Deep Inferior Epigastric Perforator Flap Breast Reconstruction in a Private Clinic: Clinical Outcomes from 2013 to 2024

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ABSTRACT

Background: The incidence of autologous breast reconstruction has been steadily increasing in recent years. Deep inferior epigastric perforator (DIEP) flap reconstruction is considered the gold standard for breast reconstruction despite its demanding technical expertise, time intensiveness, and rigorous postoperative monitoring.

Methods: We retrospectively collected data from 102 DIEP flaps utilized for breast reconstruction in 70 patients treated at private clinics between 2013 and 2024. All surgeries were performed by a single, experienced surgeon.

Results: The mean age at surgery was 42.2 ± 8 years. Immediate reconstructions were conducted in 34 patients (48%); 46% of patients had prior radiation therapy. Only one patient received adjuvant radiation therapy. Free DIEP flaps vascularized by one (53%), two (32%), or three (10%) perforators were preferentially anastomosed to the internal mammary vessels. One patient underwent a muscle-sparing procedure due to the absence of available perforators. Total flap failure occurred in four cases (3.9%), three occurred as a unilateral loss in patients who underwent bilateral reconstruction. Postoperative revisions of the microvascular anastomosis were performed in three patients, with successful flap salvage in two (67%). Fat necrosis was diagnosed in 26 breasts (25%), only a minority of cases required follow-up surgery. All patients were managed completely in a private clinic, with none requiring hospitalization in the public system.

Conclusions: Free DIEP flap breast reconstruction requires meticulous surgical planning, a well-coordinated surgical team, and close postoperative monitoring. Nevertheless, this surgery can be safely and effectively performed in a private clinic setting, with complication rates comparable to that of the public setting.

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KEY WORDS: breast reconstruction, breast surgery, deep inferior epigastric perforator (DIEP), microvascular anastomosis, private clinic

Breast reconstruction following mastectomy is a crucial component in the comprehensive treatment of breast cancer, significantly enhancing patient satisfaction and overall well-being [1]. Postmastectomy reconstruction, whether immediate or delayed, generally encompasses two primary approaches: alloplastic reconstruction and autologous reconstruction [2,3]. While alloplastic reconstruction utilizing silicone implants or tissue expanders remains the predominant choice in Israel, the prevalence of autologous breast reconstruction has been steadily increasing in recent years, particularly abdominal-based techniques [4,5].

Deep inferior epigastric perforator (DIEP) flap reconstruction has emerged as the preferred method and is currently regarded as the gold standard for breast reconstruction [6]. This technique utilizes fat and skin tissues that closely mimic natural breast tissue, effectively replacing like-with-like, while simultaneously minimizing donor site morbidity compared to other abdominal or non-abdominal based reconstruction methods [7,8]. DIEP flap reconstruction necessitates several key elements for success. It demands expert technical skills, particularly in microsurgical anastomosis, and requires rigorous postoperative monitoring and care by trained medical and nursing staff. The procedure requires longer operating times than alternative methods, involving two surgical sites, and consequently longer anesthesia and recovery periods [9,10].

To optimize surgical outcomes, patients typically undergo preoperative computed tomography (CT) angiography. This imaging technique allows for a comprehensive assessment of the vascular anatomy and perfusion of the abdominal flap. Three-dimensional image reconstruction facilitates the localization of dominant perforator vessels, providing crucial information about their diameter and anatomic course in relation to the rectus muscle [11].

In addition, perforators are marked on a two-dimensional image of the abdominal wall using an overlaid scaled grid. This detailed mapping is then utilized in the operating room, where perforators are precisely marked on the patient immediately prior to surgery.

In this study, we present the personal experience of a single private clinic performing DIEP flap reconstructions in Israel from 2013 to 2024. By examining this decade-long experience, we contribute valuable insights into the efficacy and feasibility of conducting complex autologous breast reconstructions in a private clinic.

PATIENTS AND METHODS

PATIENT SELECTION AND PREOPERATIVE PLANNING

Patients undergoing DIEP reconstruction were required to meet specific eligibility criteria, including overall medical status compatible with prolonged anesthesia, sufficient lower abdominal subcutaneous fat tissue for breast size and form reconstruction, and suitability for either bilateral or unilateral reconstruction. Smokers were advised to cease smoking 4 weeks prior to surgery. For patients expecting adjuvant radiation therapy, our protocol included immediate alloplastic reconstruction, followed by a second-stage conversion to DIEP flap performed at least 6 months after therapy completion.

