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무세포 진피 기질의 탈세포화 방법이
보형물 기반 유방 재건술의 수술 결과에
영향을 미치는가?

(Is Decellularization Process of Acellular Dermal Matrix Related to Surgical Outcome in Implant-Based Breast Reconstruction?)



아주대학교 의과대학
성형외과학교실
한형민, 이순성, 이일재*

Purpose: Various ADM products employ different decellularization methods in implant-based breast reconstruction, yet the impact on surgical outcomes remains unclear. This study compared supercritical CO₂-decellularized ADM (SCDerm®) with conventional ADMs.

Methods: A retrospective study of 768 implant-based breast reconstructions (Jan 2020–Dec 2024) at a single institution. SC-CO₂ group (SCDerm®; n=181) vs. conventional ADMs (n=587). Primary outcomes: return to OR and implant loss. Analysis: GEE and IPTW.

Table 1. Baseline Patient Characteristics

Variable	Total (N=768)	SCDerm® (n=181)	Others (n=587)	p-value
Demographics				
Age, years (mean±SD)	46.77±7.91	46.77±7.66	47.42±7.99	0.474
BMI, kg/m ² (mean±SD)	23.13±6.06	23.41±10.67	23.05±3.61	0.181
Comorbidities, n (%)				
Hypertension	83 (10.8)	15 (8.3)	68 (11.6)	0.212
Diabetes mellitus	32 (4.2)	8 (4.4)	24 (4.1)	0.845
Smoking	39 (5.1)	5 (2.8)	34 (5.8)	0.105
Oncologic treatment, n (%)				
Neoadjuvant chemotherapy	214 (27.9)	46 (25.4)	168 (28.6)	0.400
Adjuvant chemotherapy	498 (64.8)	90 (49.7)	408 (69.5)	<0.001
Preoperative radiotherapy	47 (6.1)	7 (3.9)	40 (6.8)	0.148
Postoperative radiotherapy	139 (18.1)	35 (19.3)	104 (17.7)	0.621
Mastectomy type, n (%)				
SSM	199 (25.9)	39 (21.5)	160 (27.3)	0.009
NSM	528 (68.8)	132 (72.9)	396 (67.5)	
MRM	10 (1.3)	6 (3.3)	4 (0.7)	
Reconstruction method, n (%)				
Direct-to-implant	427 (55.6)	113 (62.4)	314 (53.5)	0.043
Tissue expander	311 (40.5)	65 (35.9)	246 (41.9)	
Delayed reconstruction	30 (3.9)	3 (1.7)	27 (4.6)	
Implant position, n (%)				
Prepectoral	533 (69.4)	160 (88.4)	373 (63.5)	<0.001
Subpectoral	235 (30.6)	21 (11.6)	214 (36.5)	

SCDerm®, supercritical carbon dioxide-processed acellular dermal matrix; BMI, body mass index; SSM, skin-sparing mastectomy; NSM, nipple-sparing mastectomy; MRM, modified radical mastectomy.

Table 2. Complication Rates by ADM Type

ADM Type	n	Return to OR	Major	Minor
SCDerm®	181	8 (4.4)	5 (2.8)	3 (1.7)
Conventional ADMs	587	62 (10.5)	29 (4.9)	33 (5.6)
CryoDerm®	286	32 (11.2)	14 (4.9)	18 (6.3)
OneStep®	123	17 (13.8)	8 (6.5)	9 (7.3)
MyDerm®	113	7 (6.2)	4 (3.5)	3 (2.7)
PZB®	38	4 (10.5)	2 (5.3)	2 (5.3)
CelluDerm®	25	2 (8.0)	1 (4.0)	1 (4.0)
Others	2	0 (0.0)	0 (0.0)	0 (0.0)
Total	768	70 (9.1)	34 (4.4)	36 (4.7)

Values are presented as n (%). SCDerm®, supercritical carbon dioxide-processed acellular dermal matrix; ADM, acellular dermal matrix.

Results: Overall RTOR: 9.1% (70/768). SCDerm® 4.4% vs. conventional 10.5% (Table 2). GEE analysis (ref: OneStep®): SCDerm® OR=0.887, p=0.002 (Table 3). Risk factors: postop RT (OR=1.115, p=0.002), subpectoral position (OR=1.077, p=0.013). After IPTW adjustment (Table 4), SCDerm® showed significant RTOR reduction (OR=0.939, 95% CI 0.903–0.978, p=0.002). Implant loss: NS (OR=0.911, p=0.142) (Table 5).

Table 3. GEE Multivariable Analysis

Variable	OR	95% CI	p-value
ADM Type (ref: OneStep®)			
SCDerm®	0.887	0.824–0.956	0.002
CryoDerm®	0.989	0.919–1.064	0.757
MyDerm®	0.910	0.840–0.986	0.022
PZB®	0.928	0.820–1.051	0.238
CelluDerm®	0.914	0.803–1.039	0.170
Postoperative radiotherapy	1.115	1.040–1.196	0.002
Pathology: ILC (ref: DCIS)	1.173	1.033–1.333	0.014
Implant position: Subpectoral	1.077	1.016–1.142	0.013

OR, odds ratio; CI, confidence interval; ILC, invasive lobular carcinoma; DCIS, ductal carcinoma in situ. Model adjusted for age, BMI, hypertension, diabetes, smoking, chemotherapy, radiotherapy, pathology, mastectomy type, axillary procedure, reconstruction method, and implant position.

Table 4. Covariate Balance (IPTW)

Variable	Before IPTW			After IPTW		
	SCDerm®	Others	p	SCDerm®	Others	SMD
Age, years	46.77±7.66	47.42±7.99	0.326	47.25	47.24	0.001
BMI, kg/m ²	23.41±10.67	23.05±3.61	0.657	22.98	23.07	0.015
Hypertension	15 (8.3)	68 (11.6)	0.212	17 (10.1)	63 (10.8)	0.023
Diabetes	8 (4.4)	24 (4.1)	0.845	5 (3.0)	24 (4.1)	0.059
Smoking	5 (2.8)	34 (5.8)	0.105	6 (3.6)	30 (5.1)	0.074
Adjuvant CTx	90 (50.0)	408 (69.5)	<0.001	94 (55.6)	377 (64.3)	0.178
Prepectoral	160 (89.4)	373 (63.5)	<0.001	125 (74.0)	408 (69.6)	0.098

SMD, standardized mean difference; CTx, chemotherapy. SMD < 0.10 indicates excellent balance.

Table 5. IPTW-Weighted Primary Outcomes

Outcome	OR	95% CI	p-value
SCDerm® vs Others (ref)			
Return to OR	0.939	0.903–0.978	0.002
Implant loss	0.911	0.805–1.032	0.142

OR, odds ratio; CI, confidence interval; IPTW, inverse probability of treatment weighting. Weighted N = 762.

Conclusion: SC-CO₂ decellularized ADM (SCDerm®) showed significantly lower RTOR rates compared to conventional ADMs. The detergent-free processing may reduce complications by eliminating residual chemical irritants, supporting consideration of decellularization method in ADM selection.