

Simultaneous Bilateral Breast Reconstruction With the Transverse Rectus Abdominus Musculocutaneous Free Flap

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Objective

The purpose of the study was to assess the results and morbidity associated with simultaneous bilateral TRAM free flap breast reconstruction and describe refinements in its surgical technique.

Summary Background Data

Bilateral prophylactic total mastectomies might be an agreeable option for those patients at highest risk for breast cancer if autogenous tissue breast reconstruction could be performed with reasonable technical ease and acceptable morbidity. However, some surgeons harbor reservations regarding the extensiveness of the surgery, the associated morbidity, and the aesthetic quality of the resulting outcome.

Methods

A multicenter retrospective review of clinical experience with 120 consecutive patients who underwent 240 simultaneous bilateral TRAM free flap breast reconstructions was developed.

Results

The average operating time, including the time required for the breast ablative portion of the procedures, was 8.6 hours. The average length of hospitalization was 7.6 days. However, for the last 40 patients, these figures were reduced to 7.1 hours and 6.1 days, respectively. Nonautologous blood transfusions were needed in 33 cases (28%), but only 1 was required in the last 40 patients. Thromboses developed in six of 240 flaps (2.5%); 4 were arterial and 2 were venous. Re-exploration allowed us to restore circulation in five flaps, whereas one flap was unsalvageable and was replaced successfully with an alternate flap. An uncomplicated deep vein thromboses developed in one patient with a history of recurrent deep vein thromboses that had no adverse effect on her outcome. Minor complications developed in 18 patients (15%) (e.g., hematoma, partial wound necrosis, wound infection, or prolonged postoperative ileus) that did not affect the long-term outcome. Fourteen patients (11.6%) had abdominal wall weakness or hernias. Follow-up time averaged 37.2 months (range, 14–62 months). On last follow-up, patients' self-reported overall satisfaction with the procedure was 56% excellent, 40% good, and 4% fair.

Conclusions

Simultaneous bilateral free flap reconstruction is technically feasible with a high rate of success and an acceptable morbidity. When performed by experienced surgeons, bilateral prophylactic total mastectomies combined with simultaneous bilateral TRAM free flap reconstruction may provide an adequate surgical option with aesthetically acceptable results for patients at high risk for breast cancer.

Accurate genetic screening enables prophylactic thyroidectomy in patients with multiple endocrine neoplasia type 2A syndrome.¹ Yet for some, the analogous removal of an apparently healthy breast seems difficult to entertain. With the development of genetic markers that will permit the early identification of those at highest risk for having breast cancer develop, we face a surgical quandary. Can prophylactic bilateral total mastectomy combined with simultaneous TRAM free flap reconstruction provide a feasible alternative to years of scrupulous surveillance and worry?

In the past, reconstructive options were limited and the indications for prophylactic mastectomy were based on strong suspicion rather than sound science. Assuming the latter can be overcome with increasingly refined screening techniques, autogenous tissue reconstruction now provides an option that is amenable to many patients. Autogenous tissue breast reconstructions may have distinct advantages over artificial implants.^{2,3} Although the pedicle TRAM flap reconstruction is now routine in many centers, the microsurgical free TRAM has distinct improvements that make it a superior method of breast reconstruction.⁴⁻¹³ Still, some surgeons may harbor reservations regarding the extensiveness of the surgery, the associated morbidity, and the aesthetic quality of the resulting outcome. The current article reviews the authors' experience with 240 flaps in 120 consecutive patients who underwent simultaneous bilateral TRAM free flap breast reconstruction. In addition, we will present some technical refinements that allowed us to decrease operative time and morbidity.

PATIENTS AND METHODS

All patients who underwent reconstructive breast surgery from April 1991 to March 1995 by the author (RKK) at The Washington University Medical Center, St. Louis, were registered in a computerized database. Of the 274 patients who were observed in this manner, 60 patients who had undergone simultaneous bilateral TRAM free flap reconstruction were identified. Similar data from 60 consecutive patients who underwent the same procedure at the UCLA Medical Center by the authors (WWS and

CYA) were collected. The combined data yielded a total of 120 patients who were used as the basis for this study.

The decision to use one reconstructive procedure over another depended on physician and patient preference. If a patient was in generally good health and expressed an interest in receiving the best reconstruction possible, the surgeon advised the patient to consider autologous tissue breast reconstruction. In most cases, the TRAM flap was considered to be the donor site of choice. The free TRAM was selected over the pedicled TRAM because of the advantages mentioned below and the author's familiarity with microsurgical technique.

The data assessed included demographic information, height and weight, preoperative health status, tobacco consumption, preoperative abdominal scars, operative technique, operative time, length of hospitalization, and complications. Chart reviews conducted at the time of this report completed and/or augmented the information in the database. Information concerning complications and patient satisfaction was updated as patients were seen for follow-up. Additionally, telephone interviews were conducted regarding each patient's current level of satisfaction with the results of the procedure.

