A Comparative Study of Secondary Procedures after Subpectoral and Prepectoral Single-Stage Implant-Based Breast Reconstruction

Abeera Abbas, FEBS[1]
Hirah Rizki, FRCS[1]
Aleksandra Tanska, MD[1]
Mae Concepcion, BSc[2]
Marios Konstantinos Tasoulis, FEBS[1,3]
Gerald Gui, FRCS[1,2]

London, United Kingdom

Background: Implant-based breast reconstruction (IBR) is the most commonly used procedure to reconstruct the breast after mastectomy. The advantages and disadvantages of subpectoral versus prepectoral implant placement remain a matter of debate. This study compares the need for secondary aesthetic procedures between prepectoral and subpectoral IBR.
Methods: This is a retrospective cohort study of consecutive patients who underwent subpectoral or prepectoral IBR between 2015 and 2018 under a single surgeon at a tertiary breast unit. The primary endpoint was the number of secondary procedures performed to improve the aesthetic outcome. Secondary endpoints included the number of secondary procedures during the first year.
Results: A total of 271 one-stage IBRs were performed (subpectoral, n = 128 in 74 patients; prepectoral, n = 143 in 84 patients). Overall, more patients required secondary procedures in the subpectoral group (36.5% versus 19%; P = 0.014), although through longer follow-up. The most common procedures were pocket revision and implant exchange [11.7% versus 3.5% (P = 0.010); 11.7% versus 4.2% (P = 0.021)], whereas fat grafting was similar between the two groups (46% versus 40.5%; P = 0.777). When adjusted for follow-up time, there was no significant difference in the number of secondary procedures undertaken in the subpectoral versus the prepectoral group (21% versus 16%, respectively; P = 0.288) at 1 year.
Conclusions: The requirement for secondary procedures at 1 year was not different between groups. The need for fat grafting was not increased following prepectoral IBR. (*Plast. Reconstr. Surg.* 151: 7, 2023.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, III.

Implant-based breast reconstruction (IBR) is the most commonly used procedure for immediate reconstruction after mastectomy.[1] The implant can be placed in a subpectoral or prepectoral plane; however, the optimum position for achieving the best aesthetics and longer-term outcomes remain a matter of debate. Although prepectoral IBR has gained popularity over the past decade,[2] subpectoral implant placement is still widely used. Both prepectoral and subpectoral IBR have been shown to be safe, but each method has advantages and disadvantages, which influence clinical decision-making for individual patients.[3–8] Recent studies have compared the cosmetic and functional outcome between these techniques,[4,8–11] with the results of a meta-analysis favoring prepectoral IBR for postoperative recovery, reduced animation, and enhanced shoulder rehabilitation.[8,9]

From the [1]Breast Surgery Unit, The Royal Marsden NHS Foundation Trust; [2]The London Clinic; and [3]Division of Breast Cancer Research, The Institute of Cancer Research.
Received for publication February 19, 2021; accepted January 12, 2022.

DOI: 10.1097/PRS.0000000000009745

Disclosure: *Dr. Gui serves on the speakers bureau and is a consultant for Integra Life Science on an ad hoc basis. The remaining authors have no financial interests or conflicts of interest to report. The authors have no financial interests to declare in relation to the content of this article. No funding was received for this research.*

IBR is often considered a process of care requiring secondary procedures to optimize aesthetic outcomes. These secondary procedures may include pocket revision, capsulectomy or capsulotomy, implant adjustment or exchange, and fat grafting.[5–7,12–14] Some secondary procedures may be planned, such as exchanging tissue expanders for fixed-volume implants or nipple reconstruction. Intuitively, it may be assumed that secondary procedures may be more common after prepectoral IBR because of the absence of the muscular cover of the implant; however, there is no evidence to support this hypothesis.

The aim of this study was to assess the incidence of secondary procedures after prepectoral versus subpectoral IBR. To our knowledge, this is the first study to directly compare secondary revision surgery requirements following these two techniques.

PATIENTS AND METHODS

This is a retrospective cohort study of patients who underwent IBR by or under direct supervision of a single surgeon (G.G.) at a tertiary breast cancer unit. Eligibility criteria included women who underwent either subpectoral (subpectoral group, February of 2015 to June of 2017) or prepectoral IBR (prepectoral group, November of 2016 to December of 2018). To reduce selection bias, all consecutive patients who underwent surgery within the predetermined timeframe were included in the study.

