

Direct-to-Implant versus 2-Stage Expander Implant Immediate Breast Reconstruction: Comparison of Incidence and Predictors of Complications

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ABSTRACT

Purpose: The most important discussion about the direct-to-implant (DTI) reconstruction is the risk of ischemic problems. Therefore, there is an ongoing debate about the effectiveness and reliability of DTI reconstruction. The current study aimed to compare the outcomes of patients undergoing DTI and expander implant (EI) reconstruction and to determine the factors that may affect the occurrence of complications.

Methods: Sixty patients who underwent immediate implant reconstruction over a two-year period were included in the study. Demographic characteristics, operative characteristics and postoperative complications of the patients were retrieved retrospectively from patient records.

Results: Reconstruction was performed on 34 and 27 breasts in the DTI and EI groups, respectively. The mean follow-up period of the patients was 13.8 months (range 6–28 months). Although the postoperative complication rates were high in the DTI group, no statistically significant difference was found between the two groups ($p = 0.585$). No statistically significant difference was found between the two groups in terms of implant failure ($p = 0.579$). Implant volumes of patients with complications in the DTI group were significantly higher than those without complications ($p = 0.049$).

Conclusion: While DTI was similar to EI reconstruction in terms of implant failure, overall complication rates were higher than those in EI reconstruction. The volume of the implant is a factor that affects the development of complications in DTI reconstruction. DTI reconstruction is a reliable method that can achieve similar results to EI reconstruction with fewer surgical procedures in suitably selected patients.

Keywords: mastectomy; breast reconstruction; direct-to-implant reconstruction; expander implant reconstruction

İmplant ile Tek Aşamalı ve Doku Genişletici İmplant ile İki Aşamalı Eşzamanlı Meme Rekonstrüksiyonu: İnsidans ve Komplikasyon Oluşumuna Etki Eden Faktörlerin Karşılaştırılması

ÖZET

Amaç: Direct to implant (DTI) rekonstrüksiyon ile ilgili en önemli tartışma, konulan kalıcı implantın mastektomi flebine bası yaparak iskemik problemlere yol açacağı ve bu durumun implant kaybına neden olarak rekonstrüktif başarı oranını düşüreceğidir. Bu sebeple DTI rekonstrüksiyonun etkinliği ve güvenilirliği hakkında halen süregelen bir tartışma mevcuttur. Bu çalışmanın amacı DTI rekonstrüksiyon ile expander implant (EI) rekonstrüksiyon uygulanan hastalara ait sonuçları kıyaslamak ve komplikasyon oluşumuna etki edebilecek faktörleri tespit etmektir.

Yöntemler: İki yıllık period içerisinde implant ile eşzamanlı rekonstrüksiyon uygulanan 60 hasta çalışmaya dahil edildi. Hastalara ait demografik özellikler, operatif karakteristikler ve postoperatif komplikasyonlar retrospektif olarak hasta kayıtlarından tespit edildi. Komplikasyona etki eden faktörlerin tespiti için logistik regresyon analizi uygulandı.

Bulgular: DTI grupta 34 memede EI grupta 27 memede rekonstrüksiyon uygulandı. Hastaların ortalama takip süresi 13.8 aydı (range 6 – 28). Postoperatif komplikasyon oranları DTI grupta daha yüksek olmasına karşın her iki grup arasında komplikasyon görülme sıklığı açısından anlamlı fark saptanmadı. ($p=0,585$) İmplant kaybı bakımından iki grup arasında anlamlı fark gözlenmedi. ($p=0,579$) DTI grupta komplikasyon olan hastaların implant volümleri komplikasyon olmayanlara göre istatistiksel olarak anlamlı yüksekti ($p=0,049$).

Sonuç: DTI rekonstrüksiyon implant kaybı bakımından EI rekonstrüksiyona benzer oranlara sahip iken total komplikasyon oranları EI rekonstrüksiyona göre yüksektir. Konulacak implantın volümü, DTI rekonstrüksiyonda komplikasyon oluşumunda etkili bir faktör olarak görülmektedir. DTI rekonstrüksiyon uygun seçilmiş hastalarda daha az cerrahi prosedür ile EI rekonstrüksiyona benzer sonuçlar elde edilebilecek güvenilir bir yöntemdir.

