

The role of nipple-areola complex tattooing in breast cancer psycho-physical rehabilitation: An updated review

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ABSTRACT

Cosmetic interventions like Nipple-Areola Complex tattooing have been shown to improve outcomes in breast cancer survivors. Although it is a safe and well-tolerated technique that provides satisfactory aesthetic results, several research needs were acknowledged. This paper aims to briefly review the latest evidence regarding Nipple-Areola Complex tattooing for breast reconstruction proposes after oncological surgery, assessing studies' designs and the addressed outcomes, including any Patient Reported Outcome. Complete and primary published literature between 2023 and February 2025 was included. Pubmed, Embase, Cinahl, and Scopus were searched with these main keywords: Nipple, Areola*, Tattoo*, and dermopigmentation. A narrative synthesis was conducted to summarize the results. In the last two years, the amount of literature on the topic has increased, along with the technique application and its research interest. Observational designs [cross-sectional ($N = 5$); retrospective ($N = 5$); implementation project ($N = 1$); qualitative ($N = 1$)] addressed current research gaps, like quality-of-life assessment with validated instruments and organizational aspects. In line with previous literature, the Nipple-Areola Complex reconstruction's relevance, satisfaction with the cosmetic outcome, the fading phenomenon, and the factors influencing color durability were other outcomes assessed. Emotional, psychological, and sexual domains are patient-reported outcomes that benefit from Nipple-Areola Complex tattooing. Sustainability and professional training remain critical issues worthy of further comprehensive studies.

Background

Cosmetic interventions like Nipple-Areola Complex (NAC) tattooing have been shown to improve outcomes in breast cancer survivors [1]. Body image concerns may emerge in those who have undergone surgery and multiple demolitive treatments [1]. This may be particularly challenging and attention-worthy by health policymakers: it is established that appearance issues might result in emotional and psychological burden that impacts their private, familiar, and social lives [2]. The NAC tattooing technique is also known as medical dermopigmentation [3]: the skin is colored through the introduction of specific pigments into the superficial layer of the papillary dermis with the help of an electric device and disposable needles. Professional and organisational aspects of NAC tattooing vary extensively worldwide [4]. In the United States, variability in coverage across different companies and states

complicates accessibility to medical tattooing [5]. Similar challenges have been reported in Europe. In Italy, for instance, although NAC tattooing is the only form of medical tattooing that is regulated by law [6] and included in the Essential Levels of Care since 2019 [7], it is not equally accessible to women due to the unevenness of the services offered, many of which are private and costly for patients [4]. Furthermore, several aspects require exploration, including sustainability within public health services and the necessary training. Training in NAC tattooing is essential for tattoo artists and healthcare professionals to ensure safety and quality. Nevertheless, the subject is variable and poorly described [4]: different professionals are involved, such as tattoo artists, medical residents, plastic surgeons, and most frequently, nurses.

Tattooing for medical purposes has a wide range of applications in various clinical areas. It differs from artistic tattooing or permanent

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make-up in its aim, materials, and technique. Firstly, the treatment is aimed at individuals who, after undergoing invasive procedures such as chemotherapy, radiation therapy, or reconstructive treatments, require reconstruction or coverage of pathological skin conditions, thereby restoring the appearance of healthy skin integrity [3]. Secondly, the pigment inoculation on the NAC involves using different types of injectors equipped with needles of varying thickness and speed, capable of puncturing the skin at a constant depth. In semi-permanent cosmetic tattooing treatments, the color fades over time, and yearly touch-ups are recommended to maintain optimal results [3]. Working in this field requires artistic and technical skills in drawing and color theory, as well as an understanding of dermatological, oncological, and surgical elements [8]. Tattooing compromised skin requires specific attention.

