

# Comparison of Cost for DIEP and Free TRAM Flap Breast Reconstructions

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A recent article by Kaplan and Allen suggested that deep inferior epigastric perforator (DIEP) flap breast reconstruction was less expensive than reconstruction performed with free transverse rectus abdominis musculocutaneous (TRAM) flaps. To test that hypothesis, a series of patients who had undergone unilateral breast-mound reconstruction by the first author using DIEP or free TRAM flaps between November 1, 1996, and March 30, 2000, were reviewed. Bilateral reconstructions and reconstructions performed by other surgeons in the department were excluded to eliminate all variables except the choice of flap. All hours in the operating room and days in the hospital until discharge were included. Early readmissions for the treatment of complications were included, as were the costs of the mastectomy in the case of immediate reconstructions, but late revisions and nipple reconstructions were not. The totals were then converted into resource costs in 1999 dollars, and the DIEP and free TRAM flap groups compared. There were 21 DIEP flaps and 24 free TRAM flaps in the series. In this series, there was no significant difference between the cost of DIEP and free TRAM flap breast reconstruction. (*Plast. Reconstr. Surg.* 107: 1413, 2001.)

In a recent article, Kaplan and Allen suggested that breast reconstruction with the deep inferior epigastric perforator (DIEP) flap was significantly less expensive than reconstruction with the free transverse rectus abdominis musculocutaneous (TRAM) flap.<sup>1</sup> They reported short operating times and hospital stays for patients who had recently undergone reconstruction with the DIEP flap and compared that population with a series of patients who had undergone reconstruction in our institution approximately 10 years earlier.<sup>2</sup> In that comparison, the patients who had undergone reconstruction with TRAM flaps had longer hospital stays and higher costs than had the

patients who had undergone reconstruction more recently with the DIEP flap. The authors suggested that there were inherent advantages of the DIEP flap that made it more cost-effective. To test that hypothesis, we decided to review the recent experience of one surgeon in our group with free TRAM and DIEP flaps to see whether we could confirm their findings.

## PATIENTS AND METHODS

All available charts of patients who had undergone unilateral breast-mound reconstructions by the first author between November 1, 1996, and March 30, 2000, were included in the review. Bilateral reconstructions and reconstructions performed by other surgeons in our group were excluded to eliminate all possible variables except flap choice. All hours spent in the operating room and days spent in the hospital until the patient was discharged with a healed wound were totaled. Early readmissions for the treatment of complications were included, but subsequent revisions for symmetry and for nipple reconstruction were not. The hours of operating room time and days in the hospital were then converted into resource costs. Resource costs were defined as the cost to the hospital of providing the service of breast reconstruction, a concept analogous to that of a wholesale cost of goods which will then be sold at a higher retail cost by a store. The hospital bills, analogous to those higher retail costs, were ignored for the purposes of this study.

Resource costs were calculated starting with estimates in 1993 dollars obtained from our

TABLE I  
Resource Cost Components in 1999 Dollars

Cost Component	Dollar Value
Operating room (1 hour)	615.00
Hospital day, TRAM patient	1,330.00
Staff surgeon (1 hour)	175.00
Surgical assistant (1 hour)	48.00
Anesthesia personnel cost (1 hour)	134.00

hospital during an earlier study.<sup>2</sup> These resource costs were then converted into 1999 dollars (Table I) by using the medical cost subindex<sup>3</sup> to multiply the 1993 costs by a factor of 1.123, as suggested by Kaplan and Allen.<sup>1</sup> Because these were all autologous tissue reconstructions, the only cost factors were days spent in the hospital and hours spent in the operating room.

Statistical analysis was performed using a *t* test with independent samples. *P* values of less than 0.05 were considered to be statistically significant.

#### RESULTS

During the study period, 21 unilateral DIEP flap and 24 unilateral free TRAM flap breast-mound reconstructions were performed by the first author. As can be seen in Table II, there were no significant differences in resource costs between the free TRAM and DIEP flap groups. Although the free TRAM patients had shorter operating room times and the DIEP flap patients had slightly shorter hospital stays, the mean final cost was similar.

One reason that the cumulative operating room times were longer in the DIEP flap group was that several of those patients experienced flap-edge necrosis that required that they return to the operating room for debridement and revision (Fig. 1). This was necessary because the DIEP flap patients had a less robust blood supply to the flaps and a higher incidence of partial flap loss than did the free

TRAM flap patients.<sup>4</sup> Although the final result was satisfactory, the additional surgery added to the total operative times of the DIEP flap group, increasing the cost.

#### DISCUSSION

Breast reconstruction is a unique subspecialty of reconstructive surgery in that the aesthetic quality of the result is of paramount importance to the patient. It is not enough to simply transfer tissue successfully to the chest wall; it has to be shaped into something that imitates the opposite breast if the result is to be judged a success. Each surgeon does this differently and at a different speed. It is therefore not scientifically valid to compare the speed and cost of reconstruction by one surgeon to those of another unless the aesthetic quality of the results is also compared. Even then, the faster surgeon's speed may not be reproducible by other surgeons with less experience and talent. Therefore, the only fair way to compare the costs of the DIEP and free TRAM flaps is to compare them in the practice of a single surgeon who has experience with both operations.

