



# Comparison of Outcomes in Immediate Implant-Based Breast Reconstruction: Acellular Dermal Matrix versus Inferior Dermal Flap

Luís Mata Ribeiro, MD<sup>1</sup> Rita P. Meireles, MD<sup>2</sup> Irís M. Brito, MD<sup>2</sup> Patrícia M. Costa, MD<sup>1</sup>  
 Marco A. Rebelo, MD<sup>3</sup> Rui F. Barbosa, MD<sup>3</sup> Miguel P. Choupina, MD<sup>3</sup> Carlos J. Pinho, MD<sup>3</sup>  
 Matilde P. Ribeiro, MD<sup>3</sup>

<sup>1</sup>Plastic and Reconstructive Surgery Department, Centro Hospitalar Universitário Lisboa Central, Hospital São José, Lisbon, Portugal

<sup>2</sup>Plastic and Reconstructive Surgery Department, Centro Hospitalar e Universitário de Coimbra, Coimbra, Portugal

<sup>3</sup>Plastic and Reconstructive Surgery Department, Instituto Português de Oncologia do Porto, Porto, Portugal

**Address for correspondence** Luís Mata Ribeiro, MD, Centro Hospitalar Lisboa Central, Hospital São José, Rua José António Serrano, 1150-199 Lisboa, Portugal (e-mail: Luis1989ribeiro@hotmail.com).

Arch Plast Surg 2022;49:158–165.

## Abstract

**Background** Implant-based breast reconstruction has evolved tremendously in the last decades, mainly due to the development of new products and techniques that make the procedure safer and more reliable. The purpose of this study was to compare the outcomes in immediate one-stage breast reconstruction between acellular dermal matrix (ADM) and inferior dermal flap (IDF).

**Methods** We conducted a retrospective comparative study of patients submitted to immediate breast reconstructions with an anatomical implant and ADM or IDF in a single center between 2016 and 2018. Outcomes evaluated included major complications, early complications, reinterventions, readmissions, and reconstruction failure. Simple descriptive statistics and univariate analysis were performed.

**Results** A total of 118 breast reconstructions (85 patients) were included in the analysis. Patients in the IDF group had a higher body mass index (median = 27.0) than patients in the ADM group (median = 24). There were no statistically significant differences among both groups regarding immediate major complication, early complications, readmissions, and reinterventions.

**Conclusion** There are no significant differences in complications between the ADM and IDF approach to immediate implant breast reconstruction. In patients with higher body mass index and large, ptotic breasts, we recommend an immediate implant reconstruction with IDF.

## Keywords

- ▶ acellular dermis
- ▶ breast implants
- ▶ mammoplasty
- ▶ mastectomy
- ▶ retrospective studies

DOI <https://doi.org/10.1055/s-0042-1744404>.  
 ISSN 2234-6163.

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Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA

Immediate breast reconstruction is a critical step in reducing the psychological burden associated with breast cancer and mastectomy. This kind of reconstruction has developed immensely in the last few years, mostly since it was found to be safe from an oncological perspective (i.e., does not affect the diagnosis nor the incidence of breast cancer recurrence).<sup>1</sup>

In most western countries, due to increasing rates of obesity, implant-based reconstruction is favored by many surgeons. In these patients, autologous reconstruction is more challenging, with higher rates of severe complications and morbidity.<sup>2</sup> The subpectoral plane positioning of the implant offers a safe and reliable treatment, but there is a significant loss of lower pole coverage, breast projection, and inframammary contour mainly due to muscle attachments inferiorly.<sup>1</sup> Due to these limitations, most surgeons use a two-stage technique (placement of a tissue expander in the mastectomy pocket initially, and then changing to a permanent implant a few months later) which provides more predictable results and less tension on the skin flaps.<sup>3,4</sup>