Preoperative preparation involved abdominal wall CT angiography to localize dominant perforator vessels, determine their diameter, and assess their anatomic course relative to the rectus muscle. Three-dimensional image reconstruction was utilized, and perforators were marked on a 2D image of the abdominal wall with an overlaid scaled grid.

SURGICAL TECHNIQUE

The surgical team typically comprised two plastic surgeons, with the senior author (HK) serving as the primary operating surgeon. The procedure involved parallel surgery by two teams. The mastectomy was performed by the general surgeon while abdominal flap dissection was conducted by the lead plastic surgeon. Flap design prioritized multiple perforators to reduce the risk of fat necrosis. Internal mammary vessels were the preferred recipient vessels in most cases, with dissection performed by the assistant surgeon post-mastectomy. Vascular anastomoses were performed using a ZEISS PENTERO (Carl Zeiss Co, Oberkochen, Germany) surgical microscope. Venous anastomosis utilized a coupler device, while arterial anastomosis employed either manual suturing or a

coupler device, depending on arterial pliability. Intraoperative heparin (3000 units intravenously) was administered after arterial anastomosis completion, with a second dose given in bilateral cases if more than 4 hours elapsed between arterial anastomoses. Flap insetting involved key sutures with a 2-0 Vicryl (Ethicon, Somerville, NJ, USA) for flap positioning and de-epithelialization as needed. One suction drain was placed per breast, exiting through the upper anterior axillary line. Donor site closure included primary fascia closure with 2-0 Ethibond (Ethicon), midline tension-releasing sutures above the umbilicus with 2-0 Vicryl, and three-layer abdominal closure. Two suction drains were placed, exiting the suprapubic area.

POSTOPERATIVE MANAGEMENT AND MONITORING

Postoperative care typically involved a 3–5-day hospitalization period. Flap monitoring was conducted by trained nursing staff, including hourly assessments of flap temperature, color, and capillary refill for the first 24 hours followed by monitoring every 2 hours for 24 hours. An early mobilization protocol was implemented, along with respiratory and functional physiotherapy. Patients were encouraged to ambulate as early as possible and no later than postoperative day one (POD1). This protocol is routinely applied in our unit to support recovery and minimize postoperative complications such as venous thromboembolism. Anticoagulant and antiplatelet therapy consisted of subcutaneous prophylactic Clexane (enoxaparin sodium) for 14 days (starting 12 hours post-surgery) and daily 100 mg aspirin for 3 weeks (starting the morning after surgery). Drains were removed when secretions decreased below 25 cc per day.

RESULTS

Seventy patients (102 breasts) underwent free DIEP flap breast reconstruction between 2013 and 2024. All surgeries were performed by the senior author (HK) and assisted by a team of one or two surgeons. The procedures took place in a private hospital setting: 28 cases at Assuta Medical Center, 7 cases at Herzliya Medical Center, and 35 cases at Raphael Hospital.

The mean age at the time of surgery was 42.2 ± 8 years. The average follow-up was 59 weeks (range 6–330). Immediate reconstructions were performed in 34 patients (48.6%). Recognized risk factors for free-flap breast reconstruction were present: 11.4% were smokers, and 4.3% had type 2 diabetes mellitus. In addition, 45.7% had undergone prior radiation therapy, and one patient

received adjuvant radiation therapy. Twenty-four patients (34.3%) were BRCA carriers who chose risk-reducing surgery. Bilateral reconstruction was performed in 32 patients (45.7%), while 38 patients (54.3%) underwent unilateral reconstruction. Among those undergoing unilateral reconstruction, 24 patients (63%) had a simultaneous contralateral adjustment [Table 1].

Late reconstruction was performed in 36 patients (51.4%), while delayed reconstruction with no previous reconstruction occurred in 15 (21.4%). Free DIEP flaps were vascularized by one (53%), two (32%), or three (10%) perforators and were preferentially anastomosed to the internal mammary vessels. One patient underwent a muscle-sparing procedure due to the absence of available perforators.

