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Marijuana's Impact On Implant-based Breast Reconstruction: A Retrospective Cohort Study

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Background: Studies have shown that chronic marijuana use is associated with increased vascular inflammation, endothelial damage, myocardial infarctions, strokes, arteritis, and cardiomyopathies; however, cannabis's effect on wound healing in immediate direct-to-implant (DTI) breast reconstruction is unknown. With the increasing prevalence of marijuana use, it is imperative to understand its effects on surgical outcomes.

Methods: We performed a retrospective cohort study of consecutive patients in a quaternary-care breast cancer center undergoing immediate DTI reconstruction. Patient demographics, operative details, and surgical complications were extracted through chart review. Active cannabis use was defined as use within 12 weeks of operation. Univariate and multivariable analyses were performed.

Results: In total, 243 consecutive patients underwent immediate DTI reconstruction, and 12 reported active cannabis use. There were no significant differences in patient demographics, cancer treatment, or operative details. Active marijuana users demonstrated higher rates of cellulitis treated with IV antibiotics ($P = 0.004$), explantation for infection ($P = 0.004$), emergency department visits ($P = 0.028$), readmission ($P = 0.037$), takeback to the operating room in 90 days ($P < 0.001$), and overall major complications ($P < 0.001$). Multivariable analysis demonstrated that active marijuana users were more likely to experience cellulitis treated with IV antibiotics [odds ratio (OR) = 3.55, $P = 0.024$], takeback to the OR within 90 days of operation (OR = 4.75, $P = 0.001$), and major complications (OR = 2.26, $P = 0.048$).

Conclusions: The consumption of cannabis in the perioperative setting is associated with increased rates of complications in patients undergoing immediate DTI reconstruction; however, an analysis with a larger patient population is needed to conclude that abstinence from its use should be highly encouraged. *(Plast Reconstr Surg Glob Open 2024; 12:e6082; doi: 10.1097/GOX.0000000000006082; Published online 21 August 2024.)*

INTRODUCTION

As the number of women electing to undergo breast reconstruction after mastectomy continues to increase, implant-based reconstruction (IBR) remains the most popular choice among both patients and plastic surgeons. IBR offers not only a shorter operative time, but also allows for quicker return to day-to-day activities.[1,2] Historically, two-stage tissue expander-based reconstruction has been the preferred technique for IBR. Nevertheless, the use of single-stage direct-to-implant (DTI) breast reconstruction is growing in popularity due to the increasing use of the prepectoral plane for breast construction, advancements in intraoperative skin flap perfusion assessment and fat grafting techniques, availability of different surgical scaffolds, improvements in mastectomy techniques, and ability to complete reconstruction in a single operation with quicker patient recovery and satisfaction.[1–6] The appeal of DTI reconstruction

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is evident to both the patient and surgeon, and as its reliability and safety continue to improve, it is increasingly important to explore methods for optimizing patients before surgery.

Changes in state laws regarding the legality of medical and recreational cannabis use have resulted in a rapid increase in everyday marijuana use.[7,8] Cannabis is currently the most used recreational drug and third most used drug following alcohol and cigarettes.[9,10] As the perception around marijuana use is increasingly perceived as harmless and more patients seem to be presenting with a history of chronic marijuana use, it is important to explore the adverse effects of cannabis use on surgical outcomes, particularly in relation to wound healing and DTI breast reconstruction.[10,11] Recent literature has demonstrated that cannabis use does in fact result in adverse effects on health outcomes in patients.

Previously established literature has linked cannabis use to adverse outcomes in pulmonary and cardiovascular health. Despite misinformation that cannabis is safer than tobacco regarding lung health, it is found that chronic cannabis use presents similarly to the pulmonary complications of a chronic tobacco smoker, including airway inflammation, lung hyperinflation, and chronic bronchitis.[11–13] Cardiac adverse effects include vasculitis resulting in myocardial infarction (MI) and strokes, tachycardia, increased blood pressure, postural hypotension, and decreased oxygen carrying capacity.[14,15] Huson et al found that chronic marijuana use was linked to increased MI and stroke incidence, as mentioned before, but particularly in relation to young patients who identified as chronic marijuana users.[13] Mittleman et al and Goel et al found that risk of postoperative MI was significantly increased in patients with reported active cannabis use, increased 4.8-fold within 1 hours of surgery and 1.7-fold in the second hour.[14,15]

