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NIPPLE RECONSTRUCTION AFTER SKIN-SPARING MASTECTOMY: TECHNIQUES, OUTCOMES, AND PATIENT-CENTERED DECISION MAKING – A SYSTEMATIC REVIEW

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Summary

Skin-sparing mastectomy (SSM) preserves the breast skin envelope, improving reconstructive and cosmetic outcomes, but removal of the nipple-areola complex (NAC) can cause psychological distress and body image concerns. Nipple reconstruction is a critical component of post-mastectomy care. This systematic review summarizes current techniques, patient-reported outcomes, complications, and the role of patient-centered decision-making. Following PRISMA guidelines, a literature search identified 42 studies with ≥ 30 patients undergoing nipple reconstruction post-SSM. Techniques included local flaps (C-V, skate, star, five-flap), nipple-sharing, 3D tattooing, combined methods, and innovations like implants and reinnervation. Satisfaction ranged from 66.1% to 96%, with 3D tattooing and advanced flaps scoring highest. Complication rates were lowest for tattooing (1%) and highest for C-V flaps (14% necrosis). Shared decision-making improved satisfaction by 34% and reduced regret by 22%. Nipple reconstruction after SSM is safe, well-tolerated, and significantly enhances quality of life, with individualized planning being essential.

Key words: nipple reconstruction, skin-sparing mastectomy, patient satisfaction, breast cancer, systematic review

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INTRODUCTION

Breast cancer, with over 2.3 million annual cases globally [1], often requires skin-sparing mastectomy (SSM) to preserve the skin envelope for better aesthetic outcomes [2]. However, removing the nipple-areola complex (NAC) for oncologic safety can impact body image and self-esteem [3]. Nipple reconstruction addresses this, enhancing psychological recovery and symmetry [4]. This review was prompted by the growing use of SSM and variability in reported outcomes for nipple reconstruction. Existing studies often focus on specific techniques, lacking synthesis of patient-centered factors like invasiveness preferences or long-term durability. This article aims to guide surgeons, improve shared decision-making, and identify research gaps, such as standardized outcome measures and integration of innovations, to enhance patient quality of life [5].

METHODS

A systematic review followed PRISMA guidelines [6], registered with PROSPERO (CRD420251046194). PubMed, EMBASE, and Cochrane Library were searched (January 1990 - September 2025) using terms: "nipple reconstruction", "skin-sparing mastectomy", "nipple-areola complex", and "breast reconstruction". Reference lists were hand-searched.

Inclusion criteria

- Adult women post-SSM with immediate or delayed breast reconstruction [7]
- Any surgical or non-surgical nipple reconstruction technique [8]
- Outcomes: patient satisfaction, aesthetics, complications, psychosocial impact [9]
- Study types: RCTs, cohort studies, case series, systematic reviews (English, ≥ 30 patients) [10]

Exclusion criteria

- Studies with < 30 patients
- Non-English publications
- Studies lacking relevant outcomes

SSM types were classified by incision patterns: Type I (peri-areolar), Type II (peri-areolar with extensions), Type III (separate incisions), Type IV (elliptical for ptotic breasts) [11]. Studies covered all SSM types, focusing on reconstruction feasibility.

Data extraction was performed using standardized forms to ensure consistency and reduce bias, conducted by a single reviewer due to the independent nature of the study. Quality was assessed via the Newcastle-Ottawa Scale [12] and CASP checklist [13]. Narrative synthesis was used due to outcome heterogeneity, with funnel plots assessing publication bias where feasible.

RESULTS

From 1,478 articles (updated to September 2025), 42 studies met inclusion criteria.

Techniques and outcomes

- **Local flaps (C-V, skate, star)**: common, with 7-10 mm initial projection but 30-50% loss at 1 year [15,16].
- **Five-flap technique**: higher satisfaction, lower necrosis [17].
- **Nipple-sharing**: Ideal for unilateral cases, excellent symmetry [18].
- **3D tattooing**: highest satisfaction (mean 4.7/5), minimal complications, no projection [18].
- **Innovations**: FixNip NRI implants maintain 3.7 mm projection at 12 months [19]; targeted NAC reinnervation (TNR) achieves 88% sensory recovery [20].

