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Breast

Drain Removal Time in Pre-pectoral versus Dual Plane Prosthetic Breast Reconstruction following Nipple-sparing Mastectomy

Hannah K. Moriarty, MD
Nusaiba F. Baker, PhD
Alexandra M. Hart, MD
Grant W. Carlson, MD
Albert Losken, MD

Background: Pre-pectoral prosthetic breast reconstruction following nipple-sparing mastectomy (NSM) has become a popular approach compared with the dual plane technique. Our objective was to determine if there was a difference in time to postoperative breast drain removal in direct-to-implant or tissue expander reconstruction following NSM when comparing pre-pectoral with dual plane technique.
Methods: A total of 200 patients (335 breasts) received NSM followed by implant or expander reconstruction at our institution between the years 2009 and 2020. Direct-to-implant reconstruction had 113 pre-pectoral versus 67 dual plane, and tissue expander reconstruction had six pre-pectoral versus 149 dual plane. Our analysis included age at mastectomy, body mass index, history of preoperative breast radiation, and smoking history. Case complications included seroma or hematoma, breast or axillary infection requiring antibiotics or operative washout, device replacement due to extrusion or infection, skin necrosis, and capsular contracture. Statistical analysis was completed with Pearson chi-square test, Fisher exact test, and the two-sample *T*-test using IBM SPSS Statistics 24.0 (IBM Corp., Armonk, N.Y.).
Results: The average time until breast drain removal in dual plane implant patients was significantly less than in pre-pectoral implant patients (9.42 versus 14.01 days). The average time until breast drain removal in dual plane expander patients was significantly less than in pre-pectoral expander patients (11.47 versus 20.30 days).
Conclusion: In both implant and expander reconstruction following NSM, patients receiving dual plane device placement had a shorter postoperative time until breast drain removal when compared with patients receiving pre-pectoral device placement. *(Plast Reconstr Surg Glob Open 2022;10:e4295; doi: 10.1097/GOX.0000000000004295; Published online 23 May 2022.)*

INTRODUCTION

Implant-based breast reconstruction remains a popular method for postmastectomy breast reconstruction, with either pre-pectoral or dual plane implant techniques. In the dual plane approach, the tissue expander or implant is placed in the subpectoral plane and is supported at the superior pole by the pectoralis muscle and at the inferior pole by acellular dermal matrix.[1] The pre-pectoral approach aims to spare the pectoralis muscle dissection, and the implant or tissue expander is placed anterior to the muscle in a subcutaneous pocket most commonly supported by acellular dermal matrix.[2] The pre-pectoral approach has begun to gain favor in recent years due to its improved aesthetic outcomes, reduced animation deformity, and reduced capsular contracture.[2,3] Studies have also shown that pre-pectoral device placement is associated with increased quality of life and increased patient satisfaction with their surgical outcome.[2] Additionally, the pre-pectoral approach is thought to reduce patients' postoperative pain and analgesic consumption, as it spares the patient from muscle dissection, muscle spasms, and soft tissue rearrangement.[1,3,4]

Pre-pectoral reconstruction relies on healthy skin flaps and quality wound healing, and thus, dual plane placement may be a better option in patients with predictors of poor wound healing.[2,5] On the other hand, dual plane device placement is often favored when medial flap tissue is thin, to avoid visible implant rippling or prominent implant borders.[2,6] For patients with elevated body mass

From the Division of Plastic and Reconstructive Surgery, Emory University School of Medicine, Atlanta, Ga.

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index (BMI), some studies have shown improved outcomes with dual plane reconstruction, whereas other studies have shown lower risk of complications with the pre-pectoral approach.[2,5,7] While two-staged expander reconstruction remains the most commonly performed type of reconstruction overall,[8] the direct-to-implant (DTI) approach has recently become an increasingly popular option for surgical candidates, given its reduced number of surgeries and quicker return to desired cosmesis.[9] As pre-pectoral and dual plane approaches can be used in either expander or DTI surgeries, several studies have attempted to discern differences in complication rates between procedures.

