Background: Acellular dermal matrices (ADMs) are commonly used in tissue expander and direct-to-implant reconstruction following mastectomy. Few studies have reported outcomes of DermACELL use or compared DermACELL with AlloDerm ADM. This study sought to compare outcomes of DermACELL and AlloDerm in oncologic breast reconstruction and to review the literature reporting outcomes of patients undergoing reconstruction using DermACELL.

Methods: We conducted a retrospective cohort study to compare outcomes between DermACELL and AlloDerm ADM, and a systematic review of the literature with a meta-analysis to evaluate clinical outcomes with DermACELL.

Results: Seventy-four patients (128 breasts) undergoing immediate reconstruction were evaluated retrospectively. Chi-square analysis revealed no significant difference in postoperative outcomes between the two groups. Our systematic review of the literature yielded 12 total studies reporting DermACELL use for breast reconstruction encompassing 518 patients and 608 total breasts. A pooled analysis of the published data did not reveal a significant change in the rate of explantation when either chemotherapy or radiation was used. Meta-analysis did not show a significant difference in the rate of any of the complications evaluated.

Conclusion: DermACELL is safe to use with a relatively consistent complication profile as compared with AlloDerm. (Plast Reconstr Surg Glob Open 2022;10:e4396; doi: 10.1097/GOX.0000000000004396; Published online 20 June 2022.)

INTRODUCTION

Acellular dermal matrices (ADMs) first appeared in the early 1990s and were described in breast surgery as early as 2001.1 Today, ADMs are commonly used in tissue expander and direct-to-implant reconstruction following mastectomy. ADMs are made from donated skin removed of epidermal layers and major histocompatibility proteins. This decellularization process enhances biocompatibility and incorporation into soft tissues.

ADMs offer positional, structural, and protective support between the implant and skin. Further advantages include better definition of the inframammary fold and expansion of the lower pole, decreased operative time, improved aesthetic appearance, and a reduction in postoperative pain due to the need for less muscle and less tension placed on the mastectomy skin.2,3 ADMs are generally accepted as a safe option with low complication rates.4,5 However, some have reported ADM use increases the risk of complications such as seroma, infection, necrosis, and explantation.6–12 Moreover, there is a paucity of literature regarding more nuanced questions such as the choice of ADM.

There are several ADM products available on the market, and the effectiveness of different ADM products is clinically significant. DermACELL (LifeNet Health, Virginia Beach, Va.) is a relatively newer ADM offering several potential advantages.13 It can be stored in ambient temperatures and is ready to use without the need for rehydration or rinsing. DermACELL provides a sterility assurance level of 10−6 and is proposed to have improved vascular ingrowth and reduced biointolerance.14,15
Few studies have reported outcomes of DermACELL use or compared DermACELL to other ADMs available on the market, such as the more widely used AlloDerm (LifeCell Corp., Branchburg, N.J.). The purpose of this study was to compare outcomes of DermACELL and AlloDerm in oncologic breast reconstruction and to review the literature reporting outcomes of patients undergoing reconstruction using DermACELL. To our knowledge, this is the first systematic review and meta-analysis of all published outcomes of the use of DermACELL.

MATERIALS AND METHODS

Retrospective Study

Electronic medical records of patients aged 18–85 years old who underwent unilateral or bilateral, immediate implant-based breast reconstruction from January 2019 through August 2020 at our institution were retrospectively reviewed after institutional review board approval was obtained. Patients without at least 3 months of follow-up were excluded from the study. The mastectomies were performed by one of five surgical oncologists and all reconstructions were performed by the senior author (H.Y.K.).

Baseline demographics, clinical characteristics, postoperative results, and the type of ADM used (AlloDerm or DermACELL) were recorded. Patient demographic data recorded included age, body mass index (BMI), comorbid medical conditions, and anticoagulant, immunosuppresant, tobacco, and drug use. The comorbid medical conditions included hypertension, diabetes, hyperlipidemia, and autoimmune disease. The administration of pre- or postoperative chemotherapy and/or radiotherapy was recorded. Mean duration of drain time was also recorded.

