Review Article | Clinical Studies

Prepectoral versus subpectoral two-stage implant-based breast reconstruction: U.S. medical center experience and narrative review

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Background and Objective: With the incorporation of autologous fat grafting, acellular dermal matrix (ADM) products, and nipple-sparing mastectomy, prepectoral device placement has become more popular in selected patients when compared to partial submuscular (dual plane) or complete submuscular device placement. In this article, we aimed to present a review of the current state-of-the-art for implant-based breast reconstruction (IBBR) using expanders. Additionally, we present a case series of our experience with IBBR evaluating perioperative outcomes, complications, and patient-reported outcomes (PRO).

Methods: For our series, we retrospectively evaluated adult female patients undergoing 2-stage immediate IBBR after total mastectomy between 2011 and 2021. We performed a systematic search across PubMed MEDLINE for articles evaluating outcomes of prepectoral versus subpectoral two-stage IBBR with expanders published from database inception through February 28th, 2023.

Key Content and Findings: Both prepectoral and subpectoral are safe alternatives for two-stage IBBR. Due to current advancements in the field of breast reconstruction, prepectoral IBBR has gained popularity and has a comparable rate of complications compared to a subpectoral approach in selected patients according to high-quality articles. In patients with several comorbidities, current tobacco use, history of preoperative radiation, and limited perfusion of the mastectomy flaps, subpectoral device placement should be given special consideration as a layer of vascularized tissue can decrease the risk of major complications or unplanned procedures. As prepectoral device placement does not require dissection of the pectoral muscles, faster recovery, better implant position, decreased pain, and a shorter time to complete expansion is expected. The plane of reconstruction does not seem to significantly affect the time for expander-to-implant exchange or PRO for quality-of-life (QOL) according to most studies.

Conclusions: Prepectoral and subpectoral IBBR demonstrated a comparable rate of complications in selected patients. Nonetheless, perioperative outcomes seem to be improved using a prepectoral approach in terms of reduced pain, reduced time to conclude outpatient expansions, and less animation deformity.

Keywords: Breast implantation; tissue expansion devices; female; postoperative complications; treatment outcome

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Introduction

The global incidence of breast cancer in 2020 was 2.3 million, approximately (1). Due to the high prevalence of this pathologic process in female patients, surgeon scientists and researchers are continuously innovating with new techniques and advancements to help restore patients' anatomy and quality-of-life (QOL) while simultaneously achieving outstanding optimal aesthetic results (1-3). Among all reconstructive options, implant-based breast reconstruction (IBBR) remains the most common modality (1,4). The acceptance of alloplastic material for reconstruction is essentially driven by the fast postoperative recovery and the lack of donor site morbidity compared to autologous breast reconstruction (1,5). Furthermore, aesthetic outcomes are good-to-excellent in most patients with an acceptable complication rate (6).

IBBR can be performed in one stage or in two stages with tissue expander (TE). Most surgeons and patients opt for a two-stage reconstruction in which the expander is partially filled intraoperatively and is exchanged for a definitive implant after the prosthesis has been expanded enough in the outpatient setting (7,8). The advantages an expander offers include the ability to offload pressure on the mastectomy flaps after mastectomy and immediate breast reconstruction, and the chance to decide on an optimal definitive permanent implant following the expansion phase. In this setting, expander-based IBBR is perceived to be more reproducible, predictable, and resulting in fewer unplanned operations and complications (6).

With the incorporation of autologous fat grafting, acellular dermal matrix (ADM) products, and nipple-sparing mastectomy, prepectoral device placement has become more popular in selected patients when compared to partial submuscular (dual plane) or complete submuscular device placement (6,8,9). A better implant position and less animation deformity are also common advantages of a prepectoral technique. In this article, we aimed to present a review of the current state-of-the-art for IBBR using expanders. Additionally, we present a case series of our experience with two-stage IBBR evaluating perioperative outcomes, complications, and patient-reported outcomes (PRO). We present this article in accordance with the Narrative Review reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-23-1094/rc).

Methods

Patient series

We evaluated adult female patients undergoing 2-stage immediate IBBR after total mastectomy between 2011 and 2021. Charts were retrospectively reviewed after Institutional Review Board (IRB) approval. Our exclusion criteria were as follows: direct-to-implant reconstruction, delayed expander placement, metastatic disease, and autologous tissue-assisted reconstructions at the time of immediate IBBR.

Some aspects of the surgical technique and postoperative management like the plane of reconstruction, intraoperative volume of expanders, type of filling, use of fluorescence imaging, use of ADMs, and time for TE-to-implant exchange depended on the surgeons' and patients' preferences. The surgical technique for device placement, ADMs use, and incorporation of an inferiorly-based dermal flap (Autoderm) has been previously reported (4,8-10). Drains were removed when output was less than 30 cc per day over a period of 2 consecutive days. Each reconstruction was regarded as an independent subject for analysis. Therefore, a bilateral reconstruction in a single patient represented two research subjects.

Variables of interest

We obtained data on the number of subjects, body mass index (BMI), ethnicity/race, smoking status, comorbidities, preoperative hematocrit, follow-up, indication for reconstruction, side of reconstruction, diagnosis and staging of breast cancer, status of hormonal receptors and human epidermal growth factor receptor 2, adjuvant chemotherapy and radiotherapy, type of mastectomy, laterality of reconstruction, mastectomy specimen weight, mastectomy incision pattern, use of fluorescence imaging, implementation of nerve blocks, surface of TEs, use of ADM, type of ADM, estimated blood loss, length of stay, and time for drain removal. Data on the final volume of TEs, time for expander-to-implant exchange, implant size, type of surface of the definitive implant, and percentage of patients requiring autologous fat grafting after reconstruction were extracted.

We evaluated the 30-day rate of complications and the overall rate of complications during the first phase of IBBR. As a separate set of complications, we evaluated the morbidity after TE-to-implant exchange. The following

Table 1 Demographic data

Demographic variables	Prepectoral	Subpectoral	Total	P value
Reconstructions, n (%)	135 (25.6)	392 (74.4)	527 (100.0)	
Age (years), median [IQR]	51 [16]	51 [16.25]	51 [17]	0.879
Race/ethnicity, n (%)				0.039*
Caucasian/White	107 (79.3)	317 (80.9)	424 (80.5)	
Black//African American	22 (16.3)	37 (9.4)	59 (11.2)	
Hispanic/Latin	1 (0.7)	16 (4.1)	17 (3.2)	
Other/not reported	5 (3.7)	22 (5.6)	27 (5.1)	
BMI (kg/m^2), median [IQR]	28.4 [6.71]	26.145 [6.86]	26.45 [7]	0.015*
BMI ≥30 kg/m^2, n (%)	46 (34.1)	100 (25.5)	146 (27.7)	0.055
Smoking status, n (%)				0.009*
Never	87 (64.4)	232 (59.2)	319 (60.5)	
Current	1 (0.7)	32 (8.2)	33 (6.3)	
Former	47 (34.8)	128 (32.7)	175 (33.2)	
Diabetes mellitus, n (%)	9 (6.7)	33 (8.4)	42 (8.0)	0.517
Hypertension, n (%)	42 (31.1)	124 (31.6)	166 (31.5)	0.910
Hematocrit (%), median [IQR]	40 [6]	40 [5]	40 [5]	0.436
Follow-up (months), median [IQR]	25.9 [20.6]	48 [43.6]	40.23 [38.4]	<0.001*

*, statistically significant. IQR, interquartile range; BMI, body mass index.

complications were evaluated: surgical site infection, seroma, fat necrosis, hematoma, expander leak, prosthesis displacement, wound disruption, and capsular contracture. The rate of return to the operating room (RTOR) for evacuation of hematoma, unplanned operations for expander/implant removal, and unplanned debridement were also recorded.

