

Comparisons of Resource Costs and Success Rates between Immediate and Delayed Breast Reconstruction Using DIEP or SIEA Flaps under a Well-Controlled Clinical Trial

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Background: Every year many patients diagnosed with breast cancer are subjected to mastectomy. Some of them choose to undergo breast reconstruction to restore their body image. Immediate or delayed reconstruction is possible, depending on medical, financial, and emotional considerations. High success rate and cost-effectiveness are two important factors that may guide decision making in the management plan. The objective of this study was to compare the resource costs and success rates of immediate and delayed breast reconstructions using either deep inferior epigastric perforator (DIEP) or superficial inferior epigastric artery (SIEA) flaps. The resource cost is referred to as the cost of operation and hospitalization.

Methods: From September of 2000 through August of 2001, 42 patients underwent immediate ($n = 21$) or delayed ($n = 21$) unilateral breast reconstruction using either a DIEP ($n = 30$) or SIEA ($n = 12$) flap by one surgeon.

Results: There were no statistical differences in resource costs, success, and complication rates between DIEP and SIEA flaps in both the immediate and delayed breast reconstruction groups.

Conclusions: Using either a DIEP or SIEA flap as the autologous tissue, delayed breast reconstruction is as cost-effective as immediate reconstruction. (*Plast. Reconstr. Surg.* 117: 2139, 2006.)

A number of reconstructive options are available for immediate or delayed post-mastectomy breast reconstruction including transverse rectus abdominis musculocutaneous (TRAM) flaps,^{1,2} deep inferior epigastric perforator (DIEP) flaps,³ superficial inferior epigastric artery (SIEA) flaps,⁴ latissimus dorsi myocutaneous flaps,⁵ and implants.⁶ Each alternative has its own advantages and disadvantages with respect to postoperative complications, donor site morbidity, and aesthetic appearance.

Although the ideal timing of reconstruction remains controversial, there are some studies reporting that immediate reconstruction is more

cost-effective because it is a one-stage procedure, requiring one anesthetic procedure and one recovery period.⁶⁻⁹ However, the cohorts of these studies were diverse, and a wide variety of reconstructive options were performed by different surgeons. For a precise comparison of the two time periods with regard to cost and success rate, ideally, the operations should be performed by one surgeon and the reconstructive choice should remain the same to avoid additional variability.

In this study, in a relatively homogeneous cohort of patients, immediate and delayed reconstructions were performed by one surgeon (M.-H.C.) using SIEA or DIEP flaps. The risk factors^{2,10} for fat necrosis and partial flap loss, including smoking, preoperative radiation, and obesity, were taken into consideration in both immediate and delayed reconstruction groups.

PATIENTS AND METHODS

Between September of 2000 and August of 2001, 42 consecutive patients undergoing unilateral mastectomy and breast reconstruction using

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Table 1. Cost Components for Breast Reconstruction in Chang Gung Memorial Hospital, Taiwan, in 2000

Cost Components	Cost (US dollars in 2000)
Operating room/hour	173.00
Staff surgeon/hour	40.00
Surgical assistant/hour	12.00
Anesthesia personnel/hour	32.00
Hospital stay, microsurgery ICU/day	180.00
Hospital stay, regular ward/day	60.00

ICU, intensive care unit.

a DIEP or SIEA flap were included in this study. There were 21 patients in both immediate and delayed reconstruction groups, and each group contained 15 DIEP and six SIEA flaps. The ages ranged from 27 to 64 years (mean, 44.5 years). The risk factors,^{2,10} including tobacco use, preoperative radiotherapy, and obesity level (measured by weight/ height index), were recorded.

As the fee charged to either the patients or the insurance company is subject to the insurance regulations and may vary from institution to institution, the resource cost was adopted for this comparison study and referred to as the total fee of primary operation, operation for complications, and hospitalization. The former included the hourly fee of operating room use; hourly salaries of surgical, anesthesia, and nursing personnel; and the total expense of the operation materials. The latter was the daily fee for the ward or intensive care unit (Table 1). Because the same procedure was performed by the same surgeon in the same setting, the costs for reusable and disposable materials and equipment were estimated to be standard. The fee for the operating room use was obtained from records of the department of administration and management in surgery. The hourly fees of plastic and general surgeons, surgical assistants, anesthesiologists, and nurses were calculated from their average annual incomes. The Department of Administration and Management in Surgery and the Department of Anesthesiology provided the data for calculation.

After the breast reconstruction, all patients were admitted to the microsurgery intensive care

unit for flap monitoring for 3 to 4 days and then transferred to a regular ward. The days of readmission due to complications were also included to the total length of hospital stay.

Statistical significance was determined by using an unpaired *t* test and Fisher's exact test; *p* < 0.05 was considered statistically significant.

