Clinics in Surgery

Research Article
Published: 17 Apr, 2017

Autologous Breast Reconstruction Implant Augmentation (A.B.R.I.A.): Indications and Outcomes

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Abstract

Background: Increasing numbers of young women with normal body mass index (BMI) are receiving autologous tissue breast reconstruction, often requiring a prosthetic implant to achieve their desired volume and symmetry. Our aim is to describe the technique of autologous breast reconstruction implant augmentation (A.B.R.I.A.) and its indications and outcomes to satisfy soft tissue implant coverage, volume, and contour problems in this breast reconstruction patient population.

Methods: A single surgeon's experience with consecutive patients undergoing A.B.R.I.A. over a four year period was conducted. Outcomes related to patient demographics, indications for surgery, operative procedure, implant type, size, location and timing of placement, and complications were analyzed. In addition, a PubMed MeSH database search for related topics to identify technique variables that may influence outcome of the procedure was completed.

Results: Six patients who underwent eight breast reconstructions were included in the study. There were no implant or flap complications. The literature review identified seven reports reviewing 2341 breast reconstructions, 226 of which utilized A.B.R.I.A. including our series; these flaps had a flap loss and implant failure rate of 0.4% and 3.1% respectively. The rate of infection, seroma, partial flap loss, and hematoma are 3.5%, 1.8%, 6.1%, and 3.1%.

Conclusion: A.B.R.I.A combines the benefits of both prosthetic and autologous reconstruction including a straight forward secondary procedure, excellent implant soft tissue coverage, hidden donor site scarring, improved abdominal contour, and minimal to no donor site functional loss. This study demonstrates that autologous breast reconstruction implant augmentation has an acceptably low complication rate and can be a safe and effective option for optimizing breast reconstruction with autologous tissue.

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Received Date: *13 Dec 2016*
Accepted Date: *04 Apr 2017*
Published Date: *17 Apr 2017*

Citation:
Rebowe RE, Crantford JC, Bond A, Pestana IA. Autologous Breast Reconstruction Implant Augmentation (A.B.R.I.A.): Indications and Outcomes. Clin Surg. 2017; 2: 1406.

Introduction

Operations utilizing autologous tissue from the abdominal donor site have been an integral part of breast reconstruction since their description in the late 1970's. There are many reasons for the popularity of these procedures. The abdominal soft tissues are the ideal replacement for the breast due to its reliable blood supply, ease in molding, and natural ptosis. Moreover, advancement of microsurgical techniques to allow harvest of perforator flaps has improved these operations significantly resulting in decreased rates of abdominal donor site morbidity [1-3]. Despite this, many women are not considered candidates for abdominal based flaps due to a paucity of abdominal tissue. If these patients desire the natural ptosis and longevity of an autologous flap, they have traditionally been offered a latissimus dorsimyocutaneous (LDMC) flap, with or without an implant, or alternative microvascular free tissue transfer sites such as the thigh or the gluteal areas. These reconstructive options come with the donor site morbidity that abdominally based flaps seek to avoid such as a potentially visible posterior thorax scar and functional deficits in the upper extremity. Furthermore, the tissue they provide is not as ideal in terms of natural look and ease of molding [4,5].

At our institution, women who desire the natural ptosis and permanence of an autologous reconstruction but have a relative lack of donor site soft tissues are candidates for autologous breast reconstruction implant augmentation (A.B.R.I.A.). This technique employs standard techniques for autologous breast reconstruction followed by implant augmentation similar to that employed for cosmetic breast augmentation. Our aim is to describe the technique of A.B.R.I.A. and its indications and outcomes to satisfy soft tissue implant coverage, volume and contour problems in this breast reconstruction patient population. In conjunction, a literature review was completed to identify