PRO were evaluated with the Patient-Reported Outcomes Measurement Information System (PROMIS®) (11,12). PROMIS is a U.S. National Institute of Health/NIH-supported set of patient-reported measures and scoring procedures (13). We evaluated the domains of depression, anxiety, physical function, and pain interference. For function, scores ≥45 denote that subjects are within normal limits. The score ranges for mild, moderate, and severe function impairment are between 45–40, 40–30, and <30, respectively. For symptoms, scores ≤55 denote that subjects are within normal limits. The score ranges for mild, moderate, and severe symptoms are between 55–60, 60–70, and >70, respectively (Figure S1).

Literature review

We performed a systematic search across PubMed MEDLINE for original articles evaluating outcomes of prepectoral versus subpectoral two-stage IBBR published from database inception to February 28th, 2023. We used the following terms "prepectoral", "suprapectoral", "Subpectoral", "expander", "Expansion", "Breast", and "reconstruction". Perioperative outcomes, complications, and PRO were evaluated.

Results

Overall, 527 two-stage IBBRs were included in our analysis (*Table 1*). The prepectoral plane was used in 135 cases (25.6%), while a subpectoral plane was used in 392 cases (74.4%). Most reconstructions were performed in White/Caucasian (80.5%) or African American/Black patients (11.2%). The BMI of patients who had a prepectoral reconstruction was significantly higher (28.4 kg/m^2)

compared to patients undergoing subpectoral reconstruction 26.145 kg/m^2 (P=0.015). The rate of former and current smokers was 33.2% and 6.3%, respectively. The rate of current smokers was significantly higher in the subpectoral group (8.2% versus 0.7%, P=0.009). The percentage of reconstructions performed in patients with past medical history of hypertension or diabetes was 31.5% and 8.0%, respectively. The median follow-up in the prepectoral group was 25.9 [IQR, 20.6] and 48 [IQR, 43.6] months in the subpectoral group (P<0.001).

For breast amputation, the proportions of therapeutic (55.6% versus 62.2%) and prophylactic mastectomies (44.4% versus 37.8%, P=0.170) between the prepectoral and subpectoral groups were comparable. Data on the diagnosis and staging of breast cancer, and oncologic management are reported in *Table 2*. The proportion of reconstructions that received adjuvant radiotherapy was comparable between groups (19.3% versus 17.9%, P=0.716). Likewise, the proportion of reconstructions performed in patients receiving adjuvant systemic chemotherapy was comparable between the prepectoral and subpectoral groups (23.0% versus 27.3%, P=0.323).

The proportion of nipple-sparing procedures was significantly higher in the prepectoral group compared to the subpectoral cohort (23.7% versus 9.4%, P<0.001). Most procedures were performed as bilateral reconstructions (79.1%). The median mastectomy weight was 554 g [IQR, 428]. The proportions of reconstructions performed with the wise pattern (33.3% versus 13.0%) and inframammary incision pattern (14.8% versus 9.4%, P<0.001) were higher in the prepectoral group compared to the subpectoral group (*Table 3*). SPY fluorescence imaging to assess the perfusion of mastectomy flaps was used in a higher percentage of reconstructions in the prepectoral group compared to the subpectoral cohort (69.6% versus 16.1%, P<0.001). Likewise, nerve blocks were used more consistently during prepectoral breast reconstruction compared to subpectoral device placement (62.2% versus 34.7%, P<0.001). The proportions of reconstructions performed with smooth (71.9% versus 21.7%) and textured (28.1% versus 78.3%, P<0.001) expanders were also significantly different between groups. ADMs (97.0% versus 85.5%, P<0.001) and inferiorly based de-epithelialized dermal flaps (27.4% versus 6.4%, P<0.001) were more consistently used during prepectoral IBBR compared to subpectoral device placement (*Table 4*).

Expanders were filled with a similar volume during immediate expander placement [300 (IQR, 275) versus 210 (IQR, 200) mL, P=0.503]. Remarkably, we evidenced a prolonged median length of stay [2 (IQR, 1) versus 1 (IQR, 0) days, P<0.001] and prolonged median time for drain removal [15 (IQR, 10) versus 13 (IQR, 6) days, P<0.001] using a subpectoral approach compared to prepectoral device placement.

Overall, most of the 30-day rates of complications were comparable between groups (*Table 5*). Nonetheless, the rate of 30-day surgical site infection was higher in the subpectoral group compared to the prepectoral group (12.0% versus 5.2%, P=0.025). When evaluating the whole first phase of reconstruction (before TE-to-implant exchange), the rates of all complications were similar between groups (*Table 6*). Failure of the reconstructive process occurred in 6.6% of the cases in the subpectoral group and in 7.4% of the reconstructions in the prepectoral group (P=0.758). Latissimus dorsi flaps for salvage of the reconstruction were required in 4.3% and 3.0% of the cases in the subpectoral and prepectoral group, respectively (P=0.482).

One-hundred twenty-five reconstructions reached the second stage in the prepectoral group, while 357 underwent exchange for a definitive implant in the subpectoral group at the time of chart review (*Table 7*). The final volume of tissue expanders before exchange was comparable between groups [500 (IQR, 200) versus 460 (IQR, 191) mL, P=0.261]. Overall, the time for TE-to-implant exchange was 175 [IQR, 161.75] days. The size of the definitive implant was comparable between groups (523.7±133.4 versus 519.2±148.7 cc, P=0.769). The proportions of reconstructions receiving a smooth (95.2% versus 56.3%) or textured definitive implant (4.8% versus 43.7%, P<0.001) were significantly different between the prepectoral and subpectoral group. As expected, a larger proportion of prepectoral reconstructions had delayed fat grafting procedures compared to subpectoral reconstructions (68.0% versus 33.3%, P<0.001).

After evaluating the rate of complications following TE-to-implant exchange, we evidenced a higher rate of seroma formation (3.9% versus 0.8%, P=0.038), implant rupture (3.4% versus 0.0%, P=0.038), and reconstruction failure (5.6% versus 0.8%, P=0.024) using subpectoral device placement compared to prepectoral device placement. Some of these complications were attributed to differences in the median follow-up between groups (*Table 8*).