All mastectomies were performed using the hydrodissection technique[15] with reconstruction as described previously.[16,17] Briefly, 300 to 500 mL of hydrodissection fluid (from a stock solution made up of 1 liter of normal saline with 30 mL of 0.5% Chirocaine and 0.5 mL of 1:1000 adrenaline) per breast was infused into the oncoplastic subcutaneous plane to define the mastectomy skin flap and prepectoral space to raise the breast off the chest wall. A blunt-nose, 1.5-mm-diameter, 12-cm-long needle connected to a low-flow-rate pump was used. The oncoplastic plane created by the hydrostatic pressure raised the skin with the subdermal plexus off the anterior breast surface, facilitating scissor dissection with minimal bleeding. Nipple-sparing mastectomies were approached through an inframammary crease incision, whereas skin-sparing mastectomies were performed through a short horizontal incision to excise the nipple-areola complex. For subpectoral implant placement, after completion of the mastectomy, the subpectoral pocket was dissected and released from the inferomedial border of the pectoralis major muscle. In both prepectoral and subpectoral approaches, the lateral pocket was closed with interrupted absorbable sutures. Implants were inserted using accepted measures to minimize the risk of infection, including thorough pocket lavage with sterile water and povidone-iodine. Manipulation and handling of implants was kept to a minimum, and surgical gloves were changed before handling prostheses. Biological acellular dermal matrices (ADM) were prepared and rehydrated following manufacturer instructions. In subpectoral IBR, the ADM was interpositioned with absorbable polydioxanone II sutures (Ethicon, Inc., Somerville, N.J.) between the freed border of the pectoralis major muscle and the inframammary fold. Interrupted polydioxanone sutures were used to secure the ADM to muscle fascia in prepectoral IBR. In most cases, the inframammary crease was not disrupted; when the inframammary crease was dissected, interrupted polydioxanone II sutures were used to redefine the inframammary crease and the lateral breast fold. Biodimensional anatomical or round fixed volume implants with textured surfaces were used. The ADM used were either porcine [Strattice (AbbVie), LifeCell (Plainsboro, N.J.)] or bovine [SurgiMend PRS (SurgiMend, Princeton, N.J.), Q Medical (Toronto, Ontario, Canada)].

Data on patient demographics including age, body mass index, smoking status and comorbidities, and clinical and operative details were collected using electronic patient records. The primary endpoint was the number of secondary procedures performed during the follow-up period in both groups. The secondary outcomes were as follows: (1) a comparison of the number of secondary procedures during the first year of follow-up between the two groups, and (2) the interval to the first secondary procedure after the primary index surgery. Data on the indications for secondary procedures, the number and type of secondary procedures performed, and details on postoperative complications were also collected. The recorded complications included seroma, infection requiring antibiotics, hematoma, skin/nipple necrosis, wound dehiscence, implant loss, and capsular contracture.

A "secondary procedure" was defined as any procedure subsequently performed at a separate operation to improve the aesthetics of the reconstructed breast. These procedures included fat grafting, pocket revision, exchange of implants, nipple reconstruction, capsulotomy or capsulectomy, contralateral symmetrizing surgery, and revision surgery to convert to autologous breast reconstruction. All secondary procedures in the present cohort were driven by the patients as part of a shared–decision-making process following consultation with the surgical team.

All procedures performed in the study were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. The study was reviewed and approved by the local clinical audit committee. Data were collected and kept in accordance with the Data Protection Act (United Kingdom), the International Conference on Harmonization Guideline for Good Medical Practice, and the Trust's standard operating procedures. Guidance from the Strengthening the Reporting of Observational Studies in Epidemiology statement was applied.[18]

Statistical Analysis

Simple descriptive statistics were used for demographic variables. Categorical data were summarized using counts and percentages, and continuous data were summarized by median and interquartile range. Pearson chi-square test and Fisher exact test, as appropriate, were used to analyze categorical variables and nonparametric tests (Mann-Whitney *U* test) were used for continuous variables. Binary logistic regression was also performed to assess potential covariate effects in the outcome variables of interest. The Hosmer-Lemeshow test was used to test the fitness of the logistic regression model. Statistical analysis was performed using IBM SSPS Version 27. A value of $P < 0.05$ was considered statistically significant.

RESULTS

A total of 271 single-stage IBRs were performed (subpectoral group, $n = 128$ in 74 patients; prepectoral group, $n = 143$ in 84 patients). Patient demographics, indications for surgery, and breast cancer characteristics in both groups are summarized in Table 1. Only one patient from the subpectoral group was lost to follow-up, as she moved to another country, and the date of last follow-up was used for the present analysis.

