Back from the Future: Reappraisal of the Pedicled TRAM Flap in "Standard" Patients

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36.1
Introduction

Since Hartrampf's original description of the pedicled transverse rectus abdominis myocutaneous (TRAM) flap [1, 2], this procedure has undergone a gradual evolution: the development of microsurgical techniques, involving the sacrifice of only a small segment of rectus muscle or even preserving it [3–8], could overcome many of the drawbacks of the standard operation (donor site morbidity, fat necrosis caused by poor blood supply, etc.) [9–11]. However, according to the literature, no general consensus exists with respect to one technique or the other, either in terms of outcomes, complication rates or costs [12–19].

In this paper the authors, familiar with both pedicled and microsurgical procedures, review the experience over a 23-year period, in order to verify the results in three large groups of patients.

36.2
Materials and Methods

From January 1982 to June 1992, pedicled TRAM flaps were used in 232 cases; from July 1992 to January 2000, 352 patients were operated on: 249 of them had pedicled TRAM flap breast reconstruction, while in 103 women a free TRAM flap was used (either traditional, muscle sparing or DIEP). Patients were selected for the microsurgical flaps in the presence of a high risk for flap perfusional problems (smokers, obese women and those needing large flaps).

From April 2000 to December 2005, 79 patients received pedicled TRAM flaps (79 unilateral, 3 bilateral).

36.3
Surgical Technique: Pedicled TRAM Flap

Since it was used in the majority of patients in this series, the technique of pedicled TRAM flap harvesting is described as follows.

The patient, with the flap design marked as explained elsewhere [20], is positioned supine on the operating table, with the arms along the body.

The upper border of the flap is incised to the deep dermis. The fat layer is incised in a bevelled fashion, so that an adipose extension is transferred with the flap, which will create a smooth upper cleavage. Undermining proceeds upwards above the sternal apophysis and laterally well above the costal margin.

At the mastectomy site the area where the flap will be inset is prepared by excising the skin according to the preoperative design. The upper skin flap is undermined in a pre-fascial plane to the subclavicular area, so as to create a space where the deepithelialized and the adipose portions of the flap will be placed. The lateral and the inferior edges of the incision are not undermined in order to have a better definition of the new submammary crease. At the medial third of the inferior incision the tunnel is created, which reaches the abdominal undermining.

The medial and the lateral borders of the rectus muscle which will be harvested are identified. Two longitudinal lines are drawn over the central third of the muscular belly. Inferiorly both lines reach the upper margin of the flap. Along these two lines the anterior rectus sheath is grasped with an Adson forceps and it is incised using the electric knife. The sheath can be easily elevated off the muscle fibers, while it is adherent to the fibrous intersections (fimbriae). The fascia is gently separated from the muscular belly using a bipolar forceps. The elevation of the fascia proceeds both laterally and medially until the edges of the muscle are exposed.

The inferior border of the skin ellipse is then incised, and the two wings of the skin ellipse flap are detached

from the fascia. The contralateral portion of the flap is first elevated in the prefascial plane beyond the midline, over the medial border of the rectus muscle, until the medial row of perforators is seen. The inferior portion of the flap is elevated off the fascia until midway between umbilicus and pubis. The navel is then cut in a triangular shape, its pedicle is freed, and it is then passed under the flap.

On the side of the muscular pedicle, the skin is elevated off the fascia, until the lateral row of perforators is encountered. The fascia is incised vertically along the lateral and medial rows of perforators. The muscle is then cut vertically; dissection proceeds until the deep inferior epigastric vessel is encountered and the inferior pedicle is securely clipped and cut.

The incision in the muscle is turned upwards and it reaches the medial margin of the muscle at the level of the lower (umbilical) fimbria. The apex of the V-shaped fascial and muscular incision is midway between umbilicus and pubis. In most women the arcuate line is at this level, or lower; therefore no weakening of the abdominal wall is created where the risk of hernia or bulging is higher.

The dissection of the muscular pedicle can then proceed either preserving a lateral strip of muscle or harvesting the full width of the muscle. The more conservative muscle harvesting is preferred when the flap is small and very reliable from the perfusional point of view. The latter dissection preserves the integrity of the vascular plexus and it is to be preferred in the majority of patients.

The dissection proceeds cranially until the superior pedicle is seen. The lateral border of the muscle is freed from the fascial envelope well above the costal margin to allow an unconstricted rotation of the pedicle. The eighth intercostal nerve must be located and severed; otherwise it will maintain innervation and motility of the upper part of the muscular pedicle, which will show during sit-ups. With the flap completely dissected but still in its original location, the portion exceeding the preoperative design is resected by scissors, bleeding is stopped and vascularity is checked. Normally a good peripheral bleeding is seen, with a prevalence of venous outflow. The appearance of the flap immediately improves after resecting the contralateral portion. The flap is transferred through the tunnel to the mastectomy site. The muscular pedicle must show a tension-free rotation, without any remaining fibrous attachment pulling laterally. The skin island is temporarily stitched at the mastectomy opening with a staple, and attention is given to abdominal closure.