The development of acellular dermal matrixes (ADMs), biologic meshes that provide structural support for the ingrowth of native tissue, allowed surgeons to attempt an immediate single-stage breast reconstruction, providing better lower pole coverage and inframammary fold definition, improved aesthetic results, and reducing capsular contracture rates.<sup>5–8</sup> Another solution to the lower pole problem was the development of an inferior dermal flap (IDF). This technique was first reported by Bostwick<sup>9</sup> for immediate breast reconstruction after prophylactic mastectomies in patients with breast ptosis. The lower pole skin that is usually removed during a Wise-pattern mastectomy is deepithelialized, creating a dermal flap that can then be sutured superiorly to the pectoralis major providing complete implant coverage. Hammond et al<sup>10</sup> also reported the successful use of this technique as a two-stage procedure for oncologic breast reconstruction. The IDF serves the same purpose of a matrix, providing better coverage and better control of the implant pocket and limiting muscle dissection.<sup>11,12</sup>

This study aimed to compare the outcomes and the incidence of postoperative complications between immediate single-stage breast reconstruction using ADM or an inferior dermal sling (IDF).

## Methods

A retrospective medical record review was performed for a consecutive series of patients undergoing immediate breast reconstruction, between October 2016 and December 2018 (26 months), at *Instituto Português de Oncologia – Porto (IPO Porto)*. Patients submitted to skin-sparing mastectomy and immediate reconstruction with breast implant plus ADM and patients submitted to Wise-pattern mastectomy and immediate reconstruction with breast implant plus IDF were included and compared in this institutional review. Mastectomies included both therapeutic and prophylactic. Skin-sparing mastectomies were done on patients with non-existent or mild breast ptosis. Patients with moderate or severe breast ptosis underwent Wise-pattern mastectomies.

Patients submitted to immediate reconstruction with tissue expanders/implants exclusively, or autologous flaps were excluded from the study. Three senior oncological surgeons performed all mastectomy interventions. Five senior plastic surgeons performed the breast reconstructions.

We reviewed hospital records independently for all patients, collecting data on patient demographics, including age, body mass index (BMI), genetic risk, smoking history, diabetes mellitus, and hypertension. We also noted whether the reconstructions were unilateral or bilateral. Outcomes assessed included major immediate complications (hematoma, infection requiring intravenous pharmacological treatment, mastectomy flap necrosis, and implant extrusion), early complications (infection, hematoma, implant extrusion, seroma formation), reinterventions, readmissions, need for implant removal (any-time), length of stay, total breast drainage, and duration of breast drainage. All immediate complications that led to a reintervention or additional treatment with more extended hospitalization were classified as major. Early complications include the complications occurring after hospital discharge and within the first 6 months postoperatively. Minimum follow-up time was 6 months (6–12 months).

Statistical analysis was performed with SPSS (version 24). Descriptive statistics were presented as medians and percentiles P<sub>25</sub> and P<sub>75</sub>, for continuous variables. For categorical variables, frequencies (*n*) and percentages (%) were presented. Categorical variables associations with implant + ADM versus implant + IDF were performed with a chi-square or Fisher's exact tests. Mann-Whitney tests were performed for continuous variables associations. Significance was considered for *p* < 0.05.