Table 1. Patient Demographics, Surgical Indications, and Cancer Characteristics

Characteristic	Subpectoral (%)	Prepectoral (%)	*P*
No. of patients	74	84	
Age, yr			0.463
Median	42	41	
IQR	33–51	35–51	
BMI, kg/m²			0.415
Median	22.8	22	
IQR	21.3–24.2	20.4–24.6	
Previous breast cancer	22 (29.7)	12 (14.3)	0.018[a]
Local recurrence	3 (4.1)	2 (2.4)	0.666
Bilateral implant reconstructions	54 (72.9)	59 (70.2)	0.704
Indication			
Bilateral RRM	44 (59.5)	48(57.1)	0.632
Unilateral RRM	1 (1.4)	0	
Bilateral cancer	0	2 (2.3)	
Unilateral cancer	18 (24.4)	25 (29.7)	0.632
Unilateral cancer and contralateral RRM	11 (14.9)	9 (10.7)	0.632
Total RRM ($n = 205$ of 271)	100 of 128 (78)	105 of 143 (73.4)	0.368
Cancer characteristics			
Malignancy	29 (39.2)	36 (42.9)	0.640
IDC	8 (10.8)	16 (19)	0.150
ILC	0	5 (6)	0.033[a]
DCIS	3 (4.1)	9 (10.7)	0.115
IDC + ILC	2 (2.7)	2 (2.4)	1
IDC + DCIS	15 (20.3)	16 (19)	0.874
Other (mucinous)	1 (1.4)	1(1.2)	0.928
Grade			
1	9 (12.2)	7 (8.3)	0.426
2	10 (13.5)	13 (15.5)	0.727
3	7 (9.5)	6 (7.1)	0.597
Receptor status			
ER-positive	18 (24.3)	24 (28.6)	0.547
PR-positive	17 (23)	23 (27.4)	0.525
HER2-positive	5 (6.8)	3 (3.6)	0.475
Axillary lymph node status			
SLNB-negative	16 (21.6)	29 (34.5)	0.073
SLNB-positive	11(14.9)	2 (2.4)	0.004[a]
SLNB not done	2 (2.7)	7 (8.3)	0.128

IQR, interquartile range; BMI, body mass index; RRM, risk-reducing mastectomy; ER, estrogen receptor; PR, progesterone receptor; IDC, invasive ductal carcinoma; ILC, invasive lobular carcinoma; HER2, human epidermal growth factor receptor 2; SLNB, sentinel lymph node biopsy.
[a]Statistically significant.

Table 2. Factors Potentially Associated with Implant Complications

	Subpectoral (%)	Prepectoral (%)	*P*
No. of patients	74	84	
Smoker	4 (5.4)	5 (6)	0.882
Previous breast surgery	15 (20.3)	10 (11.9)	0.151
Previous breast radiotherapy	6 (8.1)	4 (4.8)	0.389
NACT	10 (13.5)	6 (7.1)	0.185
Adjuvant radiotherapy	9 (12.2)	2 (2.3)	0.016[a]
Implant size, cc			0.012[a]
Median	420	440	
IQR	370–470	375–490	

NACT, neoadjuvant chemotherapy; IQR, interquartile range.
[a]Statistically significant.

Table 3. Operative Details and Outcomes of Subpectoral and Prepectoral IBR

	Subpectoral (%)	Prepectoral (%)	*P*
No.	128	143	
Surgery			
Nipple-sparing mastectomy	106 (82.8)	106 (74.1)	0.084
Nipple-sacrificing mastectomy	22 (17.2)	37 (25.9)	0.084
ADM used			
Meshed	44 (34.4)	93 (65)	<0.001[a]
Sheet	78 (60.9)	50 (35)	<0.001[a]
No ADM used	6 (2.2)	0	<0.001[a]
Outcomes			
Inpatient stay in days			0.01[a]
Median	2	1	
IQR	1.5–2.5	1–3	
Follow-up, mo			<0.001[a]
Median	31	13	
IQR	14–48	9–19	
Emergency surgery for complications	11 (8.6)	12 (8.4)	0.952
Elective secondary procedures to improve aesthetics	54 (42.1)	40 (27.9)	0.014[a]
Aesthetic surgery not required	74 (57.8)	103 (72)	0.014[a]

ADM, acellular dermal matrix; IQR, interquartile range.
[a]Statistically significant.

Potential risk factors associated with surgical complications following IBR are presented in Table 2. These were similar across both groups; however, use of adjuvant radiotherapy was more common in the subpectoral group (12.2% versus 2.3%; $P = 0.016$), whereas women in the prepectoral group underwent IBR using larger implants ($P = 0.012$) (Table 2). A similar number of patients underwent nipple-sparing mastectomies in both groups (Table 3). Meshed ADM was used in most prepectoral IBRs, and ADM sheets were more commonly used with the subpectoral technique. The median length of inpatient hospital stay was 2 days in the subpectoral group and 1 day in the prepectoral group ($P = 0.01$) (Table 3). The complication rates between the subpectoral and prepectoral groups were similar, with no statistically significant difference between rates of infection, skin or nipple necrosis and wound dehiscence, or rates of hematoma and implant loss (Table 4).