Furthermore, professionals should prioritize the therapeutic relationship by addressing body image and identity issues after cancer, beginning with a personalized NAC color and shape project. Technique features, such as correct color harmonization, needle depth and range, dermograph angle, and the three-dimensional effect, are crucial to achieving a satisfactory result [9]. Moreover, the pigments deposited are superficial compared to the other permanent make-up techniques [10]. They are used to achieve the desired color shade, which can be either organic, non-organic, or a combination of both. In Europe, the REACH regulation is the reference [11]: pigments must adhere to requirements such as sterility, the total exclusion or maximum reduction of metal derivatives, the product label, lot, quantity, expiration date, and a components' report [3]. The synergy of these factors reduces the risk of pain, excessive bleeding, infection and skin reactions. It increases the chance to gain an excellent three-dimensional and natural appearance, pigment persistence, versatility and personalized outcome [3].

Recently, a review concluded that NAC tattooing represents a safe and well-tolerated technique that provides satisfactory aesthetic results [4]. However, further studies were recommended to integrate the small and methodologically weak body of literature, for example clarifying how this service may be provided and which outcomes it may reach [4]. Notably, the interest in NAC tattooing topic has extensively grown worldwide [12], as also research designs [13]. Considering current knowledge gaps, this paper aims to briefly review the latest evidence regarding NAC tattooing for breast reconstruction proposes after oncological surgery, assessing studies' designs and the addressed outcomes, included any Patient Reported Outcome (PRO).

Methods

In this narrative approach [14], complete and primary published literature between 2023 and February 2025 was included. Exclusion criteria are listed as follows: non-English languages; not eligible publication types (conference abstracts, case reports, letters, or short communications), and not pertinent papers (studying other reconstruction techniques alone or considering the tattooing on other sites or for other aims).

To reach the objectives stated above, four databases were searched (Pubmed, Embase, Cinahl, and Scopus) with these main keywords: Nipple, Areola*, Tattoo*, and dermopigmentation. Time frame and language limits were set as stated in the inclusion criteria. Reference lists of included papers have been manually checked to find further records.

The search results were imported into Zotero software and screened for eligibility by two independent reviewers (DM and MT) after removing duplicates. Any reviewer disagreements were resolved through discussion at each stage of the selection process. Results were reported by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist [15].

One reviewer (DM) manually extracted the data from the selected articles using Excel, which was cross-checked independently by another review team member (MT). Any disagreement identified was resolved through discussion with other review team members. Extracted data

included: author, year, country, study design, aim(s), sample, Patient Reported Outcome Measures (PROMs) and main results. These elements were sought according to the specific outcomes stated before. A narrative synthesis was conducted to summarize the results.

Results

As illustrated in Fig. 1, twelve papers were included, and the main results are described in Table 1. The USA ($N = 5$) and Europe (Italy $N = 3$; Spain $N = 1$; Ireland $N = 1$) were the countries most represented, followed by Mexico ($N = 1$) and Japan ($N = 1$). All the studies had an observational design, mostly cross-sectional ($N = 5$) and retrospective ($N = 5$), followed by an implementation project ($N = 1$) and a qualitative study ($N = 1$). Recent trends in the choice of NAC reconstruction studied in the last 15 years at a single academic institution show that NAC tattooing as a stand-alone reconstruction technique has increased [16]. Vachtsenovanos et al. (2023) surveyed patients who have undergone NAC tattooing in a breast unit referral [2]: the patients' satisfaction was high on the overall result and individual features (shape, height, color, appearance, and naturalness). In another study, cancer survivors evaluated other patients' cosmetic and decision satisfaction [17]: the breast reconstruction combined with NAC tattooing had the highest rates in cosmetic quality, lowest in scar visibility, and highest in treatment decision satisfaction. Similarly, Escarré et al. (2024) collected high satisfaction with dermopigmentation among patients who underwent reconstructive breast surgery [18].

