

Utility of Negative Pressure Wound Therapy: Raising the Bar in Chest Masculinization Surgery

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Background: Prophylactic use of negative pressure wound therapy (NPWT) has been shown to decrease the incidence of postoperative complications. This study aimed to evaluate the utility of NPWT in chest masculinization with free nipple graft (FNG).

Methods: All consecutive male patients undergoing chest masculinization with FNG by a single provider at a single center were reviewed. Postoperative treatment with either NPWT or standard wound care (SWC) defined this study's cohorts. Patient characteristics and postoperative complications were compared between patients receiving NPWT versus SWC.

Results: One hundred thirty-one patients with 262 closed breast incisions (NPWT=72, SWC=190) met inclusion criteria. Overall complications were higher in the SWC cohort (n=80/190, 42%) compared to the NPWT cohort (n = 13/72, 18%, $p < 0.001$). The NPWT group had significantly lower rates of partial nipple graft loss (9/72, 12.5% versus 47/190, 24.7%, $p = 0.031$), seroma formation (1/72, 1.4% versus 15/190, 7.9%, $p = 0.037$), and nipple hypopigmentation (6/72, 8.3% versus 36/190, 18.9%, $p = 0.024$) when compared to the SWC cohort. Time to drain removal was significantly faster in the NPWT group (NPWT 7 days versus SWC 9 days, $p \leq 0.001$).

Conclusions: Patients receiving NPWT over their closed incisions following chest masculinization with FNG were found to have significantly lower rates of partial nipple graft necrosis, seroma formation, and time to drain removal compared to those receiving SWC. Future prospective, randomized studies to further elucidate the role of NPWT in top surgery are warranted. (*Plast Reconstr Surg Glob Open* 2022;10:e4096; doi: 10.1097/GOX.0000000000004096; Published online 11 February 2022.)

INTRODUCTION

Chest masculinization is the most common gender-affirming surgery performed in the male transgender and nonbinary patient population.¹ The 2015 US Transgender Survey, which includes a sample of over 27,000 individuals, found that 97% of transgender male respondents had either already undergone chest reduction or reconstruction or hoped to do so in the future.² The impact of this

operation can be profound and lasting, having been demonstrated to improve psychological functioning, alleviate gender dysphoria symptoms and improve patients' well-being and quality of life.³⁻⁵

Despite advances in the field of gender affirmation surgery, chest masculinization is associated with a considerable rate of postoperative complications.⁶⁻⁸ The literature cites complication rates ranging from 11% to 33%, with some of the most common complications including nipple necrosis, wound infection, hematoma, and/or seroma formation.⁶⁻⁸ Although the majority of complications are minor, many may require hospital readmission and/or surgical intervention. In fact, existing evidence suggests that between 9% and 46% of chest masculinization procedures require some kind of revision.⁹⁻¹³ Postoperative complications and additional revisional procedures can

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add to the out of pocket expense imposed on patients. Minimizing complications after chest masculinization surgery is not only essential for optimizing patient care but also important for optimizing access to surgical care for the transgender population.

Negative pressure wound therapy (NPWT) facilitates wound healing by enhancing the inflammatory response, removing edematous fluid from the affected area, and by promoting wound bed contraction.^{14,15} Although several studies point to the benefits of NPWT for cisgender female patients undergoing breast reconstruction, there is a paucity of literature regarding the possible benefits of NPWT for transgender patients undergoing chest masculinization. Importantly, chest masculinization procedures often entail advanced techniques for nipple-areola complex (NAC) grafting to achieve a masculine appearing nipple.¹⁰ Free nipple grafts (FNGs) are susceptible to necrosis and may stand to benefit from the wound healing mechanism employed by NPWT. To date, no study has been published examining the potential use of NPWT in reducing FNG necrosis in patients seeking chest masculinization. The aim of this retrospective study was to investigate outcomes following free nipple grafting for chest masculinization in patients receiving NPWT versus those receiving standard wound care (SWC).

