Management of Significant Venous Discrepancy with Microvascular Venous Coupler

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ABSTRACT

Microsurgery has revolutionized the art of reconstruction, with the discovery of the ability to replace like tissue with like tissue transferred from a distant site. The evolution of the tissue transferred has also progressed. No longer are free flaps based off a dominant anatomically named vessel, but one of its later derivatives, the perforator. Perforator breast reconstruction dominates the authors' practice, and a frequently encountered problem is mismatched vessels. This situation typically requires more time and concentration for successful completion. Venous mismatches tend to be harder to overcome than arterial; the venous hand-sewn end-to-end anastomoses result in bunching of the larger vessel around the perimeter of the smaller. In this low flow system, these anastomotic imperfections can frequently result in anastomotic failure. Many other techniques have also been described in hopes of improving the anastomotic success. These are often timely or lack improvement in patency rates. The authors have found the MCA microvascular venous coupler to be a reliable method to overcome this problem. The end-to-end technique of microvascular coupling allows a perfect intima-to-intima anastomosis despite the variation in caliber of the vessels. The time to complete the end-to-end anastomoses is significantly reduced to only a matter of minutes.

KEYWORDS: Perforator breast reconstruction, microvascular venous coupling, venous discrepancy, gluteal artery perforator flap

Microsurgical reconstruction is a technically challenging endeavor. The success of the procedure depends on uncomplicated preservation of the revascularization of tissue. Microsurgical reconstructions of the head and neck, as well as of the lower extremity, have well-documented descriptions of the vessel mismatches often encountered.[1,2] These mismatches are a challenge to overcome technically, with no clear consensus about the solution to the problem.

In microsurgical breast reconstruction, specifically perforator flap reconstruction, we also have encountered this dilemma. This most commonly occurs with the use of gluteal artery perforator (GAP)[3] flaps, and occasionally with superficial inferior epigastric artery (SIEA) flaps. The recipient vessels in all cases were the internal mammary. To quickly and easily overcome the mismatches, the MCA microvascular venous coupler was used to perform the venous anastomoses.

PATIENTS AND METHODS

Thirty-eight GAP flaps were used for breast reconstruction from October, 2001 through July, 2002. Twenty (53 percent) were delayed reconstructions and 18 (47 per-

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cent) immediate. Six (30 percent) of the delayed reconstructions were for implant failure, one (5 percent) for a failed TRAM, with the remainder being post-mastectomy reconstructions. All reconstructions except two were for the treatment of breast cancer. The two outstanding were primary and secondary (implant failure) reconstructions for Poland syndrome. Forty-nine venous anastomoses were performed in the 38 reconstructions. Twenty-seven (71 percent) reconstructions had critical anastomoses.

The GAP flap veins ranged in size from 2.5 to 7.0 mm in diameter. The internal mammary vessels were used as recipients in all but three cases. The internal mammary veins ranged in size from 1.5 to 3.5 mm. They were exposed by resection of the third or fourth costochondral cartilage. The outstanding donor vessels were the second and third intercostal perforators, both preserved by the general surgeon at the time of mastectomy. The average GAP flap vein was 4.0 mm, and the average internal mammary vein was 2.0 mm.

All reconstructions were performed by a team of two microsurgeons. The MCA microvascular coupler was used for all anastomoses. The coupler size was equivalent to the recipient vein diameter, because this was always the smaller vessel. The average anastomotic time was 3.5 min.

Operative Technique Once the free flaps were harvested, they were transferred to the chest and secured. Under microscopic assistance, the flap and recipient vessels were skeletanized in preparation for end-to-end anastomoses. The MCA microvascular sizer was used to measure the lumen diameter while being dilated with jeweler's forceps (Figs. 1, 2). The mechanical dilation of the vessels allowed us to measure maximum luminal dilatation. The selection of coupler size is equivalent to that diameter measured on the smaller vessel.

The initial draping of the flap vein is preferred, because its pedicle length allows easier positioning of the coupler for recipient exposure (Fig. 3). The flap vein is brought through the coupler ring and draped over the pegs followed similarly with the recipient. The MCA microvascular coupler is compressed by turning the applicator handle clockwise. Once coupled, the rings are further compressed with hemostats for good measure. The applicator handle is turned counterclockwise and the coupler rings are ejected (Fig. 4).