Regarding pharmacological complications, marijuana use can potentiate the effects of both atropine and epinephrine, and chronic cannabis users require greater amounts of propofol and opioids for sedation and pain control.[16–18] Additionally, it was found that marijuana use resulted in increased airway obstruction requiring increased anesthetic dosages in the setting of patient laryngeal airway placement.[13] Multiple case studies have also demonstrated that active cannabinoid use resulted in an increased INR value in patients on warfarin, thus increasing the risk of bleeding.[19] Furthermore, chronic marijuana use was linked with increased postoperative use of opioids and hyperemesis.[20]

Pertaining to wound healing, studies demonstrate that marijuana users have increased risk of bone fracture and lower bone-to-mineral density.[20] They additionally require twice as long to heal fractures due to osteoblast-osteoclast dysregulation.[20,21] Marijuana use was also found to impact soft tissue healing by decreasing neutrophil and macrophage infiltration within the skin and subcutaneous tissues, resulting in decreased levels of inflammatory cytokines.[22] Higher rates of venthromboembolism, pulmonary embolism, and vascular graft complications following knee arthroplasty and lower extremity bypass were also noted in active marijuana smokers.[12]

Takeaways

Question: Does active cannabis use impact surgical outcomes in patients undergoing immediate direct-to-implant breast reconstruction?

Findings: In our retrospective cohort study, active marijuana users were more likely to experience cellulitis, take back to the operating room within 90 days, and major complications. They additionally had higher rates of cellulitis requiring IV antibiotics, explantation for infection, emergency department visits, readmission, takeback to the operating room, and overall major complications.

Meaning: Active marijuana use in patients undergoing single-stage direct to implant breast reconstruction increases the risk of surgical complications, highlighting the need for thorough preoperative patient evaluation by physicians before surgical intervention.

As the use of DTI reconstruction continues to grow in popularity as patients' and surgeons' preference for IBR, it is increasingly imperative to optimize patients for surgery. Although it is clear that marijuana has adverse effects on overall patient well-being, wound healing, and surgical outcomes, its relation to DTI reconstruction outcomes has not been explored. In this study, we sought to explore the relationship between marijuana use and surgical outcomes in patients undergoing immediate single stage, direct-to-implant breast reconstruction.

METHODS

Study Design

This is a retrospective cohort study on all patients who underwent immediate DTI prepectoral or subpectoral reconstruction between 2012 and 2022, at a large metropolitan, quaternary-care breast cancer center in the Midwestern United States. The procedures were performed by multiple reconstructive surgeons and multiple breast surgeons practicing in the same medical system. Patient data and outcomes were retrieved and reviewed from electronic medical records. Patients were identified using CPT code 19340. The study was approved by the institutional review board.

Data Collection and Classification

All patient electronic medical records were queried for surgical operation notes and plastic surgery clinic and telemedicine notes. Patient demographics and comorbidities were collected. Relevant cancer-related information was included, such as history of radiation, chemotherapy use, and lymph node dissection. Operative details were recorded, including unilateral or bilateral mastectomy, nipple sparing mastectomy, implant size, use of dermal flap or acellular dermal matrix (ADM), implant pocket, case and drain duration, and follow-up period.

Regarding marijuana use, patients were classified as active or nonactive marijuana users. Patients were classified as active marijuana users if they had used cannabis, in any form, within 12 weeks of their operation. Nicotine

users were similarly classified, but with the addition of a "former" category if they had a smoking history 12 weeks before their operation. Patient surgical complications were collected and classified as either minor or major surgical complications. Minor complications included skin necrosis, cellulitis treated with oral antibiotics, hematoma or seroma not requiring operative intervention, and capsular contracture not requiring explantation. Major complications included any reason for unplanned return to the operating room or hospital readmission. Long-term complications included explantation for capsular contracture, pocket change from subpectoral to prepectoral implant placement, return to the operating room for flipped implant, or more than two revisions. Other variables of interest were included.