Postoperative complications including seroma, hematoma, minor infection, major infection, skin necrosis, wound dehiscence, capsular contracture, red breast syndrome, and implant failure were defined as those occurring after the reconstruction. Major infections were defined as those requiring hospitalization for intravenous antibiotics. Minor infections were defined as cellulitis or erythema that resolved with oral antibiotics, without the need for hospitalization.

The present study used Microsoft Excel (Microsoft Corp., Redmond, Wash.) to calculate complication rates, SDs, and heterogeneity from chi-square test of independence. A P value was defined as less than 0.05 to be considered statistically significant.

Systematic Review

The study design involved a review of MEDLINE and PubMed databases for human studies published in the English language. The key search terms included “breast reconstruction,” “acellular dermal matrix,” and “DermACELL.” A set of inclusion and exclusion methodology was created based on preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. In reviewing the titles and abstracts of each article resulting from the database queries, the authors and corresponding institutions of each manuscript were blinded. In our initial screening, we included studies reporting DermACELL outcomes. The references of articles that met inclusion criteria after screening were reviewed further to identify potential studies not originally captured by the preliminary queries.

The characteristics recorded from each study included the number of patients who met inclusion criteria, age, BMI, and sex. We also recorded the use of chemotherapy and/or radiotherapy. The postoperative results included complication data for seroma, hematoma, infection, skin necrosis, wound dehiscence, capsular contracture, red breast syndrome, and implant failure.

Data from each study in the systematic review were weighted based on the number of reported patients meeting inclusion criteria. A pooled analysis to determine the effect of chemotherapy and radiotherapy was evaluated by unpaired t test.

Meta-analysis

Following data collection, the results were compiled and a meta-analysis was performed to compare the product outcomes directly. The meta-analysis was conducted using Cochrane Software Review Manager v5.0 (Cochrane Collaboration, Oxford, UK). Risk ratios (RRs) with 95% confidence intervals (CIs) were calculated for dichotomous variables. Homogeneity of risk estimates between studies was assessed using the F statistic.

RESULTS

Retrospective Study

Between January 2019 to August 2020, a total of 74 patients (128 breasts) undergoing immediate reconstruction by a single surgeon involving DermACELL or AlloDerm ADM were evaluated. The cohort that received DermACELL ADM consisted of 13 patients (25 breasts). The cohort that received AlloDerm ADM consisted of 61 patients (103 breasts). The baseline demographic and clinical characteristics are summarized in Table 1.

The AlloDerm group contained relatively more patient and breast representation in this study. The mean age was similar between the two groups with 48.1 years (±12.1) for DermACELL and 49.3 years (±13.1) for AlloDerm (P = 0.74). Mean BMI was also similar between the two groups with 28.0 kg/m² (±5.9) for DermACELL and
27.8 kg/m² (±5.3) for AlloDerm (P = 0.91). The proportion of patients with high blood pressure was different between the two groups with four DermACELL patients (30.8%) and 11 AlloDerm patients (18.0%), although this difference was not statistically significant. The other baseline characteristics (smoking and hyperlipidemia) were similar between the two groups.

Clinical outcomes’ separated by the type of ADM used and calculated as a proportion of total breasts, are summarized in Table 2. Chemotherapy and radiotherapy received at any point during the study occurred at a rate of 40.0% versus 53.4% (P = 0.92) and 24.0% versus 19.4% (P = 0.31) for the DermACELL and AlloDerm groups, respectively. The DermACELL group had lower rates of hematoma formation (DermACELL: 4.0% versus AlloDerm: 4.9%, P = 0.95), delayed wound healing (4.0% versus 13.6%, P = 0.34), skin necrosis (0% versus 16.5%, P = 0.08), implant loss/failure (16% versus 21.4%, P = 0.97), and minor infection (8.0% versus 12.6%, P = 0.80). The DermACELL group had a higher rate of major infection (20.0% versus 12.6%, P = 0.16) and explantation for infection (16.0% versus 11.7%, P = 0.30). However, none of these differences were statistically significant. The complication rates for seroma (4.0% versus 10.7%, P = 0.49), red breast syndrome (0% versus 1.0%, P = 0.67), and capsular contracture (4.0% versus 4.9%, P = 0.95) were similar between the two groups. There was also no significant difference in time to drain removal (14.6 versus 16.6 days, P = 0.13). One patient from each group required a return to the operating room for hematoma, and one patient in the AlloDerm group who underwent explantation for infection elected to undergo contralateral explantation for symmetry.

