

Closed Incision Negative Pressure Therapy in Oncoplastic Breast Surgery: A Comparison of Outcomes

Carly M. Wareham, MD*
 Manish M. Karamchandani, MD*
 Gabriel De La Cruz Ku, MD†‡
 Kerry Gaffney, MD*
 Yurie Sekigami, MD*
 Sarah M. Persing, MD, MPH§¶
 Christopher Homsey, MD§
 Salvatore Nardello, DO¶
 Abhishek Chatterjee, MD, MBA,
 FACS§¶

Background: We aim to discern the impact of closed incision negative pressure therapy (ciNPT) on wound healing in the oncoplastic breast surgery population.

Methods: A retrospective analysis was conducted on patients who underwent oncoplastic breast surgery with and without ciNPT in a single health system over 6 years. Oncoplastic breast surgery was defined as breast conservation surgery involving partial mastectomy with immediate volume displacement or replacement techniques. Primary outcomes were rates of clinically significant complications requiring either medical or operative intervention, including seroma, hematoma, fat necrosis, wound dehiscence, and infection. Secondary outcomes were rates of minor complications.

Results: ciNPT was used in 75 patients; standard postsurgical dressing was used in 142 patients. Mean age ($P = 0.73$) and Charlson Comorbidity Index ($P = 0.11$) were similar between the groups. The ciNPT cohort had higher baseline BMIs (28.23 ± 4.94 versus 30.55 ± 6.53 ; $P = 0.004$), ASA levels (2.35 ± 0.59 versus 2.62 ± 0.52 ; $P = 0.002$), and preoperative macromastia symptoms (18.3% versus 45.9%; $P \leq 0.001$). The ciNPT cohort had statistically significant lower rates of clinically relevant complications (16.9% versus 5.3%; $P = 0.016$), the number of complications (14.1% versus 5.3% with one complication, 2.8% versus 0% with >2 ; $P = 0.044$), and wound dehiscence (5.6% versus 0%; $P = 0.036$).

Conclusions: The use of ciNPT reduces the overall rate of clinically relevant postoperative complications, including wound dehiscence. The ciNPT cohort had higher rates of macromastia symptoms, BMI, and ASA, all of which put them at increased risk for complications. Therefore, ciNPT should be considered in the oncoplastic population, especially in those patients with increased risk for postoperative complications. (*Plast Reconstr Surg Glob Open* 2023; 11:e4936; doi: 10.1097/GOX.0000000000004936; Published online 25 April 2023.)

INTRODUCTION

Postoperative wound complications, including surgical site infections, wound dehiscence, and seroma or

hematoma formation, are a common cause of morbidity in the surgical patient population. The oncologic breast population is a unique subset of patients who often require chemotherapy and/or adjuvant radiation therapy, placing them at higher risk for postoperative complications. The risk of complication depends on the surgical approach and type of reconstruction performed. Olsen et al studied the rates of surgical site infection following mastectomy with and without immediate reconstruction; the mastectomy with immediate reconstruction cohort had double the rate of surgical site infections when compared with mastectomy alone (10.3% versus 5%).¹ Prevention of wound complications in the breast cancer population is paramount to prevent the delay of adjuvant treatments, especially since adjuvant radiation is almost always

From the *Department of Surgery, Tufts Medical Center, Boston, Mass.; †University of Massachusetts Medical School, Worcester, Mass.; ‡Universidad Científica del Sur, Lima, Peru; §Division of Plastic and Reconstructive Surgery, Department of Surgery, Tufts Medical Center, Boston, Mass.; and ¶Division of Surgical Oncology and Breast Surgery, Department of Surgery, Tufts Medical Center, Boston, Mass. Received for publication December 7, 2022; accepted February 22, 2023.

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indicated in oncoplastic surgery as part of the breast conservation treatment plan.

There is a growing body of evidence across multiple surgical subspecialties supporting the use of prophylactic closed incision negative pressure therapy (ciNPT) to decrease the incidence of wound complications.²⁻⁵ Multiple products are available including the portable and disposable incision management system (Prevena; KCI), as well as a pocket-sized version (PICO; Smith and Nephew). These devices provide negative pressure, which reduces lateral wound tension, promotes proliferation of local wound factors required for granulation tissue formation, and improves lymphatic drainage.⁶ Each product is unique and mechanically different from one another, utilizing different sponges and pressure settings. As such, outcomes studies for each of these products are variable, and extrapolating one product's results for another is not recommended.^{7,8} First utilized in the orthopedic population, their use has recently been extended to other specialties, including general and colorectal surgery.² Newer studies have examined their use in breast surgery.^{6,9,10} Cagney et al performed a systematic review of seven studies comparing negative pressure wound therapy (NPWT) with standard non-NPWT dressing, finding a significantly lower rate of total wound complications in the NPWT cohort.⁶ Although the use of closed incision negative pressure therapy is rapidly expanding, there is a paucity of data demonstrating its utility in oncoplastic breast surgery (OBS): a breast-conserving, single-stage procedure in which the patient's own breast tissue is preserved for reconstruction using volume displacement or replacement techniques.¹¹⁻¹³ The aim of this study was therefore to discern the impact of closed incision negative pressure therapy at -125 mm Hg (Prevena Bella) on wound healing in the oncoplastic surgery population.