Statistical Analysis

Univariate and multivariable analysis were used to evaluate differences in demographics and comorbidities, cancer history, operative details, and surgical outcome between active-marijuana and nonactive marijuana users. Continuous variables were reported as mean ± SD and median. Categorical or ordered data were summarized as a frequency and percentage. Comparisons of quantitative variables were performed using two-sample *t* test, chi-squared test, or Fisher exact test, as appropriate. Multivariable logistic regression models were used to identify independent predictors of major, minor, and long-term complications. Statistical analyses were determined with *P* values, and a *P* value less than 0.05 was considered statistically significant. All calculations were done using R (Version 4.2.1. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org).

RESULTS

At the hospital cancer center, a total of 243 consecutive patients underwent 406 breast immediate DTI reconstructions. Of those patients, 12 identified as active marijuana users, 231 as nonactive marijuana users. The 12 active marijuana users accounted for 20 of the immediate DTI breast reconstructions.

Demographics and Comorbidities

There were no significant differences between nonactive and active marijuana users in regard to patient demographics, history of diabetes mellitus, and nicotine use (Table 1).

Cancer Treatment

There were no significant differences in history of radiation or adjuvant radiation, neoadjuvant or adjuvant chemotherapy, or axillary lymph node biopsies between nonactive and active marijuana users (Table 2).

Table 1. Demographics and Comorbidities

			Marijuana Use		
		All Patients (N = 243)	Nonactive (N = 231)	Active (N = 12)	*P*
Age		51 ± 12 (51.0)	51 ± 12 (51.0)	49 ± 15 (46)	0.45
BMI		28.3 ± 6.6	28.3 ± 6.7	26.7 ± 4.6	0.44
Ethnicity	African American	48 (19.8%)	44 (19.1%)	4 (33.3%)	0.30
	White	170 (69.9%)	162 (70.1%)	8 (66.7%)	
	Other	25 (10.3%)	25 (10.8%)	0 (0%)	
History of diabetes	No	216 (89.3%)	204 (88.7%)	12 (100%)	0.37
	Yes	26 (10.7%)	26 (11.3%)	0 (0%)	
Nicotine use	None	223 (91.8%)	214 (92.6%)	9 (75%)	0.054
	Former	6 (2.5%)	6 (2.6%)	0 (0%)	
	Active	14 (5.8%)	11 (4.8%)	3 (25%)	

Numerical data are given as mean ± SD (median). Categorical or ordered data are given as frequency (column percentage).

Table 2. Cancer Treatment

			Marijuana Use		
		All Patients (N = 243)	Nonactive (N = 231)	Active (N = 12)	*P*
History of prior radiation	No	227 (93.4%)	216 (93.5%)	11 (91.7%)	0.57
	Yes	16 (6.6%)	15 (6.5%)	1 (8.3%)	
Adjuvant radiation	No	204 (84.0%)	196 (84.8%)	8 (66.7%)	0.11
	Yes	39 (16%)	35 (15.2%)	4 (33.3%)	
Neoadjuvant chemotherapy	None	196 (80.7%)	189 (81.8%)	7 (58.3%)	0.059
	Yes	47 (19.3%)	42 (18.2%)	5 (41.7%)	
Adjuvant chemotherapy	None	183 (75.3%)	173 (74.9%)	10 (83.3%)	0.74
	Yes	60 (24.7%)	58 (25.1%)	2 (16.7%)	
ALND	None	224 (92.2%)	214 (92.6%)	10 (83.3%)	0.24
	Yes	19 (7.8%)	17 (7.4%)	2 (16.7%)	

Categorical or ordered data are given as frequency (column percentage).
SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.

Operative Details

Nonactive and active marijuana users had no significant differences regarding operative details (Table 3). Most patients elected for bilateral reconstruction and required the use of ADM.

Surgical Complications

Compared with nonactive marijuana users, active marijuana users had significantly higher rates of cellulitis treated with intravenous antibiotics (P = 0.004) and explantation for infection (P = 0.004). (**See table, Supplemental Digital Content 1,** which displays peri and postoperative complications. **http://links.lww.com/PRSGO/D437**.) Active marijuana users were also more likely to experience a significantly higher incidence of postoperative visits to the emergency department (P = 0.028), hospital readmission (P = 0.037), and takeback to the operating room within 90 days of the operation (P < 0.001). Active marijuana users have significantly higher rates of categorical major complications (P < 0.001) (Table 4).