Nevertheless, some concerns emerged about color fading. On this topic, Yamamoto et al. (2024) pointed out that the fading rate tended to decrease as time progressed, but the phenomenon is significant and still occurs between 6 and 12 months [19]. Color and luminance varied from immediately after 1 month after tattooing. Studies explored factors associated with NAC tattooing: Kandi et al. studied NAC Montgomery tubercles to inform current 3D NAC tattooing better, concluding that their number did not correlate with patient age, body mass index, or NAC size [20]. Some factors that can impact the tattoo outcome are tissue thickness, sex, reconstructive technique, and history of radiotherapy [21]. Moreover, other health outcomes were assessed: the approach of Proctor et al. (2024b) was oriented to examine the relationship between medical tattooing and body-image distress and mental health outcomes among breast cancer survivors [22]: tattooed participants reported significantly lower levels of body-image distress ($p = 0.001$) than those without medical tattooing, as also fewer depressive symptoms (Cohen's $d = 0.5$), and fewer anxiety symptoms (Cohen's $d = 0.4$). Two studies used validated a PROM, the BREAST-Q: comparing data with pre-tattoo scores, sexual well-being significantly improved after NAC tattooing among bilateral Implant-based breast reconstruction patients [23]. Another study found that NAC-tattooed participants reported significantly improved scores in emotional and psychological domains compared to those not tattooed [24]. Consistent patients' satisfaction levels on nipple appearance and sexual well-being were also noted. Finally, two studies report experiences from professional and organizational perspectives: Daly et al. (2024) explored tattoo artists' point of view on therapeutic tattooing for cancer survivors, enlightening the psychological impact and factors on both artists and cancer survivors and barriers and facilitators from both perspectives [25]. Maselli et al. provided a methodological analysis of a multidisciplinary nurse-led NAC tattoo clinic implementation, reporting on patients and the professional and organizational implications of NAC tattooing as a complex intervention [26].

Discussion

This review aimed to summarize the latest evidence on NAC tattooing among breast cancer patients, focusing on available literature and patient outcomes. The last review addressing the same primary research question analyzed thirteen articles in thirteen years (from 2010

