OPEN

PRS GLOBAL OPEN

IDEAS AND INNOVATIONS

Breast

A Novel Framework for Optimizing Efficiency and Education in Microsurgical Breast Reconstruction

Mary E. Lester, MD
Jessica Berns, MD
Steven Dawson, MD
Keeley Newsom, MD
Brett Hartman, DO
Aladdin H. Hassanein, MD, MMSc

Summary: Deep inferior epigastric perforator (DIEP) flaps are becoming the most frequent choice for autologous breast reconstruction. There are many benefits to DIEP flaps, but the procedures can be lengthy and have a steep learning curve. The balance of efficiency and education can be difficult to achieve. A framework was implemented to focus on both efficiency and education at each stage of the DIEP flap procedure. The author's methods to improve efficiency include a two-team approach with assigned roles for faculty and residents. The roles are consistent across the institution. Methods to enhance education include practice in a laboratory-based microsurgical training course and assigning goals for the rotation. Trainees include independent and integrated plastic surgery residents without microsurgical fellows. Bilateral DIEPs are performed with two attendings, and unilateral DIEPs, with one attending. A retrospective review identified patients undergoing DIEP flap reconstruction from 2017 to 2020. Outcome measures include operative time and complications, which are comparable to previously published data. Focusing on education allows residents to learn each stage of the case. The authors present a framework for training residents in DIEP flap reconstruction to optimize efficiency and education. *(Plast Reconstr Surg Glob Open 2023; 11:e5445; doi: 10.1097/GOX.0000000000005445; Published online 27 November 2023.)*

DESCRIPTION OF NOVEL FRAMEWORK

Autologous breast reconstruction has high patient satisfaction, with the majority of autologous reconstruction being performed as deep inferior epigastric perforator (DIEP) flap reconstruction.[1,2] DIEP flaps have less donor site morbidity, decreased postoperative pain, quicker recovery time, and shorter hospital stays compared with transverse rectus abdominis musculocutaneous flaps. However, due to the complexity of DIEP flaps, there is greater technical difficulty and operative time.[3] Decreased operative time has been associated with improved postoperative patient outcomes. Advances in microsurgical technique including the use of a venous coupler and preoperative computed tomography angiography and perforator selection have improved efficiency.[4–6] In academic institutions, there are challenges in maintaining efficiency while maximizing trainee education. The balance of efficiency and education must be incorporated into each step of the operation for DIEP flaps. The efficiency of DIEP flaps at academic institutions with a microsurgery fellowship has been reported.[7,8] The purpose of this study is to evaluate a novel framework for performing DIEP flaps at an academic program with a plastic surgery residency and no microsurgical fellowship.

The authors obtained institutional review board approval and conducted a retrospective review of 159 patients (270 flaps) who underwent DIEP flap breast reconstruction from 2017 to 2020. The outcome measures include flap viability and operative time. The impact of resident level of training on operative time was analyzed. All data were collected via chart review and placed into a REDCap database. Continuous variables for the two groups were analyzed using *t* test. A value of *P* less than 0.05 was considered statistically significant. All statistical analyses were carried out using Microsoft Excel Data Analysis ToolPak (Microsoft Corporation, 2022).

Skills Laboratory

Efficiency in the operating room (OR) is gained by teaching fundamentals of microsurgery (FMS) in a skills laboratory. The FMS program is competency-based with progressive skill acquisition. Tasks include micro rubber band transfer, coupler time grasping, microsurgical glove suturing, microsurgical anastomosis with synthetic vessels, and microsurgical anastomosis within depth blocks.[9]

From the Division of Plastic Surgery, Indiana University School of Medicine, Indianapolis, Ind.

Received for publication July 17, 2023; accepted October 11, 2023.

Presented at the Annual Meeting for American Society of Reconstructive Microsurgery, January 14, 2022, Carlsbad, Calif.

DOI: 10.1097/GOX.0000000000005445

Disclosure statements are at the end of this article, following the correspondence information.

FMS allows residents to gain skills needed to perform the microsurgical anastomosis under direct supervision (Fig. 1). Residents must demonstrate proficiency in core skills in the laboratory before participating under the microscope in the OR.[9]

Operative Setup

The two-team model in bilateral procedures is employed with assigned educational roles for faculty and residents.[4,7,10,11] During bilateral cases, co-surgeon (attending #1) partners with the senior resident to perform the internal mammary harvest. The primary surgeon (attending #2) and chief resident simultaneously perform flap harvest. Attending #1 assists the senior resident in the first microsurgical anastomosis and later assists the chief resident with the second. All arterial anastomoses are performed by residents. For efficient use of time, attending #2 undermines the superior abdominal skin flap before flap dissection and performs abdominal closure during the microsurgical anastomoses. For unilateral DIEP flaps, one attending physician performs the flap harvest, whereas the resident prepares the internal mammary vessels (Fig. 1). The surgical technique and roles of residents and faculty are consistent throughout the institution.