Suh et al found that there were no significant differences in rates of hematoma, seroma, explantation, infection, or flap necrosis between the dual plane and pre-pectoral techniques.[10] In another study composed of patients receiving implants, pre-pectoral implant placement had fewer revision surgeries and no significant difference in complication rates of hematoma, seroma, infection, implant loss, or full thickness necrosis compared with the dual plane group.[1] In a metanalysis by Li et al that compared the two surgical approaches for both implant and tissue expander reconstructions, there were no significant differences in complication rates of implant loss, nipple or skin flap necrosis, seroma, infection, hematoma, re-operation, wound dehiscence, or overall complications.[4] Similarly, a meta-analysis by Chatterjee et al found that for a pooled sample of DTI and expander-based reconstruction patients, there were no complication differences between pre-pectoral and dual plane techniques for infection, explantation, seroma, flap necrosis, dehiscence, or capsular contracture.[11]

One currently unanswered question is whether there is a difference to drain removal between the two approaches. Breast drains are placed at the close of surgery to prevent seroma and fluid accumulation, and to mitigate dead space.[8,12] The downside of drain placement is that it creates a direct conduit for external skin flora to populate the wound bed and prolonged drain use can pose a risk for infection of the surgical site.[13–15] Therefore, longer drain duration has been associated with increased complication rates, poorer quality of life, and higher sociomedical costs due to longer hospitalizations and/or more frequent outpatient visits.[8,16] The duration of a patient's drain can vary, but on average most physicians prefer to keep the drain in place for at least a week and feel comfortable removing it once the drain output is less than 30 mL for two consecutive days.[3,9] This helps ensure that the patient received the benefit of dead space reduction while minimizing the risk for surgical site infection from external flora.

The purpose of this review was to determine if there is a difference in time to postoperative breast drain removal when comparing a tissue expander or implant placed in the pre-pectoral location or the dual plane approach in patients following nipple-sparing mastectomy (NSM).

Takeaways

Question: Does the time to postoperative breast drain removal in direct-to-implant or tissue expander reconstruction following NSM differ when comparing pre-pectoral with dual plane technique?

Findings: In this retrospective review, the average time until breast drain removal in dual plane implant patients was significantly less than in pre-pectoral implant patients (9.42 versus 14.01 days). The time until breast drain removal in dual plane expander patients was significantly less than in pre-pectoral expander patients (11.47 versus 20.30 days).

Meaning: In both implant and expander reconstruction, patients receiving dual plane device placement had significantly shorter postoperative time until breast drain removal compared with patients receiving pre-pectoral device placement.

METHODS

Patients received NSM followed by DTI or tissue expander reconstruction by the senior authors (AL, GWC) between the years 2009 and 2020. In the group of patients who received DTI reconstruction, implants were placed using pre-pectoral approach or dual plane approach. In the group of patients who received tissue expanders as the first stage of their two-stage reconstruction, expanders were also placed using pre-pectoral approach or dual plane approach. The type of reconstruction (implant versus expander) and surgical approach (pre-pectoral versus dual plane) were based on surgeon discretion following an in-depth conversation with the patient about risks and goals of care; no standardized algorithm was utilized when determining the best surgical path for the patient. Type of technique was decided based on the discretion of the operating surgeon using general surgical principles. For patients with a history of radiation and/or smoking, elective reconstruction was performed if skin was healthy-appearing and considered appropriate by attending surgeon for the stress of surgery. The size of the implant or expander was determined intraoperatively by the attending surgeon based on patient goals, breast width, and size of mastectomy pocket. Use and type of acellular dermal matrix was also determined intraoperatively based on surgeons' preference following a detailed preoperative discussion with the patient; the majority of cases were performed using Alloderm and Cortiva Allograft Dermis.