RESULTS

There were no statistical differences in the rates of tobacco use, preoperative radiotherapy, or the weight/height index between the immediate and delayed breast reconstruction groups (Table 2).

The mean operating time in the immediate and delayed reconstruction was 7.9 hours (range, 3.5 to 9.8) and 8.15 hours (range, 4.2 to 11.8), and the mean hospital stay was 8.9 day (range, 5 to 17) and 8.85 days (range, 5 to 16), respectively. Complication rates were 9.5 percent in both groups. The overall cost was calculated as US\$2952 (range, 1679 to 6443) in immediate reconstruction group and US\$ 3076 (range, 1867 to 4832.6) in delayed reconstruction group.

All flaps survived. Two patients in the immediate SIEA flap group underwent reexploration. One patient had re-anastomosis due to arterial insufficiency, and the other developed hematoma resulting in venous congestion. These two flaps were successfully salvaged. One patient in the delayed SIEA group had partial flap necrosis that required excision. One patient in the delayed DIEP group underwent reexploration for removal of a hematoma.

The resource costs of both immediate and delayed breast reconstruction using DIEP and SIEA flaps are shown in Table 3, and there was no statistical difference between the two groups.

DISCUSSION

The timing of reconstruction does not significantly hinder the detection of local recurrence of cancer or the rate of local recurrence after 5 years.¹¹⁻¹⁴ Therefore, immediate and delayed breast reconstructions have been reliably performed for many years. Lower abdominal fat re-

Table 2. Rates of Tobacco Use, Weight/Height Index, and Preoperative Radiation in the Immediate and Delayed Groups

	Immediate	Delayed	<i>p</i> (two-tailed)
Tobacco use	2	2	1.0
Mean weight/height index, kg/m ² ± SEM	21.07 ± 0.6460	20.79 ± 0.5417	0.74
Radiation	2	1	0.58

Table 3. Comparisons of Resource Costs between Immediate and Delayed Breast Reconstruction Groups Using DIEP and SIEA Flaps

Reconstruction Options	Immediate			Delayed			Average
	DIEP Flap	SIEA Flap	Mean	DIEP Flap	SIEA Flap	Mean	
No. of flaps	15	6		15	6		
Operating time, hours	7.72	8.44	7.9	7.92	9.5	8.4	8.15
Hospital stay, days	8.4	10.3	8.9	8.5	9.7	8.8	8.85
Cost, US\$ in 2000	2855.6	3249	2952.9	3046.6	3580	3199	3076
Complication rate	0	33.3% (2/6)	9.5% (2/21)	6.7% (1/15)	16.7% (1/6)	9.5% (2/21)	9.52% (4/42)

DIEP, deep inferior epigastric perforator; SIEA, superficial inferior epigastric artery.

mains as the first choice of autologous tissue for breast reconstruction in most cases. DIEP and SIEA flaps are the refinements of conventional myocutaneous flaps from the lower abdomen because they are associated with lower donor site morbidity and rapid recovery.^{2,4} The ideal timing of reconstruction is still a matter of debate. High success rate and cost-effectiveness are two important factors that may influence the decision regarding immediate or delayed reconstruction in the management plan.

Some studies reported that immediate reconstruction is more cost-effective and associated with superior aesthetic outcomes.⁶⁻⁹ However, the cohorts of these studies are diverse, and a wide variety of reconstructive options were performed by different surgeons. This study is the first to present a comparative study of immediate and delayed reconstruction regarding the resource costs and success rates in a relatively homogeneous cohort with identical reconstructive options, the same surgeon, and similar risk factors.

DIEP or SIEA flaps were used as the reconstructive options. The decision for flap selection was based on the size of the perforators of each system. Technically, we usually dissected the SIEA first and then the DIEP to find out the most suitable perforator. If a sizable (larger than average) perforator was detected from SIEA, we proceeded to do SIEA flap or vice versa. Our experience showed that 28.6 percent (12 of 42) of the SIEAs were usable. However, the higher complication rate of this flap (Table 4) was attributed to our

learning curve rather than its unreliability because all three complications occurred in the first six SIEA flaps. The experience of the surgeon is an important factor indirectly affecting the cost because the higher complication rate and the longer length of the operation.

The mean operating times for immediate and delayed reconstructions were 7.9 hours and 8.1 hours, respectively, and this time difference was statistically insignificant. In our practice, because the internal mammary artery and vein were used rather than axillary vessels as the recipient as regards pedicle dissection, immediate reconstruction did not provide a time advantage over delayed reconstruction. It is postulated that a two-team approach for mastectomy and flap harvest can shorten the operating time and anesthesia period, thus reducing the overall cost. However, the operating areas are relatively closer in a short-stature Asian patient, and two team approaches could not be routinely used at our institution.