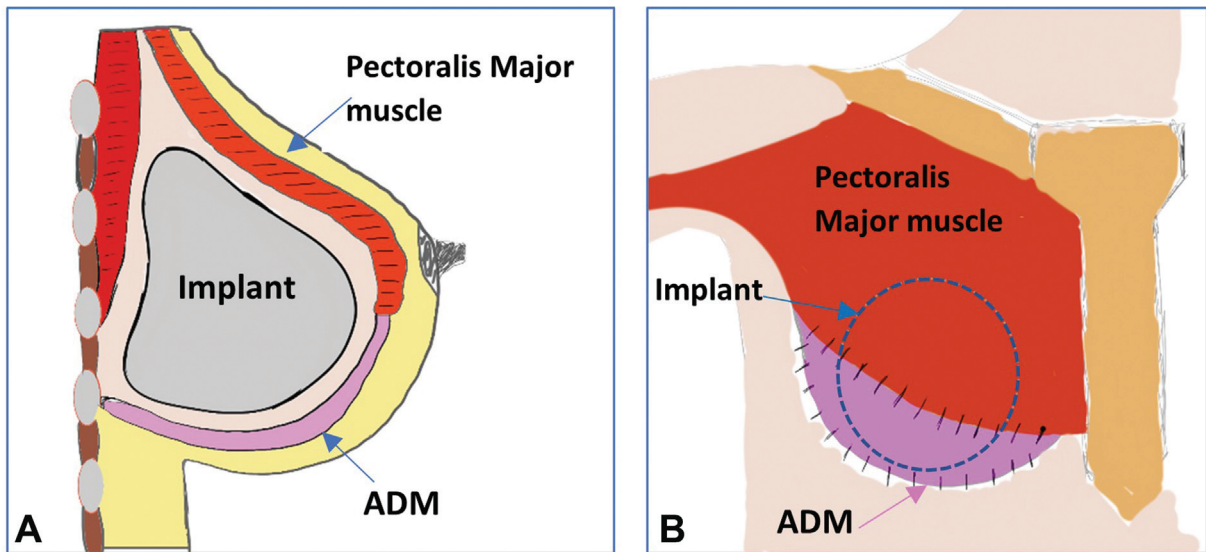
## Surgical Technique

### Acellular Dermal Matrix

All surgeons used Native (MBP Biologics, Neustadt-Glewe, Germany, license holder Decomed, Marcon, Venezia, Italy). After a skin-sparing mastectomy, the ADM was used as an inferior sling for the breast implant (► **Fig. 1**). The inferolateral margin of the pectoralis major muscle was released, and the ADM was sutured close to the inframammary fold and the inferior border of the muscle following its lateral contour. The breast implant was introduced through the central pocket left open and then placed below the pectoralis major superiorly, and the ADM inferiorly and this interface was closed over the implant with absorbable sutures. Exceptionally, in skin and nipple sparing mastectomies via inframammary approach we opted to begin the reconstruction by securing the ADM to the pectoralis major muscle. After this step we would insert the implant and finally suture the ADM to the inframammary sulcus (► **Figs. 2–6**). Two drains were used, one in the retropectoral space and the other in the subcutaneous space.

### Inferior Dermal Flap

The patient is marked in the upright position for a Wise-pattern incision (► **Fig. 7**). The vertical lines, approximately 7 cm, are positioned closer to the nipple-areola complex (NAC) than in the standard technique to decrease tension



**Fig. 1** Illustrative images depicting acellular dermal matrix + implant breast reconstruction. (A) Profile view. (B) Frontal view.



**Fig. 2** Pectoralis major muscle elevation.



**Fig. 3** Acellular dermal matrix suture to pectoralis major muscle.

on the closure. The convergence of these lines (the cephalic most vertical mark) is kept as low as possible, near the NAC. The plastic surgeon initially deepithelializes the lower pole skin (→Fig. 8) that would usually be discarded in the Wise-pattern breast reduction (the part on top of the inferior pedicle and the lateral edges). Oncologic surgeons then proceeded with the mastectomy through a classic circum-areolar incision, allowing for small modifications in a later phase. After the mastectomy is complete, the remaining incisions are done, and the lower edge of the pectoralis major muscle is lifted and the retropectoral pocket dissected (→Fig. 9). The breast implant is introduced through the pocket between the pectoralis major and IDF sling. Two short

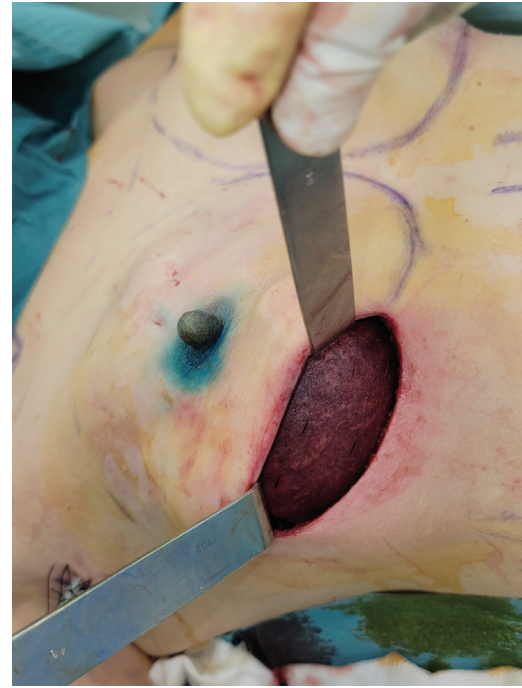
full-thickness incisions are made on the lateral and medial edges of the IDF to recreate a more natural contour. The interface between the muscle and the IDF is closed with tacking absorbable sutures (→Fig. 10). Finally, the inverted T incision is closed over the autoderma (→Fig. 11). Two drains were used, one in the retropectoral space and the other in the subcutaneous space.