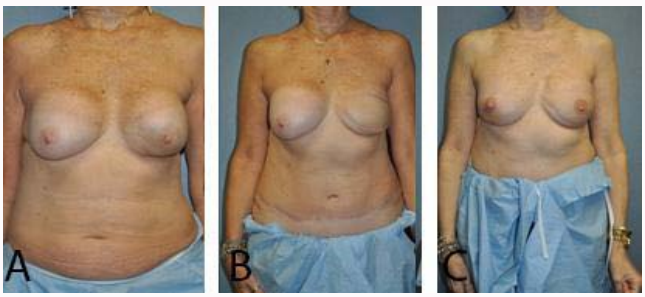

Figure 1: A) 57 year old woman with left-sided ductal carcinoma in situ prior to undergoing free tissue transfer. Note site of previous lumpectomy on left breast. B) Same patient status post muscle sparing free TRAM to the left breast. C) Same patient after placement of bilateral subpectoral Allergan Style 10 implants. *For a complete pictorial of this patient's reconstructive process, please see Supplementary Material 1.*

technique variables that may influence outcomes of this procedure.

Materials and Methods

Patients

All cases performed by the senior author (IAP) from December 2011 to January 2014 were reviewed. These cases were reviewed for variations in technique such as type and volume of implant placed, plane of implant placement, timing of implant placement, type of microsurgical anastomosis if present, and length of follow up. All complications including hematoma, seroma, infection, implant extrusion, and flap failure were analyzed. This study was approved by the Institutional Review Board at our institution.

Literature review

Surgical technique: Women who are appropriate candidates for free tissue transfer are identified in clinic and a frank preoperative discussion is held regarding risks, benefits, and alternatives to the procedures. We first perform an abdominally based microvascular transfer based according to the standard previously described technique [6,7]. The choice of muscle sparing free transverse rectus abdominus myocutaneous flap (msfTRAM) vs. deep inferior epigastric perforator (DIEP) flap is made at the time of surgery based on the individual perforator anatomy of each patient. The patient is allowed to completely recover and heal following their microvascular free tissue transfer (Figure 1A/B).

Once the patient is totally healed, operative planning for implant placement is begun. This time allows for the abdominal flap to take the natural shape of a breast, allowing us to utilize standard tissue based planning techniques when selecting an implant. In doing so, we take into account breast width, breast height, and intermammary distance. Nipple to inframammary fold (IMF) distance and sternal notch to nipple distance are estimated based on the purported placement of the nipple reconstruction. A style and approximate size of implant is selected in clinic with the patient to ensure she is comfortable with the selection [8-10].

The patient is then taken back to the operating room for placement of the implant (Figure 1C). We utilize previous incisions for implant placement, taking care to note the position of the previous microvascular pedicle. At the time of surgery, the quality and amount of flap tissue is assessed. If the flap tissue is insufficient to provide adequate coverage for the implant, the prosthesis is inserted in the sub-muscular plane. Otherwise we are comfortable placing the implant underneath the flap itself. No a cellular dermal matrix (ADM) is utilized in this secondary procedure, nor do we leave drains.

Following placement of the implant, further reconstructive goals are discussed with each patient. We offer each patient with contour irregularities further revision procedures. We discuss all options with each patient including fat grafting, liposuction, scar revision, or local flap reconstruction. Nipple tattooing and surgical nipple reconstruction are offered to all women undergoing breast reconstruction. As with any breast reconstruction method, the number of total surgeries will depend on each individual patient.

Statistical analysis

All comparisons of complication rates were analyzed for statistical significance using chi-squared tests. P values less 0.05 were considered statistically significant.

Table 1: Patient Demographics and Surgical Techniques.