Overall, secondary procedures to improve the aesthetic results were required in 42.1% of cases in the subpectoral group versus 27.9% in the prepectoral group (Table 5); however, it is important

Table 4. Surgical Complications following Subpectoral and Prepectoral IBR

	Subpectoral (%)	Prepectoral (%)	*P*
No. of implants	128	143	
Seroma	11 (8.6)	8 (5.6)	0.932
Infection	10 (7.8)	10 (7)	0.797
Inflamed skin	9 (7)	12 (8.4)	0.676
Hematoma	3 (2.3)	4 (2.8)	1
Skin flap necrosis	6 (4.7)	10 (7)	0.646
Wound dehiscence	10 (7.8)	19 (13.3)	0.146
Implant loss	9 (7)	7 (4.9)	0.456
Capsular contracture	4 (3.1)	4 (2.8)	1
Nipple necrosis[a]	11 (10.3)	11 (10.3)	1

[a]The percentage is calculated based on the number of nipple-sparing mastectomies.

Table 5. Secondary Procedures to Improve Aesthetics on Elective Operative Sessions

Characteristic	Subpectoral (%)	Prepectoral (%)	*P*
No. of implants	128	143	
Interval to first secondary procedure, mo			0.147
Median	11	9	
IQR	5.5–19.5	6.7–11.2	
Breasts requiring secondary procedure within 1 yr of initial surgery	27 (27/128, 21%) in 16 patients	23 (23/143, 16%) in 12 patients	0.288
No. of breasts requiring aesthetic surgery overall	54 (42.1)	40 (27.9)	0.014[a]
Fat grafting	59 (46)	58 (40.5)	0.777
Nipple reconstruction[b]	7/22 (31)	5/37 (13.5)	
Pocket revision	15 (11.7)	5 (3.5)	0.010[a]
Implant exchange	15 (11.7)	6 (4.2)	0.021[a]
Capsulotomy	4 (3.1)	1 (0.7)	0.192
Implant removal	4 (3.1)	4 (2.8)	1
Contralateral symmetrizing surgery	4 (3.1)	1 (0.7)	0.192
Other	14 (10.9)	1 (0.7)[c]	<0.001[a]
DIEP flap	2		
LD flap	1		
Scar revision	2		
Excision of recurrence	2		
Other adjustments	7		
Secondary procedures adjusted for follow-up at 1 yr			
Fat grafting	20 (15.6)	19 (13.3)	0.584
Nipple reconstruction[b]	0	2/37 (5.4)	0.179
Pocket revision	5 (3.9)	3 (2.1)	0.380
Implant exchange	5 (3.9)	1 (0.7)	0.073
Capsulotomy	3 (2.3)	0	0.066
Contralateral symmetrizing surgery	2 (1.6)	0	0.134
Other	0	0	

IQR, interquartile range; DIEP, deep inferior epigastric artery perforator; LD, latissimus dorsi.
[a]Statistically significant.
[b]Nipple reconstruction in nipple-sacrificing mastectomy (denominator given); no differences were observed between techniques once adjusted for follow-up.
[c]Reposition of implants.

to note that this was observed during a longer, median follow-up in the subpectoral group (28 months versus 13 months; $P < 0.001$). When this comparison was adjusted based on revision surgery within the first year of treatment, there was no difference between the subpectoral and prepectoral groups (21% versus 16%; $P = 0.288$) (Table 5). In addition, the median time from IBR to secondary revision surgery was similar between the groups (11 months versus 9 months, respectively; $P = 0.147$).

In the subpectoral group, 54 reconstructed breasts required 122 secondary procedures that were performed using 37 operating room sessions; whereas in the prepectoral group, 40 reconstructed breasts required 81 secondary procedures to improve aesthetics in 25 operating room sessions. Fat grafting was the most common secondary procedure performed in both groups. Details on secondary procedures are summarized in Table 5.

A logistic regression model was also used to assess whether any variables that were found to be significantly different between the subpectoral and prepectoral groups (Tables 1 and 2) were associated with any difference in the observed outcomes. After adjusting for these factors, the result remained the same (data not shown). The Hosmer-Lemeshow test value for the logistic regression model was 0.079 for the whole cohort and 0.621 when the regression model was performed after adjusting for follow-up time.

Subpectoral Group

One hundred twenty-eight subpectoral reconstructions were performed in 74 patients, with 54 patients undergoing a bilateral procedure. Overall, complications were observed in 11 patients: in six, following unilateral mastectomy and IBR, and in five patients following bilateral mastectomy and IBR [however, complication occurred on only one side, 11 of 128 (8.6%)] (Fig. 1).