Complications were defined as abdominal wall weakness or hernia, thrombosis requiring re-exploration; hematoma; seroma; partial skin necrosis; wound infection requiring prolonged hospitalization for intravenous antibiotics; and prolonged postoperative ileus. Operative technical assessment included the size of flap, the recipient vessels chosen, whether mesh was used in support of the abdominal wall closure, and the number of autologous or nonautologous units of blood required.

Surgical Technique

Although the operative technique essentially was the same from patient to patient, the placement and size of the flaps varied depending on the reconstructive requirements and the patient's smoking habits. In patients who smoked, we preferred a more cephalic flap with less lateral extension. This serves to reduce the length of the abdominal skin apron on closure and decreases the chance of distal flap necrosis. The dimensions of the flaps were circumscribed before surgery. In general, the superior margins were at the level of the umbilicus, the inferior margins were near the level of the iliac crest, and the lateral margins came to a gently tapered point at approximately the

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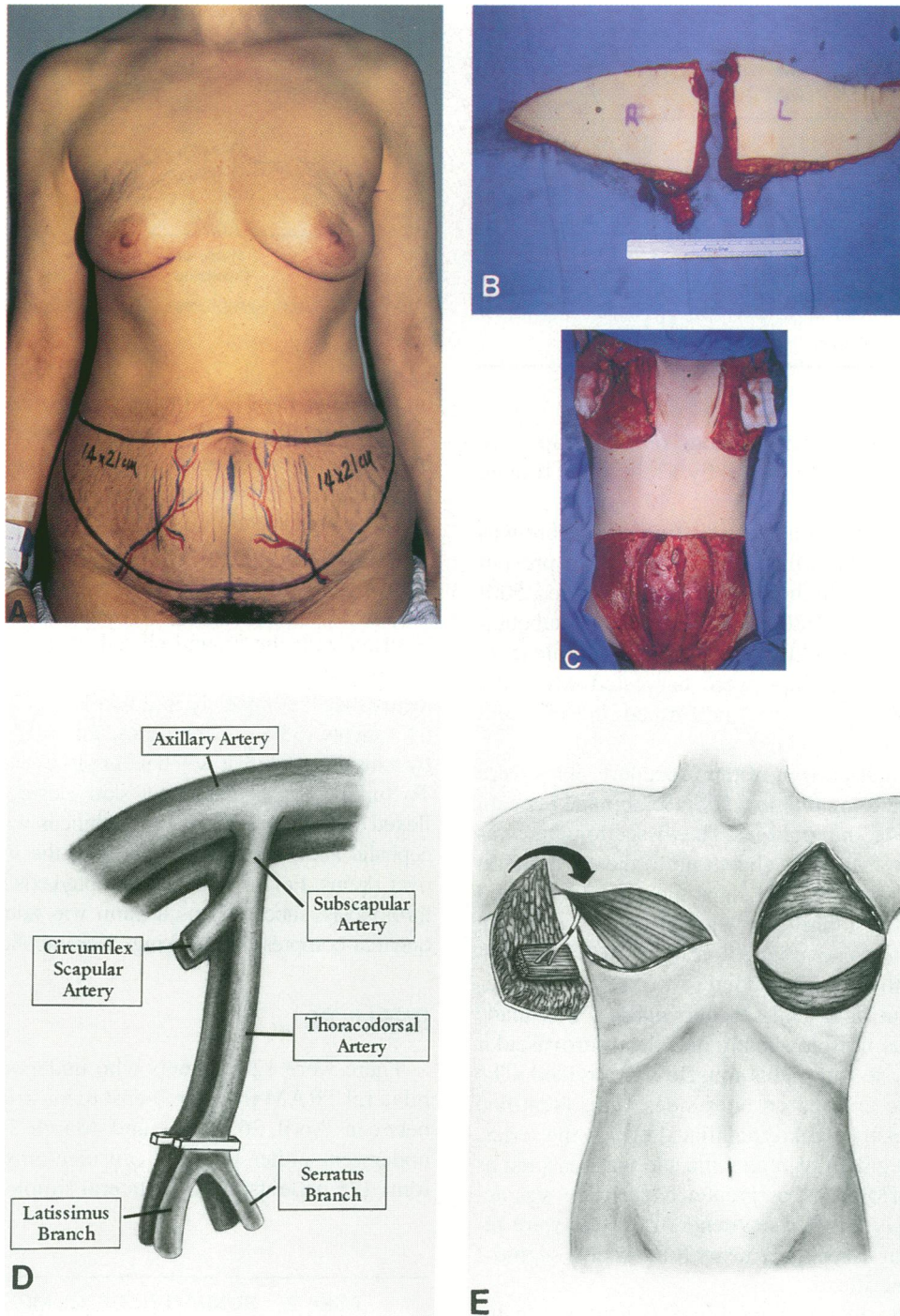


Figure 1. (A) Details of flap design and harvest. In patients who did not smoke, the cephalic portion of the flap is at the level of the umbilicus and the caudal portion is extended as inferior as deemed possible to close the abdominal apron without tension. The lateral margins of the flap extend to the midaxillary line. With surgeons on either side of the abdomen, both hemi-TRAMS can be raised simultaneously. (B) The two hemi-TRAMS shown dissected on a side table. (C) The thoracodorsal vessels are shown dissected free against a surgical gauze background. Unencumbered wide exposure without assistance is achieved with the aid of fish hooks. (D) The thoracodorsal artery is ligated just proximal to the serratus branch, leaving the serratus-to-latissimus arcade intact. The vessel then is mobilized proximally up to the circumflex scapular branch. (E) The flap is wedged in the axilla and revascularized with the muscle facing upward for easy exposure. Once the anastomoses are complete, the flap then is flipped over the pectoralis muscle (arrow), and the rectus muscle is secured to the pectoralis in a position in which the pedicle lies comfortably without kinks or tension. The flap then is de-epithelialized with the size of the cutaneous paddle being commensurate with the extent of the skin resection during the mastectomy.