Patient Number	Age At Operation	Flap Type	Implant Type	Implant size (Right/Left)	Pocket (Right/Left)	Fat Grafting Required	Contralateral Procedures	Additional Procedures
1	57	msfTRAM (Left)	Allergan style 10, 120 mL moderate profile, smooth silicone gel implant	120/120	Subpectoral/ Subpectoral	None	Right Aug/Vertical Mastopexy (Superomedial Pedicle)	Bilateral Nipple/Areola Reconstruction
2	46	msfTRAM (Left)	Allergan style 10, 180 mL moderate profile, smooth silicone gel implant	none/180	None/ Subpectoral	None	Right Vertical Mastopexy (Superomedial Pedicle)	Bilateral Axillary Liposuction
3	37	Pedicle TRAM (Right)	Mentor Smooth Round Moderate Profile Plus 150 mL silicone gel implant	150/325	Sub-flap/ Subpectoral	None	Left sided expander/ implant recon 20 years after autologous recon	Bilateral Nipple/Areola Reconstruction
4	54	msfTRAM (Bilateral)	Allergan style 10, 150 mL moderate profile, smooth silicone gel implant	150/150	Subpectoral/ Subpectoral	80cc Bilateral Breasts	None	Bilateral Nipple/Areola Reconstruction
5	55	DIEP (Right)	Mentor Smooth Round Moderate Profile Plus 225 mL silicone gel implant	225/300	Sub-flap/ Subpectoral	20cc Reconstructed Breast	Left Aug	Nipple/Areola Reconstruction
6	46	R msfTRAM/L DIEP (Bilateral)	Mentor Smooth Round Moderate Profile Plus 275 mL silicone gel implant	275/275	Sub-flap/ Sub-flap	None	None	None

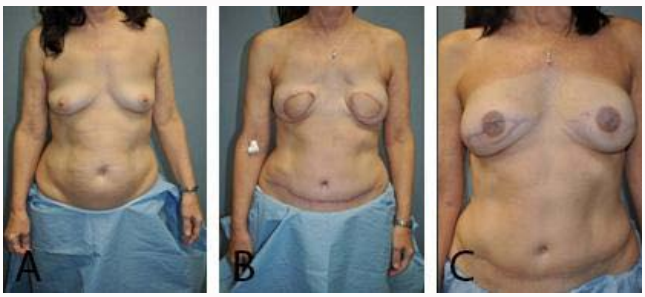

Figure 2: A) 54 year old woman with left breast invasive ductal carcinoma. Patient was an A cup prior to surgery and wished to remain her size or increase in size following surgery. B) Same patient following bilateral muscle sparing free TRAM reconstruction C) Patient after placement of bilateral subpectoral 150cc Allergan Style 10 Implants. *For a complete pictorial of this patient's reconstructive process, please see Supplementary Material 2.*

Results

Our results

Six patients with a mean age of 49.5 years and a mean BMI of 22.1 underwent breast reconstruction with 8 autologous flaps (Table 1). Muscle sparing free TRAM flaps were used in 63% (5/8) of cases followed in frequency by DIEP flaps (2/8) and a single pedicled TRAM. Indications for the use of autologous tissue include previous radiation (4/6), failed implant reconstruction, and level of activity. All patients underwent delayed augmentation with a mean implant volume of 190 mL. Placement of implants was distributed equally between sub-flap (4/8) and sub-pectoral (4/8) pockets. Median time from breast reconstruction to implant augmentation was 5.5 months. There were no implant/flap complications. Following completion of the reconstruction with the implant, further revision of the reconstructed breast or contralateral breast may be indicated. Two patients, comprising three reconstructions, did undergo further fat grafting for contour irregularities. We did regularly perform symmetry procedures on the contralateral breast for symmetry. One patient each received contralateral mastopexy, augmentation, mastopexy and augmentation, contralateral expander/implant reconstruction, and bilateral axillary liposuction. Four patients went on to have nipple and areola reconstruction or tattoo.

Average follow up was 8.5 months. An example patient is shown in Figure 2.

Discussion

Since their introduction in the 1970's, abdominally based flaps have become the preferred method for autologous tissue reconstruction of the breast. While surgical advancements have provided various methods of tissue harvest, all abdominal flaps share certain characteristics that make this tissue the ideal breast replacement. These factors include a reliable axial blood supply, ease of molding, and the aesthetically pleasing body contouring provided by the donor site. Utilizing all of these advantages allows the reconstructive surgeon to provide the patient with a permanent breast mound replacement with natural feel and ptosis [1,2].