Three DermACELL patients underwent either adjuvant or neoadjuvant radiation. One patient experienced capsular contracture and cellulitis in the irradiated breast, but none of the patients had a major complication requiring explantation.

Systematic Review

We systematically reviewed the literature describing results of DermACELL use in breast reconstruction (Fig. 1). Twelve papers were included in final analysis. Overall, the systematic review encompassed 518 patients and 608 total breasts. The complication data are summarized in Table 3.

Seven studies reported the average patient age and the use of pre- and/or postoperative radiotherapy, and six studies reported patient BMI and the use of pre- and/or postoperative chemotherapy. A pooled analysis of the published data did not reveal a statistically significant difference in the rate of explantation for infection when either chemotherapy (chemotherapy: 13.0% versus no chemotherapy: 6.0%, P = 0.31) or radiation (radiation: 8.6% versus no radiation: 9.1%, P = 0.91) were used.

The included studies reported data by patient, by breast, or both. More studies presented data by breast than by patient alone. Thus, outcomes data were compiled based on those studies reporting complications in terms of the number of breasts (nine of 12 studies). Of the three studies not included in Table 3, one reported data...
only by patients and the other two studies reported data only for drainage duration. In our pooled data analysis, the most commonly reported complication was delayed wound healing (11.8%), followed by infection (5.7%), skin necrosis (5.5%), and wound dehiscence (5.1%). The overall incidence of explantation for infection was 3.4% (range: 0%–11.1%).

Outcomes from our pooled analysis compared favorably to those from our cohort (Table 4). However, the rates of infection (overall: 5.7% versus Swisher: 20.0%), explantation (3.4% versus 16.0%), and implant loss/failure (2.5% versus 16.0%) were higher in our study.

**Meta-analysis**

We conducted a meta-analysis of included studies that directly compared outcomes of DermACELL and AlloDerm using a random-effect model. [See figure, Supplemental Digital Content 1, http://links.lww.com/PRSGO/C70], which displays the meta-analysis of outcomes of DermACELL versus AlloDerm. (A) Implant failure, (B) skin necrosis, and (C) hematoma, http://links.lww.com/PRSGO/C70; See figure, Supplemental Digital Content 2, which displays (A) seroma, (B) red breast syndrome, (C) infection, (D) drain removal (days). The black diamond the represents the 95% CI, http://links.lww.com/PRSGO/C71.

Our meta-analysis did not reveal a significant difference in the rate of any complication. This included implant failure (RR: 1.29, 95% CI: 0.65–2.56, \(P = 0.46, I^2 = 0\%), skin necrosis (RR: 0.83, 95% CI: 0.33–2.10, \(P = 0.69, I^2 = 0\%), hematoma (RR: 0.59, 95% CI: 0.18–1.89, \(P = 0.38, I^2 = 0\%\) ) [See figure, Supplemental Digital Content 1, http://links.lww.com/PRSGO/C70], seroma (RR: −0.03, 95% CI: −0.12 to 0.05, \(P = 0.46, I^2 = 44\%), red breast syndrome (RR: 0.15, 95% CI: 0.02–1.21, \(P = 0.08, I^2 = 39\%\), infection (RR: 0.98, 95% CI: 0.25–3.82, \(P = 0.97, I^2 = 37\%\)), and drain duration (RR: −0.98, 95% CI: −2.15 to 0.18, \(P = 0.10, I^2 = 53\%\) ). [See figure, Supplemental Digital Content 2, http://links.lww.com/PRSGO/C71.]

The incidence of red breast syndrome and days to drain removal were both decreased in cases using DermACELL, with results trending toward significance.