The response rates using the PROMIS instrument for the domains of anxiety, depression, pain interference, and physical function were 10.8%, 38.5%, 36.8%, and 31.7%,

Table 2 Oncologic data and indication for surgery

Oncologic variables	Prepectoral	Subpectoral	Total	P value
Reconstructions, n (%)	135 (25.6)	392 (74.4)	527 (100.0)	
Indication, n (%)				0.170
Therapeutic	75 (55.6)	244 (62.2)	319 (60.5)	
Prophylactic	60 (44.4)	148 (37.8)	208 (39.5)	
Side, n (%)				0.937
Right	67 (49.6)	193 (49.2)	260 (49.3)	
Left	68 (50.4)	199 (50.8)	267 (50.7)	
Pathology, n (%)				0.493
No malignancy	60 (44.4)	148 (37.8)	208 (39.5)	
IDC	52 (38.5)	165 (42.1)	217 (41.2)	
ILC	12 (8.9)	25 (6.4)	37 (7.0)	
DCIS	10 (7.4)	46 (11.7)	56 (10.6)	
LCIS	0 (0.0)	1 (0.3)	1 (0.2)	
Phyllodes	0 (0.0)	2 (0.5)	2 (0.4)	
Other	1 (0.7)	5 (1.3)	6 (1.1)	
Stage, n (%)				0.111
Stage 0	10 (7.4)	47 (12.0)	57 (10.8)	
Stage 1	42 (31.1)	97 (24.7)	139 (26.4)	
Stage 2	16 (11.9)	74 (18.9)	90 (17.1)	
Stage 3	7 (5.2)	24 (6.1)	31 (5.9)	
Tumor status, n (%)				0.713
Tis	10 (7.4)	47 (12.0)	57 (10.8)	
Tx	0 (0.0)	1 (0.3)	1 (0.2)	
T1	32 (23.7)	98 (25.0)	130 (24.7)	
T2	24 (17.8)	67 (17.1)	91 (17.3)	
T3	9 (6.7)	28 (7.1)	37 (7.0)	
T4	0 (0.0)	1 (0.3)	1 (0.2)	
Node status, n (%)				0.407
N1	18 (13.3)	42 (10.7)	60 (11.4)	
N2–N3	2 (1.5)	13 (3.3)	15 (2.8)	
ER negative, n (%)	18 (13.3)	46 (11.7)	64 (12.1)	0.624
PR negative, n (%)	25 (18.5)	72 (18.4)	97 (18.4)	0.969
HER2 positive, n (%)	16 (11.9)	32 (8.2)	48 (9.1)	0.199
Pre-mastectomy radiation, n (%)	3 (2.2)	6 (1.5)	9 (1.7)	0.593
Neoadjuvant chemotherapy, n (%)	30 (22.2)	62 (15.8)	92 (17.5)	0.091
Adjuvant chemotherapy, n (%)	31 (23.0)	107 (27.3)	138 (26.2)	0.323
Adjuvant radiotherapy, n (%)	26 (19.3)	70 (17.9)	96 (18.2)	0.716

IDC, invasive ductal carcinoma; ILC, invasive lobular carcinoma; DCIS, ductal carcinoma in situ; LCIS, lobular carcinoma in situ; ER, estrogen receptor; PR, progesterone receptor; HER2, human epidermal growth factor receptor 2.

Table 3 Surgical outcomes of the first stage of immediate implant-based breast reconstruction

Surgical variables	Prepectoral	Subpectoral	Total	P value
Reconstructions, n (%)	135 (25.6)	392 (74.4)	527 (100.0)	
Type of mastectomy, n (%)				<0.001*
Skin-sparing mastectomy	103 (76.3)	355 (90.6)	458 (86.9)	
Nipple-sparing mastectomy	32 (23.7)	37 (9.4)	69 (13.1)	
Laterality, n (%)				0.435
Unilateral	25 (18.5)	85 (21.7)	110 (20.9)	
Bilateral	110 (81.5)	307 (78.3)	417 (79.1)	
Mastectomy weight (g), median [IQR]	567 [400.5]	550 [439.5]	554 [428]	0.404
Type of mastectomy incision, n (%)				<0.001*
Wise pattern	45 (33.3)	51 (13.0)	96 (18.2)	
Inframammary	20 (14.8)	37 (9.4)	57 (10.8)	
Other	70 (51.9)	304 (77.6)	374 (71.0)	
Fluorescence imaging, n (%)	94 (69.6)	63 (16.1)	157 (29.8)	<0.001*
Nerve block, n (%)	84 (62.2)	136 (34.7)	220 (41.7)	<0.001*
TE surface, n (%)				<0.001*
Smooth	97 (71.9)	85 (21.7)	182 (34.5)	
Textured	38 (28.1)	307 (78.3)	345 (65.5)	
ADM, n (%)	131 (97.0)	335 (85.5)	466 (88.4)	<0.001*
Autoderm, n (%)	37 (27.4)	25 (6.4)	62 (11.8)	<0.001*
Intraoperative volume (mL), median [IQR]	300 [275]	210 [200]	250 [200]	0.503
Length of stay (days), median [IQR]	1 [0]	2 [1]	1 [1]	<0.001*
Drain removal (days), median [IQR]	13 [6]	15 [10]	14 [9]	<0.001*

*, statistically significant. IQR, interquartile range; TE, tissue expander; ADM, acellular dermal matrix.

Table 4 Acellular dermal matrix products used for breast reconstruction

ADM	Prepectoral	Subpectoral	Total
Alloderm, n (%)	36 (26.7)	279 (71.2)	315 (59.8)
Dermacell, n (%)	46 (34.1)	17 (4.3)	63 (12.0)
Ovitex†, n (%)	9 (6.7)	17 (4.3)	26 (4.9)
Cortiva, n (%)	31 (23.0)	22 (5.6)	53 (10.1)
Ovitex‡, n (%)	7 (5.2)	0 (0.0)	7 (1.3)

†, poly(glycolic acid); ‡, reinforced with permanent polypropylene. ADM, acellular dermal matrix.

respectively (*Table 9*). The overall median T-score for anxiety was 49 [IQR, 46–54], depression was 48 [IQR, 43–58], pain interference was 55 [IQR, 50–63], and physical function was 45 [IQR, 38–51] (*Figure 1*). Only for the depression domain, we evidenced better T-scores using a prepectoral approach compared to the subpectoral technique [43.5 (IQR, 35–53) versus 50 (IQR, 43–53), P=0.027].