However, not all women have sufficient abdominal tissue to perform a total autologous reconstruction. Though the desires, age, and co-morbidity profile of a particular woman may allow her the benefits of an abdominally based reconstruction, her relative paucity of abdominal fat and overlying skin would limit the ability of the reconstructive surgeon to provide a satisfactory outcome utilizing only this tissue. While alternative flaps such as the superior gluteal artery perforator (SGAP) flap, inferior gluteal artery perforator (IGAP) flap, transverse upper gracilis (TUG) flap, or profunda artery perforator (PAP) flap are autologous tissue options, women without sufficient tissue for abdominal free tissue transfer rarely have sufficient tissue in these sites [11-13]. Stacked flaps are available to these women and have a generally good success, but they do require a longer operating time and increased number of vascular anastomoses which can increase the risk associated with the procedure including medical complications and flap loss [14,15]. While the LDMC flap can be utilized for autologous reconstruction, the transverse scarring across the superior thorax and functional deficit following muscle harvest make this flap a less ideal candidate in younger women and can be associated with lower satisfaction scores [5,16]. Therefore, it may be beneficial to perform the autologous reconstruction and subsequently, or simultaneously, augment the planned flap with a prosthetic implant. At our institution, we have termed this process autologous breast reconstruction implant augmentation (A.B.R.I.A.).

We have found that A.B.R.I.A. can combine the benefits of both autologous and implant based reconstruction. The autologous reconstruction will provide the natural appearance and feel of a breast mound while also providing ample soft tissue for coverage of the implant. The implant will allow for increased projection,

Table 2: Literature Review of All Articles Detailing A.B.R.I.A.

	[17]	[18]	[19]	[20]	[21]	[22]	[23]	Our Group	Total	Percent
Total Number of Reconstructions	1307	250	243	88	174	110	161	8	2341	
Reconstructions with Flap/Implant Combination	5	5	19	44	18	110	17	8	226	9.65%
Implant Placement										
Submuscular	5	4		43	14	73	6	4	149	71.98%
Sub Flap	0	1		1	4	37	11	4	58	28.02%
Vessel Anastomoses										
Thoracodorsal	5	5	0	43	12	35	0	0	100	44.25%
IMA	0	0	0	0	6	75	17	7	105	46.46%
Pedicle	0	0	19	1	0	0	0	1	21	9.29%
Timing of Implant										
Simultaneous	5	5	14	30	14	59	0	0	127	56.19%
Delayed	0	0	5	14	4	51	17	8	99	43.81%

Table 3: Reported Complications of A.B.R.I.A.

	[17]	[18]	[19]	[20]	[21]	[22]	[23]	Our Group	Total	Percent	*p* value
Flap Failure Rate (0.4%)											***p*=0.256**
Simultaneous	0	0	0	0	0	0	0	0	0	**0.00%**	
Delayed	0	0	0	0	0	1	0	0	0	**1.01%**	
Implant Removal Rate (3.1%)											***p*=0.110**
Simultaneous	0	0	3	2	1	0	0	0	6	**4.72%**	
Delayed	0	0	0	0	0	0	1	0	1	**1.01%**	
Infection (3.5%)											***p*=0.01**
Simultaneous	1	0	3	2	1	1	0	0	8	**6.30%**	
Delayed	0	0	0	0	0	0	0		0	**0.00%**	
Partial Flap Loss (6.1%)											***P*=0.53**
Simultaneous	0	0	3	0	2	4	0	0	9	**7.09%**	
Delayed	0	0	0	0	0	5	0	0	5	**5.05%**	
Seroma (1.8%)											***p*=0.075**
Simultaneous	1	0	0	3	0	0	0	0	4	**3.15%**	
Delayed	0	0	0	0	0	0	0	0	0	**0.00%**	
Hematoma (3.1%)											***p*=0.41**
	0	0	0	2	2	1	0	0	5	**3.94%**	
	0	0	0	0	0	2	0	0	2	**2.02%**	

improve contour abnormalities, and further shape the autologous reconstruction. This process has proved a reliable way to perform reconstructions that are safe, stable, and aesthetically pleasing to both patient and surgeon.