**DISCUSSION**

With a growing emphasis on value-based care, it is of the utmost importance for both patient safety and cost optimization to determine the best standard of care possible. The use of ADMs has become standard practice in tissue expander and direct-to-implant reconstruction following mastectomy. Complete implant coverage
using ADM reduces the risk of exposure, capsular contracture, and an unnatural breast step-off.\textsuperscript{14,18,19} The use of ADMs may also improve patient satisfaction.\textsuperscript{20–22} However, the relative effectiveness between the different available products has not been adequately tested, especially for DermACELL.\textsuperscript{23} The question of which ADM to use is convoluted, with mixed or negligible differences in complication rates. This problem is compounded by several other factors to consider, such as drainage duration, cosmetic outcomes, ease of use, and cost.\textsuperscript{10}

Studies assessing ADMs are inherently biased with conflicts of interest.\textsuperscript{24} Proponents of DermACELL, which entered the market in 2010, comment on its superior level of decellularization and that it does not require dehydration or rinsing before use.\textsuperscript{25–27} Conversely, proponents of AlloDerm point to more established data regarding its safety and efficacy.\textsuperscript{26,28,29} The cost associated with ADMs is also a factor worthy of consideration. Previous studies have reported DermACELL as being more expensive than AlloDerm; however, the cost for each may vary by institution.\textsuperscript{30}

The aseptic process of both products comes with an inherent risk as preexposure to gentamicin and vancomycin may contraindicate the use of ADMs in patients with antibiotic sensitivities.\textsuperscript{15,30} Nevertheless, these products appear to be safe and there does not appear to be any difference in long-term outcomes between the two ADMs.\textsuperscript{31,32}

The present study attempted to elucidate the potential superiority of DermACELL or AlloDerm by comparing their outcomes. The baseline demographic and clinical characteristics were similar between the two groups (Table 1). The median length of follow-up for AlloDerm was greater by 36 days ($P = 0.09$).

We showed the complication rates and drain duration were statistically similar between the two groups. The time to drain removal was on average 2.1 days less in the DermACELL group than in the AlloDerm group ($P = 0.13$) in our cohort. Likewise, the overall effect found for drain duration in our meta-analysis neared significance ($P = 0.10$). We did not include our unpublished data in the meta-analysis. If permitted, however, the meta-analysis would have yielded a significant decrease in drain duration for cases using DermACELL as compared to AlloDerm (RR: $-1.10$, 95% CI: $-2.17$ to $-0.03$, $P = 0.04$). These findings support the direction of other studies which have reported significant differences in the total number of days to drain removal in favor of DermACELL.\textsuperscript{24,33–36}

This trend may be explained by subtle differences in the fenestrations of the natural material, which could allow fluid from the ADM to escape and facilitate more efficient drainage.\textsuperscript{37} This could also be due to DermACELL’s advantage in promoting host tissue integration and revascularization. One study using in vivo rat models found that vessel ingrowth with DermACELL nearly doubled that of AlloDerm, providing a theoretical mechanism for the resolution of inflammation and edema.\textsuperscript{15}

The complication rates for seroma, red breast syndrome, and capsular contracture in our study were similar between the two groups. This finding seems to be validated by Greig et al\textsuperscript{15} who found no differences in seroma,
hematoma, flap necrosis, and infection in a retrospective study of 64 patients. Likewise, Zenn and Salzberg\textsuperscript{27} studied 140 patients and found no difference in infection, implant loss, or hematoma, concluding that each ADM product was safe.

It should be noted that the DermACELL group had atypical rates of major infection (20.0%). This high infection rate could be due to our study’s limitations of a small sample size. The DermACELL cohort consisted of only 13 patients and was therefore subject to greater variance. This entailed five breasts out of 25 total breasts, and four of these breasts were explanted for infection. Without operational definitions, a substantial problem in the literature exists for reporting infections. These reporting errors may explain discrepancies in standard infection rates, which can range from 0% to 24% in breast reconstruction.\textsuperscript{38,29}