Patient-reported outcomes

- **3D tattooing**: highest satisfaction (92-96%) [18].
- **Local flaps**: good projection but prone to flattening [15,16].
- **Nipple-sharing**: best symmetry for unilateral cases [18].
- TNR: 88% erogenous sensation recovery [20].

Complications

- **C-V flap**: 14% necrosis [15,16].
- **Five-flap**: 5% asymmetry [17].
- **Tattooing**: 1% fading/allergy [18].
- **Infection**: rare across techniques [23].
- **FixNip NRI**: 8.3% infection/removal [19].

Patient-centered decision-making

- Shared decision-making increased satisfaction by 34% and reduced regret by 22% [22-24].
- Preferences: 62% prioritized avoiding surgery, 28% valued projection, 14% declined reconstruction due to fatigue or risk aversion [25-27].
- Tattooing gained popularity for minimal invasiveness (Tabs. I-II) [28].

DISCUSSION

Nipple reconstruction post-SSM significantly improves psychosocial and aesthetic outcomes [34,35]. Technique

Table I. Comparison of nipple reconstruction techniques Post-SSM.

Technique	Initial projection	Satisfaction (%)	Major complications (%)	Best indication	References
C-V flap	7-10 mm	70-85	14 (necrosis)	Bilateral/unilateral SSM	15,16,29
Skate flap	7-9 mm	72-88	8 (necrosis)	Bilateral SSM	15,16,30
Five-flap	8-10 mm	90-93	5 (asymmetry)	Bilateral SSM	17,31
Nipple sharing	7-9 mm	88-92	2 (minor)	Unilateral SSM	18,32
3D tattooing	0 mm	92-96	1 (fading/allergy)	Any, especially comorbidities	18,28,33
FixNip NRI	3-4 mm	90	8.3 (infection/removal)	Post-mastectomy durability	19
TNR	Variable	88 (sensory)	Variable (delayed recovery)	Sensory restoration	20

Table II. Comparison of related systematic review.

Review focus	Year	Key findings	Pros	Cons	References
NSM *vs* SSM PROs/complications	2023	NSM superior in sexual/psychosocial well-being (MD 7.64/4.71); similar complications	Validated BREAST-Q meta-analysis	Heterogeneous follow-up; non-RCTs	[38]
NSM oncologic outcomes	2022	Low recurrence (3.4%); high survival (96.3%)	Large pooled analysis	Short follow-up in some	[39]
Recent trends in reconstruction	2025	Shift to minimally invasive; tattooing trends up	Highlights patient decisions	Case series dominant	[40]

choice should consider anatomy, expectations, and comorbidities [36,37]. Shared decision-making enhances satisfaction and reduces regret [22-24]. Optimal timing is 3-6 months post-reconstruction for vascular stability [36]. Flap-based methods struggle with projection loss [15,16], while tattooing offers high satisfaction with minimal risk [18]. Tattooing and nipple-sharing are cost-effective, reducing surgical burden [18,37].

Comparative reviews provide context. A 2023 meta-analysis found nipple-sparing mastectomy (NSM) superior in sexual (MD 7.64) and psychosocial well-being (MD 4.71) versus SSM, with similar complications but higher NAC necrosis in NSM [38]. Its strength lies in BREAST-Q data, but non-RCT designs limit generalizability. This review, focusing on SSM, offers broader technique coverage. A 2022 NSM review reported low recurrence (3.4%) and high survival (96.3%) [39], relevant as NSM may reduce reconstruction needs. Its large sample is a strength, though short follow-up is a limitation. Recent 2025 trends highlight tattooing's rise and innovations like FixNip NRI (3.7 mm projection) and TNR (MD -1.73 for sensation) [19,20,40], suggesting hybrid approaches for future research.

Limitations

Outcome heterogeneity and reliance on observational studies [27,29]. Publication bias may inflate satisfaction rates [27].

CONCLUSIONS

Nipple reconstruction after SSM is safe and enhances satisfaction and aesthetics [34,35]. Individualized, shared decision-making is crucial [22-24]. Further research should standardize outcomes and evaluate innovations [27].

Conflict of interest statement

The author declares no conflict of interest.

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Ethical consideration

Ethical approval was not required for this systematic review as it is based on previously published studies and does not involve human or animal participants. The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki.

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