Table 1. CLINICAL SUMMARY OF SIMULTANEOUS BILATERAL TRAM FREE FLAP PATIENTS*

Number of patients	120
Number of TRAM free flaps	240
Average age (yr)	46.7 (34–69)
Average follow-up (mo)	37.2 (14–62)
Average hospital stay (days)	7.6 (5–15)
Average operative time (hr) (includes mastectomy and/or implantectomy)	8.6 (5.5–14)

* Ranges are given in parentheses.

midaxillary. The average dimensions of each flap were 26.14-cm wide (range, 20–35 cm) by 12.5-cm tall (range, 9–17 cm) (Figs. 1A–1E).

While the patient was on the operating table, care was taken not to abduct the arms greater than 80° to prevent brachial plexus injury. In the latter half of the series, 500-mL dilute epinephrine (1:800,000) was injected subcutaneously in the surgical fields. Working in a multiple team fashion, the abdominal flaps were harvested while the mastectomy or explanation was performed and recipient axillary vessels were dissected.

For the abdominal portion of the procedure, flaps were raised from lateral to medial in a subfascial plane beneath the fascia of the external oblique. The dissection then was carried anterior to the rectus sheath up to the most lateral row of rectus perforators. The flaps then were separated in the midline. The umbilicus was delivered and freed, and the dissection was continued on both sides from medial to lateral up to the most medial row of rectus perforators. At that point, a fascial-sparing incision was made through the rectus muscle sheath, and the neurovascular segmental supply to the rectus muscle was divided. The inferior epigastric arteries on both sides were identified and dissected back to the external iliac. Early in the series, a 10- to 12-cm segment of rectus muscle was resected as part of the flap. However, as greater experience was accrued, successively smaller segments of muscle were resected. In the final cases, only a small (4–6 cm) segment of muscle was sacrificed.

Simultaneously, bilateral modified radical mastectomies, bilateral subcutaneous mastectomies, or bilateral capsulectomies with implantectomies were performed depending on the clinical scenario. The recipient thoracodorsal vessels were dissected out until the bifurcation to the serratus. The vessels were ligated just proximal to this bifurcation, preserving a vascular retrograde connection to the serratus (Fig. 1D). In 224 (93%) of 240 flaps, the thoracodorsal vessels were deemed adequate for microanastomosis. In eight cases (3.3%), the thoracoacromial vessels were used, and in eight cases (3.3%), the circumflex-scapular vessels were used. During the latter half

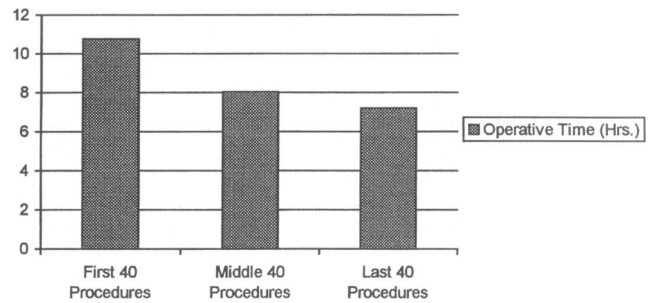


Figure 2. Graphic representation of decrease in operative time.

of the series, the TRAM flaps were revascularized rapidly without recourse to the operating microscope by using loupe magnification and 2.5-mm 3M microvascular anastomotic rings for the vascular repair.

The rectus muscle was sutured to the pectoralis muscle in a position in which the vascular pedicle was comfortable without tension, kink, or twists. The breast mound then was contoured, de-epithelialized, and inset in its final position with the wound closed over drains.

The abdomen was closed by first repairing the anterior rectus sheath completely in a two-layer fashion. In the latter 64 patients (53%) of the series, this was further reinforced by a fascial mesh that was held in place with a fascial stapler. To further aid in abdominal skin closure, the patient was flexed slightly at the hip. The umbilicus was replanted in the cephalic abdominal skin apron, and the wound was closed over drains. For perioperative prophylaxis against deep vein thrombosis, subcutaneous heparin was administered and sequential compression stockings were applied.