Several studies have shown smoking, BMI, chemotherapy, and radiation therapy serve as independent risk factors for complications in breast reconstruction.\textsuperscript{40} Remington et al\textsuperscript{41} in a cohort study of 166 patients undergoing breast reconstruction using AlloDerm found the overall infection rate to be 16.9%, and a BMI greater than 27.0 was significantly associated with this finding. Hill et al.\textsuperscript{42} studied 79 patients over a 5-year period and found ADM use combined with smoking was associated with a 57% risk for infection. These studies shed light on our study, which included patient characteristics with an atypical rate for infection. These data agree with Arnaout et al.’s head-to-head comparison of DermACELL and AlloDerm.\textsuperscript{28} It is difficult to determine the standardized rate for each of these respective outcomes because there has not been substantial data collected using DermACELL.

Our retrospective cohort study was limited by a relatively small sample size and lack of standardized follow-up. The retrospective nature of this study did not permit randomization and therefore was not protected against the possibility of selection bias. Although the breast reconstruction was performed by the same surgeon (H.Y.K.), the mastectomies were performed by several surgical oncologists and the data do not account for possible differences in the mastectomy technique. A comparison of outcomes of staged reconstruction versus direct-to-implant reconstruction was beyond the scope of this study, but remains an important consideration worthy of investigation in future comparisons of ADMs.

Our systematic review found delayed wound healing for DermACELL occurred at the highest rate of all the complications (11.8%). However, this outcome was not heavily reported in the literature and thus was only represented by two studies or a total of 72 breasts. A delayed wound healing rate of 11.8% would be high. Another systematic review of AlloDerm use in postmastectomy patients found delayed wound healing to occur at a rate of 0.5%.\textsuperscript{50} The increased rate produced from our study’s systematic review may implicate a potential disadvantage of DermACELL, but this conclusion is subject to a small sample size with limited evidence and would seem to disagree with the rate found in our cohort data (4.0%). This underscores how our systematic review data was limited by nonstandardized reporting of outcomes. Table 3 excluded three of the final 12 studies because the data was presented by patient only, whereas all the other studies presented data by breasts. Thus, more research with greater standardization is needed.

The remaining complication rates for seroma, infection, hematoma, explantation, necrosis, implant failure, capsular contracture, wound dehiscence, and red breast syndrome gathered from the systematic review all occurred at a rate of 5.7% or lower. These data agree with Arnaout et al.’s head-to-head comparison of DermACELL and AlloDerm.\textsuperscript{28} It is difficult to determine the standardized rate for each of these respective outcomes because there has not been substantial data collected using DermACELL.

The rate of skin necrosis in our study was higher in the AlloDerm group, although this difference was not statistically significant. The rate of 16.5% is above the normal range reported in the literature for necrosis when using AlloDerm (<14%).\textsuperscript{12,13,43–45} This finding may offer a potential benefit of using DermACELL over AlloDerm. However, in a meta-analysis, Wu et al.\textsuperscript{46} found no difference in the rate of necrosis (RR: 0.49, 95% CI: 0.12–1.89, \(P = 0.30\)) between AlloDerm and DermACELL.

Our retrospective cohort study was limited by a relatively small sample size and lack of standardized follow-up. The retrospective nature of this study did not permit randomization and therefore was not protected against the possibility of selection bias. Although the breast reconstruction was performed by the same surgeon (H.Y.K.), the mastectomies were performed by several surgical oncologists and the data do not account for possible differences in the mastectomy technique. A comparison of outcomes of staged reconstruction versus direct-to-implant reconstruction was beyond the scope of this study, but remains an important consideration worthy of investigation in future comparisons of ADMs.

Despite these limitations, our study provides new data regarding outcomes of breast reconstruction with ADMs. Our study as a whole suggests DermACELL’s efficacy is comparable to AlloDerm in postmastectomy.