Twenty-seven patients (36.4%) needed secondary revision surgery on 44 breasts (34.4%) after an uneventful recovery, and an additional 10 breasts required secondary surgery in five patients after initial complications (Fig. 1). Over a median follow-up period of 28 months (range, 1 to 59 months), 122 secondary procedures were performed on 54 of 128 reconstructed breasts. In most patients ($n = 17$ of 54), only one operating room session was needed. Overall, 37 operating

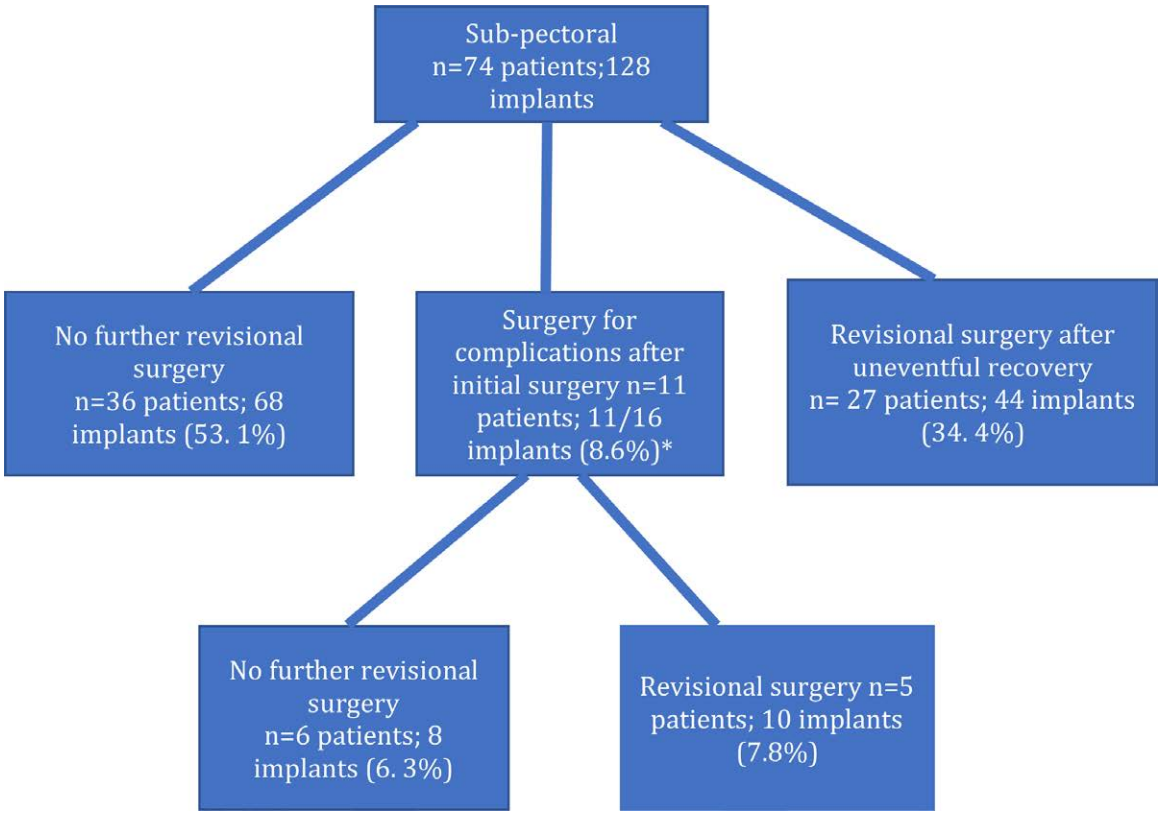

Fig. 1. Flow diagram showing patient outcomes in the subpectoral group. Complications were seen in 11 of 16 reconstructed breasts in 11 patients.

room sessions were used to perform these 122 secondary procedures.

The most commonly performed secondary procedure was fat grafting, undertaken in 59 of 128 subpectoral reconstructions (46%); 16 of these were bilateral procedures. Nine patients required a single round of fat grafting to their breasts. However, six patients underwent two rounds of fat grafting, and two patients were fat-grafted three times. Details on secondary procedures are summarized in Table 5.

Prepectoral Group

One hundred forty-three prepectoral IBRs were performed in 84 patients; in 59, these were bilateral procedures. Sixty-one (72.6%) patients did not require secondary revision surgery. Thirteen reconstructed breasts (8.4%) in 12 patients presented complications after the initial surgery, and of these, seven patients (four bilateral and three unilateral; 11 breasts) required secondary revision surgery (Fig. 2).

Sixteen of 84 patients (19%) after an uneventful recovery needed secondary revision surgery on 29 of 143 breasts (20.2%) over a median follow-up period of 13 months (range, 1 to 32 months) (Fig. 2). To improve aesthetics, 81 secondary procedures were performed using 25 operating room sessions. Six patients required revision surgery performed over two operating room sessions and one patient over three operating room sessions to achieve the desired aesthetic outcome. Fat grafting was the most commonly used secondary procedure [n = 58 of 143 (40.5%)], with four patients requiring two rounds to obtain the desired outcome.

DISCUSSION

There have been several publications in recent years comparing the prepectoral and subpectoral techniques for IBR.[4,5,7–11] These studies suggest prepectoral IBR as a safe alternative to subpectoral reconstruction, associated with lower postoperative pain and less animation deformity, but with potentially more rippling. Therefore, an optimal approach to immediate IBR has yet to be established.[19] The existing literature has focused on safety and postoperative complications of both techniques, identifying rates of implant loss similar to those seen in our present cohort.[7] The present study focuses on the requirement for secondary procedures to optimize aesthetic outcomes, including breast form and symmetry following subpectoral or prepectoral IBR.