To further discern the indications and risks of A.B.R.I.A., a literature review was performed to discern the current trends as well as the specific risks of this technique. A Pubmed Medical Subject Headings (MeSH) search was performed on available Pubmed and Medline literature. Inclusion criteria included articles in English language journals pertaining to human subjects. Only articles with more than one subject and follow up greater than 6 months were included. Furthermore, only articles that listed complications as they specifically pertain to the technique variables described above were included. Exclusion criteria included articles in non-English language journals, case studies, articles that described only technique without patient examples, or articles that did not include sufficient follow up or complication information for their provided cases. In order for a complication to be included in the analysis, it must be reported in the majority of the papers reviewed.

A Pubmed MeSH search for "Mammaplasty," which includes all articles related to augmentation and reconstruction, returned 9,112 results. Separate Pubmed searches that included the MeSH term "Mammaplasty" as well as "Autologous" or "Implant" returned 984 results and 1,867 articles respectively. A pubmed search for all headings together produced 268 results. Articles that met our inclusion criteria were reviewed as were the references of the included articles to ensure all pertinent information was included. Overall, we found 12 articles that pertained to A.B.R.I.A. Seven of these articles met our previously described criteria for inclusion.

These seven articles included description of 226 breast reconstructions (Table 2). In 149 (72%) of these breast reconstructions, the implant was placed in the subpectoral plane while in the remaining 58 (28%) cases the implant was placed underneath the autologous reconstruction (sub-flap). Twenty-one (9.2%) of the reconstructions were performed utilizing a pedicled TRAM flap. 205 (90.8%) of the reconstructions utilized either the muscle sparing free transverse rectus abdominus myocutaneous flap (msTRAM) or the deep inferior epigastric perforator flap (DIEP). One hundred (48.8%) of these free tissue transfers utilized the internal mammary artery (IMA) pedicle, and 105 (51.2%) utilized the thoracodorsal (TD) pedicle. Ninety-nine (43.9%) of these reconstructions were performed in a delayed fashion, with implant or expander placement at a later time following autologous reconstruction, while 127 (56.1%) reconstructions were performed with simultaneous flap and implant placement.

All included reconstructions recorded information regarding complication rates. The rate of flap loss and implant removal (describing reconstructive failure in both cases) was 0.4% and 3.1%, respectively. The rate of seroma and hematoma were equally low at 1.8% and 3.1% each, while the rate of partial flap loss was slightly higher at 6.1%. Documented infections can range between an acute infection of the implant itself (necessitating removal) to erythema of the flap or surrounding skin that was responsive to antibiotic therapy. As most papers reviewed failed to give a firm definition of observed infection, we report here the total rate of infection listed in the literature as 3.5%.

To determine which differences in technique, if any, make a difference in outcome, we compared the incidence of complications in each reported subgroup of procedure variations. The only difference in technique that is consistently reported to affect the rate of complication is the timing of placement of the implant. Those that performed the implant placement in a delayed fashion compared to flap coverage reported different outcomes than those authors that reported performing implant placement and flap inset at the same time. The results of this comparison are shown in Table 3 [17-23]**.** As shown**,** the overall rate of infection is the only complication that is affected by any statistically significant amount when these two groups are compared.