Anahtar sözcükler: mastektomi, meme rekonstrüksiyonu, kalıcı implant ile rekonstrüksiyon, expander implant ile rekonstrüksiyon

Immediate breast reconstruction with an implant after mastectomy is often preferred because of its short operative surgery time, the fact that it does not create donor area morbidity, and it is an easy-to-apply technique (1,2). Immediate reconstruction with an implant can be performed as a single-stage (direct-to-implant [DTI]) or two-stage (expander implant [EI]) surgery.

EI reconstruction is preferred more frequently as it is found to be more reliable than DTI reconstruction (3). The major reason for this is that DTI reconstruction may lead to ischemic complications with the pressure created by a permanent implant placed in a single session. Despite this negative opinion, the operation time is shortened with DTI reconstruction, the number of postoperative control visits is reduced, and breast reconstruction can be completed in a single session. DTI reconstruction is increasingly preferred in patients, because of the aforementioned advantages (4). The results obtained in studies comparing both methods are contradictory. While some studies report increased complication rates in DTI reconstruction (5,6), others report that the complication rates are high in EI reconstructions, or there is no statistically significant difference between both methods in terms of complication rates (7–11). On the account of the conflicting results in the literature, the selection of a method for immediate reconstruction with an implant after mastectomy is a matter of debate.

The aim of this study was to compare the long-term results of patients undergoing DTI and EI reconstructions in terms of complications and identify the variables that may affect complication rates in both groups.

Materials and Methods

A total of 61 immediate breast reconstruction surgeries performed for oncological purposes in 60 patients who underwent mastectomy between 2018 and 2020 were included in the study. Breast reconstructions performed for prophylactic purposes were not included in the study to obtain a homogeneous sample. The reconstructions were divided into two groups, the DTI group and the EI group. Medical records of patients were retrospectively reviewed and age, length of hospital stay, smoking, comorbidities, body mass index (BMI), mastectomy type (skin and nipple sparing), incision type, implant volume, chemotherapy, and radiotherapy findings were retrieved to examine the effects of these variables on complications.

Complications were classified as major and minor depending on the need for surgical intervention. Infection, seroma, hematoma, capsular contracture, and full-thickness necrosis over mastectomy flap were classified as major complications, while superficial necrosis over mastectomy flap and superficial necrosis over nipple areola complex were classified as minor complications.

Surgical Technique

All mastectomies were performed by the general surgery team. The breast tissue was carefully removed, preserving the subdermal plexus. In patients who had tumor positive for nipple during the operation, nipple areola complex was resected and skin sparing mastectomy was performed. In other patients, nipple sparing mastectomy was performed by preserving the nipple areola. Axillary curettage was performed in cases with positive sentinel lymph nodes based on frozen biopsy.

After mastectomy was completed, the circulation of the mastectomy flap and the condition of the pectoral muscle was clinically observed. DTI reconstruction was performed in sentinel lymph node negative patients in whom there were no circulatory problems in the mastectomy flap and the pectoral muscle was anatomically suitable. EI reconstruction was performed in patients with positive sentinel lymph node and who were thought to have circulatory problems in the mastectomy flap. All the implants and expander implants used were placed in a submuscular pocket prepared under the pectoral muscle. The entire surface of the implants was closed with muscle tissue. Acellular dermal matrix (ADM) and derivative materials were not used in any of the patients.

Statistical Analysis

Software SPSS version 15.0 for Windows (IBM Corp., Armonk, NY) was used for statistical analysis of the data. Descriptive statistics were presented as number and percentage for categorical variables and mean, standard deviation, minimum, maximum, and interquartile range for numerical variables. The ratios in the groups were compared with the Chi-Square Test. Since the data was not normally distributed, Mann–Whitney U test was used to compare variables between two independent groups. Logistic regression analysis was performed to examine the risk factors. The cut-off value was examined by ROC (receiver operating characteristic) curve analysis. $P < 0.05$ was accepted as statistically significant in all analyses.