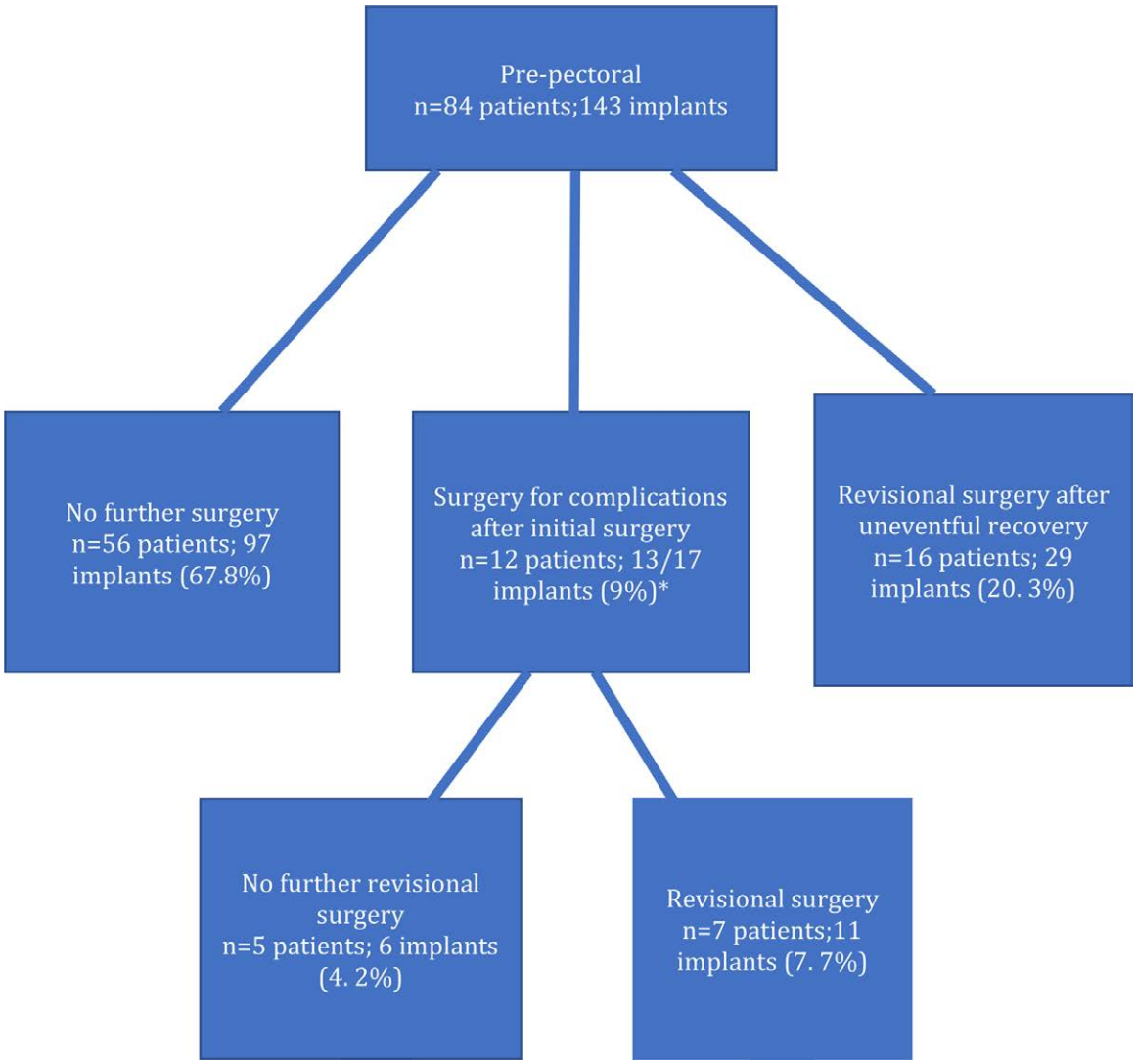

Fig. 2. Flow diagram showing patient outcomes in the prepectoral group. Complications were seen in 13 of 17 reconstructed breasts in 12 patients.

A systematic review on prepectoral IBR with ADM identified the need for revision surgery in 21.4% of patients,[20] the most common being fat grafting (11.9%) and implant exchange (14.3%). However, the majority of the included studies provided level IV evidence, and there were no details on indication for surgery. A study by Reitsamer et al. reported outcomes at 36-month follow-up for 200 prepectoral IBRs with no data or details on any operation performed to improve rippling despite mentioning this observation.[21] The requirement for fat grafting after IBR has been variably reported between 12% and 93%.[6,7,22] In this cohort, across both groups, 117 (43.2%) fat grafting procedures were performed, with the majority requiring only one round of lipomodeling to complete the reconstructive journey.