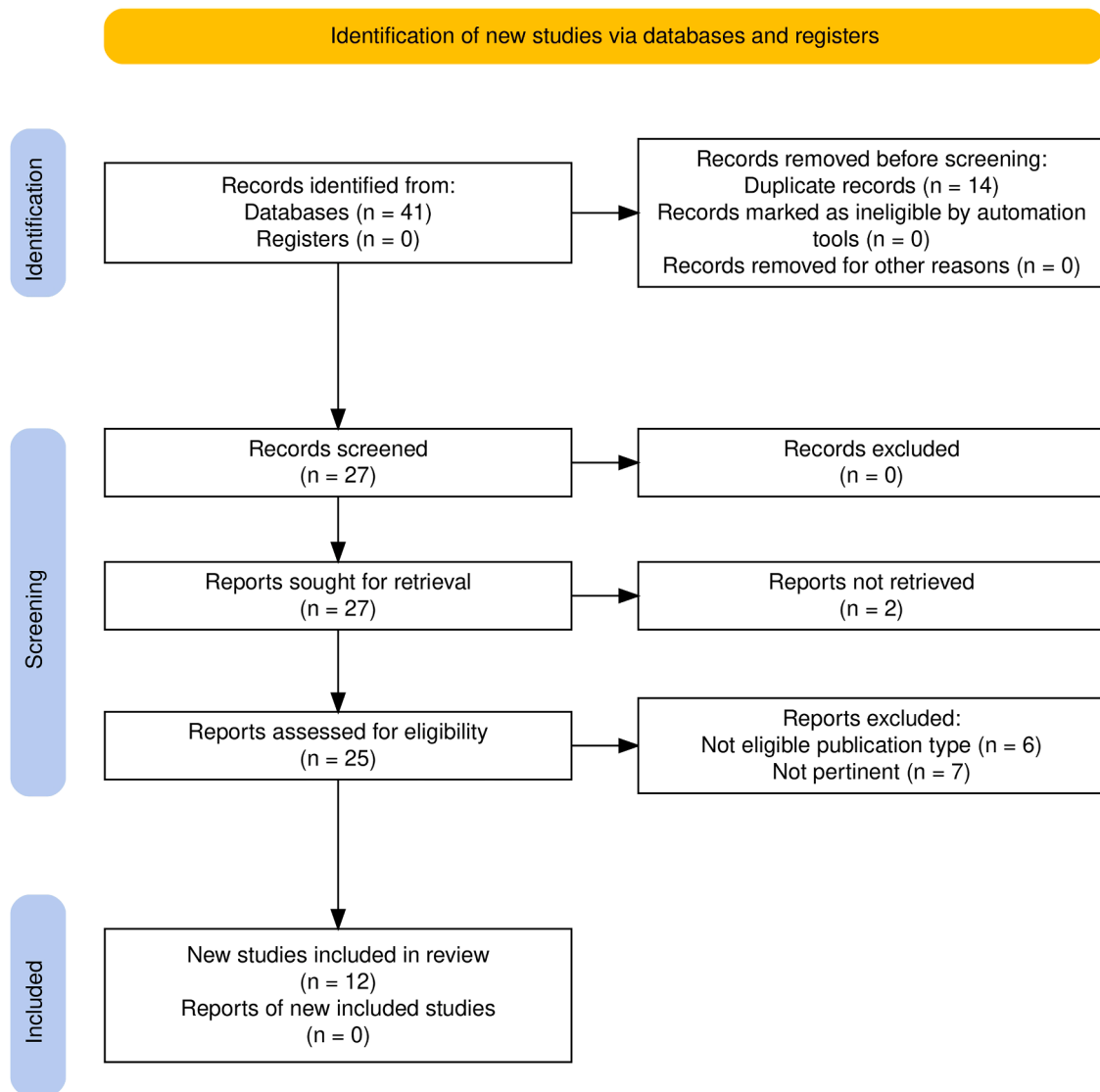


Fig. 1. Fig. 1 PRISMA study selection process.

to February 2023) [4]. In comparison, twelve articles on the topic were retrieved in the last two years, proving that the amount of literature significantly increased. Moreover, the 15-year retrospective analysis by Byrnes et al. in the USA shows that surgical NAC reconstruction with a tattoo was the most frequent line of treatment and that the tattoo-only option is an emergent one [16].

The geographical distribution of the included studies and their observational designs, shown in the results section, are in line with previous literature [4], as are several outcomes. NAC reconstruction's relevance emerged as a necessary step for a relationship with self and others [2]. Satisfaction with outcome was collected both in detail (shape, color, appearance, naturalness) [2], and overall satisfaction on a 1–5-Likert scale (mean score 4.4) [18]. In this last paper, fading was a widespread phenomenon, that made some patients consider a permanent solution [18]; in another analysis, color fading tended to decrease over time [19]. Factors influencing cosmetic (color durability) results were also noted: tissue thickness [21], sex [21], age [18], reconstructive technique [21], and history of radiotherapy [21]. Previous chemotherapy negatively influenced color durability in one study [18], but not in Lusetti et al [21].

Remarkably, important aspects that required further exploration were considered, including quality-of-life-related and organizational

ones. In the survey by Proctor et al. (2024b), body image, anxiety, and depression concerns were lower in tattooed patients [22]. Further studies should clarify these relationships by taking into account demographic and clinical characteristics and ensuring diversity in the sample. Furthermore, the use of validated PROMs is positively spreading, favoring generalizability and validity of results: their little use indeed represented a frequent limitation in previous studies [4]. Emotional and psychological domains were more favorable in tattoo patients [22], and sexual well-being scores were higher after the tattoo in Jones et al [23]. These quality-of-life data are crucial for understanding the relevance of this intervention in healthcare systems and its therapeutic value. Professional and organizational aspects have been identified as complex and worthy of further focus [25]. Despite the development of encouraging training curricula [27], the need for greater consistency has emerged, including the exploration of the relationship between competence and patient outcomes. Technical and artistic expertise should be combined with advanced oncological care competence. Finally, novel and comprehensive approaches to research may help to continue the pathway of sustainability and personalization of care in this field [26], which are key factors for health intervention in complex healthcare systems. NAC reconstruction after oncological surgery affects patient satisfaction, rehabilitation, and overall health, as

Table 1
Summary of studies included.

