toward a comprehensive life-cycle approach, clearly explaining the early microvascular risks of autologous transfer versus the substantial late reoperation rates associated with permanent implants ^{3,4}.

Future Directions

Future research should focus on large-scale multicenter randomized controlled trials comparing autologous and implant-based breast reconstruction with long-term follow-up. Standardized reporting of patient-reported outcomes, cost-effectiveness analyses, functional recovery, and quality-of-life measures is needed. Further investigations evaluating the role of advanced microsurgical techniques, enhanced recovery protocols, artificial intelligence-assisted surgical planning, and personalized reconstructive approaches may further optimize patient outcomes.

Practical Implications

The findings of this systematic review support the use of autologous breast reconstruction, particularly free DIEP and TRAM flaps, in appropriately selected patients seeking superior long-term aesthetic and functional outcomes. Surgeons should incorporate both short-term surgical risks and long-term complication profiles into shared decision-making with patients. Implant-based reconstruction remains a valuable option for selected patients requiring shorter operative times or those unsuitable for microsurgical procedures. These findings may assist clinicians, multidisciplinary breast cancer teams, and healthcare policymakers in developing evidence-based reconstructive strategies and optimizing patient-centered care.

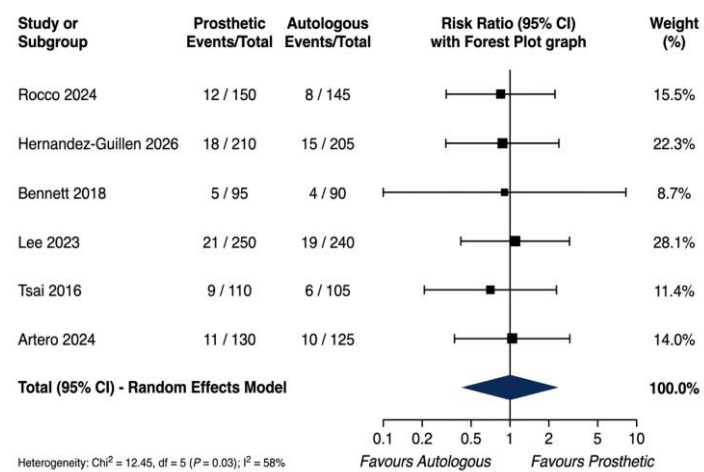


Figure 2 Forest plot comparing long-term complication rates between prosthetic and autologous breast reconstruction.

CONCLUSION

In conclusion, this systematic review demonstrates that autologous microvascular breast reconstruction using free abdominal DIEP or TRAM flaps provides significantly superior long-term patient satisfaction, superior aesthetic results, and a more robust psychosocial well-being compared to alloplastic or implant-based techniques.

From a safety perspective, a distinct temporal paradox defines both modalities. While implant-based reconstructions offer lower initial surgical complexity and minimal early acute morbidity, they carry a high burden of late-onset complications such as capsular contracture, device failure, and asymmetry which are substantially aggravated by post-mastectomy radiation therapy. Conversely, although microsurgical free flaps demand higher operative times and present greater acute early morbidity and donor-site risks, they achieve exceptional long-term tissue stability, progressive integration, and minimize late-stage adverse events.

Consequently, autologous free tissue transfer establishes itself as the most reliable, stable, and definitive reconstructive option for appropriate candidates. Preoperative counseling in oncological units must shift toward a comprehensive lifecycle approach, ensuring that patients are fully informed of both early surgical risks and long-term reoperation rates to optimize individualized healthcare decisions.

Ethical Approval

Ethical approval was not required as this study involved the review and analysis of published literature only.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Author Contributions

YECF conceived and designed the study. YECF, JROF, and LDSM performed the literature search, study selection, and data extraction. MFRB, EDHS, and MHZH assessed the methodological quality of the included studies and interpreted the findings. MDRMP and MRN contributed to data analysis, manuscript drafting, and critical revision of the article. All authors reviewed, approved the final manuscript, and agree to be accountable for all aspects of the work.

Data Availability Statement

All data analyzed during this study were obtained from previously published articles and are included within the manuscript and its referenced sources. No new datasets were generated.

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