The present study quantifies the secondary procedure rate after IBR, showing that 72% of patients in the prepectoral group did not require additional aesthetic surgery within the study follow-up. In the subpectoral group, 42.1% of the patients required a secondary procedure to improve aesthetics. The most common secondary procedure in our series was fat grafting, with a similar requirement in the subpectoral (46%) and prepectoral (40.5%) group (46% versus 40.5%; $P = 0.777$). The overall number of patients requiring pocket revision and implant exchange in the subpectoral group was higher compared to the prepectoral group (11.7% versus 4.2%), perhaps because of longer follow-up in the subpectoral group, although at 1 year, the number of pocket adjustments and implant exchanges were similar

between the two groups. Reasons for the pocket revision and/or implant exchange may include pocket displacement as a result of the anatomical location of the implant in subpectoral IBR. Animation deformity is reported in approximately 66% of patients with subpectoral implants, often requiring surgical intervention that includes repositioning of the implant pocket to the prepectoral plane[6]; however, there were no cases of implant exchange/pocket revision for animation deformity in this cohort. An additional reason may be the higher proportion of women that received adjuvant radiotherapy in the subpectoral group in our study.

Although procedures such as scar revision, implant exchange, and conversion to autologous reconstruction were more frequent in the subpectoral group (Table 5), this is likely to reflect the longer follow-up in this group. When adjusted for all procedures performed within 1 year after the IBR, the numbers of secondary procedures were similar in both groups.

Prepectoral IBR has been associated with less postoperative pain and is gaining popularity, as the risk of postoperative complications has been shown to be similar to subpectoral reconstruction.[8,23,24] The present study further supports the similar complication profile previously reported across the two techniques.

All patients in this cohort had textured implants and, although with limited follow-up, there were no cases of implant removal for breast implant-associated illness[25] or breast implant–associated anaplastic large-cell lymphoma (BIA-ALCL).[26] However, there is now emerging evidence that implants with textured surface may be linked to BIA-ALCL. In this context, it is important that all patients are appropriately informed and counseled about this risk, which, based on the latest Medicines and Healthcare products Regulatory Agency reports in the United Kingdom, is estimated to be one in 15,000 implants sold.[27]

The present study has a number of limitations. This is a retrospective analysis, with patients in the subpectoral group having a longer follow-up compared to those in the prepectoral group. In addition, the median follow-up in the prepectoral group may be limited to fully evaluate the long-term aesthetic outcome of the technique. This is inevitable, as the surgical procedures evolved, including availability of ADM specifically designed for the prepectoral approach. However, both groups have similar demographics, risk factors for IBR, and consistency of surgical approach, which reduce potential bias.

CONCLUSIONS

This study suggests that the overall requirement of secondary procedures to improve or maintain the aesthetic outcomes at 1-year after mastectomy and IBR was similar in both the prepectoral and the subpectoral groups. Prepectoral IBR was associated with an acceptable complication rate profile and its potential benefits are not compromised by secondary procedure requirements.

Abeera Abbas, FEBS
Breast Surgery Unit
The Royal Marsden NHS Foundation Trust
Fulham Road
London SW3 6JJ, United Kingdom
abeera@doctors.org.uk

ACKNOWLEDGMENTS

The authors would like to acknowledge the National Institute for Health Research Biomedical Research Centre for supporting this study; and biostatistician Kabir Mohammed for assisting with statistical analysis.

REFERENCES

1. Leff DR, Bottle A, Mayer E, et al. Trends in immediate post-mastectomy breast reconstruction in the United Kingdom. *Plast Reconstr Surg Glob Open* 2015;3:e507.
2. Tasoulis MK, Iqbal FM, Cawthorn S, MacNeill F, Vidya R. Subcutaneous implant breast reconstruction: time to reconsider? *Eur J Surg Oncol.* 2017;43:1636–1646.
3. Bernini M, Meattini I, Casella D. Two-stage implant based breast reconstruction: should we always exchange the tissue expander for an implant right away? *Gland Surg.* 2016;5:369–371.
4. Casella D, Bernini M, Bencini L, et al. TiLoop Bra mesh used for immediate breast reconstruction: comparison of retropectoral and subcutaneous implant placement in a prospective single-institution series. *Eur J Plast Surg.* 2014;37:599–604.
5. Salibian AA, Frey JD, Karp NS. Strategies and considerations in selecting between subpectoral and prepectoral breast reconstruction. *Gland Surg.* 2019;8:11–18.
6. Viezel-Mathieu A, Alnaif N, Aljerian A, et al. Acellular dermal matrix-sparing direct-to-implant prepectoral breast reconstruction: a comparative study including cost analysis. *Ann Plast Surg.* 2020;84:139–143.
7. Yang JY, Kim CW, Lee JW, Kim SK, Lee SA, Hwang E. Considerations for patient selection: prepectoral versus subpectoral implant-based breast reconstruction. *Arch Plast Surg.* 2019;46:550–557.
8. Zhu L, Mohan AT, Abdelsattar JM, et al. Comparison of subcutaneous versus submuscular expander placement in the first stage of immediate breast reconstruction. *J Plast Reconstr Aesthet Surg.* 2016;69:e77–86.
9. Bernini M, Calabrese C, Cecconi L, et al. Subcutaneous direct-to-implant breast reconstruction: surgical, functional, and aesthetic results after long-term follow-up. *Plast Reconstr Surg Glob Open* 2015;3:e574.
10. Gruber RP, Kahn RA, Lash H, Maser MR, Apfelberg DB, Laub DR. Breast reconstruction following mastectomy: a comparison of submuscular and subcutaneous techniques. *Plast Reconstr Surg.* 1981;67:312–317.