Discussion

Prepectoral IBBR was the first technique described

Table 5 30-day complications after immediate tissue expander placement

30-day complications	Prepectoral	Subpectoral	Total	P value
Reconstructions, n (%)	135 (25.6)	392 (74.4)	527 (100.0)	
30-day seroma, n (%)	18 (13.3)	40 (10.2)	58 (11.0)	0.316
30-day hematoma, n (%)	3 (2.2)	16 (4.1)	19 (3.6)	0.318
30-day RTOR for hematoma	2 (1.5)	9 (2.3)	11 (2.1)	0.568
30-day surgical site infection, n (%)	7 (5.2)	47 (12.0)	54 (10.2)	0.025*
30-day SSI-related TE removal	3 (2.2)	17 (4.3)	20 (3.8)	0.267
30-day wound disruption, n (%)	22 (16.3)	54 (13.8)	76 (14.4)	0.472
30-day skin flap necrosis	15 (11.1)	40 (10.2)	55 (10.4)	0.766
30-day dehiscence	7 (5.2)	16 (4.1)	23 (4.4)	0.588
30-day excision or debridement	11 (8.1)	41 (10.5)	52 (9.9)	0.437
30-day wound-related TE removal	3 (2.2)	9 (2.3)	12 (2.3)	0.961
30-day morbidity, n (%)	35 (25.9)	110 (28.1)	145 (27.5)	0.632

*, statistically significant. RTOR, return to the operating room; SSI, surgical site infection; TE, tissue expander.

Table 6 Complications of the first stage of immediate implant-based breast reconstruction

First stage complications	Prepectoral	Subpectoral	Total	P value
Reconstructions, n (%)	135 (25.6)	392 (74.4)	527 (100.0)	
Seroma, n (%)	33 (24.4)	84 (21.4)	117 (22.2)	0.467
Hematoma, n (%)	5 (3.7)	19 (4.8)	24 (4.6)	0.538
Surgical site infection, n (%)	20 (14.8)	70 (17.9)	90 (17.1)	0.418
SSI-related TE exchange	0 (0.0)	4 (1.0)	4 (0.8)	0.239
SSI-related TE removal	7 (5.2)	25 (6.4)	32 (6.1)	0.617
Fat necrosis, n (%)	0 (0.0)	9 (2.3)	9 (1.7)	0.076
Wound disruption, n (%)	30 (22.2)	73 (18.6)	103 (19.5)	0.363
Skin flap necrosis	22 (16.3)	47 (12.0)	69 (13.1)	0.201
Wound dehiscence	13 (9.6)	32 (8.2)	45 (8.5)	0.599
Excision and debridement	16 (11.9)	47 (12.0)	63 (12.0)	0.966
Wound-related TE removal	8 (5.9)	18 (4.6)	26 (4.9)	0.537
Wound-related TE exchange	2 (1.5)	7 (1.8)	9 (1.7)	0.814
Capsular contracture, n (%)	5 (3.7)	11 (2.8)	16 (3.0)	0.570
Contracture-related TE removal	2 (1.5)	1 (0.3)	3 (0.6)	0.104
Displacement of the TE, n (%)	1 (0.7)	6 (1.5)	7 (1.3)	0.489
TE leak, n (%)	5 (3.7)	5 (1.3)	10 (1.9)	0.075
Leak-related TE removal	1 (0.7)	0 (0.0)	1 (0.2)	0.088
LD flap for salvage, n (%)	4 (3.0)	17 (4.3)	21 (4.0)	0.482
Failure of TE, n (%)	10 (7.4)	26 (6.6)	36 (6.8)	0.758

SSI, surgical site infection; TE, tissue expander; LD, latissimus dorsi.

Table 7 Surgical outcomes of the second stage of implant-based breast reconstruction

Second stage outcomes	Prepectoral	Subpectoral	Total	P value
Definitive implant, n (%)	125 (25.9)	357 (74.1)	482 (100.0)	
Final volume (mL), median [IQR]	500 [200]	460 [191]	470 [200]	0.261
Time for definitive implant (days), median [IQR]	165 [118]	177 [177]	175 [161.75]	0.791
Implant size (mL), mean ± SD	523.7±133.4	519.2±148.7	520.4±144.8	0.769
Implant surface, n (%)				<0.001*
Textured	6 (4.8)	156 (43.7)	162 (33.6)	
Smooth	119 (95.2)	201 (56.3)	320 (66.4)	
Fat graft, n (%)	85 (68.0)	119 (33.3)	204 (42.3)	<0.001*

*, statistically significant. IQR, interquartile range; SD, standard deviation.

Table 8 Complications after tissue expander-to-implant exchange (second stage)

Second stage complications	Prepectoral	Subpectoral	Total	P value
Definitive implant, n (%)	125 (25.9)	357 (74.1)	482 (100.0)	
Seroma, n (%)	1 (0.8)	14 (3.9)	15 (3.1)	0.038*
Hematoma, n (%)	0 (0.0)	1 (0.3)	1 (0.2)	0.554
Surgical site infection, n (%)	7 (5.6)	20 (5.6)	27 (5.6)	0.999
SSI-related device exchange	1 (0.8)	5 (1.4)	6 (1.2)	0.602
SSI-related device removal	2 (1.6)	7 (2.0)	9 (1.9)	0.789
Capsular contracture, n (%)	16 (12.8)	54 (15.1)	70 (14.5)	0.525
Capsulotomy	2 (1.6)	16 (4.5)	18 (3.7)	0.144
Capsulectomy	5 (4.0)	30 (8.4)	35 (7.3)	0.103
Fat necrosis, n (%)	7 (5.6)	15 (4.2)	22 (4.6)	0.519
Implant malposition, n (%)	5 (4.0)	19 (5.3)	24 (5.0)	0.559
Capsulorrhaphy	3 (2.4)	13 (3.6)	16 (3.3)	0.505
Implant rupture, n (%)	0 (0.0)	12 (3.4)	12 (2.5)	0.038*
Skin flap necrosis, n (%)	1 (0.8)	1 (0.3)	2 (0.4)	0.436
Wound dehiscence, n (%)	3 (2.4)	10 (2.8)	13 (2.7)	0.812
Wound-related implant removal	1 (0.8)	6 (1.7)	7 (1.5)	0.479
Implant removal, n (%)	11 (8.8)	56 (15.7)	67 (13.9)	0.055
Successful reconstruction, n (%)	124 (99.2)	337 (94.4)	461 (95.6)	0.024*

*, statistically significant. SSI, surgical site infection.

using prosthetic material for reconstruction of the breast mound (14). Initial reports employing this plane suggested it was associated with an unacceptable rate of complications, including a high rate of capsular contracture, implant exposure, and infection (14,15). Nonetheless, technological advancements in expander and implant manufacturing, ADM products, autologous fat transfer, and new technologies have allowed us to experience the renaissance of the prepectoral approach (16).

Animation deformity, disruption of the pectoral muscle,

Table 9 Patient-reported outcomes measurements

PROMIS	Prepectoral	Subpectoral	Total	P value
Anxiety (n=57)[†]				
T-score, median [IQR]	51 [47–55.75]	49 [46–53]	49 [46–54]	0.420
Depression (n=203)[‡]				
T-score, median [IQR]	43.5 [35–53]	50 [43–53]	48 [43–58]	0.027*
Pain interference (n=194)[§]				
T-score, median [IQR]	57 [51.25–62]	54 [50–63]	55 [50–63]	0.847
Physical function (n=167)[¶]				
T-score, median [IQR]	42.5 [38–47]	46 [39–51]	45 [38–51]	0.222

*, statistically significant. [†], 29.8-month follow-up; [‡], 32.13-month follow-up; [§], 31.11-month follow-up; [¶], 31.11-month follow-up. PROMIS, Patient-Reported Outcome Measurement Information System®; IQR, interquartile range.