METHODS

Study Design

All transgender patients undergoing mastectomy with FNG by a single provider between 2018 and 2020 were retrospectively reviewed. The following International Classification of Diseases, Ninth Revision (ICD-9) and Tenth Revision (ICD-10) codes were utilized to identify patients with a diagnosis of gender dysphoria and the related conditions: F64.0, F64.1, F64.2, F64.8, F64.9, 302.6, and 302.85. The cohort was subsequently filtered for patients who underwent simple mastectomy and FNG using Current Procedural Terminology codes (Table 1). For the purposes of this study, each breast was considered an independent observation. The cohort was then divided into two groups based on postoperative wound care: NPWT or SWC.

Data Collection

Demographics, comorbidities, surgical details, postoperative and healing complications, time to drain removal, revision rates, and unplanned reoperations were collected from the electronic health record (EHR). Ethnicity was categorized as White, African American, or other due to the low representation of American Indians, Asians, and Pacific Islanders in our region.¹⁶ Patients were excluded from the study if they were less than 18 years of age, had a history of radiation of the breast, tattoos in the area of the incision, previous breast surgeries or skin, or were lost to follow-up. Patients who missed their first postoperative appointment or three or more consecutive follow-up appointments were considered lost to follow-up. This study was approved by the institutional review board (MHRI 2018-173).

Takeaways

Question: In patients undergoing chest masculinization with FNGs, is NPWT associated with lower rates of postoperative complications when compared with SWC?

Findings: In this retrospective study of patients undergoing chest masculinization with FNGs, patients who received NPWT had significantly lower rates of partial nipple graft loss, seroma formation, and nipple hypopigmentation as well as faster time to drain removal when compared with patients who received SWC.

Meaning: NPWT was associated with lower rates of postoperative complications including partial nipple graft loss in the studied cohort of patients undergoing chest masculinization with FNGs.

Complications

Each complication was considered a separate event and counted once per breast, allowing for our calculation of complication rates. Minor complications included uncomplicated hematoma, surgical site infection, or partial nipple graft loss/necrosis. Partial nipple graft loss was defined as any skin changes greater than 5mm as documented in postoperative clinical documents. Major complications involved hematomas requiring surgical decompression, wound dehiscence, or total FNG necrosis. Only complications occurring within 90 days of the index procedure were included in the analysis.

Perioperative Care and Operative Technique

Following the guidelines established by the World Professional Association for Transgender Health (WPATH) specific to transgender patients undergoing breast surgery, all patients required approval by a psychiatrist before treatment and a year of exogenous hormones before surgery.¹⁷ All patients received preoperative antibiotics.

The chest masculinization procedure is initiated by excising an ellipse of skin and subcutaneous tissue, which includes the NAC. Each nipple is then excised as a full-thickness graft. To ensure maximal graft viability, fat is removed from the FNGs while preserving the dermis. The FNGs are then sutured to the desired location. This is followed by an incision along the inframammary fold followed by the

Table 1. ICD-9, ICD-10, and CPT Codes

ICD-9/ICD-10 Code	Description
F64.0	Transsexualism
F64.1	Gender identity disorder in adults
F64.2	Gender identity disorder in children
F64.8	Other gender identity disorders
F64.9	Gender identity disorder, unspecified
302.6	Gender identity disorder in children
302.85	Gender identity disorder in adolescents or adults
CPT code	Description
19303	Mastectomy, simple, complete
19304	Mastectomy, subcutaneous
15202	Full-thickness graft, free

CPT, Current procedural terminology.

removal of breast tissue, which is sent to surgical pathology for measurement. The superior mastectomy flap is then matched to the inferior mastectomy flap. One Blake drain is placed in the prepectoral space of each breast. Lipectomy is then performed over the deltopectoral triangle and the lateral chest wall to minimize dog-ears. The inframammary fold incision is then closed in layers, followed by the placement of either an NPWT device or SWC (bolster dressing). SWC dressings included Xeroform occlusive petrolatum gauze (Covidien, Minneapolis, Minn.). For patients receiving NPWT, a 13-cm Prevena Peel and Place Incision Management System (3M, St. Paul, Minn.) was applied and set to 125 mm Hg of continuous pressure. (See Video [online], which displays double incision mastectomy with free nipple grafting followed by application of NPWT with Prevena Peel and Place Incision Management System [3M].)