Two resident groups were defined based on the level of training. The chief resident group (chief) was in the final year of training: year 6 for the integrated program or year 3 for the independent program. The senior resident group (senior) included trainees in the fourth or fifth year of an integrated program and trainees in the first or second year of the independent program.

Overall, 159 patients and 270 total flaps were included in the study (Table 1). Patient demographics, cancer treatment, and operative outcomes were similar between bilateral and unilateral DIEPs (Table 1). Flap success was 98.9% (267/270 flaps) and had no correlation with resident training. Bilateral DIEPs had an average OR time of 510 minutes compared with unilateral DIEPs OR time of 417 minutes. Bilateral chief OR time was 497 minutes versus 564 minutes for senior ($P < 0.05$). Unilateral DIEP flap reconstruction OR time was not significantly different: 409 minutes for chief compared with 431 minutes for senior ($P = 0.25$) (Table 2).

Takeaways

Question: How can you optimize education of residents while maintaining excellent outcomes and efficiency?

Findings: Incorporation of a microsurgery skills laboratory and teams in the operating room.

Meaning: Balance of education and efficiency is achievable with excellent outcomes when learning outside the operating room is incorporated into a novel framework.

DISCUSSION

DIEP flaps are currently the most frequent autologous reconstruction in the United States.[1] The authors' average operative time for a bilateral DIEP flap and unilateral DIEP is 510 minutes (8.5 h) and 417 minutes (7.0 h), respectively, with high success rates. Previously reported operative times for bilateral DIEP flaps range from 238 to 636 minutes.[4,5,7,12] Operative times would likely be faster with a microsurgery fellow or two surgeon unilateral DIEPs. However, the design approach integrates efficiency and education for each step of the procedure. The resident role in the OR is assigned according to the training level and proficiency with the surgical maneuvers. The progression of duty begins with preparation of the breast envelop, advances to internal mammary vessel harvest and microsurgical anastomosis, and concludes with perforator flap dissection.

The emphasis on education and efficiency sets the framework for each case. Well-established roles and educational objectives for the residents crystallize the practice performed during simulation in the microsurgical laboratory. Data show that senior resident participation has a larger impact on operative time in bilateral DIEP flap reconstruction compared with unilateral cases (Table 2). A second microsurgical anastomosis may contribute to the difference in operative time. Working in parallel instead of in series improves efficiency but does not sacrifice teaching.

DIEP flap breast reconstruction with trainees can be performed using this framework to optimize both efficiency and education. Paramount to this framework is the assignment roles to both attending and trainee for each stage of the procedure. Microsurgical simulation outside of the OR clearly improves efficiency in the OR. Future

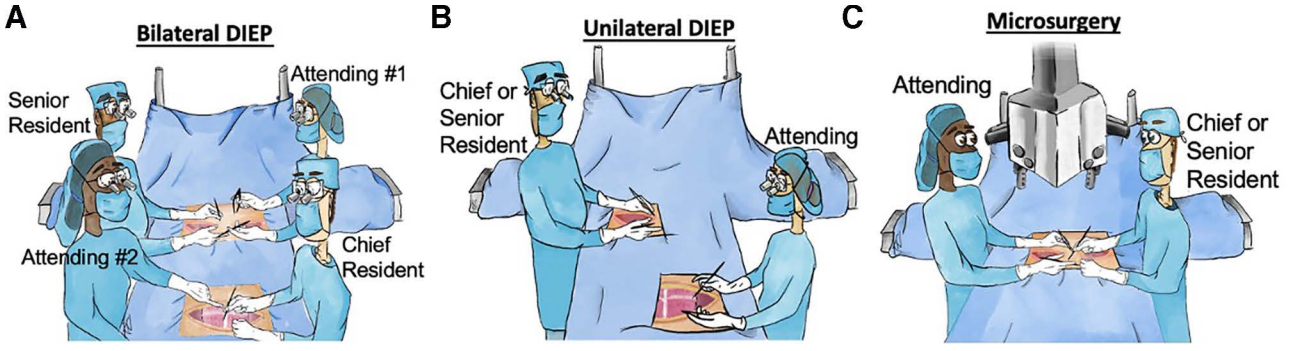

Fig. 1. DIEP flap setup for efficiency and education. A, Bilateral DIEP with attending #2 and chief resident harvesting the flaps and attending #1 and senior resident at the recipient site. B, Unilateral DIEPs are performed with one attending and a resident. C, Microsurgery performed by a senior resident under direct supervision by attending.