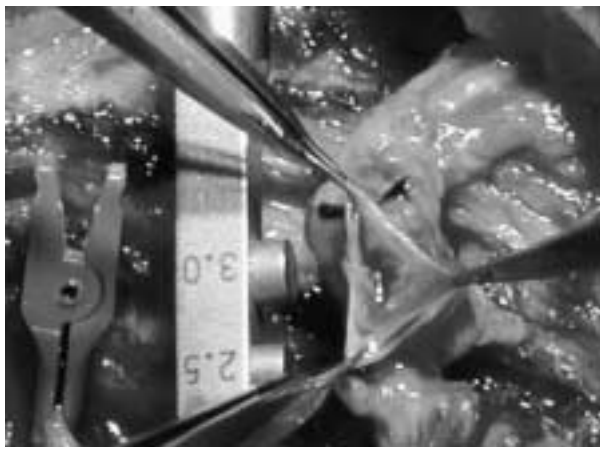

Figure 2 Luminal measurement of the S-GAP vein (7 mm).

RESULTS

Evaluation of an anastomotic technique is best examined in the situations in which there is a critical vein (single venous anastomosis). Twenty-seven of the 38 S-GAP breast reconstructions had a critical venous anastomosis. One (3.5 percent) of the 27 required re-exploration for venous congestion. Intraoperatively, it was discovered that the obstruction was due to a twist in the vein, while the anastomosis remained patent. A correction was made, and the flap was salvaged. Typical vessel discrepancy was 2 to 3 mm (ratio: 2 to 2.5:1), with the greatest differential of 5 mm (ratio: 3.5:1, as shown in Figure 4A).

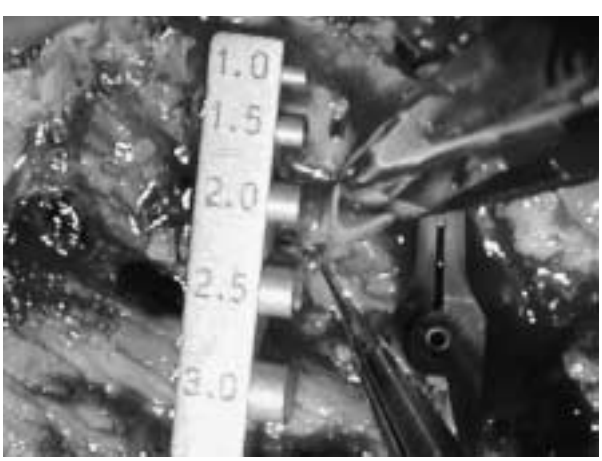

Figure 1 Luminal measurement of the internal mammary vein (2 mm).

Figure 3 A 7-mm S-GAP vein after it has been draped over the pegs of a 2-mm coupler ring.