11. Schnarrs RH, Carman CM, Tobin C, Chase SA, Rossmeier KA. Complication rates with human acellular dermal matrices: retrospective review of 211 consecutive breast reconstructions. *Plast Reconstr Surg Glob Open* 2016;4:e1118.
12. Ducic I, Seiboth LA, Iorio ML. Chronic postoperative breast pain: danger zones for nerve injuries. *Plast Reconstr Surg.* 2011;127:41–46.
13. Nigro LC, Blanchet NP. Animation deformity in postmastectomy implant-based reconstruction. *Plast Reconstr Surg Glob Open* 2017;5:e1407.
14. Spear SL, Schwartz J, Dayan JH, Clemens MW. Outcome assessment of breast distortion following submuscular breast augmentation. *Aesthetic Plast Surg.* 2009;33:44–48.
15. Tasoulis MK, Agusti A, Karakatsanis A, Montgomery C, Marshall C, Gui G. The use of hydrodissection in nipple- and skin-sparing mastectomy: a retrospective cohort study. *Plast Reconstr Surg Glob Open* 2019;7:e2495.
16. Tasoulis MK, Teoh V, Khan A, Montgomery C, Mohammed K, Gui G. Acellular dermal matrices as an adjunct to implant breast reconstruction: analysis of outcomes and complications. *Eur J Surg Oncol.* 2020;46:511–115.
17. Gui G, Tsang FJ. 'Meshed enhanced hammock' or 'tent': a new patient centred pre-pectoral one-stage immediate breast reconstruction technique for varying ptosis. *Ann Plast Reconstr Surg.* 2019;3:1026.
18. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth* 2019;13:S31–S34.
19. Potter S, Conroy EJ, Cutress RI, et al. Short-term safety outcomes of mastectomy and immediate implant-based breast reconstruction with and without mesh (iBRA): a multicentre, prospective cohort study. *Lancet Oncol.* 2019;20:254–266.
20. Salibian AA, Frey JD, Choi M, Karp NS. Subcutaneous implant-based breast reconstruction with acellular dermal matrix/mesh: a systematic review. *Plast Reconstr Surg Glob Open* 2016;4:e1139.
21. Reitsamer R, Peintinger F, Klaassen-Federspiel F, Sir A. Prepectoral direct-to-implant breast reconstruction with complete ADM or synthetic mesh coverage: 36-months follow-up in 200 reconstructed breasts. *Breast* 2019;48:32–37.
22. Manrique OJ, Banuelos J, Abu-Ghname A, et al. Surgical outcomes of prepectoral versus subpectoral implant-based breast reconstruction in young women. *Plast Reconstr Surg Glob Open* 2019;7:e2119.
23. Nahabedian MY, Cocilovo C. Two-stage prosthetic breast reconstruction: a comparison between prepectoral and partial subpectoral techniques. *Plast Reconstr Surg.* 2017;140(Prepectoral Breast Reconstruction):22S–30S.
24. Sbitany H, Piper M, Lentz R. Prepectoral breast reconstruction: a safe alternative to submuscular prosthetic reconstruction following nipple-sparing mastectomy. *Plast Reconstr Surg* 2017;140:432–443.
25. Adidharma W, Latack KR, Colohan SM, Morrison SD, Cederna PS. Breast implant illness: are social media and the Internet worrying patients sick? *Plast Reconstr Surg.* 2020;145:225e–227e.
26. Johnson L, O'Donoghue JM, McLean N, et al. Breast implant associated anaplastic large cell lymphoma: the UK experience. Recommendations on its management and implications for informed consent. *Eur J Surg Oncol.* 2017;43:1393–1401.
27. Medicines and Healthcare products Regulatory Agency. Breast implants: report cases of anaplastic large cell lymphoma (ALCL). Published December 17, 2014. Available at: https://www.gov.uk/drug-device-alerts/medical-device-alert-breast-implants-report-cases-of-anaplastic-large-cell-lymphoma-alcl. Accessed March 26, 2021.