Table 1. patient demographics

Characteristic	Patients (N=70)
Breasts reconstructed	102
Mean age (years)	42.2 ± 8
Immediate reconstruction	34 (48.6%)
BRCA carriers	24 (34.3%)
Bilateral reconstruction	32 (45.7%)
Unilateral reconstruction	38 (54.3%)
Simultaneous contralateral adjustment	24 (63% of unilateral)
Late reconstruction	36 (51.4%)
Delayed reconstruction (no prior reconstruction)	15 (21.4%)
Smokers	8 (11.4%)
Type 2 diabetes mellitus	3 (4.3%)
Prior radiation therapy	32 (45.7%)
Adjuvant radiation therapy	1 (1.4%)

COMPLICATIONS

Total flap failure occurred in four cases (3.9%), with three involving unilateral loss in a patient who underwent bilateral reconstruction. Postoperative revisions of the microvascular anastomosis were performed in three patients, with successful flap salvage in two cases (67%). Partial flap necrosis occurred in three cases (2.9%), which required debridement in the operating room. Hematoma developed in five patients (4.9%) during hospitalization, necessitating surgical evacuation. Postoperative infection was observed in three cases (2.9%) and responded well to oral antibiotics. Fat necrosis was diagnosed in 26 breasts (25%), but follow-up surgery was required only in a minority of these cases [Table 2].

Table 2. Postoperative complications

Complication	n
Total flap failure	4 (3.9%)
Partial flap necrosis (requiring debridement)	3 (2.9%)
Hematoma (requiring surgical evacuation)	5 (4.9%)
Postoperative infection	3 (2.9%)
Fat necrosis	26 (25.0%)
Aesthetic revision offered	51 (73.0%)
Aesthetic revision elected	36 (51%)

All patients were managed entirely in a private setting, with no cases requiring hospitalization in the public system. Aesthetic revision of the reconstruction was offered to 51 patients (73%), of whom 36 (70%) elected to undergo revision surgery. Fat injection was the most common follow-up procedure. The number of follow-up surgeries per patient ranged from 1 to 4, with one surgery being the most frequent.

DISCUSSION

We found that free DIEP flap breast reconstruction can be performed safely and effectively in a private clinic, with outcomes comparable to those reported in tertiary hospitals. In this study, we analyzed data from 70 patients and 102 breasts reconstructed using free DIEP flaps. Our results show that the procedure is associated with an acceptable rate of complications, provided that rigorous surgical planning, a highly coordinated surgical team, and meticulous postoperative monitoring by trained personnel are in place.

Surgical outcomes are undeniably important, but patient-reported outcomes and quality of life measures are equally essential for evaluating the success of DIEP flap breast reconstruction. Pusic and co-authors [12] found that patients who underwent DIEP flap reconstruction reported significantly higher satisfaction with their breasts and overall results compared to those who had implant-based reconstruction.

The success of DIEP flap reconstruction in private clinic is also closely associated with surgical volume and experience. Albornoz and colleagues [13] found that higher-volume centers, performing more than 89 cases annually, exhibited significantly lower complication rates compared to lower-volume centers, regardless of whether the setting was academic or private.

These findings highlight the importance of experience and specialized training in minimizing complications and

improving efficiency, factors that are especially relevant in private clinics, where resources may be more limited than in large academic centers.

Although DIEP flap breast reconstruction typically requires more resources than implant-based reconstruction, it has proven to be more cost-effective in the long term. Matros and co-authors [14] conducted a cost-utility analysis comparing DIEP flap and implant-based reconstructions, finding that despite higher initial costs, DIEP flap reconstruction was more economical over time due to reduced complications and fewer revision surgeries.

Private clinics, however, face unique challenges and potential advantages in performing DIEP flap reconstructions. Previous studies have discussed these aspects, noting advantages such as more personalized care and efficient scheduling. Challenges include limited resources compared to academic centers, the need for specialized equipment, and the guarantee of adequate postoperative monitoring. One particular area of concern is flap monitoring. While continuous monitoring technologies such as implantable Doppler probes and tissue oximetry are increasingly used in tertiary centers and have shown promise in early detection of vascular compromise, they may not always be feasible in the private clinic setting due to cost, availability, and staffing limitations. In our experience, the use of continuous Doppler monitoring, although effective in identifying arterial inflow, may not reliably detect venous outflow obstruction .We have found that structured clinical monitoring performed hourly during the first 48 hours by trained nursing staff and focusing on flap color, temperature, and capillary refill is a highly effective and reliable method for early complication detection. Clinical signs remain the most sensitive and accessible indicators of vascular compromise and often provide immediate insight into the nature of the problem. Proper patient selection, clear protocols for managing complications, and partnerships with local hospitals for comprehensive care are critical to addressing these challenges.