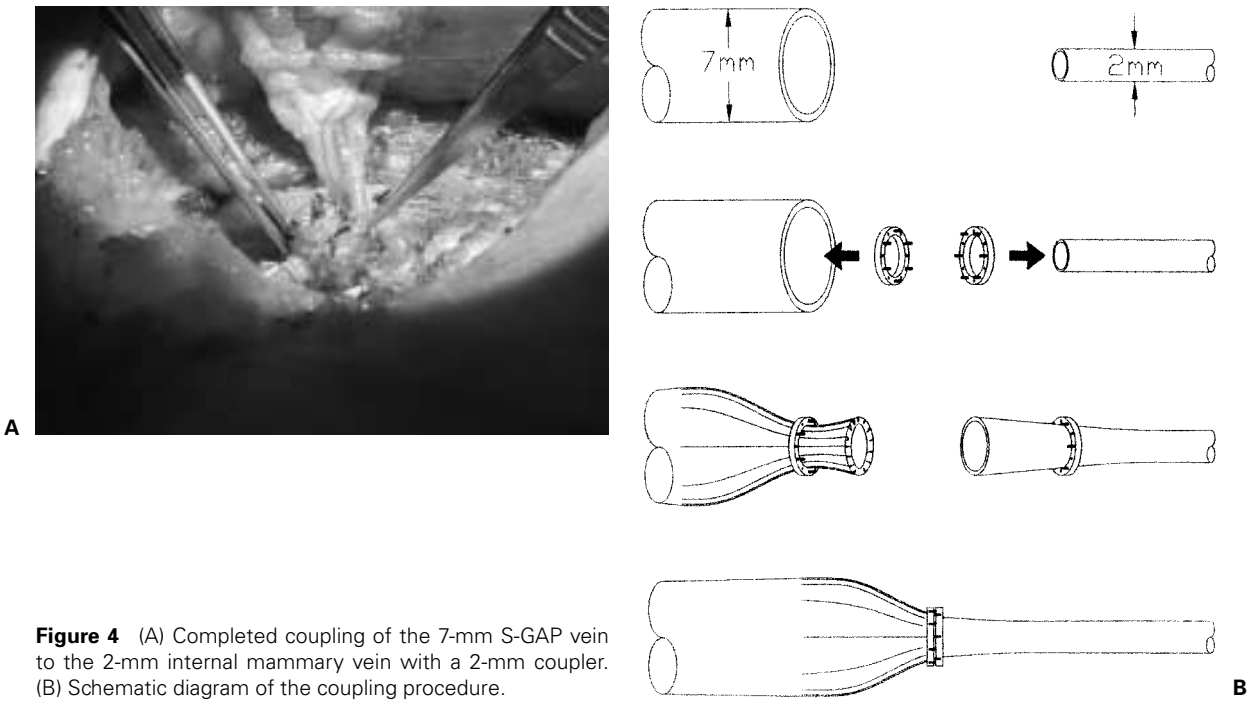

Figure 4 (A) Completed coupling of the 7-mm S-GAP vein to the 2-mm internal mammary vein with a 2-mm coupler. (B) Schematic diagram of the coupling procedure.

DISCUSSION

The critical evaluation of microsurgical anastomoses has been an ongoing process since its origin. Perfection of the technique insures a successful outcome. We have found the use of the MCA micovascular coupler to be a tremendous asset in our practice of perforator flap breast reconstruction. The value of its application and effectiveness has been well-documented.[1,2,4–9] Previous articles have describe the device's limitations, mostly regarding its use in vessels of "minimal discrepancy,"[4–6] and have explored its effectiveness in the end-to-side technique for vessels of greater discrepancy.[10]

Alternative methods have also been described in hopes of better overcoming size discrepancy. Mechanical dilatation or spatulation of the end of the smaller vessel has been described to increase vessel diameter.[11,12] A "fish-mouth" incision has also been described to increase vessel diameter, and has been applied in both end-to-end and end-to-side anastomoses.[13] Even extremes such as perioperative vessel dilatation using a percutaneous transluminal angioplasty catheter have been described to overcome significant size discrepancy.[14] Most microsurgeons, when confronted with the problem of significant size discrepancy, will most often choose to perform an end-to-side anastomosis; this has been suggested in experimental studies to have a higher patency rate.[12,15]

Our position is quite contrary to current thinking. We, in fact, believe that the ideal situation for end-to-end venous coupling is not only minimally discrepant vessels, but extremely discrepant vessels. The MCA microvascular coupler performs a perfect intima-to-intima anastomosis, even on these largely discrepant vessels. This alone is a nearly impossible task to complete with hand-sewn techniques. Typical bunching of the larger vessel lumen often causes luminal invagination or constriction of the anastomoses.

The instrumental dilatation of the smaller vessel to obtain coupler size maximizes the caliber of the anastomoses. The larger vessel is neatly draped over the ring and pegs, creating pleats. During compression, we closely watch the perimeter of the larger vessel, to make sure it remains fully draped over the rings, thus avoiding extraluminal debris to contaminate the anastomoses. The ability to visualize the lumen to point of anastomosis is difficult to duplicate in hand-sewn techniques.

Although limited to perforator flap breast reconstruction, similar size discrepancies are often found in head and neck, as well as lower extremity, reconstruction. We have easily overcome discrepancies of 2 to 3.5:1, with 100 percent patency of the 27 critical anastomoses. We note that the re-exploration was caused by poor vessel alignment prior to coupling and not due to an anastomotic failure. All of these anastomoses were also completed in 3 to 5 min, which is difficult to accomplish with any hand-sewn techniques.

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