Author(s)/Year	Country	Study design	Aim(s)	Sample	PROMs	Main results
Vachtsenovanos et al. (2023)	Italy	Survey	To assess emotional and social issues of breast cancer treatment	N = 81	Ad-hoc questionnaire	36 % of the sample considered NAC reconstruction extremely important, 48 % considered it somewhat necessary; 60 % thought the NAC reconstruction was necessary for their relationship with others and for themselves. 75 % of the sample group had no tattoos, of which 48 % felt that the dermo-pigmentation procedure was invasive. Shape: 52 % satisfied and 42 % were highly satisfied. Color: 53 % rather satisfied, 40 % very satisfied. Appearance: 56 % satisfied, 38 % greatly. Naturalness: 52 % satisfied, 42 % greatly.
Kandi et al. (2023)	USA	Retrospective study	To establish a relationship between the amount of NAC Montgomery tubercles given patient characteristics to better inform current 3D NAC tattooing practices.	N = 211	No	Patients had 5.0 ± 5.2 Montgomery tubercles (range, 0–25 MTs). The number of Montgomery tubercles did not correlate with patient age, BMI, or NAC size. Premenopausal females were more likely than postmenopausal females to have a greater number of MTs per breast ($P = 0.0183$).
Padullés-Escarré et al. (2024)	Spain	Cross-sectional descriptive observational study,	To evaluate the degree of satisfaction of women treated with NAC dermopigmentation and reconstruction after breast reconstruction.	N = 128	Likert-based Questionnaire adapted from a previous study	Mean satisfaction with dermopigmentation was 4.4 (± 0.88) and 3.79 (± 1.06) for reconstruction in a 1–5 Likert scale. Complications were rare; 54.5 % did not offer the expected projection; 91.6 % the color had faded; 51.4 % would choose permanent tattooing. The older the age and previous chemotherapy treatment negatively influenced the color durability ($P \leq 0.05$).
Cálix Garcia et al. (2024)	Mexico	Retrospective study	To evaluate PROs for satisfaction among Hispanic women who underwent NAC reconstruction with 3D tattooing after breast reconstruction Vs No tattoo	N = 70	BREAST-Q	3D NAC tattooing group demonstrated increased psychosocial well-being (mean [standard deviation] score of 84.73 [8.56]). They expressed greater satisfaction with nipple reconstruction, with a mean score of 3.73 [0.44] compared with the no tattoo group (mean score of 3.48 [0.65]).
Byrnes et al. (2025)	USA	Retrospective study	To quantify recent trends in choice of NAC reconstruction and explore driving factors.	N = 138	No	17.4 % ($n = 24$) were in the surgical-only group, 16.7 % ($n = 23$) tattoo-only, and 65.9 % ($n = 91$) both surgical and tattoo. Over the 15-year period, patients receiving tattoo-only NAC reconstruction significantly increased ($P < 0.0001$), while those receiving both surgical and tattoo significantly decreased ($P = 0.007$).
Daly et al. (2024)	Ireland	Qualitative study	To identify TAs' perspectives on the types, impacts, barriers, and facilitators of therapeutic tattooing for CSs.	N = 22	No	The themes emerged from TAs' interviews were emotional management of artists, emotional transformation of CSs, stigma and its effects on CSs, barriers and facilitators among artists and CSs. Therapeutic tattooing can be both beneficial and harmful for CSs and TAs. There is a need for better therapeutic tattooing training for TAs and healthcare providers.
Jones et al. (2024)	USA	Retrospective study	To collect patient preferences and satisfaction of NAC reconstruction with 3D tattoo among bilateral Implant based breast reconstruction patients.	N = 104	BREAST-Q	Patients prefer small areola size with a higher position compared to classic values. Race, BMI and implant size can influence these values. Sexual well-being is improved after NAC reconstruction.
Lusetti et al. (2023)	Italy	Retrospective study	To evaluate all the factors which could influence the result of the NAC pigmentation.	N = 97	No	Radiotherapy resulted a risk factor for retattooing ($p < 0.05$) while the autologous breast reconstruction resulted a protective factor for retattooing. Neo- and adjuvant chemotherapy were not statistically significant. Tissue thickness, sex, reconstructive technique and history of radiotherapy could influence the final result.