Results

Between 2018 and 2020, DTI reconstruction was performed on 33 patients (Fig. 1), while two-session EI reconstruction was performed on 27 patients (Fig. 2). Both cohorts showed similar characteristics except for BMI, mastectomy type, axillary curettage, neoadjuvant chemotherapy, and radiotherapy characteristics (Table 1). The rate of nipple sparing mastectomy was higher in the DTI group than that in the EI group ($p = 0.017$). The rates of axillary curettage, neoadjuvant chemotherapy, postoperative radiotherapy, and mean BMI values of the DTI group were lower than those in the EI group ($p < 0.001$, $p = 0.023$, $p = 0.001$, $p = 0.015$, respectively). Mean age was 46.97 ± 11.5 years (range: 28–78 years) in the DTI group, while it was 46.96 ± 8.12 years (range: 31–65 years) in the EI group. Mean BMI was 23.73 ± 3.6 (range: 18.76–30.8) in the DTI group and 26.76 ± 5.1 (range: 19.47–37.64) in the EI group. The mean follow-up period of the patients was 13.8 months (range 6–28 months).

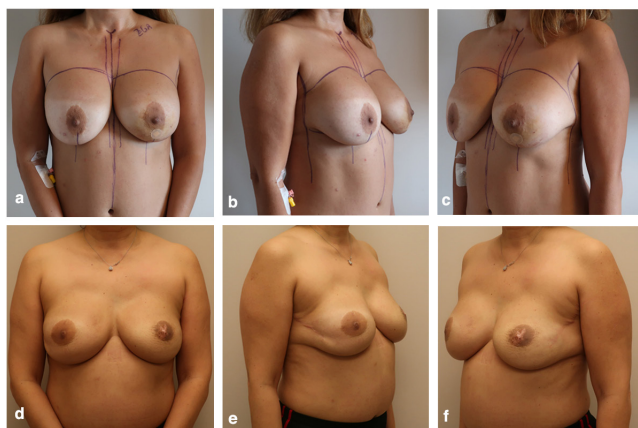


Fig. 1 A 46-year-old patient. She had a history of left breast cancer and underwent bilateral nipple-sparing mastectomy followed by direct-to-implant reconstruction with medium height, moderate plus projection, anatomic 375 cc implants. Preoperative (a,b,c) and postoperative pictures at 15 months follow up (d,e,f)

While bilateral reconstruction was performed in 14 patients (42.4%) in the DTI group, only one of these patients had bilateral breast cancer. Bilateral reconstruction was performed in 6 patients (22.2%) in the EI group, while unilateral reconstruction was performed in 21 patients (77.8%). Breasts that underwent prophylactic intervention for bilateral reconstructions were not included in the study. In the DTI group, nipple sparing mastectomy was performed in 31 breasts (91.2%) and skin sparing mastectomy was performed in 3 breasts (8.8%). In the EI group, nipple sparing was performed in 18 breasts (66.7%) and skin sparing mastectomy was performed in 9 breasts

(33.3%). Lateral incision was most commonly preferred in both groups. (27 breasts [79.4%] in the DTI group, 20 breasts [74.1%] in the EI group).

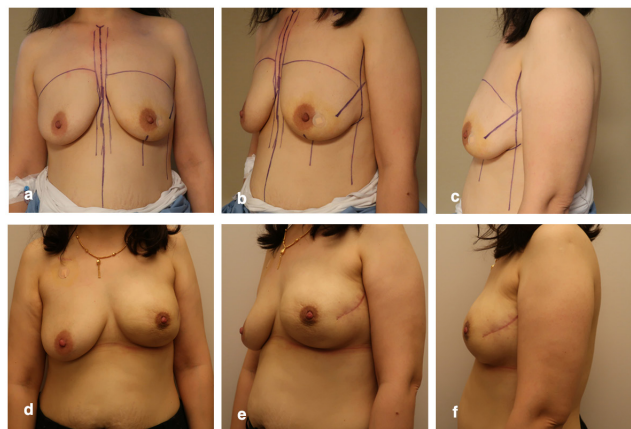


Fig. 2 A 34-year-old patient. She had a history of left breast cancer and underwent unilateral nipple-sparing mastectomy followed by expander implant reconstruction with Mentor Contour Profile Becker 35 (Mentor Worldwide, Santa Barbara, Calif.) 325 cc implant. Preoperative (a,b,c) and postoperative pictures at 9 months follow up (d,e,f)

Mentor CPG implants were used in DTI reconstructions (Mentor Worldwide, Santa Barbara, Calif.). The average implant volume was 339.55 ± 74.11 ml (range 155–475 ml) in the DTI group. Mentor Contour Profile Becker 35 implants were used in EI reconstructions (Mentor Worldwide, Santa Barbara, Calif.). The average implant filling volume in the EI group was 327.03 ± 114.6 ml (range 70–460 ml).