METHODS

Study Cohort

Patients who underwent OBS between January 2015 and December 2021 were included in the study. Oncoplastic operations were defined as breast conservation surgery with immediate volume displacement techniques, including mastopexy or breast reduction patterns or volume replacement techniques such as symmetry local-regional flaps. Patients who underwent autologous free-flap reconstruction [ie, deep inferior epigastric perforator flap (DIEP) or transverse rectus abdominis flap (TRAM)] were excluded. All patients were reviewed at a multidisciplinary breast oncology conference which includes medical, surgical, and radiation oncologists, as well as representatives from radiology and pathology. Of note, the decision to use closed incision negative pressure therapy was at the individual surgeon's discretion, which was primarily based on patients' predisposing risk factors, such as obesity, smoking status, history of previous skin incisions, immunosuppression, etc. The Prevena Bella closed incision negative pressure therapy system at -125 mm Hg (KCI, an Acelyty company, San Antonio, Tex.)

Takeaways

Question: Does closed incision negative pressure therapy improve wound healing in the oncoplastic breast surgery population?

Findings: Closed incision negative pressure therapy reduces the overall rate of clinically significant postoperative complications, including wound dehiscence.

Meaning: Closed incision negative pressure therapy should be considered in the oncoplastic breast population, especially in those with increased risk for postoperative complications.

was used in all patients who received closed incision negative pressure therapy and standard dressings included skin glue and Steri-Strip skin adhesive closure. [Figures 1–5](#) demonstrate our method of placement. We refer to the Prevena Bella closed incision negative pressure therapy device as ciNPT from this point forward.

Data Collection

Clinicopathologic data were retrospectively collected from the electronic medical record. Clinical records with the codes 2F30.Z, 2E65.Z and 2C6Z were included (2F30.Z-“Benign breast disease,” 2E65.Z-“Carcinoma in situ of breast,” and 2C6Z-“Malignant neoplasm of breast,” of the International Statistical Classification of Diseases 11th edition). Additional screening for oncoplastic operations

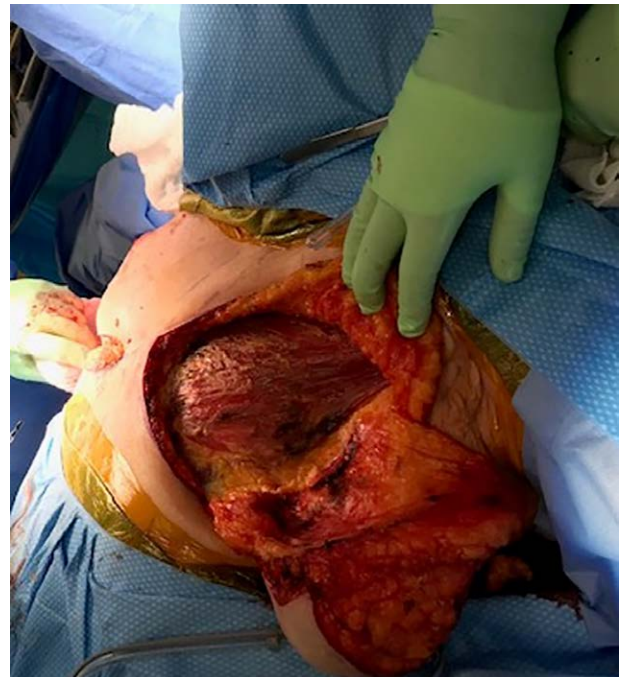


Fig. 1. Placement of ciNPT dressing on left mastectomy. The patient has a history of radiation and there was extensive undermining in the case. Principles of placement can be used in the same fashion for an oncoplastic wise pattern or circumvertical pattern.



Fig. 2. Step 1: place skin glue and tape strips medial and lateral to where the ciNPT dressing will lie to minimize leak. Step 2: place ciNPT dressing directly over the incision without the skin glue and tape strips. Step 3: Place ciNPT dressing to wall suction to collapse sponge. Step 4: use the Tegaderm dressings to cover all the edges of the ciNPT dressing and all the regions of the tape strips to minimize chance of leak.