## Results

A total of 85 women underwent immediate implant-based breast reconstruction. Seventy-three women underwent reconstruction with ADM, comprising 101 reconstructions



**Fig. 4** Implant insertion below pectoralis major and acellular dermal matrix.



**Fig. 6** Acellular dermal matrix covering lower pole of the implant.



**Fig. 5** Acellular dermal matrix anchoring to inframammary fold.

(45 unilateral and 28 bilateral). Twelve women were submitted to reconstruction with IDF, totaling 17 reconstructions (7 unilateral and 5 bilateral).

Patient demographics and comorbidities are shown and compared in ►Table 1. Patients in the IDF group had higher BMI (median = 27.0) than patients in the ADM group (median = 24.0) ( $p = 0.009$ ). There were no more statistically significant results.

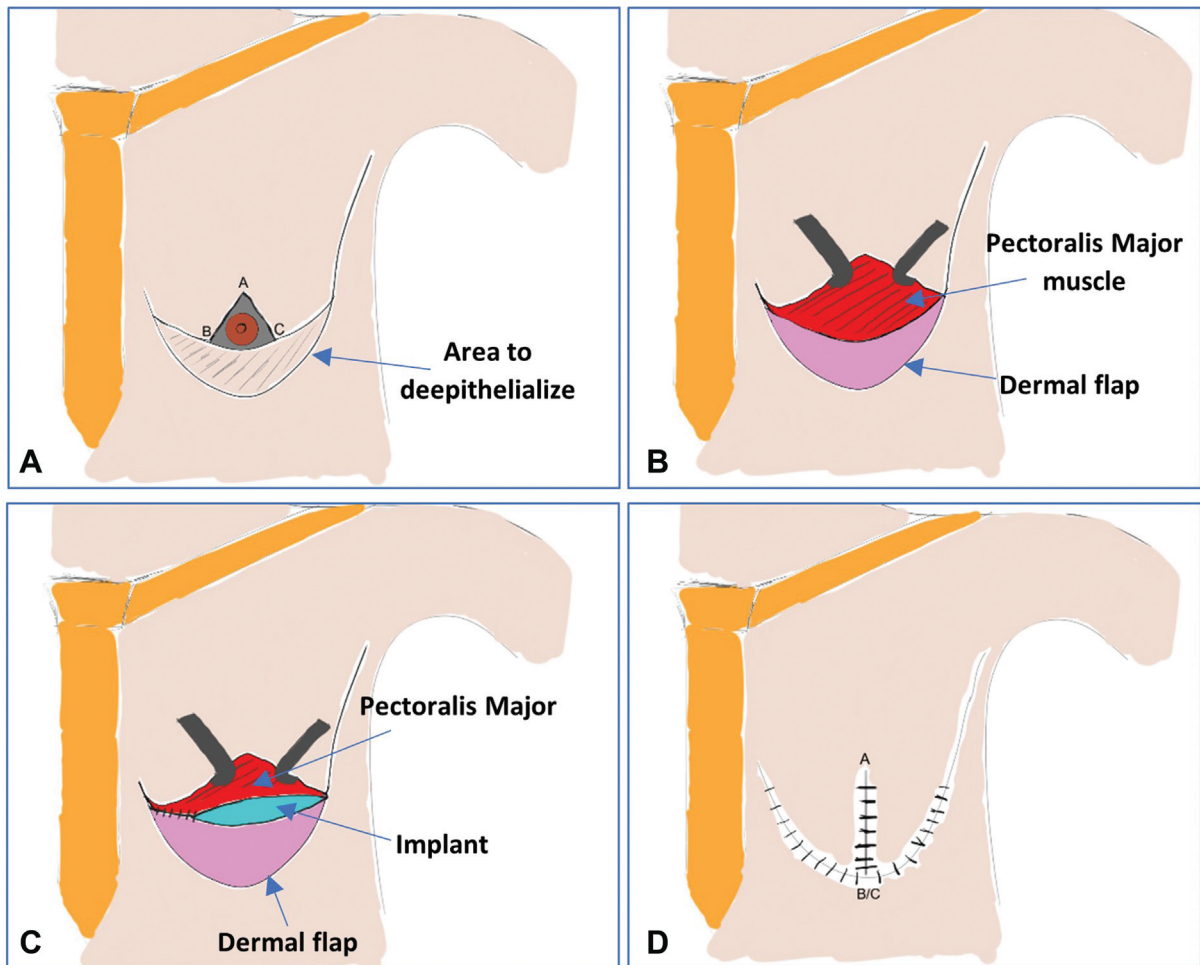
Outcomes are displayed in ►Table 2. There were no statistically significant differences among both groups.