### Table 4. Summary of Weighted Systematic Review Outcomes Compared to Swisher et al

| Complication            | Overall Rate, % | Swisher et al. Rate, % | Total Range, % | No. Studies Reporting |
|-------------------------|-----------------|------------------------|----------------|----------------------|
| Seroma                  | 3.7             | 4.0                    | 0–22.2         | 8                    |
| Infection               | 5.7             | 20.0                   | 0–11.1         | 7                    |
| Hematoma                | 1.2             | 4.0                    | 0–5.4          | 6                    |
| Explantation            | 3.4             | 16.0                   | 0–11.1         | 6                    |
| Delayed healing         | 11.8            | 4.0                    | 8–22.2         | 2                    |
| Skin necrosis           | 5.5             | 0.0                    | 0–16.7         | 6                    |
| Implant failure         | 2.5             | 16.0                   | 0–22.2         | 8                    |
| Wound dehiscence        | 5.1             | 4.0                    | 3.4–7.5        | 3                    |
| Capsular contracture    | 1.8             | 4.0                    | 0–12.5         | 5                    |
| Red breast syndrome     | 1.2             | 0.0                    | 0–2.5          | 7                    |
reconstruction. However, more research is required to contextualize the use of DermACELL and the other various ADM options available.

CONCLUSIONS

DermACELL is safe to use with a relatively consistent complication profile as compared with AlloDerm. DermACELL may have the advantages of reduced incidence of red breast syndrome, capsular contracture, necrosis, drain removal time, and improved vascular ingrowth. However, more research with increased sample sizes and stratification of variables should be conducted. A greater degree of standardization is needed when reporting outcomes that compare ADM products available on the market.