RESULTS

There were 120 patients who underwent simultaneous bilateral TRAM free flap breast reconstruction (240 flaps) between April 26, 1991, and March 7, 1995. Patients underwent either bilateral capsulectomy and implantectomy (75 patients, 63%), bilateral simple mastectomy (26

Table 2. SUMMARY OF COMPLICATIONS

Complication	Number (% of total)
Flap loss	1 flap (0.4)
Thrombosis	6 flaps (2.5)
Skin necrosis	6 patients (5)
Hematoma or seroma	7 patients (5.8)
Wound infection	4 patients (3.3)
Prolonged postoperative ileus	1 patient (0.8)
DVT	1 patient (with history of DVTs) (0.8)
Hernia	14 patients (11.6)

DVT = deep vein thrombosis.

Table 3. RESULTS OF PATIENTS WITH TRADITIONAL CONTRAINDICATIONS TO PEDICLE TRAM FLAP

Contraindication	Number of Patients	Excellent [number (%)]	Good [number (%)]
Tobacco	40	30 (75)	10 (25)
>30% IDBW	24	10 (42)	14 (58)
Abdominal scars	70	38 (54)	30 (43)

IDBW = Ideal body weight.

patients, 22%), or unilateral modified radical mastectomy with simple mastectomy on the opposite side (19 patients, 16%) at the same time as breast reconstruction. The 75 patients (63%) who underwent capsulectomies and implantectomies required reconstruction because their expanders or implants had ruptured, formed hard tender capsules, became infected and exposed, or otherwise failed. Of those patients who suffered from implant failure, 39 (52%) had undergone prior simple or subcutaneous mastectomies and 27 (36%) were status postbilateral modified radical mastectomies. Additionally, nine patients (12%) suffered from silicone mastitis, either from silicone injections or from implant rupture with extensive silicone infiltration into the breast parenchyma.

Demographic information is summarized in Table 1. The mean age was 46.7 years (range, 34–69 years). The duration of follow-up averaged 37.2 months (range, 14–62 months). The average duration of hospital stay was 7.6 days (range, 5–15 days). The average operating time was 8.6 hours (range, 5.5–14 hours). This includes the time required for the implantectomy or mastectomies as well as the reconstruction. In the early part of the series, operating times were up to 14 hours, whereas over the last 40 flaps, the average time was reduced to 7.1 hours (Fig. 2).

Complications occurred in 38 patients (32%) (Table 2). Thrombosis developed in 6 flaps (2.5%) of 240: 4 were arterial and 2 were venous. Re-exploration allowed us to restore circulation in five, whereas one flap was unsalvageable because of recurrent arterial thrombosis and was replaced successfully with a free flap from the gluteal area. Six patients (5%) had small areas of skin necrosis, either in the abdominal skin apron or the breast skin flaps. Seven patients (5.8%) had small hematomas or seromas, four of which required surgical drainage. Four patients (3.3%) had wound infections requiring intravenous antibiotics, and one patient (0.8%) suffered from prolonged postoperative ileus. Deep vein thrombosis developed in one patient with a history of deep vein thromboses 2 weeks after surgery after a 6-hour automobile ride. There were 14 patients with abdominal wall weakness or hernias (11.6%), 10 of which required surgical correction. There was no incidence of fat necrosis or delay in wound healing.

Table 4. TYPES OF PREOPERATIVE ABDOMINAL SCARS*

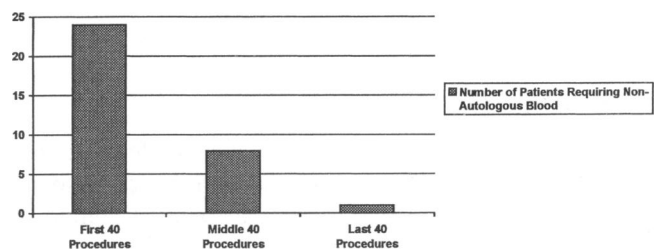
Type of Abdominal Scar:	Number of Patients (%)
Low transverse	34 (28)
Lower midline	28 (23)
Upper midline	8 (7)
RLQ	14 (12)
RUQ	6 (5)

RLQ = right lower quadrant; RUQ = right upper quadrant.
* Some patients had multiple abdominal scars.

Many patients presented with traditional relative contraindications for the pedicle TRAM. Forty patients (33%) were either active smokers or had a history of tobacco use. Twenty-four (20%) were classified as severely overweight (>30% above ideal body weight). Seventy patients (58%) had abdominal scars of various kinds (Tables 3 and 4). The rate of complications did not correlate with either the patients' history of smoking, body habitus, or previous abdominal surgery.

In 76 patients (63%), supporting mesh was used in the abdominal closure. However, this did not correlate with a significantly lower incidence of hernia. Seventy-two patients (60%) required blood transfusions perioperatively, including 33 patients (28%) early on in the series who required nonautologous blood. In the last 40 cases, only 1 nonautologous blood transfusion was required (Fig. 3). We attribute this to increased control of blood loss through epinephrine vasoconstriction, accrued experience with the operation, and a decrease in operative times.