## Discussion

One-stage breast reconstruction is nowadays commonly performed in most centers, especially since the significant developments made regarding the production of silicone implants allowing a more natural contour and feel, being close to matching the contralateral breast.<sup>2</sup> Despite this, it was difficult providing a moderate size reconstruction due to lack of sufficient soft tissue coverage of the implant. The pectoralis major muscle was usually dissected and sutured to the serratus myofascial component inferiorly, providing a well vascularized cover for the implant but a minimal, rigid, pocket. The use of ADM and IDF allowed surgeons to more easily cover the lower pole of the breast, creating a natural ptotic shape, capable of more expansion and avoiding dissection of the serratus fascia or muscle which helps to reduce surgical morbidity and improve patient recovery.<sup>2,8,13</sup>

In our study, comparing two groups of patients submitted to breast reconstruction using either ADM or IDF, we found the patients in the IDF group to have significantly higher BMI values.

Similar ranges of complications have been reported for immediate breast reconstruction using ADM and IDF.<sup>8</sup> Our immediate major complications rate using ADM was 15.8% which is slightly less than the average results reported in the literature, ranging from 16.7 to 36.8%.<sup>3,5,8,14–16</sup> Concerning IDF reconstruction we had a 23.5% rate of major complications which is also in accordance to most published results (7.5–32.2%).<sup>2,8,11,13,17</sup>



**Fig. 7** Illustrative images depicting inferior dermal flap + implant breast reconstruction. (A) Wise-pattern markings (“A,” “B,” and “C” represent the vertices) and area to be deepithelialized; gray area will be removed. (B) After mastectomy, showing pectoralis major and IDF. (C) After implant placement and initial closing sutures between pectoralis major and IDF. (D) Final aspect, the initial points “B” and “C” joint together.



**Fig. 8** Initial Wise-pattern markings and deepithelialization.



**Fig. 9** Pectoralis major muscle dissected and pocket created; # signals PM muscle; \* signals inferior dermal flap.



**Fig. 10** Implant insertion and initial closing sutures.



**Fig. 11** Final intraoperative result.

Most authors point out that IDF reconstructions are commonly performed in women with large volume breasts and ptosis and also heavier mastectomy specimen weights, which can represent a risk factor for complications.<sup>10,16</sup> Although we did not evaluate breast dimensions nor mastectomy weights, the cohort of patients submitted to IDF reconstruction had a significantly higher BMI compared with the ones that underwent ADM reconstruction. In a thinner woman with smaller, less ptotic breasts, this technique might not be feasible since there is not enough tissue to

**Table 1** Patient demographics and preop comorbidities comparison between ADM and IDF

	ADM (n = 101)	Inferior dermal flap (n = 17)	p-Value
Age	44.5 (38.0–49.0)	45.0 (43.0–51.0)	0.192
BMI	24.0 (21.0–26.5)	27.0 (23.0–27.5)	0.009 <sup>a</sup>
Neoadjuvant chemotherapy			
No	99 (98.0%)	17 (100.0%)	> 0.990
Yes	2 (2.0%)	0 (0.0%)	
Genetic risk			
No	55 (54.5%)	9 (52.9%)	> 0.990
Yes	46 (45.5%)	8 (47.1%)	
Smoking			
No	87 (86.1%)	12 (70.6%)	0.148
Yes	14 (13.9%)	5 (29.4%)	
DM			
No	98 (97.0%)	17 (100.0%)	> 0.990
Yes	3 (3.0%)	0 (0.0%)	
Hypertension			
No	96 (95.0%)	14 (82.4%)	0.088
Yes	5 (5.0%)	3 (17.6%)	

Abbreviations: ADM, acellular dermal matrix; BMI, body mass index; DM, diabetes mellitus; IDF, inferior dermal flap.