Table 1. Patient Demographics and Treatment Data of DIEP Flap Reconstruction

Patient Characteristics	Bilateral	Unilateral	*P*
No. flaps	222	48	
Mean age ± SD, y	48 ± 9.2	54 ± 7.7	<0.05
Mean BMI ± SD, kg/m²	31 ± 6.3	31 ± 5.7	0.47
Comorbidities			
Smoking status	5 (2%)	1 (2%)	0.79
Diabetes status	16 (7%)	6 (12%)	0.31
Hypertension	56 (25%)	15 (31%)	0.65
Breast cancer treatment			
Chemo	53 (23%)	7 (15%)	0.58
Radiation	30 (13%)	23 (48%)	0.26
Outcomes			
Flap take back	8 (3.6%)	3 (6%)	0.89
Anastomosis revision	5 (2.2%)	3 (6%)	0.64
Flap loss	1 (0.4%)	2 (4%)	0.44
Hematoma	5 (2.2%)	3 (6%)	0.57
Seroma (%)	17 (7.6%)	5 (10%)	0.88
Surgical site infection (%)	26 (11.7%)	11 (23%)	0.94
Abdominal wounds (%)	19 (8.5%)	9 (19%)	0.79
Breast wounds (%)	27 (12%)	13 (27%)	0.69
Venous thromboembolism (%)	1 (0.4%)	0 (0%)	0.15

Table 2. DIEP Flap Reconstruction Operative Times by Resident Level

Case Type	Bilateral DIEP (%)			Unilateral DIEP (%)		
Resident type	Chief	Senior	*P*	Chief	Senior	*P*
Mean OR time ±, min	497 ± 79	564 ± 95	<0.05	409 ± 84	431 ± 91	0.25
No. flaps performed	178	44		32	16	

studies will include comparing resident intraoperative anastomosis time during DIEP flap based on the participation in the microsurgical skills laboratory. Education can be balanced with operative progression by organized steps, assigned roles, microsurgical skills laboratory training, and a two-team approach.

Mary E. Lester, MD
Division of Plastic Surgery
Indiana University School of Medicine
545 Barnhill Drive, Emerson Hall 232
Indianapolis, IN
E-mail: melester@iu.edu

DISCLOSURES

The authors have no financial interest to declare in relation to the content of this article. The Indiana University Department of Surgery was awarded an educational grant for our microsurgery skills laboratory from Zimmer-Biomet on December 13, 2019, for $3114.00. The Indiana University Department of Surgery was awarded an educational grant for our microsurgery skills laboratory from Zimmer-Biomet on July 5, 2023, for $34,600.00.

REFERENCES

1. ASPS. ASPS National Clearinghouse of plastic surgery procedural statistics. 2022. Available at https://www.plasticsurgery.org/documents/News/Statistics/2020/plastic-surgery-statistics-full-report-2020.pdf. Accessed December 19, 2022.
2. Pittelkow E, DeBrock W, Christopher L, et al. Advantages of the delayed-immediate microsurgical breast reconstruction: extending the choice. *J Reconstr Microsurg.* 2022;38:579–584.
3. Laporta R, Longo B, Sorotos M, et al. Time-dependent factors in DIEP flap breast reconstruction. *Microsurgery.* 2017;37:793–799.
4. Haddock NT, Dumestre DO, Teotia SS. Efficiency in DIEP flap breast reconstruction: the real benefit of computed tomographic angiography imaging. *Plast Reconstr Surg.* 2020;146:719–723.
5. Schaverien MV, Ludman CN, Neil-Dwyer J, et al. Contrast-enhanced magnetic resonance angiography for preoperative imaging in DIEP flap breast reconstruction. *Plast Reconstr Surg.* 2011;128:56–62.
6. Wu GJ, Loewenstein SN, Mailey BA, et al. Unique complications of venous anastomotic couplers: a systematic review of the literature. *J Reconstr Microsurg.* 2020;36:403–411.
7. Haddock NT, Teotia SS. Efficient DIEP Flap: bilateral breast reconstruction in less than four hours. *Plast Reconstr Surg Glob Open.* 2021;9:e3801.
8. Haddock NT, Tycher JT, Teotia SS. Deliberate practice and process analysis in DIEP flap breast reconstruction: an immediate and sustained decrease in morbidity and operative time. *Plast Reconstr Surg.* 2023;152:791e–800e.
9. Chauhan R, Ingersol C, Wooden WA, et al. Fundamentals of microsurgery: a novel simulation curriculum based on validated laparoscopic education approaches. *J Reconstr Microsurg.* 2022;39:517–525.
10. Haddock NT, Kayfan S, Pezeshk RA, et al. Co-surgeons in breast reconstructive microsurgery: what do they bring to the table? *Microsurgery.* 2018;38:14–20.
11. Smit JM, Dimopoulou A, Liss AG, et al. Preoperative CT angiography reduces surgery time in perforator flap reconstruction. *J Plast Reconstr Aesthet Surg.* 2009;62:1112–1117.
12. Issa CJ, Lu SM, Boudiab EM, et al. Comparing plastic surgeon operative time for DIEP flap breast reconstruction: 2-stage more efficient than 1-stage? *Plast Reconstr Surg Glob Open.* 2021;9:e3608.