Unfortunately, combining two procedures can also expose patients to the combined risks of each separate surgery. The autologous reconstruction may expose her to vascular compromise of the flap and its sequelae. Similarly, utilizing a breast prosthesis can lead to an increased risk of hematoma, seroma or infection. Fortunately our report indicates that ABRIA is safe overall, with very low risk of flap loss or implant removal (0.4% and 3.1% relatively). Likewise, the incidence of hematoma, seroma, and partial flap loss is also extremely low (3.1%, 1.8%, and 6.1% respectively). While the rate of reported infection was extremely low (3.5%), all of these infections occurred when the flap and implant were placed simultaneously. This information would corroborate the conclusions of Roehl et al., [22] who found an increased risk of long term complications, including a significant number with capsular contracture, in those patients in whom implants and autologous tissue reconstructions were performed simultaneously. The rate of infection reported in the literature is comparable to the latissimus dorsi flap and implant reconstruction, with reported infection rates of 1.2-5.4%. [24-26] At this time, we would not hesitate to perform A.B.R.I.A. on appropriate patients, but we will warn any patients whom are contemplating a combined procedure that this may expose them to an increased risk of infection of the implant or the surrounding soft tissue envelope.

As with any surgical procedure, patient selection is critical. Previous authors have outlined the ideal candidates for combining prosthetic implant and abdominal autologous tissue reconstruction. Kronowitz et al. described this procedure as most useful in young women with medium to large size breasts [20]. Serletti and Moran note than women who benefit most from the combined procedure have minimal abdominal donor tissue and large, ptotic breasts [18]. Likewise, multiple authors note that the procedure is particularly helpful in matching symmetry to a previously reconstructed or natural contralateral breast [18,21]. There is also significant evidence that combining implants and abdominal autologous tissue can provide a stable long term reconstruction for women with previously irradiated breasts [27]. Miller et al. has previously provided the most specific guidelines on patient selection. They enumerated five patient preferences that were key to their decision to pursue A.B.R.I.A. These included insufficient abdominal tissue for total autologous reconstruction, desire for immediate breast reconstruction, and patient comfort with prosthetic implants, wish to avoid tissue expansion, and preference for abdominal donor site [17].

In our practice, we have found that utilizing A.B.R.I.A. in young patients with low BMI provides the best aesthetic outcome and risk profile for combining these procedures. The guidelines for patient selection set forth by Miller et al. have certainly proven true in our practice environment. In particular, avoiding the scar and functional deficit of the latissimus dorsi flap is a critical component of the decision for both the surgeon and the patients. Furthermore, appropriate patient education about the risks involved with utilizing prosthetic implants in the setting of reconstruction has played a critical role in our patient's overall comfort with the procedure.

The variations in surgical techniques have not proven to play a significant role in patient outcomes, though the lack of reporting of these variables in relation to surgical outcomes and complications is a limitation in our report. There does not seem to be a particular affinity for placing the implant in the sub-muscular or sub-flap pocket, nor does this seem to influence the final outcomes. Similarly, there does not seem to be a preference for which recipient vessels are utilized for the microanastomoses. While avoiding pressure on the microvascular pedicle has traditionally been a concern in any autologous reconstruction, it does not appear that placement of the implant has any impact on these vessels, regardless of which recipient vessels are chosen. The demonstrated rate of total flap loss and partial flap necrosis was 0.4% and 6.1%, both of which are very well within previously reported acceptable limits.

As with any study, our research does have its own set of limitations. The data from our institution is a small data set without sufficient power for drawing wide conclusions. When combined with our literature review, we believe that we have provided a set of data with sufficient power to guide surgical decisions at our institution and for other surgical teams. This review is limited, however, to the amount and type of previously reported data. The lack of standard definition of complications, in particular infection and partial flap loss or fat necrosis, is a limitation of literature reviews in general and must be recognized when counseling patients utilizing information garnered from this report.

Conclusion

We have found that combining lower abdominal autologous tissue reconstruction with implant based reconstruction can provide stable long term reconstructions to a certain subset of individuals. Typically these are young patients with low BMI and limited abdominal donor tissue that wish to avoid the donor site morbidity of the latissimus dorsi flap. Complications rates combining abdominal autologous and prosthetic implant reconstruction are acceptably low and in general do not seem to be influenced by technique variables. When utilizing these techniques during the same procedure, there is an increased risk of infection that the patient must be aware of for true informed consent. Overall, autologous breast reconstruction implant augmentation is a safe and reliable way to provide an aesthetically pleasing breast reconstruction.

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