Note: Results presented as median (P<sub>25</sub>–P<sub>75</sub>) or n (%); p-value calculated with Mann–Whitney test for continuous variables and chi-square/Fisher's test for categorical variables.

<sup>a</sup>Statistically significant.

**Table 2** Outcomes comparison between ADM and IDF group

	ADM (n = 101)	IDF (n = 17)	p-Value
Major immediate complications			
No	85 (84.2%)	13 (76.5%)	0.182
Yes	16 (15.8%)	4 (23.5%)	
Major hematoma			
No	98 (97.0%)	15 (88.2%)	0.151
Yes	3 (3.0%)	2 (11.8%)	
Infection			
No	100 (99.0%)	17 (100.0%)	> 0.990
Yes	1 (1.0%)	0 (0.0%)	
Mastectomy flap necrosis			
No	87 (86.1%)	15 (88.2%)	> 0.990
Yes	14 (13.9%)	2 (11.8%)	
Prosthesis extrusion			
No	88 (90.7%)	17 (100.0%)	0.352
Yes	9 (9.3%)	0 (0.0%)	
Minor immediate complications			
No	81 (80.2%)	11 (64.7%)	0.203
Yes	20 (19.8%)	6 (35.3%)	

(Continued)

**Table 2** (Continued)

	ADM (n = 101)	IDF (n = 17)	p-Value
Minor hematoma			
No	99 (98.0%)	17 (100.0%)	0.990
Yes	2 (2.0%)	0 (0.0%)	
Minor infection			
No	101 (100.0%)	17 (100.0%)	—
Yes	0 (0.0%)	0 (0.0%)	
Marginal flap necrosis			
No	83 (82.2%)	11 (64.7%)	0.111
Yes	18 (17.8%)	6 (35.3%)	
Early complications			
No	84 (83.2%)	14 (82.4%)	> 0.990
Yes	17 (16.8%)	3 (17.6%)	
Early infection			
No	95 (94.1%)	17 (100.0%)	0.591
Yes	6 (5.9%)	0 (0.0%)	
Early hematoma			
No	100 (99.0%)	17 (100.0%)	> 0.990
Yes	1 (1.0%)	0 (0.0%)	
Early prosthesis exposure			
No	91 (90.1%)	16 (94.1%)	> 0.990
Yes	10 (9.9%)	1 (5.9%)	
Seroma			
No	94 (93.1%)	14 (82.4%)	0.157
Yes	7 (6.9%)	3 (17.6%)	
Total breast drainage (mL)	370.0 (180.0–840.0)	450.0 (210.0–820.0)	0.558
Duration of breast drainage (d)	8.0 (6.0–12.0)	8.0 (7.0–9.0)	> 0.990
Reintervention			
No	84 (83.2%)	13 (76.5%)	0.501
Yes	17 (16.8%)	4 (23.5%)	
Readmitted			
No	89 (88.1%)	16 (94.1%)	0.689
Yes	12 (11.9%)	1 (5.9%)	
Surgery if readmitted			
No	1 (8.3%)	1 (100.0%)	0.154
Yes	11 (91.7%)	0 (0.0%)	
Prosthesis removal anytime			
No	84 (83.2%)	17 (100.0%)	0.127
Yes	17 (16.8%)	0 (0.0%)	

Abbreviations: ADM, acellular dermal matrix; IDF, inferior dermal flap. Note: Results presented as median (P<sub>25</sub>–P<sub>75</sub>) or n (%); p-value calculated with Mann–Whitney test for continuous variables and chi-square/Fisher's test for categorical variables.

create a dermal sling used to cover the implant.<sup>8</sup> Not only the measurements required to perform this technique are dependent on the breast dimensions they are also dependent on what size the patient wants because the permanent implant will always have to be smaller than the native breast in immediate one-stage reconstructions.<sup>12</sup> We offered a contralateral mastopexy/breast reduction to all patients who underwent unilateral reconstruction with IDF since the conversion of a ptotic breast into a young breast shape produced a significant asymmetry.<sup>16</sup>