Multivariable analysis demonstrates that active marijuana use is a significant predictor of three and a half times higher rates of cellulitis treated with IV antibiotic (OR = 3.55, P = 0.024), nearly five times higher rates of takeback to the operating room within 90 days of operation (OR = 4.75, P = 0.001), and more than twice as high rates of major complications (OR = 2.26, P = 0.048) (Table 5). Additional factors, including prior radiation, neoadjuvant chemotherapy, adjuvant chemotherapy, active and former smoking, and obesity, are significant predictors of cellulitis treated with IV antibiotics, explant for exposure, hospital readmission, major complications, and operating room takeback within 90 days.

DISCUSSION

As the prevalence of marijuana use among patients continues to escalate, it is imperative for the surgical community to understand the associated risks of cannabis use and its potential implications on surgical outcomes. This understanding is crucial to providing informed clinical recommendations, risk stratifying patients, and optimizing operative outcomes. This study explored the relationship between active marijuana use and surgical outcomes in patients undergoing DTI reconstruction. The findings demonstrate that active marijuana use within 12 weeks of immediate

Table 3. Operative Details

			Marijuana Use		
		All Patients (N = 243)	**Nonactive (N = 231)**	**Active (N = 12)**	***P***
Laterality	Bilateral	152 (62.6%)	144 (62.3%)	8 (66.7%)	>0.99
	Unilateral	91 (37.4%)	87 (37.7%)	4 (33.3%)	
NSM	No	111 (45.7%)	103 (44.6%)	8 (66.7%)	0.13
	Yes	132 (54.3%)	128 (55.4%)	4 (33.3%)	
Implant size (units)		490.4 ± 148.1 (485.0)	488.7 ± 148.0 (475.0)	524.3 ± 150.2 (605.0)	0.15
Use of dermal flap	No	171 (70.4%)	163 (70.6%)	8 (66.7%)	0.75
	Yes	72 (29.6%)	68 (29.4%)	4 (33.3%)	
Use of ADM	No	30 (12.3%)	30 (13.0%)	0 (0.0%)	0.37
	Yes	213 (87.7%)	201 (87.0%0	12 (100.0%)	
Implant position	Subpectoral	53 (21.8%)	50 (21.6%)	3 (25.0%)	0.73
	Prepectoral	190 (78.2%)	181 (78.4%)	9 (75.0%)	
Case length (h)		3.9 ± 1.1 (3.8)	3.9 ± 1.1 (3.8)	3.7 ± 0.5 (3.6)	0.51
Duration of breast drains (d)		15 ± 7.0 (13.0)	15 ± 7.0 (13.0)	17 ± 5.0 (16.0)	0.14
Duration of follow-up (d)		382 ± 438 (266)	381 ± 440 (262)	418 ± 415 (336)	0.51

Numerical data are given as Mean ± SD (Median). Categorical or ordered data are given as frequency (column percentage).

Table 4. Breast Level: Major, Minor, and Long-term Complications

			Marijuana Use		
		All Patients (N = 243)	**Nonactive (N = 231)**	**Active (N = 12)**	**Comparison *P* Value**
Major complications	No	175 (72.0%)	172 (74.5%)	3 (25.0%)	**<0.001***
	Yes	68 (28.0%)	59 (25.5%)	9 (75.0%)	
Minor complications	No	157 (64.6%)	151 (65.4%)	6 (50.0%)	0.35
	Yes	86 (35.4%)	80 (34.6%)	6 (50.0%)	
Long-term complications	No	216 (88.9%)	206 (89.2%)	10 (83.3%)	0.63
	Yes	27 (11.1%)	25 (10.8%)	2 (16.7%)	

Categorical or ordered data are given as frequency (column percentage).
*P < 0.05.

Table 5. Multivariable Prediction of the Presence of Complications in Active Marijuana Users

Complications	OR	*P*
Cellulitis treated with IV Abx	3.55	0.024*
Explantation for exposure	0.70	0.7
Emergency department visit	0.63	0.3
Hospital readmission	0.74	0.3
Back to OR within 90 days	4.75	<0.001*
Major complications	2.26	0.048*

*Statistically Significant, $P < 0.05$.

reconstruction significantly impairs surgical outcomes, such that marijuana use was a significant predictor of return to the operating room within 90 days, cellulitis requiring admission and treatment with IV antibiotics, and overall major complications.