The fascial defect is repaired first by separate figure-of-eight stitches using 2/0 nylon, then by a continuous running suture.

When the full width of muscle is harvested, the portion of the muscle which has been preserved below the lower intersection is moved superiorly when the sheath is repaired, thus contributing to abdominal competence and strength. The fascial defect is not repaired above the costal margin, in order to avoid any stricture around the muscular pedicle. A resorbable mesh is then positioned on the abdominal sheath and it is sutured under some tension. This protects the underlying fascial repair in case of strong movements or tension in the early postoperative period.

The patient is placed in a semi-sitting position and the skin is sutured in two layers, using a 3/0 resorbable suture and an intradermal 3/0 nylon suture. The navel is exposed through a triangular opening and sutured in the new position using 5/0 nylon. Although no plication of the rectus fascia is done in order to relocate the navel in the midline, the length of the umbilical pedicle is sufficient to expose it through a midline opening. Two drains are positioned to collect fluids in both halves of the abdominal undermining.

The flap is shaped by moving the temporary staples until a satisfactory shape is obtained.

36.4
Results

In the group of patients who underwent pedicled flap transfer from 1982 to 1992, there was no total flap necrosis; major necrosis (involving more than 15% of the flap surface, or extensive liponecrosis) occurred in 7% of patients and a 11% minor necrosis rate was seen. In the group of patients who had pedicled flap transfer from 1992 to 2000, no major necrosis was recorded and a 5% minor necrosis was observed. In the free flap group a total flap loss occurred in three cases and one marginal necrosis was seen; seven patients were reoperated on for anastomosis revision. The incidence of abdominal wall bulging was 8% in both groups.

Aesthetic results were absolutely comparable in all groups of patients.
In the group of patients operated on from 2000 to 2005, no flap loss and no major necrosis were recorded; however, there was a 5% minor flap necrosis and a 5% rate of abdominal wall weakness.

36.5
Discussion

This paper reviews the experience of the senior author, analyzing how his choice of breast reconstruction with autogenous tissues has evolved over a 23-year time course.

In the first period of this experience (1982–1992), pedicled flaps were used in all women and a 7% major

necrosis and a 11 % minor necrosis rate were recorded, which allowed the detection of patients at high risk for partial flap necrosis. In the second period (1992 – 2000), patients were strictly selected according to their risk of having perfusional complications and only "standard" patients received pedicled TRAM flaps, while patients considered at high risk (obese, smokers, patients needing large flaps) had free flap transfer. This determined a drop in the total amount of flap vascular complications, with a 5 % rate of minor necrosis in the pedicled group, which is acceptable for the "standard" patient. In smokers, obese women and patients needing large flaps a 3 % total failure risk was considered an adequate price to pay to avoid a 20 – 25 % risk of flap perfusional problems.

From 2000 on, there was a reappraisal of the pedicled TRAM flap, offered to all the "standard" patients requiring autogenous breast reconstruction. High risk patients were offered other procedures (implants, local flaps) and microsurgical techniques were reserved only for an extremely selected subset of patients, after discussing all of the possible alternatives.

The reasons for this choice can be summarized as follows:

1. Nowadays economic factors have increasing importance and each surgeon should choose a procedure taking into account not only the clinical outcome and the risk of complications, but also the resource costs. According to the Italian National Health System, where autogenous breast reconstruction is usually performed on a delayed basis, microsurgical techniques are considered more cost expensive than conventional procedures, requiring longer operative time and postoperative stay. In our series the pedicled TRAM flap breast reconstruction required a mean operative time of 205 min, a mean hospital stay of 2.3 days and 2 – 4 secondary stages on an outpatient basis (except contralateral operations). According to our experience, microsurgical procedures required a mean operative time of 310 min and a mean hospital stay of 6.6 days (to guarantee a continuous flap monitoring), with higher costs than the pedicled flap, but with comparable results.

2. Maximal care in avoidance of complications played a major role in cost reduction. Vascular related complications were minimized by not extending the flap further from the lateral margin of the contralateral muscle. A knowledge of microsurgical muscle-sparing techniques allowed the operator to adopt a very conservative approach even with the pedicled flap, which was always raised with maximal care in preserving the fascia at the level of the arcuate line, where the risk of hernia or bulging is higher.

3. Preoperative selection of patients was very conservative: risk factors such as long-term smoking history and heavy obesity were considered absolute contraindications, posing serious problems even with the use of free flaps (risk of abdominal skin necrosis).

4. The introduction onto the market of increasingly sophisticated devices and the evolution of techniques of implant-based breast reconstruction has expanded the possibilities for the reconstructive surgeon to obtain results comparable with those of autogenous tissues in selected patients, which caused a drop in autogenous tissue breast reconstruction from 80 % to 35 % in our series.

36.6
Conclusions

In the experience of the senior author, the latest innovation in autogenous tissue breast reconstruction is a way back to the past, with the use of the pedicled technique in "standard patients," which allows a reduction of costs in terms of operative time, hospital stay and immediate complications, and with an excellent outcome.

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