REFERENCES

1. Macadam SA, Lennox PA. Acellular dermal matrices: use in reconstructive and aesthetic breast surgery. Can J Plast Surg. 2012;20:75–89.
2. Breuing KH, Colwell AS. Inferolateral AlloDerm hammock for implant coverage in breast reconstruction. Ann Plast Surg. 2007;59:250–255.
3. Ho G, Nguyen TJ, Shahabi A, et al. A systematic review and meta-analysis of complications associated with acellular dermal matrix-assisted breast reconstruction. Ann Plast Surg. 2012;68:346–356.
4. Colwell AS, Damjanovic B, Zahedi B, et al. Retrospective review of 331 consecutive immediate single-stage implant reconstructions with acellular dermal matrix: indications, complications, trends, and costs. Plast Reconstr Surg. 2011;128:1170–1178.
5. Salzberg CA. Focus on technique: one-stage implant-based breast reconstruction. Plast Reconstr Surg. 2012;130(5 Suppl 2):958–1038.
6. Brooke S, Mesa J, Uluer M, et al. Complications in tissue expander breast reconstruction: a comparison of AlloDerm, DermaMatrix, and FlexHD acellular inferior pole dermal slings. Ann Plast Surg. 2012;69:347–349.
7. Liu AS, Kao HK, Reish RG, et al. Postoperative complications in prosthesis-based breast reconstruction using acellular dermal matrix. Plast Reconstr Surg. 2011;127:1755–1762.
8. Michelotti BF, Brooke S, Mesa J, et al. Analysis of clinically significant seroma formation in breast reconstruction using acellular dermal grafts. Ann Plast Surg. 2013;71:274–277.
9. Pannucci CJ, Antony AK, Wilkins EG. The impact of acellular dermal matrix on tissue expander/implant loss in breast reconstruction: an analysis of the tracking outcomes and operations in plastic surgery database. Plast Reconstr Surg. 2013;132:1–10.
10. Venturi ML, Mesbahi AN, Boehmler JH IV, et al. Evaluating sterile human acellular dermal matrix in immediate expander-based breast reconstruction: a multicenter, prospective, cohort study. Plast Reconstr Surg. 2013;131:9e–18e.
11. Lee KT, Mun GH. Updated evidence of acellular dermal matrix use for implant-based breast reconstruction: a meta-analysis. Ann Surg Oncol. 2016;23:600–610.
12. Weichman KE, Wilson SC, Weinstein AL, et al. The use of acellular dermal matrix in immediate two-stage tissue expander breast reconstruction. Plast Reconstr Surg. 2012;129:1049–1058.
13. Greig H, Roller J, Ziaziaris W, et al. A retrospective review of breast reconstruction outcomes comparing AlloDerm and DermaCELL. JPRAS Open. 2019;2:19–26.
14. Bullocks JM. DermACELL: a novel and biocompatible acellular dermal matrix in tissue expander and implant-based breast reconstruction. Eur J Plast Surg. 2014;37:529–538.
15. Capito AE, Tholpady SS, Agrawal H, et al. Evaluation of host tissue integration, revascularization, and cellular infiltration within various dermal substrates. Ann Plast Surg. 2012;68:495–500.
16. Alderman A, Gutoski K, Ahuja A. ASPS clinical practice guideline summary on breast reconstruction with expanders and implants. Plast Reconstr Surg. 2014;134:648e–655e.
17. Ibrahim AM, Koolen PG, Ganor O, et al. Does acellular dermal matrix really improve aesthetic outcome in tissue expander/implant-based breast reconstruction? Aesthetic Plast Surg. 2015;39:359–368.
18. Gamboa-Bobadilla GM. Implant breast reconstruction using acellular dermal matrix. Ann Plast Surg. 2006;56:22–25.
19. Salzberg CA. Nonexpansive immediate breast reconstruction using human acellular tissue matrix graft (AlloDerm). Ann Plast Surg. 2006;57:1–5.
20. Al-Ghazal SK, Fallowfield L, Blamey RW. Comparison of psychological aspects and patient satisfaction following breast conserving surgery, simple mastectomy and breast reconstruction. Eur J Cancer. 2000;36:1938–1943.
21. Nahabedian MY. Implant-based breast reconstruction following conservative mastectomy: one-stage vs. two-stage approach. Gland Surg. 2016;5:47–54.
22. Wilkins EG, Cederna PS, Lowery JC, et al. Prospective analysis of psychosocial outcomes in breast reconstruction: one-year postoperative results from the Michigan Breast Reconstruction Outcome Study. Plast Reconstr Surg. 2000;106:1014–25; discussion 1026.
23. Hallberg H, Rafnssdotter S, Selvaggi G, et al. Benefits and risks with acellular dermal matrix (ADM) and mesh support in immediate breast reconstruction: a systematic review and meta-analysis. J Plast Surg Hand Surg. 2018;52:130–147.
24. Chang EI, Liu J. Prospective unbiased experience with three acellular dermal matrices in breast reconstruction. J Surg Oncol. 2017;116:365–370.
25. Moore MA, Samsell B, Wallis G, et al. Decellularization of human dermis using non-denaturing anionic detergent and endonuclease: a review. Cell Tissue Bank. 2015;16:249–259.
26. Vashi C. Clinical outcomes for breast cancer patients undergoing mastectomy and reconstruction with use of DermACELL, a sterile, room temperature acellular dermal matrix. Plast Surg Int. 2014/2014:704323.