In our study, we found a difference between both techniques concerning reconstructive failure that even though is not statistically significant might be clinically relevant. ADM reconstruction group had more implant removals than the IDF group (16.8% vs. 0%). Despite the similar complications rate between both groups, there are some differences regarding their nature that we believe can explain this circumstance. The IDF group suffered mostly from seroma (which usually does not compromise the reconstructive process) and marginal skin necrosis. Since the IDF reconstruction provides a complete vascularized layer (as opposed to ADM) for implant coverage, even if the skin does not survive there is still a healthy layer of tissue beneath protecting the implant and making the extrusion less likely. On the other hand, in the ADM group the most frequent complications were marginal/mastectomy flap necrosis, prosthesis extrusion, and infection. These can all lead to reconstructive failure. Hon et al,<sup>8</sup> in a study comprising 101 immediate breast reconstructions and comparing patients submitted to ADM and IDF reconstruction, did not find a significant difference between both groups concerning reconstructive failure. The authors used a two-stage approach for all patients. We think this may have contributed to their low complication rates. Randomized prospective clinical studies are needed to evaluate this hypothesis.

Acellular matrixes are allogeneic products, and as such, they need to be secondarily vascularized by adjacent well-perfused tissue. Logically, they cannot guarantee a successful outcome when the lower pole skin is poorly perfused.<sup>17</sup> IDF has the advantage of keeping their own blood supply and providing an implant pocket that is completely vascularized.<sup>16</sup> It preserves the submammary fold attachments and provides a thicker layer (compared with ADM) between the implant and the skin contributing to a more natural consistency and feel.<sup>8,16</sup> It may also provide better tolerance to postoperative radiotherapy if needed.<sup>8,18</sup> T-junction breakdown is quite common in Wise-pattern mastectomies and can lead to exposure and implant loss.<sup>12</sup> When using the IDF technique, this critical area of fragility is placed directly over the vascularized dermis, which protects the implant but also limits skin breakdown initially.<sup>13</sup> Consequently, even if the skin necrosis and the IDF becomes exposed, it is still capable of surviving and protecting the implant with meager rates of reconstructive failure.<sup>11,17</sup> If the ADM were used in this context (Wise-pattern mastectomies for large breasts), wound breakdown would lead to ADM exposure and consequently to infection and implant extrusion.<sup>12</sup>

This study has several limitations. The retrospective nature, the limited number of patients, and the fact it was conducted in

a single center make it impossible to generalize the results. The short follow-up time (6–12 months) does not allow us to make any statements regarding long-term outcomes (i.e., capsular contracture, implant malposition). The study did not evaluate additional factors that could have altered the outcomes such as radiotherapy, chemotherapy, breast size, mastectomy weight, ptosis grade, ADM size, nor did it evaluate aesthetic outcomes. We also need to acknowledge the potential presence of possible confounding variables. Economic costs (operating procedure time and ADM cost) were also not analyzed.

Our study suggests there are no significant differences in major immediate complications and early complications between the ADM and IDF approach to immediate implant breast reconstruction. In patients with a higher BMI and large, ptotic breasts (suitable for Wise-pattern skin mastectomies), we recommend an immediate implant reconstruction with an IDF. The main benefits of the IDF are its easy availability, no additional costs, and exclusive use of autologous tissue. Further prospective multicenter studies focused on complication rates and long-term outcomes are needed to clarify these conclusions.

#### Author Contributions

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by L.M.R. and R.M. L.M.R. wrote the first draft of the manuscript and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

#### Availability of Data and Material

The data was collected from the digital clinical files of the patients operated in Hospital IPO Porto in January 2020.

#### Ethical Approval

The study was approved by the Institutional Review Board of the Instituto Português de Oncologia–Porto (IPO Porto) (IRB No. CES 237/021).

#### Patient Consent

Informed consent was obtained from all individual participants included in the study.

#### Funding

None.

#### Conflict of Interest

None declared.

#### Acknowledgment

We would like to thank Edgar Mesquita for helping with the statistical analyses included in the article.

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