Sixty patients (50%) underwent a second outpatient minor revisional surgery to improve the final aesthetic result. The surgeons' own assessments of the final results (62% excellent, 36% good, and 2% fair) conform well with the patients' reported satisfaction with the procedure (56% excellent [Figs. 4A–4D], 40% good [Figs. 5A–5D], and 4% fair [Figs. 6A–6D]). Patients were especially pleased with the aesthetic improvement to their abdomen because the donor defect essentially results in an abdominoplasty. Overall, patient satisfaction was high-

**Figure 3.** Number of patients requiring nonautologous blood.

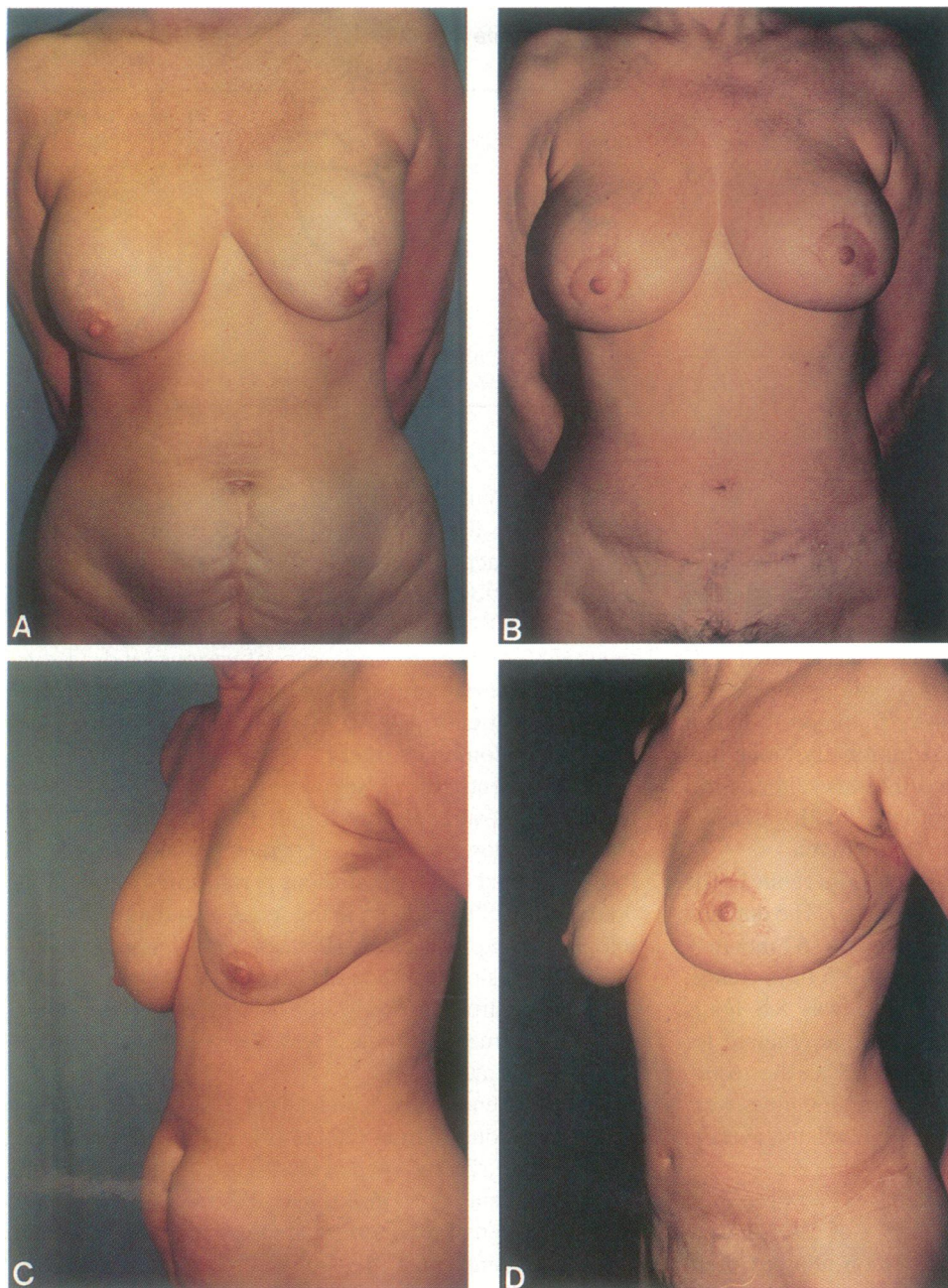


Figure 4. (A–D) A 48-year-old non-smoking woman with prior bilateral subcutaneous mastectomies and failed reconstruction with implants that had ruptured twice. Preoperative and postoperative photographs, front and oblique views. This result was considered excellent.