Although the postoperative complication rates were higher in the DTI group than those in the EI group, there was no statistically significant difference between the two groups (11 patients [32.4%] in the DTI group, 7 patients [25.9%] in the EI group; $p = 0.585$). The most common complication observed in the DTI group was superficial necrosis of the mastectomy flap (3 patients [8.82%]), while capsular contracture was the most common complication in the EI group (2 patients [7.41%]) (Table 2). Full-thickness necrosis of the mastectomy flap developed in two patients from the DTI group. In one of these two patients, the implant was lost and the reconstruction was failed, while reconstruction was successfully salvaged in the other patient. In the EI group, one patient experienced implant loss due to full-thickness necrosis developing on the mastectomy flap, and another patient experienced implant loss due to infection, and reconstruction were failed in both patients. The implant failure rate was 2.94% in the DTI group and 7.4% in the EI group. There was no statistically significant difference between the two groups in terms of implant failure ($p = 0.579$).

Table 1. Characteristics of patients and reconstructions			
	Direct to Implant	Expander Implant	p
Age			
Mean ± SD (range)	46,97±11,5 (28-78)	46,96±8,12 (31-65)	0,998 [#]
Median (IQR)	45 (40-55,5)	46 (41-52)	
Length of Hospitalisation			
Mean ± SD (range)	3±1,53 (2-8)	3,48±2,39 (2-12)	0,444 [*]
Median (IQR)	2,5 (2-3)	3 (2-3)	
Tobacco Use, n (% of patients)	9 (26,5%)	9 (33,3%)	0,559 [¥]
Comorbidity, n (% of patients)	11 (32,4%)	7 (25,9%)	0,585 [¥]
BMI			
Mean ± SD (range)	23,73±3,6 (18,8-30,8)	26,76±5,1 (19,5-37,6)	0,015 [*]
Median (IQR)	23,5 (20,6-26,9)	26,6 (21,8-30,8)	
Mastectomy, n (% of breasts)			
Nipple Sparing	31 (91,2%)	18 (66,7%)	0,017 [¥]
Skin Sparing	3 (8,8%)	9 (33,3%)	
Incision, n (% of breasts)			
Lateral	27 (79,4%)	20 (74,1%)	0,728 [¥]
Inverted T	3 (8,8%)	1 (3,7%)	
Inframammary fold	2 (5,9%)	2 (7,4%)	
Elliptical	2 (5,9%)	3 (11,1%)	
Vertical	0 (0,0%)	1 (3,7%)	
Reconstruction, n (% of breasts)			
Bilateral	14 (42,4%)	6 (22,2%)	0,074 [¥]
Unilateral	19 (57,6%)	21 (77,8%)	
Side			
Right	18 (52,9%)	11 (40,7%)	0,343 [¥]
Left	16 (47,1%)	16 (59,3%)	
Axillary Curettage, n (% of breasts)	4 (11,8%)	17 (63,0%)	<0,001 [¥]
Implant Volume			
Mean (Min-Max)	339,6 (155-475)	327 (70-460)	0,608 [#]
Median (IQR)	340 (280-375)	350 (365-400)	
Neoadjuvant chemotherapy, n (% of patients)	7 (20,6%)	13 (48,1%)	0,023 [¥]
Preoperative radiotherapy, n (% of patients)	1 (2,9%)	0 (0,0%)	1,000 [¥]
Adjuvant chemotherapy, n (% of patients)	13 (39,4%)	15 (55,6%)	0,264 [¥]
Postoperative radiotherapy, n (% of patients)	7 (21,2%)	18 (66,7%)	0,001 [¥]
Complications, n (% of breasts)	11 (32,4%)	7 (25,9%)	0,585 [¥]

*Ki Kare Test *Student t Test *Mann Whitney U Test

Table 2. Summary of complications		
Complications	Direct to Implant	Expander Implant
Minor		
Superficial Nipple Necrosis	2(5,88%)	1(3,70%)
Mastectomy Flap Necrosis (Superficial Thickness)	3(8,82%)	1(3,70%)
Major		
Infection	0 (0,0%)	1(3,70%)
Hematoma	1(2,94%)	1(3,70%)
Seroma	1(2,94%)	0 (0,0%)
Mastectomy Flap Necrosis (Full Thickness)	2(5,88%)	1(3,70%)
Capsular contracture	2(5,88%)	2 (7,41%)

The analysis conducted according to patient characteristics did not reveal any effect of smoking, comorbidities, BMI, type of mastectomy, type of incision used, axillary curettage, chemotherapy, and radiotherapy on the development of complications in both groups. In the DTI group, implant volumes of patients with complications were significantly higher compared to those without complications (p = 0.049). (Table 3) No significant factor was found in the logistic regression analysis of factors affecting complications (Table 4).