Multivariate analysis demonstrated that active marijuana users were twice as likely to experience major complications ($P < 0.001$) and nearly five times more likely to experience return to operating room within 90 days ($P < 0/001$) compared with non-marijuana users. In total, 75% of marijuana users experienced major complications, including significantly higher rates of emergency department visits ($P = 0.028$), hospital readmission ($P = 0.037$), and takeback to the operating room within 90 days ($P < 0.001$). Although these findings present a unique perspective within the context of DTI reconstruction, they align with existing evidence on the negative effects of marijuana use. A population-based cohort study conducted in Ontario, Canada found that all-cause ER visits or hospitalizations were significantly greater among cannabis users.[23] Various ICD-10 codes were recorded in relation to these incidents, with trauma, cardiovascular, neurological, respiratory, and infection listed as some of the top contributing diagnosis.[23] Additionally, a national US-based cohort study found that patient cannabis use was associated with an increased risk of morbidity after major elective, inpatient, noncardiac surgery.[24] These collective outcomes attest to the heightened reliance of marijuana users on hospital emergency department and inpatient services, extending to major complications requiring further escalation to operating room takeback, as observed in our DTI patient cohort. It is important to acknowledge the escalating research interest in the adverse implications of marijuana use on vascular outcomes. Marijuana's role in vascular inflammation, clotting, and spasm must be considered in DTI-based patients, given their increased tendencies towards hospitalization and operating room takeback requirements.[11–13]

The regression analysis also indicated that rates of cellulitis treated with IV antibiotics were almost four times higher amongst marijuana users ($P = 0.024$). In our study cohort, 58.3% of marijuana patients experienced cellulitis treated with IV antibiotics ($P = 0.004$) and 58.3% required explanation for infection ($P = 0.004$). These outcomes demonstrate a vulnerability to postoperative infections in active marijuana users. Preliminary mice trials conducted by Wang et al found that cannabis receptor activation decreased macrophage and neutrophil infiltration, resulting in a marked antiinflammatory effect.[22] Several orthopedic studies involving total hip and knee arthroplasty demonstrate that marijuana users are significantly more likely to develop implant-related complications and require revision surgery due to infection.[25–27] Additionally, Law et al found that active marijuana users who underwent total knee arthroplasty were significantly more likely to require revision surgery with a significantly shorter time to revision compared with non-marijuana users.[26] The study by Garoosi et al analyzed the relationship between marijuana and nicotine use and surgical complications in patients undergoing IBR and found that the cannabis use cohort had a significantly higher risk of developing surgical site infection.[28] This was an excellent population-based study; however, it was based off a database that did not offer specific details regarding postoperative complications and had limited data on preoperative information such as dermal matrix use, position of implants, and prior radiation, which were all factors considered in our regression analysis. Additionally, it did not focus exclusively on DTI reconstruction. Nevertheless, this study does support our findings that surgical complications, such as infections, are a leading concern in marijuana users undergoing IBR. These studies along with our findings suggest that cannabis use may be linked to immune vulnerability, particularly in the setting of implant or prosthesis-based surgery, resulting in poor surgical outcomes, need for takeback, and explantation.

Multivariate regression analysis identified multiple additional factors associated with surgical complications. Prior radiation, neoadjuvant and adjuvant chemotherapy, active and former nicotine use, and higher body mass index did correlate with higher rates of surgical complications, including cellulitis treated with IV antibiotics, explant for exposure, hospital readmission, major complications, and takeback to the operating room within 90 days of surgery. Established studies and surgical guidelines have enumerated the surgical risks associated with elevated patient body mass index, prior radiation, and nicotine use.[1,2,29–32] In regard to chemotherapy use, neoadjuvant and adjuvant chemotherapy were found to be predictors of higher rates of major complications and explant for exposure. However, multiple studies have investigated the relationship between the two and found that chemotherapy use did not impact surgical outcomes following mastectomy and immediate breast reconstruction.[33–35] Further investigation is required to draw definitive conclusions about this relationship. These results highlight the continued importance of developing a comprehensive approach that considers a multitude of factors in patient optimization, allowing surgeons to tailor treatment plans to individual patient profiles for enhanced safety and optimal surgical outcomes.