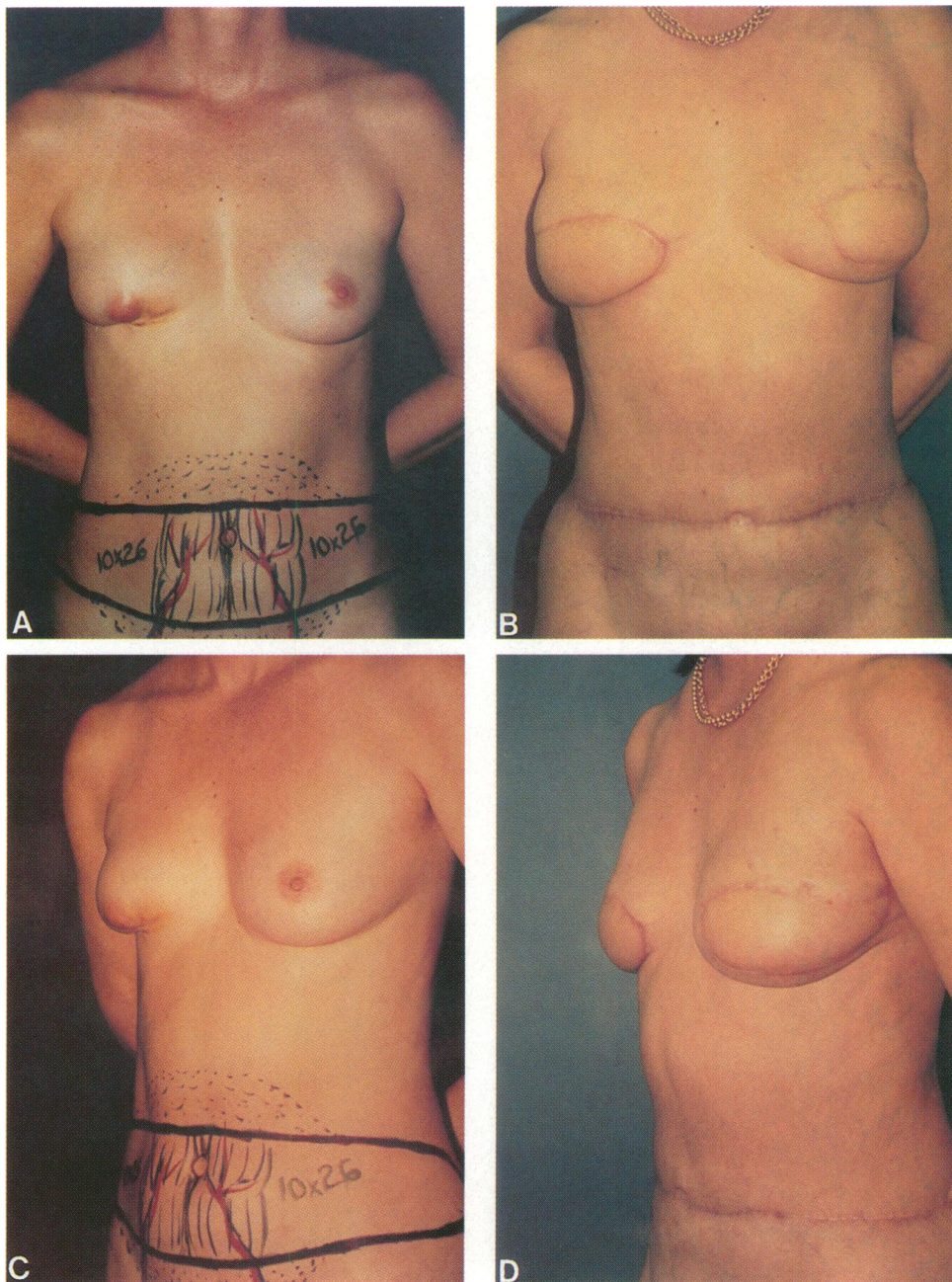
est in those who had undergone previous breast surgeries and suffered from implant failure. However, aesthetic results were best in those undergoing immediate breast reconstruction.

DISCUSSION

Capsular contracture, implant rupture or leakage, deflation, wrinkling, infection, and the hypothetical association with systemic disorders are all potential complications of prosthetic breast reconstruction.^{2,14,15} Even in the absence of complications, they have several drawbacks

that can reduce overall patient satisfaction. Patients often report that their implanted breast does not look or feel normal. Using only tissue expansion and implants, it is difficult to recreate the normally appearing ptotic breast that moves naturally during activities. Furthermore, a lack of sensation often leads to difficulty in accepting the breast as “one’s own.” The TRAM flap, conversely, provides a soft, warm, naturally appearing reconstruction with the added cosmetic benefit of an abdominoplasty. In addition, the return of some sensation in the flap often makes it easier for the patient to psychologically accept the breast as her own.¹⁶

Figure 5. (A–D) A 35-year-old woman with minimal abdominal redundancy who had invasive cancer of the right breast and multifocal carcinoma *in situ* of the left breast. She underwent simultaneous bilateral mastectomies and reconstruction. Because she was a smoker, we designed the flaps in a more cephalic position. Preoperative and postoperative photographs, front and oblique views. The postoperative photograph is before nipple–areola reconstruction. This result was considered good.