The outcome of interest was time to postoperative breast drain removal, which was determined using retrospective chart review. The standard of practice at our institution is for the drain to remain in position for a minimum of 1 week postoperatively, with removal after 2 consecutive days of less than 25 mL output. Demographic data and complication rates were retrospectively gathered from patients' electronic medical records. Demographic data collected for our analysis included age at mastectomy, BMI, history of preoperative breast radiation, tissue expansion volume, and smoking history. Case complications collected for our analysis included seroma, hematoma, breast or axillary infection requiring antibiotics

or operative washout, device replacement due to extrusion or infection, skin necrosis, and capsular contracture (grades 3 and 4).

Complications, history of radiation, and smoking history were assessed as binary variables. BMI was assessed as an ordinal variable with three categories (<18.5, ≥18.5 and <30, and ≥30). The intraoperative saline injection volume of tissue expanders was assessed as an ordinal variable with three categories: 0–200 mL, 200–400 mL, and 400–600 mL. Age at mastectomy was assessed as a numeric variable. Statistical analysis was completed with Pearson chi-square test, Fisher exact test, and two-sample *T*-test. Additionally, a univariate logistic regression model was created that controlled for BMI as a covariate. All results were concluded using an α level of 0.05. All statistical analysis was conducted using the IBM SPSS Statistics 24.0 (IBM Corp., Armonk, N.Y.).

RESULTS

A total of 200 patients (335 breasts) received NSM followed by DTI or tissue expander reconstruction between the years 2009 and 2020. Over the duration of this study, 180 breasts underwent DTI reconstruction following NSM: 37% (n = 67) were dual plane and 63% (n = 113) were pre-pectoral. Additionally, 155 breasts underwent tissue expander reconstruction following NSM: 96% (n = 149) were dual plane and 4% (n = 6) were pre-pectoral. Demographic characteristics for each breast case are shown in Table 1. No significant demographic differences existed between pre-pectoral and dual plane implant or expander patients for the variables of age at mastectomy, history of preoperative breast radiation, or history of smoking. BMI was significantly different between pre-pectoral and dual plane implant groups; BMI was not significantly different between pre-pectoral and dual plane expander groups.

Complication rates for each breast case are also shown in Table 1 with types of complication summarized in Table 2. We found no significant difference in complication rates between the pre-pectoral and dual plane approaches in our analysis of both DTI and expander groups. We did find a higher percentage of complications amongst the dual plane tissue expander group (27.5%) compared with the dual plane implant group (16.4%).

The results of the logistic regression analysis controlling for BMI are shown in Table 3. The average time until breast drain removal in pre-pectoral implant patients was 14.01 days, which was significantly different from the average of 9.42 days until breast drain removal in dual plane implant patients ($P = 0.003$). The average time until breast drain removal in pre-pectoral expander patients was 20.30 days, which was significantly different from the average of 11.47 days until breast drain removal in dual plane expander patients ($P = 0.004$). The volume of tissue expansion did not significantly influence time to drain removal (Table 4).

DISCUSSION

Our study found that in nipple-sparing mastectomy followed by immediate reconstruction, patients who received direct-to-implant or tissue expander reconstruction had a shorter duration of their postoperative breast drain when surgeons used the dual plane technique compared with the pre-pectoral technique. In the DTI group, patients who received dual plane reconstruction had their breast drains removed on average 4.5 days earlier than patients who received pre-pectoral reconstruction. In the tissue expander group, patients who received dual plane reconstruction had their breast drains removed roughly 9 days earlier than patients who received pre-pectoral reconstruction.

We did find that there was a higher rate of complications amongst dual plane expander patients (27.5%) compared with dual plane implant patients (16.4%). This is likely due to the larger sample size of patients receiving dual plane expanders, as well as potential selection bias in that patients at higher risk for complications are more likely to receive two-staged reconstruction than DTI reconstruction. However, complications were not significantly different when comparing pre-pectoral with dual plane approach within our implant group or within our expander group. BMI was the only demographic factor that significantly differed and thus was controlled for in logistic regression. As complication rates by reconstructive device did not differ and demographic variables were controlled by logistic regression, the conclusion can be drawn that the difference in time to postoperative drain removal depends on the surgical reconstructive technique.