Patients were instructed to limit strenuous physical activities and wear a compressive elastic wrap or garment until their first postoperative visit. Patients were also instructed to keep their dressings dry and in place until their first postoperative visit 7–10 days after surgery. Showering from the waist down was permitted, but patients were instructed to only sponge bathe the upper torso and arms. All dressings were removed at the first postoperative visit and patients were transitioned to wound care involving Xeroform, bacitracin, and gauze or bandages, which they were instructed to change daily. Patients were advised to continue always wearing their compression garment except for showering. Blake drains were removed when output was less than 20 ml for two consecutive days.

Postoperative follow-up care was standardized across the studied cohort, regardless of whether a patient received SWC versus NPWT. All patients were instructed to follow up in clinic 1 week following surgery. Patients who missed their first postoperative visit were considered “lost to follow-up” and excluded from further analysis.

Statistical Analysis

Continuous variables were described by means and SDs or median and quartiles where appropriate. The student *t* test, Wilcoxon rank sum, or Kruskal–Wallis tests were used to examine statistically significant differences between continuous variables as appropriate. Categorical variables were described by frequencies and percentages. Chi-square and Fisher exact tests were used to examine statistically significant difference between categorical variables. Statistical analysis was performed using STATA v.16 (StataCorp, College Station, Tex.) with significance defined as a *P* value less than 0.05.

RESULTS

One hundred thirty-nine patients underwent trans-masculine chest reconstruction with FNG in the studied period. Eight patients were lost to follow-up and excluded from analysis, leaving a total of 131 patients in the studied cohort. Thirty-six patients (25.8%) received NPWT and 95 patients (72.5%) patients received SWC dressings post-operatively. (See figure, Supplemental Digital Content 1, which displays NPWT with 13-cm Prevena Peel and Place

Incision Management System [3M] applied and set to 125 mm Hg of continuous pressure [A]. SWC included tie-over bolsters using Xeroform occlusive petrolatum gauze [B], <http://links.lww.com/PRSGO/B936>.) Overall, the patient population was young with a median age at time of surgery of 24 years (interquartile range [IQR] 20, 29) and no significant difference in age between the NPWT and SWC groups (*P* = 0.145). The median body mass index (BMI) for the studied population was 28.2 kg/m² (IQR 24.2, 35) with no difference between cohorts (*P* = 0.753). The majority of patients were White (*n* = 58; 44.3) followed by African American (*n* = 47; 35.8%), with no difference between cohorts. Relative to the NPWT group, patients in the SWC group were more likely to have a history of smoking and to have smoked within 4 weeks before surgery, but neither of these trends reached statistical significance (smoking history, *P* = 0.101; smoking within 4 weeks of surgery, *P* = 0.060). Patient demographics and comorbidities are detailed in Table 2.

A total of 262 breasts were identified (NPWT = 72, SWC = 190). The median weight of breast tissue resected in the overall studied population was 562 g (IQR 430, 828) and was not significantly different between the NPWT and SWC groups (NPWT 562 g versus SWC 576 g; *P* = 0.939). No intraoperative complications were encountered. The median time to drain removal was 8 days (IQR 7, 11). Time to drain removal was significantly faster in the NPWT group (NPWT 7 days versus SWC 9 days, *P* ≤ 0.001).

Overall complications were higher in the SWC cohort (*n* = 80/190, 42%) compared with the NPWT cohort (*n* = 13/72, 18%, *P* < 0.001). Total FNG loss occurred in 11 breasts (*n* = 11/262, 4.20%). Although there was no difference in the incidence of total nipple graft loss between the NPWT and SWC groups (11 NPWT 1.4% versus SWC 5.3%, *P* = 0.145), the incidence of partial nipple graft loss was significantly higher in the SWC cohort (NPWT 12.5% versus SWC 24.7%, *P* = 0.031). Further analysis of this finding in three BMI categories (20–25, 25–30, and >35) reveals that patients in the NPWT group had a lower incidence of partial FNG necrosis across all BMI categories (Fig. 1). The incidence of seroma formation and nipple hypopigmentation were also significantly lower in the NPWT group (seroma formation: NPWT 7.9% versus SWC