The TRAM flap was popularized in the United States by Hartrampf et al.^{17,18} as a cephalically based pedicle transfer that necessitates the sacrifice of the entire rectus abdominis muscle. The free TRAM, originally described by Holmstrum,¹⁰ has several improvements over the pedicle TRAM that make it a superior method of reconstruction.^{4–11,19,20} These advantages stem largely from its increased blood supply and decreased abdominal wall defect because of a more limited resection of the rectus muscle. A more robust blood supply allows for better healing of a larger skin flap and increased volume for primary contouring. The elimination of the subcutaneous tunnel decreases postoperative discomfort and allows the

surgeon greater freedom of design for breast reconstruction. In addition, the free TRAM can be performed in patients for whom the pedicled TRAM flap traditionally had been contraindicated (*e.g.*, patients who smoke, patients with abdominal scars, and patients who are too thin or obese). The current study included a majority of patients with these risk factors (Table 4).

Our complication rates compare favorably with those of previous studies of free and pedicle TRAM flaps. Historically, overall complication rates have ranged from 20% to 38%, total flap loss from 0% to 6%, partial flap loss–fat necrosis from 0% to 30%, and the incidence of hernia from 0.2% to 16%.^{4,5,21}

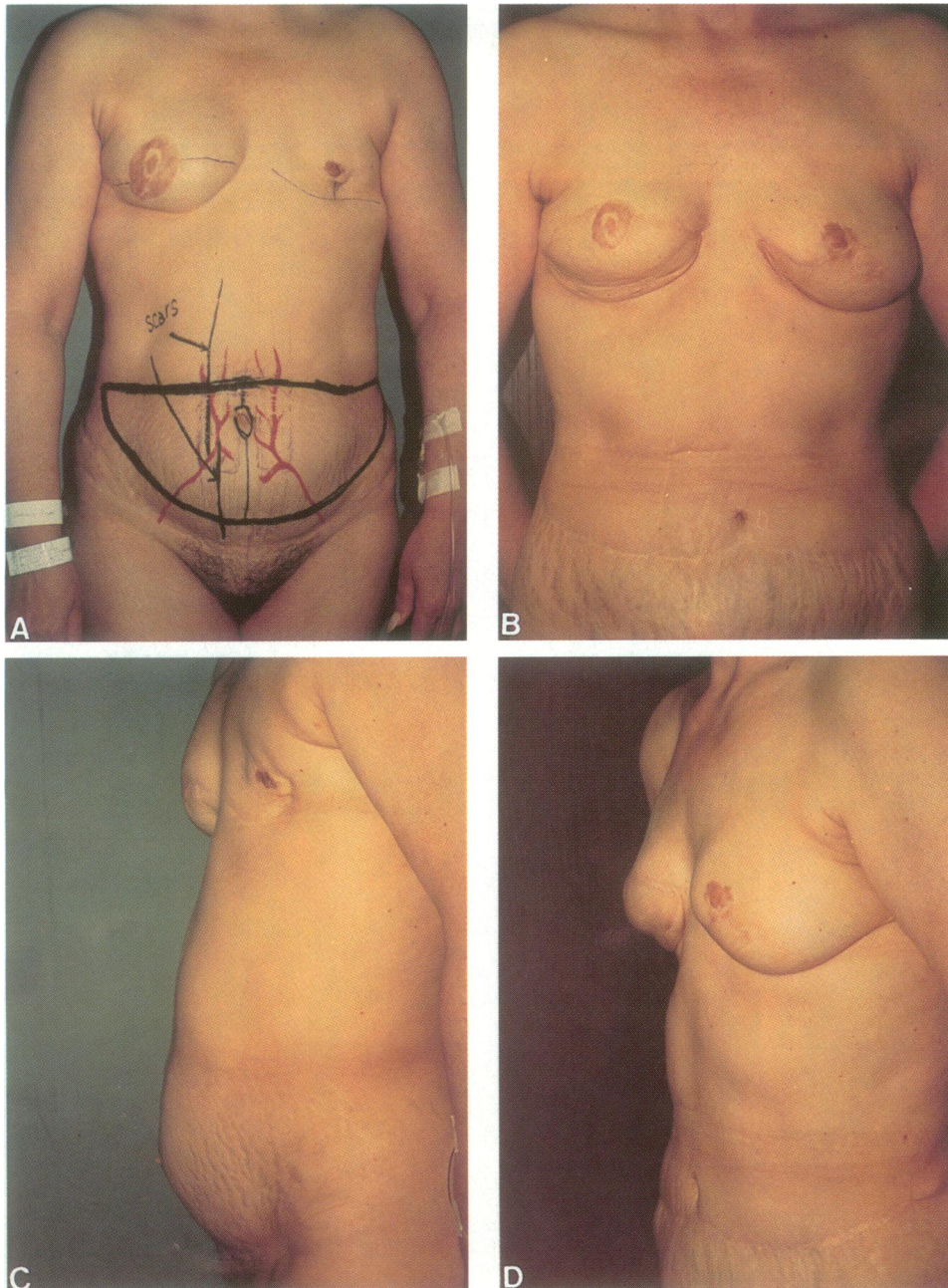


Figure 6. (A–D) A 42-year-old non-smoking woman with prior bilateral mastectomies and failed reconstruction with silicone prostheses. Attempts at reinsertion of the left implant failed because of recurrent extrusion. Perfusion of the right flap was good despite the presence of vertical scars in the right paramedian area. Preoperative and postoperative photographs, front and oblique views. This result was considered fair.