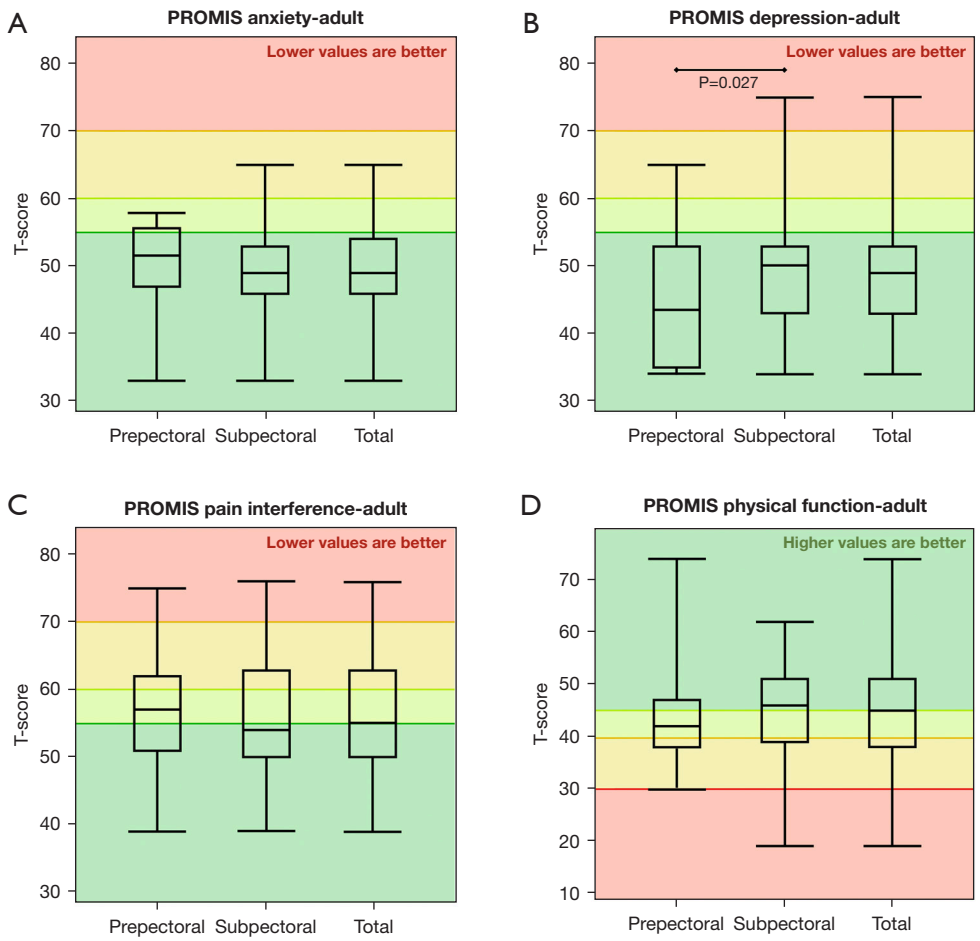

Figure 1 T-scores for anxiety, depression, pain interference, and physical dysfunction using PROMIS scores comparing prepectoral versus subpectoral two-stage IBBR. (A) PROMIS scores for anxiety (lower values are better). (B) PROMIS scores for depression (lower values are better). (C) PROMIS scores for pain interference (lower values are better). (D) PROMIS scores for physical function (higher values are better). PROMIS, Patient-Reported Outcome Measurement Information System®; IBBR, implant-based breast reconstruction.

pain secondary to chest wall irritation, and muscle spasm are common complications encountered with partial and total muscle coverage (17). Furthermore, due to the medial origin of the pectoralis major muscle fibers, optimal placement of the prosthetic device may not be achieved with partial or total subpectoral muscle coverage (17). Most surgeons will elect not to disrupt the medial origin of the pectoralis major muscle to minimize the risk of symmastia or medical device displacement when using a subpectoral approach. Therefore, subpectoral device often results in lateral displacement of the reconstruction and a wider-than-expected sternal cleavage (17). On the other hand, with subpectoral implant placement, the resultant reconstruction has a more natural and smooth shape as it is covered with more tissue, and the implant will not interfere with mammographic assessment of the gland.

Despite the theoretical benefit of new technologies, subpectoral expander placement is preferred in certain types of patients for immediate IBBR (18). In patients with multiple comorbidities, morbid obesity, history of pre-mastectomy radiotherapy, extremely thin mastectomy flaps, recent or current tobacco use, and border line perfusion of flaps on angiography, a subpectoral approach may offer a safer complication profile (18).

Complications

Despite some studies have reported comparable rates of complications between prepectoral and subpectoral TE placement (19-23), other reports have highlighted that rates of complications differ depending on the plane of prosthesis placement for two-stage IBBR. Initial reports from Nahabedian and Cocilovo indicated that the percentage of patients who had surgical complications was 20.5% and 22% for the prepectoral and partial subpectoral cohorts, respectively (17). Periprosthetic infection (8.1% versus 4.8%) and seroma (4.8% versus 2.4%) occurred to a greater extent in prepectoral reconstruction (17), while the rate of hematoma was higher with a partial subpectoral approach (17). The incidence of prosthesis explanation was comparable among groups (6.5% versus 7.2%) (17). Remarkably, they highlighted that the average time for expander explantation was 26 days for subpectoral TE placement and 44.8 days for prepectoral reconstructions in the cases where prosthesis removal was needed (17). Of the patients who had subpectoral reconstruction, 7.2% (6/83 breasts) required conversion to prepectoral implant placement (17).

Bettinger *et al.* presented a series of 294 reconstructions with subpectoral/subserratus expander placement without ADM, subpectoral with ADM (dual plane), and prepectoral TE placement (24). The three types of reconstructions had comparable rates for infection (overall 6.8%, P=0.37) and seroma (overall 4.42%, P=0.44). Higher rates of skin necrosis (P=0.049) and overall expander complications (P=0.01) were found in the subpectoral with ADM group (dual plane) compared to prepectoral or complete submuscular IBBR (subpectoral/subserratus) (24). The authors highlighted the fact that there were more patients with cardiac disease (P=0.03) and current and former smokers in the subpectoral with ADM group compared to the other two cohorts (P=0.08) (24). When evaluating any expander complications, complete submuscular expander placement (subpectoral/subserratus) exhibited the least rate of IBBR complications on univariable analysis (24). On multivariable analysis this association was lost (P=0.12) (24).