27. Zenn MR, Salzberg CA. A direct comparison of alloDerm-ready to use (RTU) and DermACELL in immediate breast implant reconstruction. Eplasty. 2016;16:e23.
28. Arnaout A, Zhang J, Frank S, et al. A randomized controlled trial comparing AlloDerm-RTU with DermACELL in immediate subpectoral implant-based breast reconstruction. Curr Oncol. 2020;27:184–195.
29. Gabriel A, Maxwell GP. AlloDerm RTU integration and clinical outcomes when used for reconstructive breast surgery. Plast Reconstr Surg Glob Open. 2018;6:e1744.
30. Cheng A, Saint-Cyr M. Comparison of different ADM materials in breast surgery. Clin Plast Surg. 2012;39:167–175.
31. Stein MJ, Arnaout A, Lichtenstein JB, et al. A comparison of patient-reported outcomes between AlloDerm and Dermacell in immediate alloplastic breast reconstruction: a randomized control trial. J Plast Reconstr Aesthet Surg. 2021;74:41–47.
32. Salzberg CA, Ashikari AV, Koch RM, et al. An 8-year experience of direct-to-implant immediate breast reconstruction using
human acellular dermal matrix (AlloDerm). *Plast Reconstr Surg*. 2011;127:514–524.
33. Pittman TA, Fan KL, Knapp A, et al. Comparison of different acellular dermal matrices in breast reconstruction: The 50/50 study. *Plast Reconstr Surg*. 2017;139:521–528.
34. Danino MA, El Khatib AM, Doucet O, et al. Preliminary results supporting the bacterial hypothesis in red breast syndrome following postmastectomy acellular dermal matrix- and implant-based reconstructions. *Plast Reconstr Surg*. 2019;144:988e–992e.
35. Lee KT, Hong SH, Jeon BJ, et al. Predictors for prolonged drainage following tissue expander-based breast reconstruction. *Plast Reconstr Surg*. 2019;144:9e–17e.
36. Lim YM, Lew DH, Roh TS, et al. Analysis of factors that affect drainage volume after expander-based breast reconstruction. *Arch Plast Surg*. 2020;47:33–41.
37. Mowlds DS, Salibian AA, Scholz T, et al. Capsular contracture in implant-based breast reconstruction: examining the role of acellular dermal matrix fenestrations. *Plast Reconstr Surg*. 2015;136:629–635.
38. Agarwal S, Ettinger RE, Kung TA, et al. Cohort study of immediate implant exchange during acute infection in the setting of breast reconstruction. *J Plast Reconstr Aesthet Surg*. 2017;70:865–870.
39. Lalani T. Breast implant infections: an update. *Infect Dis Clin North Am*. 2018;32:877–884.
40. Nahabedian MY, Tsangaris T, Momen B, et al. Infectious complications following breast reconstruction with expanders and implants. *Plast Reconstr Surg*. 2003;112:467–476.
41. Remington AC, Gurtner GC, Wan DC, et al. Identifying risk factors for postoperative major complications in staged implant-based breast reconstruction with AlloDerm. *Breast J*. 2019;25:597–603.
42. Hill JL, Wong L, Kemper P, et al. Infectious complications associated with the use of acellular dermal matrix in implant-based bilateral breast reconstruction. *Ann Plast Surg*. 2012;68:432–434.
43. Gunnarsson GL, Børsen-Koch M, Arffinmann S, et al. Successful breast reconstruction using acellular dermal matrix can be recommended in healthy non-smoking patients. *Dan Med J*. 2015;60:A4751.
44. Lardi AM, Ho-Asjoe M, Mohanna PN, et al. Immediate breast reconstruction with acellular dermal matrix: factors affecting outcome. *J Plast Reconstr Aesthet Surg*. 2014;67:1098–1105.
45. Gdalevitch P, Ho A, Genoway K, et al. Direct-to-implant single-stage immediate breast reconstruction with acellular dermal matrix: predictors of failure. *Plast Reconstr Surg*. 2014;133:738e–747e.
46. Parikh RP, Brown GM, Sharma K, et al. Immediate implant-based breast reconstruction with Acellular Dermal Matrix: a comparison of sterile and aseptic AlloDerm in 2039 consecutive cases. *Plast Reconstr Surg*. 2018;142:1401–1409.
47. Robertson SA, Jeevaramatnam JA, Agarwal A, et al. Mastectomy skin flap necrosis: challenges and solutions. *Breast Cancer (Dove Med Press)*. 2017;9:141–152.
48. Zenn M, Venturi M, Pittman T, et al. Optimizing outcomes of postmastectomy breast reconstruction with acellular dermal matrix: a review of recent clinical data. *Eplasty*. 2017;17:e18.
49. Wu LH, Zhang MX, Chen CY, et al. Breast reconstruction with allderm ready to use: a meta-analysis of nine observational cohorts. *Breast*. 2018;39:89–96.
50. Jansen LA, Macadam SA. The use of AlloDerm in postmastectomy alloplastic breast reconstruction: part I. A systematic review. *Plast Reconstr Surg*. 2011;127:2292–2244.
51. Bilezikian JA, Tenzel PL, Bebb GG, et al. The broad application of prepectoral direct-to-implant breast reconstruction with acellular dermal matrix drape and fluorescent imaging in a community setting. *Plast Reconstr Surg*. 2020;145:291–300.
52. Ortiz JA. Clinical outcomes in breast reconstruction patients using a sterile acellular dermal matrix allograft. *Aesthetic Plast Surg*. 2017;41:542–550.