Over the course of this series, operative times and the requirement for blood transfusion decreased markedly. This can be attributed to certain technical modifications that were made as greater experience was acquired (Table 5). The following factors were thought to be important to an improved success rate and shortened operative time:

1. **Accrued experience.** Surgical volume and experience have been shown to have a significant effect on outcome in coronary artery bypass grafting and percutaneous transluminal coronary angiography.^{22,23} Although similar data on TRAM free flaps are lacking, it would seem logical to advise that this
2. **Multiple operative teams working simultaneously.** This allows the plastic surgeons to begin the simultaneous harvesting of both TRAM flaps while the general surgeons perform the mastectomy.
3. **Simultaneous revascularization of both flaps under**

surgery be performed by experienced surgeons who perform a larger volume of these procedures. In addition, near the midportion of the series, the surgical teams visited one another at their respective institutions and helped each other perform a reconstruction. As shown in coronary artery bypass graft surgery, this type of exchange and subsequent “cross-fertilization” of ideas can be quite helpful.²⁴

loupe magnification without recourse to the microscope. This allows the abdomen to be closed by a third team, unencumbered by the presence of a surgical microscope in the middle of the operative field. The use of loupes for microanastomoses has been shown to be safe and effective.²⁵ However, this technique is recommended for those experienced microsurgeons who already have an adequate facility with the microscope and feel comfortable relying on their loupes alone.

4. The use of vessel couplers instead of sutures for the vascular anastomosis. This technique was used for both venous and arterial anastomosis at the UCLA center and for the venous side only at Washington University. This reduced the time required for the anastomosis considerably.
5. Control of blood loss through epinephrine vasoconstriction. This clearly has been of great use because the number of blood transfusions required in the last half of the series was diminished greatly.
6. Rapid abdominal fascial closure. Closing the abdomen expeditiously before abdominal swelling has had time to occur can prevent a more difficult and tight closure.

The wider application of autogenous tissue breast reconstruction may have profound implications for the preventative treatment of breast cancer in the future. With the discovery of genes linked to familial forms of the disease (*e.g.*, BRCA1 and BRCA2), genetic screening likely will provide the early identification of those patients at highest risk.^{26,27} At present, the efficacy of prophylactic mastectomy still is debated vigorously in the surgical literature.²⁸⁻³¹ For example, skeptics point to animal models that show questionable long-term efficacy when cancer is induced by potent carcinogens.³²⁻³⁵ Others argue that even a "total" mastectomy often leaves a percentage of breast tissue behind.³⁶ Most convincing, perhaps, are the case reports of patients in whom cancer develops after the patient has undergone "prophylactic" mastectomy.^{37,38} Still, to many, it seems intuitive that patients who have germ-line genetic defects certainly would benefit from a surgical procedure to remove a maximal portion of breast tissue. Two recent studies give merit to this belief. The first, a large prospective cohort analysis, has shown a significant decrease in the incidence of breast cancer in women who have undergone prophylactic mastectomy.³⁹ The second study has calculated the approximate gain in life expectancy for women with the BRCA1 or BRCA2 mutations who undergo prophylactic mastectomies.⁴⁰ Specifically, this study suggests that an 85% reduction in cumulative risk for breast cancer would add between 2.9 to 5.3 years in life expectancy for a 30-year-old woman undergoing the procedure. Given that this data is preliminary, further definitive research is warranted.

Technologic advances often proceed at a rate faster

Table 5. FACTORS ASSOCIATED WITH A DECREASE IN OPERATIVE TIME AND BLOOD LOSS

Increased experience
Multiple teams working simultaneously
Simultaneous revascularization of both flaps using loupes
Use of vessel couplers
Epinephrine injection for vasoconstriction
Rapid closure of the abdomen

than we as practitioners are able to implement. As more patients with genetic predispositions to breast cancer are identified, it seems likely that surgeons will be asked with increasing regularity to "do something." Until prospective trials can decide the issue more decisively, it may be useful to know that the technique described in this article has a good success rate, acceptable morbidity, and a high level of patient satisfaction. If future studies can show long-term efficacy, we rapidly may be approaching the age when bilateral total mastectomy with simultaneous TRAM free flap reconstruction may offer patients a comforting alternative to years of screening examinations, mammographic surveillance, and worry.

In conclusion, simultaneous bilateral free flap reconstruction technically is feasible with a high rate of success and an acceptable morbidity. The surgery demands a committed surgical team and requires attention to technical details. Compared to bilateral pedicled TRAMs, bilateral microvascular free TRAMs allow for more reliable transfer of larger flaps with less disruption of the abdominal wall. It also is applicable to a wider range of patients, including those with abdominal scars, significant obesity, and a smoking history. Although many surgeons may have been wary to recommend total mastectomy with free TRAM reconstruction because of a concern over the extensiveness of the surgery and the quality of the reconstruction, as greater experience with the procedure is accrued, these fears appear to be unfounded. Although the successful application of this technique is at present a reality, the authors believe that its greatest use may be realized in the years to come as a potential prophylactic measure for those at highest risk for breast cancer.

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