In this study, the operative times and hospital stays of patients reconstructed with free TRAM and DIEP flaps by one surgeon were compared. In this way, biases caused by different operating speeds and different goals were eliminated. In both groups, the goal was identical: a result of high aesthetic quality (Fig. 2). Although this goal was not achieved in every case, aesthetic quality was never compromised to achieve a shorter operative time. In this way, a fair comparison between the cost of the free TRAM and the DIEP flaps could be made.

We would agree with Drs. Kaplan and Allen that the DIEP flap has many advantages and that patients who undergo reconstruction with DIEP flaps have less pain than that experienced by patients who undergo TRAM flap reconstruction. If pain were the only reason to keep patients

TABLE II  
Hospital Days, Operating Room Times, and Resource Costs of Breast-Mound Reconstruction Using DIEP and Free TRAM Flaps

Flap Group	No. of Flaps	Hospital Days	Operating Room Hours	Total Cost in 1999 Dollars	<i>p</i>
DIEP	21	6.00	11.27	18,941	
Free TRAM	24	6.11	10.63	18,038	
Immediate DIEP	14	6.29	11.23	19,281	0.457
Immediate free TRAM	16	6.50	10.19	18,550	
Delayed DIEP	7	5.43	11.36	18,263	0.296
Delayed free TRAM	8	5.63	9.81	17,016	



FIG. 1. (Left) Partial necrosis of the distal edge of a DIEP flap (flap was oriented vertically). (Right) The appearance after debridement and revision.

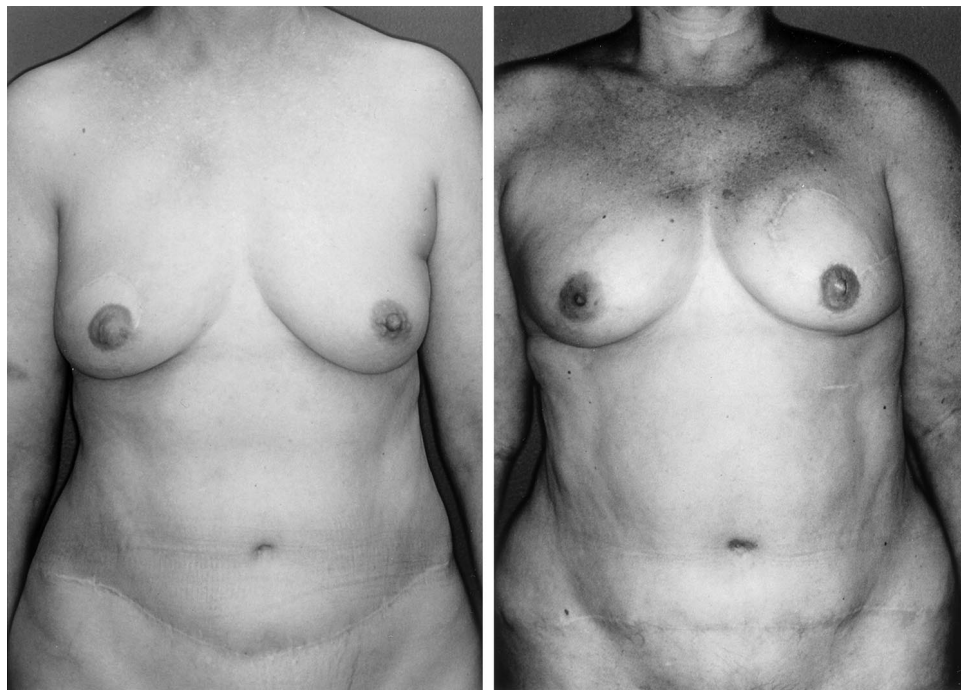


FIG. 2. (Left) Result of left-breast reconstruction with a free TRAM flap. (Right) Result of left-breast reconstruction with a DIEP flap.

in the hospital, most DIEP and some free TRAM flap patients could have been discharged earlier and would have had lower costs in our study. We believe, however, that all free-flap patients should be monitored in the hospital for at least 3 full

days after a free-tissue transfer so that if the vascular pedicle becomes obstructed, the patient will have a reasonable chance of having the flap salvaged.<sup>5</sup> For this reason, all our patients stayed in the hospital for 4 full days, even if they did not

require intravenous pain medication for all of that time.

As our experience with DIEP flaps increases, we are becoming more and more convinced of their importance to patients and to surgeons who perform breast reconstruction. DIEP flaps do cause less donor-site morbidity, which in many—if not most—patients is worth the cost in reduced flap blood supply. We are hopeful that, with increasing experience, our operative times and costs will decrease and that we will learn how to select patients better so that partial flap losses and fat necrosis<sup>4</sup> are minimized. The DIEP flap has an important place in the future of breast reconstruction, and we are all indebted to the pioneers like Koshima and Soeda,<sup>6</sup> Allen and Treece,<sup>7</sup> Dupin et al.,<sup>8</sup> Blondeel,<sup>9</sup> Feller and Galla,<sup>10</sup> Ninkovic et al.,<sup>11,12</sup> and others who began this work. The DIEP flap is not without its own disadvantages, however, and is not necessarily the best choice for every patient. It is a sophisticated surgical procedure that is more difficult, not easier, than a free TRAM flap. The advantages of the DIEP flap include reduced postoperative pain, less abdominal-wall weakness, and a faster recovery. They do not, unfortunately, also include lower cost.

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