Table 2. Demographics and Comorbidities

	Total (N = 131)	NPWT (N = 36)	SWC (N = 95)	<i>P</i>
Age (y); median (IQR)	24 (20, 29)	23 (20, 28)	25 (21, 29)	0.145
BMI (kg/m ²); median (IQR)	28.15 (24.2, 35)	27.8 (24.7, 32.3)	28.1 (24.2, 35.5)	0.753
Race				0.100
African American	47 (35.8)	16 (44.4)	31 (32.6)	
White	58 (44.3)	17 (47.2)	41 (43.6)	
Other	26 (19.8)	3 (8.3)	23 (24.2)	
Diabetes mellitus	6 (4.6)	0 (0)	6 (6.3)	0.123
Smoking within 4 wk of surgery	21 (16.0)	2 (5.6)	19 (20.0)	0.060
Smoking history	44 (33.6)	8 (22.2)	36 (37.9)	0.101
ASA score, median (IQR)	2 (2,2)	2 (1,2)	2 (2,2)	0.096

All variables represented as n (n%) unless otherwise stated.

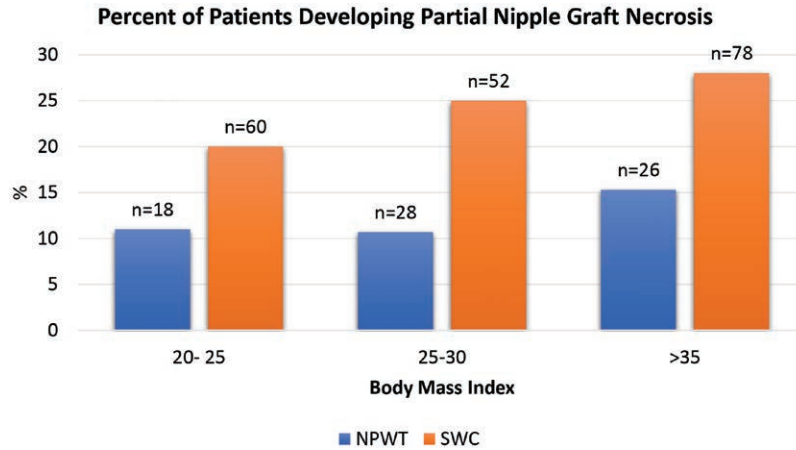


Fig. 1. Patients with NPWT had lower rates of partial nipple graft necrosis across all BMI groups.

1.4%, $P = 0.037$; nipple hypopigmentation: NPWT 8.3% versus 18.9%, $P = 0.024$). The incidence of surgical site infections, hematoma formation, and wound dehiscence did not differ significantly between cohorts. Postoperative complications are detailed in [Table 3](#).

DISCUSSION

This single-site retrospective analysis compares complication rates after chest masculinization with FNG in 72 breasts that received NPWT versus 190 that received SWC. Rates of partial FNG necrosis, seroma formation, and nipple hypopigmentation were significantly lower in the NPWT group compared with the SWC group. Lower rates of partial FNG necrosis were observed across three different BMI categories. Patients in the NPWT group also had their drains removed significantly faster relative to patients in the SWC group. Our findings suggest that using NPWT as a postoperative dressing in patients undergoing chest masculinization surgery with FNG may help to circumvent several postoperative complications and facilitate a faster recovery.

One of the primary goals of chest masculinization surgery is to achieve the aesthetics of a male NAC which, in comparison with a female NAC, tends to be smaller and more ovoid in shape and located more laterally on the chest wall.¹⁰ Indeed, studies have shown that nipple appearance is a key component to a patient’s overall satisfaction with chest masculinization surgery.¹⁸ Preservation

of the nipple has been well demonstrated to improve the psychosocial well-being, providing a sense of normalcy to patients.¹⁹ Various surgical techniques have been proposed to achieve these goals. Among these techniques is the double incision mastectomy with nipple grafting, which offers several advantages including flexibility for areola resizing and repositioning.²⁰⁻²² This technique is not without its drawbacks, however. Complications such as long residual scars, pigmentary changes, decreased sensation of the NAC and potential for inadequate graft and partial graft necrosis can worsen aesthetic outcomes and decrease patient satisfaction.⁹