In the DTI group, a cut-off value above 360 for implant volume was obtained with 72.7% sensitivity and 65.2% specificity (positive predictive value: 50% negative predictive value: 83.3%). In the DTI group, when the implant volume was above 360, complication rate was fivefold higher (p = 0.038 OR 95% CI: 1.03–24.3).

Discussion

In the classic mastectomy technique, addressing the loss of skin caused after resection of the skin with tumoral tissue was a necessity in order to achieve a successful reconstructive result. In implant-based breast reconstruction, it is possible to overcome this problem only with EI reconstruction over two sessions. For this reason, many reconstructive surgeons are more familiar with two-stage EI reconstruction. The development of mastectomy techniques and the widespread use of nipple sparing, skin sparing mastectomy have made DTI reconstruction easier to perform. However, the opinion that ischemic complications are more frequent in DTI reconstruction (6,12–14) and the fact that reconstructive surgeons are more familiar with the EI reconstruction technique and tend to continue practicing the technique they are experienced in has limited the use of DTI reconstruction.

Table 3. Patient and Reconstruction Characteristics Associated with Complication

	Direct to Implant			Expander Implant		
	Complicated (n, % of breasts)	Uncomplicated (n, % of breasts)	p [‡]	Complicated (n, % of breasts)	Uncomplicated (n, % of breasts)	p [‡]
Age						
Mean ± SD (range)	44,4±5,4 (29-50)	49,6±12,7 (28-78)	0,463 [‡]	45,8±7,3 (31-53)	47,3±8,5 (34-65)	0,684 [‡]
Length of Hospitalisation						
Mean ± SD (range)	3±1,1 (2-6)	3±1,7 (2-8)	0,434 [*]	5±3,8 (2-12)	2,95±1,3 (2-7)	0,112 [*]
BMI						
Mean ± SD (range)	24,3±4,1 (18,9-30,3)	23,4±3,4 (18,8-30,8)	0,632 [*]	28,3±5,3 (20,7-34,5)	26,2±5,0 (19,5-37,6)	0,362 [‡]
Tobacco Use	4 (44,4%)	5 (55,6%)	0,425	3 (42,9%)	4 (57,1%)	0,653
Comorbidity	5 (45,5%)	6 (54,5%)	0,434	3 (42,9%)	4 (57,1%)	0,328
Mastectomy						
Nipple Sparing	11 (35,5%)	20(64,5%)		5 (27,8%)	13(72,2%)	
Skin Sparing	-	3(100%)		2 (22,2%)	7(77,8%)	
Incision						
Lateral	9 (33,3%)	18(66,7%)	1,000	5 (25%)	15(75,0%)	0,176
Inframamary fold	1 (50,0%)	1(50%)		-	2(100%)	
Inverted T	1 (33,3%)	2(66,7%)		1 (100%)	-	
Elliptical	-	2(100%)		-	3(100%)	
Vertical	-	-		1 (100%)	-	
Axillary Curettage	1 (25,0%)	3(75%)	1,000	3 (17,6%)	14 (82,4%)	
Implant Volume						
Mean ± SD (range)	375,4±66,3 (280-475)	322,3±72,6 (155-475)	0,049[‡]	327,8±145,3 (70-460)	326,7±106,3 (80-460)	0,738 [*]
Neoadjuvant chemotherapy	2(28,6%)	5(71,4%)	1,000	3 (23,1%)	10(76,9%)	1,000
Preoperative radiotherapy	-	1(100%)	1,000	-	-	-
Adjuvant chemotherapy	6(46,1%)	7(53,9%)	0,458	3 (20,0%)	12(80,0%)	0,662
Postoperative radiotherapy	3(42,8%)	4(57,2%)	1,000	4 (22,2%)	14(77,8%)	0,653