Contrary to previous studies reporting a significant cost difference between immediate and delayed reconstructions,⁶⁻⁹ our study showed only a \$246 higher cost in the delayed group (Table 3), which was not statistically significant ($p = 0.345$). Moreover, Kroll et al.¹⁵ reported that immediate reconstruction using free TRAM and a DIEP flap was even more expensive than delayed reconstruction.¹⁵ The higher costs due to additional anesthesia and admission in delayed reconstruction were not applicable in our study for two reasons: first, a two-team approach was not avail-

Table 4. Comparison of Resource Costs of DIEP and SIEA Flaps for Breast Reconstruction

Reconstruction Options	DIEP Flap	SIEA Flap	Average
No. of cases	30	12	
Operating time, hours	7.8	9.0	8.14
Hospital stay, days	8.45	9.25	8.68
Cost, US\$ in 2000	2951	3414.5	3083.4
Complication rate	3.3% (1/30)	25% (3/12)	9.52% (4/42)

DIEP, deep inferior epigastric perforator; SIEA, superficial inferior epigastric artery.

able (similar anesthesia and operating time) and, second, the additional admission cost of mastectomy was not significant (\$60/day) compared with the overall cost of breast reconstruction at our institution.

It is our conclusion that, as the resource costs and success rates were similar in both immediate and delayed breast reconstructions using DIEP and SIEA flaps, cost should not be a determining factor in deciding the timing of breast reconstruction.

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REFERENCES

1. Elliott, L. F., Eskenazi, L., Beegle, P. H., Jr., Podres, P. E., and Drazan, L. Immediate TRAM flap breast reconstruction: 128 consecutive cases. *Plast. Reconstr. Surg.* 92: 217, 1993.
2. Kroll, S. S., Gherardini, G., Martin, J. E., et al. Fat necrosis in free and pedicled TRAM flaps. *Plast. Reconstr. Surg.* 102: 1052, 1998.
3. Blondeel, P. N. One hundred free DIEP flap breast reconstruction: A personal experience. *Br. J. Plast. Surg.* 52: 104, 1999.
4. Chevray, P. M. Breast reconstruction with superficial inferior epigastric artery flaps: A prospective comparison with TRAM and DIEP flaps. *Plast. Reconstr. Surg.* 114: 1077, 2004.
5. Hayes, A. J., Garner, J. P., Nicholas, W., and Laidlaw, I. J. A comparative study of envelope mastectomy and immediate reconstruction (EMIR) with standard latissimus dorsi immediate breast reconstruction. *Eur. J. Surg. Oncol.* 30: 744, 2004.
6. Kroll, S. S., Evans, G. R. D., Reece, G. P., et al. Comparison of resource costs between implant-based and TRAM flap breast reconstruction. *Plast. Reconstr. Surg.* 97: 364, 1996.
7. Elkowitz, A., Colen, S., Slavin, S., Seibert, J., Weinstein, M., and Shaw, W. Various methods of breast reconstruction after mastectomy: An economic comparison. *Plast. Reconstr. Surg.* 92: 77, 1993.
8. Khoo, A., Kroll, S. S., Reece, G., et al. A comparison of resource costs of immediate and delayed breast reconstruction. *Plast. Reconstr. Surg.* 101: 964, 1998.
9. McGhan, an Inamed Company. *Surgical Reconstruction of the Breast for Women with Breast Cancer: A Reference Guide for Breast Care Nurses.* Wicklow, Ireland: Arklow, 2002.
10. Kroll, S. S. Fat necrosis in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps. *Plast. Reconstr. Surg.* 106: 576, 2000.
11. Feller, W. F., Holt, R., Spear, S., and Little, J. W. Modified radical mastectomy with immediate breast reconstruction. *Am Surg.* 52: 129, 1986.
12. Langstein, H. N., Cheng, M. H., Singletary, S. E., et al. Breast cancer recurrence after immediate reconstruction: Patterns and significance. *Plast. Reconstr. Surg.* 111: 712, 2003.
13. Slavin, S. A., Love, S. M., and Goldwyn, R. M. Recurrent breast cancer following immediate reconstruction with myocutaneous flaps. *Plast. Reconstr. Surg.* 93: 1191, 1994.
14. Kroll, S. S., Schusterman, M. A., Tadjalli, H. E., Singletary, S. E., and Ames, F. C. Risk of recurrence after treatment of early breast cancer with skin sparing mastectomy. *Ann. Surg. Oncol.* 4: 193, 1997.
15. Kroll, S. S., Reece, G. P., Miller, M. J., et al. Comparison of cost for DIEP and free TRAM flap breast reconstructions. *Plast. Reconstr. Surg.* 107: 1413, 2001.