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Table 1 (continued)

Author(s)/Year	Country	Study design	Aim(s)	Sample	PROMs	Main results
Proctor et al. (2024a)	USA	Survey	To examine how breast CSs evaluated the cosmetic and decision satisfaction of other patients who made cosmetic intervention choices post-mastectomy.	N = 330	No	Participants rated images of patients with reconstruction and medical tattooing highest in cosmetic quality, lowest in scar visibility, and highest in treatment decision satisfaction.
Proctor et al. (2024b)	USA	Cross-sectional descriptive observational study,	To examine the relationship between medical tattooing and body-image distress and mental health outcomes among breast CSs.	N = 251	Ad-hoc questionnaire	Participants with medical tattoos reported significantly lower body-image distress, depression and anxiety symptoms, and perceived stress compared to those without medical tattoos.
Yamamoto et al. (2024)	Japan	Observational study	To clarify fading, RGB values change, and color reproducibility for NAC tattoos.	N = 59	No	RGB and luminance significantly changed and faded from 1 to 3, 3 to 6, and 6 to 12 months postoperatively; time-adjusted fading rates showed a trend of decreasing fading during the same period, but no significant difference; luminance was 9 % brighter than contralateral NAC at 12 months after; color reproducibility tended to be higher with dark or reddish pigments.
Maselli et al. (2024)	Italy	Implementation project	To report on the development of a multidisciplinary nurse-led service for NAC tattooing for women who underwent breast cancer surgery with NAC removal.	NA	No	The Breast Unit, the Research departments and three nurse-tattooists were engaged; the informative material was created and shared with patients, families and local associations. Patients were contacted by the nurse case manager. Each treatment consists of NAC shaping and tattooing with a dermographer and sterile needles. It involves 3–4 sessions, 30–40 days apart, in an ambulatory setting.

Legend: NAC = Nipple Areola Tattooing; RGB = Red Green Blue; CSs = Cancer Survivors; NA = Not Applicable; TAs = Tattoo Artists.

scars influence satisfaction with appearance and serve as reminders of past treatments [28]. The NAC reconstruction choice should be tailored to patients' needs, indications, and preferences, which could include novel non-invasive approaches [29]. Nevertheless, most of the research included in the review focused on high-income countries. Further efforts are necessary from researchers and policymakers to assess how low-resource settings can be reached, ensuring equity and accessibility.

Conclusion

Among breast cancer survivors, appearance issues with the NAC significantly impact their private, familiar, and social lives. Several observational studies suggest NAC tattooing restores physical integrity with satisfactory cosmetic outcomes. Emotional, psychological, and sexual well-being domains are PROs that benefit from NAC tattooing: the increased use of PROMs is encouraging, leading to more robust and generalizable data supported by mixed study methodologies.

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CRediT authorship contribution statement

Deborah Maselli: Writing – original draft, Methodology, Conceptualization. **Martina Torreggiani:** Methodology, Conceptualization. **Valeria Soffientini:** Methodology, Conceptualization. **Enrica Tamagnini:** Methodology, Conceptualization. **Stefano Botti:** Writing – review & editing, Validation. **Paola Ferri:** Writing – review & editing, Supervision. **Stefania Costi:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

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