The elevated rate of complications demonstrated by patients who identified as active marijuana users underscores the immediate impact of marijuana use on postoperative outcomes in DTI reconstruction. This evidence necessitates a proactive approach, prompting us to strongly recommend that surgeons performing DTI breast reconstruction implement standardized screening

protocols. Although the primary objective of this intervention is to uphold patient safety and enhance surgical outcomes, it additionally contributes to financial optimization for hospital systems and surgeons as it may decrease emergency department visits, hospitalization, and returns to the operating room, decreasing the financial burden on health care systems. Established DTI guidelines have highlighted the significance of overall health and nicotine abstinence as essentials for an ideal patient candidate.[1,2] Patients with prior breast radiation, preexisting scars, thin mastectomy skin flaps, morbid obesity, uncontrolled comorbidities, and advanced oncological disease are not considered optimal candidates for DTI reconstruction.[1,2,29] These factors act as guidelines for patient candidacy and, when found unfavorable, strongly guide surgeons towards a two-stage reconstruction approach. This study, the first of its kind, introduces a nuanced perspective and suggests that active marijuana smokers may be better suited for delayed, two-stage reconstruction, thus minimizing complications and allowing surgeons to more effectively manage any potential complications that arise throughout the course of treatment. As such, a comprehensive screening tool encompassing marijuana use is imperative for the decision-making process for surgeons performing DTI breast reconstruction, with the ultimate goal of optimizing patient outcomes and resource utilization.

Although this study provides valuable insight on the relationship between cannabis and surgical complications in DTI reconstruction, several limitations must be considered. First, the sample size of active marijuana user patients may limit the power of the study, restricting the ability to fully appreciate all associations between marijuana use and surgical complications. This is not surprising, as surgeons at our cancer center are less inclined to operate on patients who actively use marijuana due to concern for the possible concomitant use of other substances, specifically nicotine, and because of the unknown effects of marijuana on mastectomy skin flaps. However, the study biostatistician ascertains that the sample size is adequate to compare the two groups. This is further supported by the in-depth univariate and step-wise regression analysis conducted that indicates significant surgical complications associated with active marijuana use. Although appropriate for our single-institution study, it is important to consider applying the study to a larger population size at multiple institutions to fully assess the implications of marijuana use, maximizing the power, generalizability, and external validity of these findings. Second, the study relies on patient-reported cannabis use, as our institution policy does not call for routine drug testing. Patient-reported use may be influenced by recall and social desirability bias. This may lead to lower numbers amongst active marijuana users, which would impact the accuracy of the data. Thirdly, they study's classification of marijuana users as active or nonactive depending on a 90-day period before surgery may not capture the true impact of chronic marijuana use on surgical outcomes. Additionally, it does not consider mode, quantity, and frequency of cannabis use, which may impact the degree and type of surgical complications in active marijuana users. Despite these limitations, this study provides important findings to the growing literature on the relationship between marijuana use and surgical complications, the first of which explores DTI outcomes. Further research with a larger, multi-institute sample size and standardized cannabis use assessment will allow for a more nuanced understanding and focused clinical recommendations on the relationship between DTI outcomes and marijuana use.

CONCLUSIONS

In conclusion, this study demonstrates that active marijuana use in patients undergoing single-stage DTI breast reconstruction postmastectomy are at a higher risk of surgical complications, particularly major complications, including but not limited to takeback to the operating room, cellulitis treated with IV antibiotics, and explantation for infection. They also experienced higher rates of postsurgical emergency department visits, hospital readmissions, and operating room takebacks. Based on these findings, it is advised that physicians make a concerted effort to conduct a thorough preoperative evaluation before surgical intervention. Although the power of the study prevents us from suggesting that surgery be definitively delayed due to marijuana use within 12 weeks of operation, with a more holistic approach, surgeons can make an educated decision on whether they should move forward with surgery or delay. The evolving landscape of cannabis use and its interplay with surgical outcomes necessitate ongoing investigations, particularly with a larger sample size at multiple institutions, to contribute to the growing literature. Ultimately, this study emphasizes the importance of considering marijuana use as a factor in surgical decision-making and patient counseling, to optimize patient outcomes and safety in DTI breast reconstruction.

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DISCLOSURES

Dr. Atisha is a key opinion leader for MTF Biologics. All other authors have no financial interests to declare in relation to the content of this article.

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