Walia *et al.* presented another comparative study with 26 and 109 prepectoral and subpectoral reconstructions, respectively (25). The authors reported a trend toward lower rates of complications in the prepectoral group compared to subpectoral placement (17.4% versus 30.7%, P=0.127) (25). One important remark from the study, was that the rate of nipple ischemia was significantly higher in the prepectoral group compared to the subpectoral group (8% versus 0%, P=0.004) (25).

Manrique *et al.* evaluated patients between 18 and 40 years old who underwent mastectomy and immediate 2-staged breast reconstruction (26). Overall, the rate of the total number of complications did not significantly vary between the prepectoral compared to subpectoral groups during the first (9.6% versus 13.7%, P=0.264) or second stage of reconstruction (1.1% versus 1.7%, P=1.00). Overall, 10 (5.4%) and 8 (6.5%) prostheses were removed during the observation period (P=0.683) (26).

In contemporary studies using a matched-pair analysis methodology, Momeni *et al.* (20) compared prepectoral to subpectoral IBBR and found no difference in the rate of mastectomy skin necrosis rate (15% versus 15%, P=1.0) or all postoperative complications between groups (32.5% versus 42.5%, P=0.356) (20). More specifically, the rate of major (7.5% versus 22.5%, P=0.060) and minor complications were similar between the matched cohorts (30% versus 22.5%, P=0.446). Despite the matched-pair analysis, it is important to mention that TEs were intraoperatively filled to a greater extent with respect to their total capacity in the pre-pectoral group compared to

the subpectoral (50.0% versus 10.4%, P<0.001) (20).

In another study, although the rate of clinically significant necrosis requiring operative debridement was comparable between prepectoral versus subpectoral reconstructions, prepectoral patients generated higher rates of necrosis (27.3% versus 17.4%, P=0.01) (27). In this present study, a higher percentage of nipple-sparing mastectomies were included in the prepectoral group compared to the subpectoral group, which may affect the outcomes regarding the rate of complications (56.2% versus 28.2%, P<0.01) (27).

In a contemporary propensity score-matched analysis evaluating postoperative outcomes within 90 days after surgery, prepectoral reconstruction with expander experienced higher rates of seroma compared to subpectoral expander placement (16.9% versus 3.4%, P<0.001) (28). Beyond this specific complication, the authors did not evidence significant differences in the rate of reconstructive failure (4.4% versus 3.4%, P=0.62) (28). Another propensity score-matched analysis, demonstrated a similar rate of overall perioperative complications per patient comparing bilateral prepectoral to subpectoral TE placement (32% versus 31%, P=1.000) (29). The rate of each specific complication including hematoma, seroma, impaired wound healing, and infection were comparable between groups (29).

In one of the latest comparative studies, our group presented a propensity score-matched study in which the rate of complications was comparable between patients undergoing prepectoral tissue expander placement versus subpectoral placement (8). More specifically, when evaluating the rate of 30-day complications and the overall rate of complications of the first phase of IBBR, similar rates of complications were found between both cohorts (8). When evaluating the rate of complications after TE-to-implant exchange, the authors also evidenced that the rate of complications was similar between groups once the definitive implant was inserted after TE-to-implant exchange (8).

Surgical outcomes

Several authors have evaluated the perioperative outcomes of two-stage IBBR using the prepectoral and subpectoral techniques. For instance, as there is the need to elevate chest muscles for subpectoral approach, it has been hypothesized this technique involves additional surgical time to the reconstruction compared to prepectoral reconstruction. In a recent study, the authors reported that the anesthesia time was significantly reduced in the case of prepectoral prosthesis insertion compared to subpectoral TE placement for unilateral (212.1 versus 232.8 minutes, P<0.01) and bilateral reconstructions (284.4 versus 352.5 minutes, P<0.01) (27). Other series have confirmed these findings regarding the surgical time. According to Sbitany and colleagues, the surgical time was prolonged with subpectoral expander placement compared to prepectoral device placement [4.3 (range, 3.5–4.8) versus 3.9 (3.3–4.3) hours, P=0.001] (30). Likewise, in Asian patients a prolonged surgical time with subpectoral expander placement compared to prepectoral has been reported (76.56 versus 58.46 minutes, P<0.001) (23). Remarkably, evaluating the prepectoral versus subpectoral technique with propensity score matching, authors from the University of Texas Southwestern Medical Center determined there was no associated change in surgical time implementing either one approach or the other (103 versus 104 minutes, P=0.891) (29).

Likewise, as the pectoralis muscles are not dissected and elevated with the prepectoral technique, some studies have stated the estimated blood loss with this technique is reduced compared to subpectoral implant placement. In fact, a contemporary propensity score matched-analysis demonstrated a lower median estimated blood loss employing a prepectoral approach for two-stage IBBR compared to subpectoral reconstruction [150 (IQR, 93.75–200) versus 100 (IQR, 50–200) mL, P=0.048) (8). In line with these findings, due to the compliance of the pocket, a larger intraoperative volume can be achieved with prepectoral approach. Our group also presented a series in which the intraoperative volume of TE was significantly higher in patients undergoing prepectoral expander reconstruction compared to subpectoral device placement [300 (IQR, 150–400) versus 200 (IQR, 100–300) mL, P=0.025] (8). These reconstructions were compared also after propensity score matching.

Due to the association between prolonged use of drains and postoperative complications, several authors have evaluated the role of the plane of TE placement and the duration of drains or time for drain removal. Kraenzlin *et al.* compared 169 and 117 prepectoral and subpectoral reconstructions and determined that both the length of stay (1.1 versus 1.2 days, P=0.08) and time for drain removal (22.1 versus 21.7 days, P=0.72) were comparable between the two cohorts (27). In a recent comparative study evaluating the prepectoral and subpectoral expander position with fenestrated ADM for anterior coverage after non-nipple-sparing mastectomy, the authors also found no difference for the time to drainage removal (9.04±3.5 versus

9.31±2.9 days, P=0.705) (21). Furthermore, when defining prolonged drain duration as >12 days for drain removal, the rate for prolonged drain was comparable between groups (22.2% versus 20.9%, P=0.550) (21). Conversely, in our previous study, we found a prolonged time for drain removal using a subpectoral approach compared to prepectoral expander placement [15 (IQR, 13–21) versus 13 (IQR, 10–16) days, P=0.001] (8). Similar to our outcomes, in a case-matched cohort study, the duration of drains was shorter in the prepectoral group at an average of 12.3 (range, 5–27) compared to 15.4 (range, 5–31) days in the partial submuscular group (P=0.002) (22). Interestingly, also using propensity score-matching, Haddock *et al.* demonstrated that subpectoral implant placement was associated with a significantly shorter time for drain removal (15 versus 18 days, P=0.012) (29).