Fig. 3. Step 5: Surgeon should set up the ciNPT pump with connector. Step 6: Connect ciNPT dressing to ciNPT pump. Step 7: If a drain was placed, make sure it exits outside the area of the ciNPT sponge to avoid certainty of leak. Only after placement of ciNPT dressing and connection to pump, place Tegaderm CHG dressing around drain (not before the placement of ciNPT dressing).

was done using CPT codes 19366, 14301, 14302, 19316, or 19318 that were associated with a partial mastectomy (CPT code 19301). Variables included age; BMI; baseline pre-existing conditions including diabetes, smoking, hypertension, COPD, and chronic heart failure; preoperative macromastia symptoms (ie, back, shoulder, or neck pain, rash, bra strap grooving); Charlson Comorbidity Index and American Society of Anesthesiologists (ASA) physical status classification system levels; specimen weight; number of pre- and postoperative clinic visits; and 2-year reoperation rate.

Primary outcomes collected were rates of clinically significant complications including hematoma and seroma



Fig. 4. Before the placement of ciNPT for left sided mastectomy and right-sided symmetry wise skin incision reduction.



Fig. 5. After the placement of ciNPT for left sided mastectomy and right-sided symmetry wise skin incision reduction.

formation, fat necrosis, wound dehiscence, nipple loss, hypertrophic scarring, and infection. Complications were identified and confirmed by the surgeons from the institution. Clinically significant complications were defined as those that required either medical or operative intervention or those requiring additional procedures such as core biopsies. Secondary outcomes were rates of minor complications not requiring significant medical or operative intervention. Included complications were those that occurred within the entire follow-up period of the patient, which was typically within 6 months to 2 years.

Hematoma and seroma formation were only considered clinically significant when aspiration was necessary. Fat necrosis that required core biopsy for diagnosis was considered clinically significant. Wound dehiscence requiring operative intervention or wound vacuum-assisted closure device placement was considered clinically significant; superficial wound dehiscence not requiring intervention or requiring topical ointments versus dressing changes was considered a minor complication.

Hypertrophic scarring requiring corticosteroid injections was considered clinically significant. Infection requiring operative intervention or antibiotics was defined as clinically significant.

Statistical Analysis

For descriptive analysis of qualitative variables, we used frequencies and percentages. For quantitative variables, we used the mean and standard deviation. The chi-square test and Fisher exact test examined the differences between qualitative variables, and the Student *t* test was used for quantitative variables. Survival probabilities were assessed with the Kaplan-Meier method and were compared with the log-rank test. The outcomes reported had 95% of confidence intervals, and results with a *P* less than 0.05 were considered statistically significant. We used the Statistical Package for Social Sciences software (version 24.0).

Ethics Statement

The study was approved by the institutional review board of the Tufts Medical Center. The identifiable information of the participants was anonymized, and the patients were coded with unrelated numbers.

RESULTS

Clinicopathologic Characteristics

A total of 217 patients underwent OBS between January 2015 and December 2021. In 75 (35%) patients, ciNPT was used, and standard dressing was used in the remaining patients. Mean age (standard 54.79 ± 11.99 versus ciNPT 55.39 ± 11.97; *P* = 0.73) and Charlson Comorbidity Index (3.48 ± 1.8 versus 3.07 ± 1.73; *P* = 0.11) were similar between the two groups. The ciNPT cohort had a higher baseline BMI (28.23 ± 4.94 versus 30.55 ± 6.53; *P* = 0.004), ASA score (2.35 ± 0.59 versus 2.62 ± 0.52; *P* = 0.002), and rate of preoperative macromastia symptoms (18.3% versus 45.9%; *P* ≤ 0.001). Baseline comorbid conditions, including diabetes mellitus, hypertension, COPD, heart failure, and smoking status were similar between the two groups.

The ciNPT cohort had a greater total specimen weight (655.52 ± 606.22 versus 869.68 ± 681.05; *P* = 0.05). Sixty-seven (30.9%) patients underwent level I volume displacement; 149 (68.7%) underwent level II volume displacement. There was no difference in the total number of postoperative visits between the two groups (4.17 versus 4.77; *P* = 0.13). However, the ciNPT cohort was seen sooner in clinic following the procedure (postoperative day 10.85 ± 4.72 versus 7.45 ± 5.64; *P* < 0.001). There was no difference in the time to adjuvant therapy (standard 57.25 ± 41.6 versus ciNPT 60.77 ± 38.0 days; *P* = 0.6), and no difference in the rate of positive margins (standard 12 versus ciNPT 7; *P* = 0.69). (See figure, **Supplemental Digital Content 1**, which depicts the demographic and clinical features of all patients who underwent oncoplastic surgery from 2015 to 2021. <http://links.lww.com/PRSGO/C503>.)