Table 1. Summary of Demographic Characteristics by Breast

	Type of Surgery					
	Implant			Tissue Expander		
Case Characteristic	Pre-pectoral (n = 113)	Dual Plane (n = 67)	Significance	Pre-pectoral (n = 6)	Dual Plane (n = 149)	Significance
Age at mastectomy (average years)	48.6	47.1	0.37	49.0	45.6	0.39
BMI						
<18.5	6 (5.3)	4 (6.0)	**0.001**	0 (0)	4 (2.7)	0.063
≥18.5 and <30	93 (82.3)	63 (94.0)		6 (100)	135 (90.6)	
≥30	14 (12.4)	0 (0)		0 (0)	10 (6.7)	
BMI (overall average)	24.4	22.3	**<0.001**	26.9	23.5	0.063
History of radiation, n (%)	10 (8.8)	5 (7.5)	0.75	0 (0.0)	5 (3.4)	0.65
History of smoking, n (%)	18 (15.9)	10 (14.9)	0.86	0 (0.0)	36 (24.2)	0.17
Complication, n (%)	22 (19.5)	11 (16.4)	0.61	1 (16.7)	41 (27.5)	0.56

Boldface values were significant when an alpha level of 0.05 was used.

Table 2. Summary of Types of Complications by Breast

	Type of Surgery			
	Implant		Tissue Expander	
Type of Complication, n (%)	Pre-pectoral (n = 113)	Dual plane (n = 67)	Pre-pectoral (n = 6)	Dual Plane (n = 149)
Superficial nipple necrosis	6 (5.3)	3 (4.5)	1 (16.7)	25 (16.8)
Skin flap necrosis	5 (4.4)	5 (7.5)	0 (0.0)	11 (7.4)
Seroma	4 (3.5)	0 (0.0)	0 (0.0)	2 (1.3)
Hematoma	6 (5.3)	2 (3.0)	0 (0.0)	8 (5.4)
Grade 3 or 4 capsular contracture	2 (1.8)	1 (1.5)	0 (0.0)	1 (0.7)
Infection	4 (3.5)	3 (4.5)	0 (0.0)	11 (7.4)
Device removal/exchange	10 (8.8)	4 (6.0)	0 (0.0)	10 (6.7)
Any complication	22 (19.5)	11 (16.4)	1 (16.7)	41 (27.5)

Table 3. Univariate Logistic Regression Analysis of Breast Cases Controlling for BMI as a Covariate

	Type of Surgery					
	Implant			Tissue Expander		
	Pre-pectoral (n = 113)	Dual Plane (n = 67)	Significance	Pre-pectoral (n = 6)	Dual Plane (n = 149)	Significance
Time to postoperative drain removal (d)	14.01	9.42	**0.003**	20.30	11.47	**0.004**

Boldface values were significant when an alpha level of 0.05 was used.

Table 4. Univariate Logistic Regression Analysis of Time to Drain Removal by Intraoperative Tissue Expander Volume (mL)

	Type of Surgery			
	Tissue Expander Volume			Tissue Expander
	0–200 mL (n = 48)	200–400 mL (n = 69)	400–600 mL (n = 37)	Significance
Time to postoperative drain removal (d)	12.04	14.14	10.24	0.091

Our findings differ from what has previously been reported in the literature. In a study looking at drain times for DTI patients, Kim and Hong found that the time to drain removal was shorter in the pre-pectoral group than in the dual plane group, with no difference in complication rates.[17] Compared with Kim and Hong's study, our study had a larger number of patients receive pre-pectoral implant reconstruction and a smaller number of patients receive dual plane reconstruction. In a study looking at drain times for tissue expander patients, Suh et al found that there was no difference in time to drain removal between pre-pectoral and subpectoral expander patients.[10] In another study looking at tissue expander patients, Schaeffer et al found that the time to drain removal in pre-pectoral patients was less than the time to drain removal in dual plane patients.[18] Compared with the studies by Suh et al and Schaeffer et al, our study had a smaller sample size of pre-pectoral tissue expander patients. In addition, we found that volume of tissue expansion was not significantly associated with time until drain removal, which differs from the literature in that Lim et al found a strong correlation between tissue expander volume and duration of drain placement.[19]