The findings of this study suggest that the utilization of NPWT may play a role in reducing the incidence of many of these postoperative complications, including partial graft necrosis. Devascularization (secondary to either venous engorgement or poor arterial flow), excessive closing tension, and development of seroma or hematoma have all been implicated in nipple necrosis following breast reconstruction.²³⁻²⁵ NPWT addresses several mechanisms known to contribute to graft necrosis. First, NPWT has been shown to reduce tissue stress and appositional forces, thereby reducing the risk of dehiscence, scarring, and poor cosmesis.²⁶ Second, several studies have found NPWT to increase microcirculation, improve oxygen saturation levels, and stimulate angiogenesis.^{27,28} Third, NPWT helps facilitate a continuous removal of fluid and exudate around the wound bed which is thought to promote wound healing and reduce the risk of infection.²⁹ These wound healing benefits offered by NPWT also likely contributed to the significantly lower incidence of nipple hypopigmentation observed in the NPWT group in this study. Hypopigmentation of the NAC has been reported to occur in up to 42% of patients undergoing the FNG technique.³⁰ The findings of our study suggest that the use of NPWT may be beneficial in lowering the incidence of postoperative nipple hypopigmentation in patients undergoing surgical chest masculinization. (See figure, [Supplemental Digital Content 2](#), which displays preoperative [A] and 6-month postoperative [B] photographs of a patient who received NPWT, <http://links.lww.com/PRSGO/B937>.)

Table 3. Postoperative Complication Rates of SWC versus NPWT

Complications	NPWT (N = 72)	SWC (N = 190)	P
Total nipple graft loss	1 (1.4)	10 (0.145)	0.145
Partial nipple graft loss	9 (12.5)	47 (24.7)	0.031
Dehiscence	2 (2.7)	3 (1.6)	0.420
Surgical site infection	0 (0)	3 (1.6)	0.380
Seroma	1 (1.4)	15 (7.9)	0.037
Hematoma	1 (1.4)	11 (5.8)	0.112
Nipple hypopigmentation	6 (8.3)	36 (18.9)	0.024

All values reported in n (n%) unless otherwise stated. Significance defined as $p < 0.05$.

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We also identified a significant reduction in time to drain removal in the NPWT group versus the SWC group, a finding that is consistent with existing literature on the efficacy of NPWT.³¹ Again, these findings are likely explained by the wound healing benefits offered by NPWT. Expedited removal of drains can improve patient comfort and convenience, allow patients to resume their normal daily activities sooner after surgery, and reduce the risk of infection and seroma formation.³²

Gender affirmation surgeries are often cost-prohibitory, particularly in patients of lower socioeconomic status and/or patients who do not have health insurance.² As part of any recommendation to utilize NPWT for its wound healing benefits, we must therefore also consider the financial implications of NPWT versus SWC. Although we did not measure the costs of NPWT versus SWC in this study, one economic analysis found that the use of NPWT following breast reconstruction was associated with a significant reduction in complications, which translated into significant overall cost savings.³³ Future studies should consider the possible financial benefits of NPWT in top surgery.

Limitations

The main limitations of this study relate to its retrospective design and small cohort size. The retrospective design of this study limited our ability to pinpoint the exact date of onset of complications in the studied cohort. As a result, we were not able to compare the time of onset of complications between the SWC and NPWT groups. In addition, cost is a major deterrent to undergoing chest masculinization and this study was not equipped to assess the financial constraints of using an NPWT device. Furthermore, because of its retrospective design, this study was not able to investigate the ideal strength or time of NPWT use. Additionally, relative to the NPWT group, patients in the SWC cohort of this study were more likely to have a positive smoking history and to have smoked within 4 weeks of surgery. Although we did find a difference in time to drain removal, our study was not equipped to analyze the difference in drain output. Future studies should attempt to analyze drain output when comparing NPWT with SWC. Although these differences did not reach statistical significance, higher rates of smoking in the SWC group may have contributed to the higher rates of postoperative complications in this cohort.

CONCLUSIONS

Chest masculinization is the most common gender-affirming surgery performed in the transgender population. This is the first study examining the utility of NPWT for FNG in chest masculinization surgery. The authors found that relative to patients with SWC, patients with NPWT had a lower rate of overall postoperative complications. These findings are consistent with a growing body of evidence demonstrating the beneficial effects of NPWT on wound healing. These favorable results warrant future prospective, randomized studies to further elucidate the role of NPWT in top surgery.

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