Complications

The overall clinically relevant complication rate requiring either medical or surgical intervention was significantly lower in the ciNPT cohort (16.9% versus 5.3%; *P* = 0.016), as were the total number of complications (14.1% versus 5.3% with 1 complication, 2.8% versus 0% with >2 complications; *P* = 0.044). The rate of wound dehiscence was significantly lower in the ciNPT group (5.6% versus 0%; *P* = 0.036). There was no difference in the rates of seroma, hematoma, fat necrosis, or infection requiring intervention. There was no difference in the rates of minor complications not requiring intervention (20.4% versus 13.3%; *P* = 0.2). (See figure, **Supplemental Digital Content 2**, which demonstrates the surgical outcomes of all patients who underwent oncoplastic surgery from 2015 to 2021. <http://links.lww.com/PRSGO/C504>.)

DISCUSSION

Previous literature has shown that postoperative complications, including wound dehiscence, surgical site infections, and seroma, are significantly lower in OBS when compared with postmastectomy reconstruction followed by radiation therapy (18.9% versus 45.3%).¹⁴ The importance of breast conservation (of which oncoplastic surgery is an example) cannot be understated with studies noting good survival after breast preservation efforts in cancer surgery.¹⁵ Our complication rate in the standard dressing cohort is within the expected range (16.9%), and our ciNPT cohort has a lower than expected rate (5.3%). This is one of the few studies comparing ciNPT with standard surgical dressing in the oncoplastic breast population.^{9,16} We have shown that the use of ciNPT in the oncoplastic population reduces the total rate of clinically relevant postoperative complications, the number of complications per patient when they do occur, and specifically, the rate of wound dehiscence requiring operative intervention. This supports existing literature which shows decreased rates of wound dehiscence using ciNPT in breast surgery.⁶ There was no change in the rates of hematoma, seroma, fat necrosis, nipple loss, hypertrophic scarring, and infection requiring intervention. Of note, we found no difference in seroma formation in patients who received ciNPT compared with those who received standard dressing, which is in conflict with previous literature demonstrating decreased seroma formation with ciNPT.⁶ In general, we do not use drains, even in large volume displacement oncoplastic surgery, unless more than 1000 g is removed from either breast.

NPWT was originally designed to treat wounds associated with unfavorable healing factors.¹⁷ In breast reconstruction, diabetes, smoking, and high BMI (>40) have been shown to increase complications following surgery.¹⁸ Furthermore, Silverman et al described expert panel consensus guidelines detailing indications for closed incision negative pressure dressing for soft tissue management that also included immunosuppression and previous surgery as additional reasons to consider ciNPT.¹⁹ Therefore, surgeons at our institution typically opt for ciNPT in high-risk patients with these characteristics. Given this, it is not surprising that the ciNPT cohort had higher BMI and ASA levels in our study. It

is unclear why the ciNPT cohort had higher rates of preoperative macromastia symptoms, but perhaps this is related to the higher BMIs. Our findings that complications are lower in the ciNPT population despite their higher number of comorbidities further supports the use of ciNPT in OBS.

The ciNPT cohort of patients were seen sooner in clinic, on average 7 days when compared with 10 days in the standard dressing group. This finding can be explained by our institutional policy of removal of the ciNPT on postoperative day 7.

Our study is not without limitations. First, a major limitation is the retrospective nature of our study, which may risk selection bias. However, as mentioned previously, ciNPT was typically utilized in high-risk patients, making our findings that postoperative complications were lower in those who received ciNPT even more significant. A future prospective, randomized control study would be beneficial. Second, there was no standardization for the rationale behind choosing ciNPT versus standard dressing, which is currently based on surgeon discretion. More recently, the surgeons in this study adhere to the expert consensus ciNPT guidelines for incision and soft tissue management.^{19,20} Third, we did not collect the dates of when complications occurred, and therefore, there is survivorship bias as those with shorter follow-up times may seem to have fewer complications. However, as this was true for both cohorts, it is unlikely to have significant effects on our overall conclusions.

CONCLUSIONS

Our study supports the growing body of evidence that ciNPT reduces postoperative complications and demonstrates that ciNPT can do the same in the oncoplastic population. Closed incision negative pressure therapy should therefore be considered in the oncoplastic population, especially in those patients at increased risk for postoperative complications.

Carly M. Wareham, MD
Department of Surgery
Tufts Medical Center
800 Washington Street
Boston, MA 02111

E-mail: cwareham@tuftsmedicalcenter.org

DISCLOSURE

Prevena Bella closed incision negative pressure system (KCI, an Acelyty company, San Antonio, Tex.) was used in this study. Dr. Chatterjee is a consultant for 3M and Royal. All the other authors have no financial interest to declare in relation to the content of this article.

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