In our study, total flap failure occurred in four cases (3.9%), with three cases involving unilateral loss in a patient who underwent bilateral reconstruction. Bilateral DIEP flap breast reconstruction presents unique challenges that may contribute to higher complication rates compared to unilateral procedures. In bilateral reconstructions, surgeons must identify suitable vascular structures to supply both flaps, potentially increasing operative complexity and duration. This extended surgical time can lead to increased tissue handling and a higher risk of complications. Studies have documented a high-er incidence of flap failure in bilateral DIEP reconstructions. Wade and colleagues [15] analyzed 565 DIEP flaps performed on 468 women, including 371 unilateral and 97 bilateral reconstructions. The results showed that bilateral reconstructions had a significantly higher rate of postoperative complications requiring reoperation, with a risk ratio of 2.1 ($P = 0.002$). The main cause of reoperation in bilateral cases was venous congestion, with a risk ratio of 3.1 ($P = 0.011$). In addition, the risk of total flap loss was six times greater in bilateral reconstructions compared to unilateral procedures (risk ratio 6.4, $P = 0.011$). However, the rates of revision breast and abdominal surgery were similar between the two groups. The authors concluded that while both unilateral and bilateral DIEP flap breast reconstructions are generally safe, bilateral reconstructions are associated with a higher risk of complications and total flap loss, which should be discussed with patients. Laurent et al. [16] compared 157 unilateral and 42 bilateral DIEP flaps, focusing on complications. The intra-operative complication rate was similar between the groups (12.1% for unilateral and 4.8% for bilateral flaps, $P = 0.26$). However, postoperative complications were significantly higher in bilateral reconstructions (54.7%) compared to unilateral (30.6%, $P = 0.003$). Surgical re-exploration rates were similar between the groups (12.7% for unilateral and 11.9% for bilateral, $P = 0.88$), and the rate of total flap loss was also comparable (2.5% for unilateral and 2.4% for bilateral, $P = 1$). The researchers concluded that while the total flap loss rate was similar between unilateral and bilateral reconstructions, the overall complication rate was significantly higher for bilateral DIEP breast reconstructions, suggesting that such procedures should be considered on a case-by-case basis.

The association between postoperative anticoagulation protocols and hematoma formation in breast reconstruction surgery remains a subject of ongoing investigation. Tuaño et al. [17] reported that a standardized 2-week enoxaparin regimen in patients undergoing DIEP flap reconstruction reduced venous thromboembolism (VTE) incidence to 0%, without elevating the rate of hematoma complications. Another retrospective analysis similarly found no significant difference in re-operative hematoma rates between patients who received postoperative enoxaparin and those who did not [18]. In our study, we implemented a similar anticoagulation protocol, and our hematoma rate aligned with previously reported outcomes, further supporting the safety of extended VTE prophylaxis in this patient population.

While DIEP flap reconstruction can be cost-effective in the long term, private clinics must consider the initial investment and reimbursement structures. Careful financial planning and potential collaboration with hospitals to share costs are essential to successfully establishing a microsurgery practice [19].

Our findings suggest that private clinics can offer a safe alternative for patients opting for DIEP flap breast reconstruction, with outcomes comparable to those achieved in larger medical centers. Patients can have greater flexibility and choice in selecting the setting for their surgery without compromising safety or effectiveness.

In addition, private clinics may offer advantages such as personalized care, shorter waiting times, and enhanced continuity of care. However, successful DIEP flap breast reconstruction in private clinic settings requires careful consideration of resources, experience, and financial factors. Maintaining a high surgical volume, implementing appropriate protocols, and ensuring adequate support and resources are crucial for delivering comprehensive patient care and achieving favorable outcomes.

CONCLUSIONS

With appropriate surgical expertise, a dedicated surgical team, and thorough postoperative care, free DIEP flap breast reconstruction can be successfully performed in a private clinic, offering similar outcomes to those achieved in tertiary hospitals. Future research could focus on patient satisfaction, quality of life, and long-term outcomes in private versus public settings to further understand the potential benefits and limitations of each approach.

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A belief in a supernatural source of evil is not necessary; men alone are quite capable of every wickedness.

Joseph Conrad (1857–1924), Polish-British novelist and story writer