[‡]Student t Test ^{*}Mann Whitney U Test

Table 4. Odds ratios for complication, logistic regression analysis results

	Direct to Implant			Expander Implant		
	p	OR	95% CI Min-Maks	p	OR	95% CI Min-Maks
Age	0,062	0,92	0,84-1,00	0,671	0,98	0,87-1,09
Length of Hospitalisation	1,000	1,00	0,62-1,61	0,094	1,41	0,94-2,11
Tobacco Use	0,370	2,06	0,42-9,97	0,537	1,75	0,30-10,34
Comorbidity	0,264	2,36	0,52-10,67	0,246	3,00	0,47-19,18
BMI	0,485	1,07	0,88-1,31	0,350	1,09	0,91-1,29
Mastectomy	0,999	0,00	0,00	0,757	0,74	0,11-4,87
Incision	0,811	1,25	0,20-7,75	0,853	0,83	0,12-5,72
Axillary Curettage	0,739	0,67	0,06-7,25	0,210	0,32	0,05-1,90
Implant Volume	0,060	1,01	1,00-1,02	0,982	1,00	0,99-1,01
Neoadjuvant chemotherapy	0,811	0,80	0,13-4,96	0,745	0,75	0,13-4,25
Adjuvant chemotherapy	0,278	2,25	0,52-9,73	0,436	0,50	0,09-2,86
Postoperative radiotherapy	0,722	1,35	0,26-7,07	0,537	0,57	0,10-3,38

OR: Odds ratio, CI: Confidence interval

Those who advocate the EI reconstruction technique suggest that the revision rates are low in this method, and the aesthetic outcome and patient satisfaction are better (15,16). Those who advocate the DTI reconstruction technique argue that the patient does not experience the psychological trauma of breast loss due to breast reconstruction in a single session. They suggest that sexual well-being is higher, overall cost decreases due to less visits and absence of a second surgery (7,8,17–19). The aim of the current study was to compare the DTI and EI reconstruction techniques in terms of complications and implant failure and to determine the factors that may affect the complications.

In their study, Srinivasa et al. (9) showed that the complication rates were higher in patients undergoing DTI reconstruction than those in patients undergoing EI reconstruction, but this difference was not statistically significant. Similarly, in the current study, although the complication rate was higher in the DTI group (11 [32.4%] patients) than that in the EI group (7 [25.9%] patients), no statistically significant difference was found between the two groups ($p = 0.585$). Srinivasa et al. (9) found that the rate of major complications was higher in the DTI reconstruction group compared to the EI reconstruction group. Unlike these results, the rate of major complications was similar in the DTI and EI groups in the current study (DTI 17.64% and EI 18.51%), and the rates of hematoma, seroma, infection, and capsular contracture were similar between the groups. It has been reported in the literature that the complication rate of breast reconstruction with implant varies between 0.2% and 52% (8,12,19,20). The complication rates observed in both groups in the current study are consistent with the literature.

As mentioned earlier, the view that a full-volume implant in DTI reconstruction will create pressure on the mastectomy flap and increase the risk of implant failure as a result of ischemia is one of the most important discussion topics related to this technique. In the literature, this rate has been reported as 0.4%–16% for DTI reconstructions (11,21). Azouz et al. (8) and Roostaeian et al. (22) found that the implant failure rates in DTI and EI reconstruction were similar. In the current study, implant failure was observed in only one patient (2.94%) from the DTI group and in two patients (7.41%) from the EI group. There was no significant difference between the two groups in terms of implant failure ($p = 0.579$). This may have been due to the small number of patients with ptotic and large breasts in DTI group and breast volume was within normal limits in the majority of patients in the DTI group.

In the current study, the DTI and EI groups differed in terms of BMI, mastectomy type, axillary curettage, neoadjuvant chemotherapy, and adjuvant radiotherapy characteristics. It has been reported that high BMI values increase the incidence of complications in patients undergoing breast reconstruction (23). Antony et al. (24) showed that every 5-unit increase in BMI values increases the occurrence of complications by 1.51 times. In the current study, mean BMI was significantly higher in the EI group (26.76 ± 5.1) than that in the DTI group (23.73 ± 3.6) ($p = 0.015$). Despite this finding, the incidence of complications was low in the EI group. High BMI did not have a significant effect on the occurrence of complications in either group.