Taking into consideration the same concept of compliance of the mastectomy pocket, as no muscle limits the anterior wall of implants, with prepectoral device placement it is hypothesized larger expansion volumes can be achieved in shorter periods of time. Furthermore, as the device is not in contact with the chest wall and expansion does not stretch the pectoralis muscle, expansion can be fastened without causing significant pain to patients with prepectoral device placement. For instance, Wormer *et al.* achieved higher final volume at expansion completion (477.5±159.6 versus 543.7±122.9 mL, P=0.017), and reduced the time to expansion completion (62.5±50.2 versus 40.4±37.8 days, P<0.001), and reduced number of visits to complete expansion (3.9±1.8 versus 2.3±1.7, P<0.001) with a prepectoral approach compared to subpectoral reconstruction technique (19). Likewise, Kraenzlin *et al.* also found that with prepectoral device placement, the number of clinic visits was reduced by 2.4 compared to subpectoral IBBR with expanders (P<0.01) (27). In contrast to the previous studies, using non-matched cohorts, authors from the Bucheon St. Mary's Hospital, Catholic University of Korea, reported comparable outcomes for the time to complete expansions (88.64 versus 81.46 days, P=0.365), the mean number of clinic visits for completion (5.69 versus 5.08, P=0.91), and the final postoperative expander volume (315.38 versus 314.23 mL, P=0.950).

Using propensity score-matching, Haddock *et al.* demonstrated that with prepectoral expander placement, patients were able to conclude the expansion process in a shorter period of time (23 versus 49 days, P<0.001) and with a reduced number of clinic visits (1.19±1.59 versus 2.30±1.61, P<0.001) (29). Moreover, the proportion of patients undergoing prepectoral expander placement who required clinic-based expansions was significantly lower than the subpectoral group (45% versus 77%, P<0.001). On the other hand, our group previously demonstrated a comparable time to initiate outpatient expansions [22 (IQR, 16–29) versus 25 (IQR, 16–36.75) days, P=0.27] and similar time to conclude postoperative expansions between the prepectoral and subpectoral groups [50 (IQR, 40–85) versus 48.5 (IQR, 34.75–78.25) days, P=0.66] (8). In their study, they also highlighted that in patients who required adjuvant radiotherapy, the time to start radiation therapy was comparable between the prepectoral versus subpectoral group [134 (IQR, 96–291) versus 126.5 (IQR, 84.5–186.2) days, P=0.58] (8).

Despite a hypothetical decrease in time to achieve full expansion and a reduced number of outpatient visits to achieve the desired volume of the tissue expander, several authors have argued that the time for TE-to-implant exchange is comparable using a prepectoral approach compared to subpectoral device placement. In young patients (18–40 years), the time for TE-to-implant exchange for prepectoral reconstruction and subpectoral reconstruction has been shown to be comparable [6.5 (4.9–11.2) versus 5.6 (4.4–10.6) months, P=0.182] according to Manrique *et al.* (26). Likewise, another study published by our group also demonstrated a comparable time for TE-to-implant exchange in their recent propensity score-matched analysis despite the time for exchange in the prepectoral cohort was lower [150 (IQR, 95–222) days] compared to the subpectoral group [175 (IQR, 108–226) days, P=0.53] (8). Wormer *et al.* reported that the time to TE-to-implant exchange was also similar between prepectoral and subpectoral reconstructions (200.5±93.3 versus 169.3±56.1, P=0.191) (19).

Similar outcomes to the studies mentioned before have been also portrayed by Momeni *et al.* (20). Although some of the patients that had tissue expanders underwent autologous free tissue transfer or hybrid reconstructions as part of the second stage of reconstruction, the mean interval between stage 1 and 2 ± SD, in prepectoral reconstruction was shorter (5.6±2.2 months) compared to subpectoral reconstructions (6.7±2.5 months, P=0.49). On the contrary, other series have demonstrated that the use of prepectoral device placement reduces the time for expander-to-implant exchange compared to subpectoral technique (5.38±3.1 versus 7.6±3.57, P=0.013) (21). More specifically, on subgroup analysis, the time to reach exchange for a definitive implant was shorter in patients who did not need adjuvant treatment (3.3±0.7 versus 6.5±3.4, P=0.021)

and patients who needed adjuvant chemotherapy and radiotherapy (8.0±3.4 versus 11.1±3.2, P=0.047), but not chemotherapy alone (6.6±2.5 versus 6.3±2, P=0.731) (21).

In some patients there is an evident step-off between the prepectoral implant and the chest wall, as there is no additional tissue normally present with submuscular or partial subpectoral device placement (31). The most common resource used nowadays to address these deformities is fat grafting (4,31). In this setting, it has been reported that patients undergoing prepectoral breast reconstruction will require higher rates of postoperative fat grafting to decrease contour deformities and implant rippling (31). For instance, one study from the Mayo Clinic, Rochester, determined that the requirements of fat grafting in young female patients were higher with prepectoral tissue expander placement compared to subpectoral (93.6% versus 80.5%, P=0.001) (26). Likewise, Escandón *et al.* also demonstrated a similar trend in their latest propensity score-matched analysis (8). Despite there was a similar rate of postoperative complications comparing prepectoral versus subpectoral tissue expander placement, higher volumes of postoperative fat grafting were required in the prepectoral group compared to subpectoral implant placement (138.86±73.6 versus 55.88±37.3 mL, P=0.008) (8).

Finally, evaluating the cost-effectiveness of prepectoral TE placement compared to subpectoral placement, several authors have highlighted there can be an increased cost in the early preoperative period associated with prepectoral reconstruction. In the study by Kraenzlin *et al.* the operating room charges for prepectoral reconstruction were $31,276.8 compared to $22,231.8 in subpectoral TE placement (P<0.01) (27). The authors found that the associated use of large amounts of ADM in the prepectoral population generate higher costs (23,27). Further studies evaluating the impact of the number of postoperative clinic visits for expansion and the cost related to the management of major complications are necessary.

Perioperative pain and management

As previously mentioned, placing the expander in the prepectoral space decrease irritation as there is no contact with the chest wall and the pectoralis muscle is not elevated during surgery or stretched during postoperative expansions. Due to these advantages, several surgeons attribute a less painful postoperative recovery to prepectoral expander placement compared to subpectoral implant placement. For instance, Walia *et al.* evaluated scores in the early postoperative period (25). Pain scores at 12 hours, 1 day, 7 days, and 30 days postoperatively were significantly lower with a prepectoral expander placement compared subpectoral approach (25). When adjusting for age group, BMI class, smoking status, and history of radiation therapy and chemotherapy on multivariable analysis, the significance of these associations persisted (25). In line with these findings, Nelson *et al.* highlighted that on postoperative day 1 and day 2, subpectoral expander placement generated higher mean pain scores compared to prepectoral reconstruction (P=0.042) (28). However, by day 3 and 4, and afterward throughout postoperative day 10, pain scores were not significantly different between prepectoral versus subpectoral IBBR using tissue expanders (28).