There is no universal set of rules to aid surgeons' decisions on whether to pursue pre-pectoral versus dual plane reconstruction.[4] Given that no consensus exists in the literature, the surgeons in this study similarly did not follow an algorithm for determining surgical course but rather determined course based on shared decision-making with the patient. However, some studies have suggested that dual plane reconstruction is a more appropriate course in patients with elevated BMI.[3,20,21] Similarly, a meta-analysis by Li et al found that for a pooled group of implant and expander patients, the patients best-suited for pre-pectoral reconstruction were those with a normal BMI and a small-to-medium breast size.[4]

One demographic factor that may impact surgical course selection and outcomes is the patients' BMI. We chose to only look at NSM to control for breast size and to minimize BMI and breast size as a variable since they both would potentially impact drain removal. Studies have shown that elevated BMI is associated with increased surgical site infection in breast reconstruction cases which could prolong the time to drain removal.[22] For these reasons, we also decided to control for BMI in our logistic regression. However, even after controlling for BMI differences between groups, we still found that for both implant and expander groups the dual plane approach had lower time to drain removal than the pre-pectoral surgical approach.

Other studies in the literature have looked at predictors of time to drain removal. For instance, Lee et al found that many factors independently influenced time to drain removal in a group of subpectoral tissue expander patients, including use of acellular dermal matrix, initial expander inflation volume, and history of hypertension.[8] Another study looking at immediate subpectoral reconstruction with tissue expanders found that BMI of 25 kg/m^2 or more, tissue expander size of 500 mL or more, and intraoperative bleeding of 100 mL or more were significantly associated with longer postoperative drain duration.[16] Our study could have been more robust had we considered these other predictors for time to drain removal and added them to our logistic regression.

There are several limitations to our study. As previously mentioned, this study was retrospective in nature. Thus,

there is likely selection bias in how the surgical approach for each candidate was determined. For instance, a patient with a higher BMI or with factors that potentiate poor wound healing might have been more likely to receive dual plane reconstruction based on surgeon discretion. Additionally, the patients included in this study reflected patients from only two attending plastic surgeons at a single institution. Therefore, each surgeon's preference for and comfort level with the two surgical approaches are specific to this study and likely influenced our results. A randomized control trial including multiple institutions is needed to study each approach in more detail, analyze the effect of breast weight and BMI as selection criteria, and mitigate the effects of selection bias and surgeons' technical preference.

Other limitations to this study include the small sample size of pre-pectoral tissue expander patients. There were only six reconstructed breasts that received pre-pectoral tissue expander placement compared with 149 breasts that received dual plane tissue expander placement. Ideally, a future study would include a larger population of patients who received pre-pectoral tissue expanders to improve the power of the study and more accurately estimate the true value of postoperative time to drain removal for this population of patients. This study could be additionally improved by including more robust patient variables, such as use and type of acellular dermal matrix, size of implant or tissue expander, and comorbid conditions.

CONCLUSIONS

We have demonstrated that the time to drain removal following NSM is lower in the dual plane group compared with the pre-pectoral group for both DTI and tissue expander; however, with similar complication rates among groups. The benefits of pre-pectoral implant reconstruction are numerous, and these data do not intend to disparage the authors preferred method of prosthetic-based reconstruction. This merely provides additional data for patient education, and reconstructive surgeons need to weigh the drawbacks of potentially longer time to drain removal with the aesthetic and quality of life benefits of pre-pectoral placement when determining the reconstructive approach best-suited for the patient. Further multi-institution studies need to be conducted to corroborate these results.

Albert Losken, MD
Emory Division of Plastic Surgery
550 Peachtree Street NE, Suite 9000
Atlanta, GA 30308
E-mail: alosken@emory.edu

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