In the current study, nipple sparing mastectomy rates were significantly higher in the DTI group compared to the EI group ($p = 0.017$). In a series of 297 breast reconstructions, Blok et al. (25) showed that nipple sparing mastectomy was a risk factor for implant loss. In this study, nipple sparing mastectomy was performed in all of the three patients who developed implant failure. When all patients who developed complications were considered (11 patients in the DTI group and seven in the EI group), nipple sparing mastectomy was performed in all patients who developed complications in the DTI group and five of the seven patients who developed complications in the EI group. Although nipple sparing mastectomy was performed in most of the patients who developed complications in both groups, no statistically significant effect of nipple sparing mastectomy on the development of complications was found.

Chemotherapy is not identified as a risk factor for breast reconstruction with an implant (26). While the rates of neoadjuvant chemotherapy were significantly higher in the EI group than those in the DTI group ($p = 0.023$), the rates of adjuvant chemotherapy were similar between the groups. Consistent with the literature, the results obtained in this study showed that neoadjuvant and adjuvant chemotherapy has no effect on the development of complications. It has been reported that radiotherapy increases the risk of complications and capsular contracture in patients undergoing breast reconstruction with an implant (27). Although higher rates of complication development after radiation therapy were observed in the DTI group (3 [37.5%] patients), the rates of capsular contracture development were similar between the groups (2 [5.55%] patients in the DTI group; 2 [7.41%] patients in the EI group) and no effect of radiotherapy on complication development was identified.

Another parameter in which EI and DTI reconstruction groups differed was axillary dissection. The frequency of axillary dissection was high in the EI group. Anthony et al. (24) showed that axillary dissection is an independent risk factor for breast reconstruction with an implant. In the current study, axillary dissection was not found to be a statistically significant risk factor in both groups. In contrast to the current study, Anthony et al. (24) performed EI reconstruction on all patients and ADM was used during reconstruction. We believe that non-vascularized ADM may increase the effect of axillary dissection on the development of complications. In the current study, no non-vascularized ADM-like foreign body was used during breast reconstruction.

Implant volumes of patients with complications in the DTI reconstruction group were significantly higher than those in patients without complications ($p = 0.049$). Salzberg et al. (19) stated that implants close to 650 cc can be used in DTI reconstructions performed using ADM in eligible patients with large and ptotic breasts. Another study conducted in our clinic on patients with large ptotic breasts requiring skin reduction showed that implants with a volume of ≤ 500 cc can be safely used in patients undergoing skin reduction in DTI reconstruction (28). In the current study, ROC analysis performed for the DTI group identified that implants of ≤ 360 cc and below can be safely used in the DTI group while the use of implants > 360 cc increased the rate of complications increased by fivefold ($p = 0.038$ OR 95% CI: 1.03–24.3).

The major limitations of the study were that it was conducted in a single center and had small sample size. DTI reconstruction is a method that is technically more difficult and requires a longer learning curve compared to EI reconstruction. The fact that this may negatively affect the complication profile of patients operated on at an early stage in the DTI reconstruction group was the second major limitation. Another limitation was that patients in the EI reconstruction group were included in the study only with follow-up data after the first surgery.

Conclusion

The results of the current study show that DTI reconstruction has comparable complication rates with EI reconstruction. Implant failure rates are low in both techniques and both are reconstructively reliable techniques. The results also show that implant volume has an effect on the development of complications for DTI reconstruction; whereas, the other factors had no effect on the

development of complications. DTI reconstruction is a reliable and effective method that can be considered in patients with normal breast volume, normal BMI, and when planned implant volume is low. Alternative reconstructive techniques such as two-stage EI reconstruction or skin reduction should be considered in patient groups outside this profile.

Declarations

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Conflicts of interest/Competing interests

All of the authors declare that they have no conflict of interest.

Ethics approval

Ethical approval was given by the Acibadem Mehmet Ali Aydınlar University, School of Medicine Ethics Committee with the reference number, ATADEK-2023-05/167.

Availability of data and material

Available upon request.

Authors' contributions

AA conceived and designed the analysis, collected the data, wrote the paper, surgeon who performed the breast reconstructions; SY conceived and designed the analysis, participated in the design of the study; HK conceived and designed the analysis, a member of surgical team performed mastectomy; AEA conceived and designed the analysis, a member of surgical team performed mastectomy; CU conceived and designed the analysis, a member of surgical team performed mastectomy.

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