In a case-matched cohort study, Schaeffer *et al.* evaluated prepectoral versus partial subpectoral breast reconstruction with ADM (22). Prepectoral expander placement yielded lower average pain scores within the first 8 hours after surgery (mean: 3.4; range, 0–7.7) compared to partial submuscular reconstruction (mean: 6.1; range, 1–9; P<0.001) (22). In line with these findings, when measuring the postoperative dose in morphine equivalent units (MEU), patients who received prepectoral had lower doses of intravenous (IV) opioids [746 (range, 0–3,825) versus 1,855 (range, 300–6,280) MEU, P<0.001] and oral opioids [361 (range, 0–750) versus 687 (range, 225–2,625) MEU, P<0.001] compared to subpectoral device placement (22).

In another contemporary study, the authors reported that opioid consumption measured by oral morphine equivalents (OME) was significantly reduced with prepectoral expander placement in the post-anesthesia care unit (PACU) [15.5 (range, 0–33.75) versus 42 (range, 15–57.5) OME, P<0.001] and on the floor [22.5 (range, 7.5–37.5) versus 32.5 (range, 20–58.5) OME, P<0.001] (30). Likewise, using a numerical rating scale (NRS) for pain scores, prepectoral approach yielded lower pain scores in the floor and PACU compared to subpectoral reconstructions (30). One of the criticisms of the aforementioned study was the presence of a higher proportion of reconstructions incorporated into the enhanced recovery after surgery (ERAS) pathway in the prepectoral group compared to the subpectoral group (78.6% versus 20.9%, P<0.001) (30). Remarkably, in subgroup analysis evaluating only patients who were part of the ERAS protocol, comparable oral morphine equivalents were required during the total postoperative between groups [58 (range, 30–74.3) versus 45 (range, 15–60.5) OME, P=0.063] (30). However, authors reported that the use of ERAS, skin-sparing mastectomy versus nipple-sparing mastectomy, and prepectoral reconstruction

versus subpectoral reconstruction were associated with reduced total postoperative opioid consumption (30).

Copeland-Halperin *et al.* presented a series of 152 women representing 258 breasts undergoing mastectomy and reconstruction, mostly with tissue expanders (71.5%). The use of prepectoral versus dual plane was compared (32). Although the authors did not find any significant difference in the rate of different complications, on multivariate regression analysis the prepectoral cohort required 33% fewer days on opioid analgesic medication [adjusted incidence rate ratios (IRR) =0.68; 95% confidence interval (CI): 0.48–0.93; P=0.016] and were 66% less likely to require opioid prescription refills [adjusted odds ratio (OR) =0.34; 95% CI: 0.13–0.88; P=0.027] (32). In another study, Wormer *et al.* found that postoperative analgesics were reduced with prepectoral TE placement. More specifically, the dose of Ketorolac (28.4±6.2 versus 9.1±6.2 mg, P<0.001) and total morphine equivalents for opioid medications (30.4±19.6 versus 22.6±18.5, P=0.026) were significantly reduced using prepectoral expander placement compared subpectoral device placement (19). The total inpatient postoperative dose for acetaminophen (2,084±764.5 versus 1,985.9±683.1 mg, P=0.974) and gabapentin (395.3±267.2 versus 364.5±447.6 mg, P=0.077) were not significantly different between cohorts, but a trend toward lower analgesics was evident in the prepectoral group (19).

Conflicting outcomes have also been reported. In a recent propensity score-matched analysis published by the Plastic Surgery group at the Memorial Sloan Kettering Cancer Center, the authors reported that the morphine milligram equivalents (57.4±32.3 versus 60.5±50.8, P=0.383) administrated during the postoperative period and proportion of patients receiving paravertebral blocks (79% versus 77.3%, P=0.876) were comparable between subpectoral versus prepectoral reconstructions (28). On the other hand, the proportion of patients receiving postoperative ketorolac was higher in subpectoral reconstructions (13.4% versus 5.9%, P=0.048) (28).

QOL

Mastectomy can bring terrible physical and psychological aftermath for women, can generate dissatisfaction, and negatively impact social interaction and family dynamics (33). Therefore, concerns regarding QOL of women after mastectomy have produced interest in providing not only oncologic treatment but also improved conditions after reconstruction. Previous studies have demonstrated no reconstruction can negatively impact the QOL of women in patients who express the desire to reconstruct (33). Several studies have evaluated the implications of IBBR using prepectoral or subpectoral technique.

Despite the advantages that prepectoral expander placement offers to patients, a significant difference in QOL using different validated tools has not materialized. Walia *et al.* compared the scores for different domains of the BREAST-Q between prepectoral and subpectoral reconstructions (25). Results were comparable for satisfaction with breasts (P=0.127), psychosocial well-being (P=0.211), sexual well-being (P=0.337), physical well-being of the chest (P=0.326), satisfaction with outcome (P=0.289), satisfaction with information (P=0.082), and satisfaction with surgeon (P=0.147) (25). Interestingly, using the RAND-36 subscales for physical health, subjects allocated in the prepectoral group demonstrated lower scores [56 (range, 44–85) versus 83 (range, 61–94), P=0.046], which persisted after adjusting for different confounders (25). Scores for mental health using the RAND-36 were comparable between groups (25).

In another study using the BREAST-Q instrument, Nelson *et al.* identified no significant difference in the parameters of physical well-being of the chest comparing prepectoral TE placement compared to subpectoral placement 2 weeks (P=0.297), 6 weeks (P=0.914), and 12 months after surgery (P=0.686) (28). Similar results were obtained on subgroup analysis for unilateral and bilateral reconstructions (28). Remarkably, a trend toward better outcomes for physical well-being of the chest was evident over time (28).

We found one study evaluating physical function after IBBR. Schaeffer *et al.* demonstrated that full active shoulder range of motion (AROM; abduct the shoulder 180°) was reached at an earlier time point with prepectoral expander placement compared to subpectoral device placement [11.8 (range, 7–21) versus 24.2 (range, 7–42) days, P<0.001] (22). Additional studies are required to fully evaluate physical function in terms of biomechanics following prepectoral and subpectoral IBBR with TEs.

Limitations

When thin or questionable perfusion of the mastectomy flaps is encountered, intraoperative decision-making can lead surgeons to elect most commonly a subpectoral or dual-plane implant placement or delayed reconstruction

compared to prepectoral (17). Most studies had a level of evidence of IV or suffered from a mild-to-moderate risk of bias. The retrospective methodology of our retrospective series and the one from other studies included in our review can limit data extraction for some variables that may significantly affect the use of a prepectoral versus subpectoral expander placement.

Conclusions

Both prepectoral and subpectoral are safe alternatives for two-stage IBBR. Due to current advancements in the field of breast reconstruction, prepectoral IBBR has gained popularity and has a comparable safety profile compared to a subpectoral approach in selected patients. In patients with several comorbidities, current tobacco use, history of preoperative radiation, and limited perfusion of the mastectomy flaps, subpectoral device placement should be given special consideration as a layer of vascularized tissue can decrease the risk of major complications or unplanned procedures. As prepectoral device placement does not require dissection of the pectoral muscles, faster recovery, better implant position, decreased pain, and a shorter time to complete expansion is expected. The plane of reconstruction does not seem to significantly affect the time for TE-to-implant exchange or PRO for QOL according to most studies.

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