Venous Coupler for Free-Flap Anastomosis: Outcomes of 1,000 Cases

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Abstract. *Since the advent of microvascular free tissue transfer, adjunctive surgical techniques have become sought as a means to improving overall surgical time and outcomes in oncological surgery. Anastomotic devices have provided one such avenue, with staples and coupling devices suggested as an alternative to traditional suturing. We describe our experience with two such devices, automatic staples and the anastomotic ring coupler, in 1,000 cases of free tissue transfer. In 1,400 anastomoses, there was a significant reduction in anastomotic time from suturing (22 minutes) with the use of staples (15 minutes) or the ring coupler (4 minutes), p<0.01. This was without any increase in complication rates. These findings support the use of these devices and suggest an increasing role for modern devices in microvascular surgery.*

Reconstructive surgery following oncological resections has advanced considerably since the advent of microvascular free-flap techniques in 1973 (1, 2). Free tissue transfer has enabled larger and more complex defects to be adequately reconstructed with a range of donor sites, and has facilitated wider oncological resections. Free-flap surgery necessarily requires the anastomosis of an artery and vein at the recipient site in order to provide a blood supply to the transferred tissue, and for many years the gold standard has been microvascular anastomosis with sutures.

More recently, advanced anastomotic devices have been developed to aid arterial and venous anastomosis, with the use of staples and the 'anastomotic ring coupler' being the more widely discussed modern techniques. A recent article by Camara *et al*. described the use of anastomotic couplers for use in free deep inferior epigastric artery perforator (DIEP) flap surgery (3), which demonstrated the utility of the anastomotic coupler in 12 free flaps. We have now utilized these devices in over 1000 free flaps and would like to share our experience.

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Patients and Methods

A cohort study was undertaken, with 1,000 consecutive patients undergoing a range of reconstructive procedures recruited through a single institution. This comprised breast reconstructive cases (600 cases), extremity reconstruction (150 cases) and head and neck cases (250 cases). Three modes of vascular anastomosis were performed: standard sutures, the 'Anastoclip' Vascular Closure Staples (VCS) micro-staple clips (AnastoClip Vessel Closure System, Le Maitre Vascular Inc, Sulzbach, Germany) and a microvascular anastomotic coupling device (Microvascular Anastomotic Coupling System, Synovis Micro Companies Alliance Inc, St Paul, MN, USA). Our preliminary use of these anastomotic procedures has been described (4).

The devices were applied intraoperatively by the primary surgeon in each case, with decision to use the particular device at the discretion of the surgeon. There were no particular intraoperative criteria for selection of a particular anastomotic technique. For the ring coupler, vessel wall eversion was achieved with the device itself, while for stapled anastomoses eversion was achieved with a combination of stay sutures and everting forceps in order to achieve ideal intima-to-intima apposition.

Two main outcome parameters were assessed: anastomotic time and anastomotic failure. Anastomotic times were recorded by the scout nurse in each case, and anastomotic failure was confirmed in theatre at revision surgery. Data were analysed statistically with the Fisher exact test, with a *p*-value of less than 0.05 considered as having statistical significance.

Results

In 1,000 reconstructive cases, 2,500 vascular anastomoses were performed, of which 1,400 comprised the use of either of the two adjunctive anastomotic devices. These devices

were thus used in 80% of all venous anastomoses and 10% of all arterial anastomoses, with the anastomotic ring coupler used in 1,000 cases and staples in 400 cases. In cases of sutured anastomoses, mean anastomotic time was 22 minutes, compared to 15 minutes with staples and 4 minutes for the ring coupler, a significant reduction in anastomotic times with the use of these devices ($p<0.01$). In terms of anastomotic failures, there were 90 failures overall, of which 12 were arterial failures and 78 were venous failures. Of these, all arterial failures were sutured (no stapled or coupled arterial anastomoses failed), and of the venous failures, 29 were sutured, 20 were stapled and 29 were coupled ($p>0.05$).

Discussion

We have used the Unilink ring system anastomotic coupler (Meteko Instrument AB, Stockholm, Sweden) for over 10 years, in a range of donor site and recipient sites for a range of reconstructive needs, including reconstruction of the breast, head and neck and extremities. In addition, we have used anastomotic couplers for both arterial and venous anastomoses. The range of potential applications for anastomotic couplers is thus ever increasing. An additional device that works as an adjunctive tool to the coupler is the use of micro-clips. The VCS clip-applier system (Autosuture Norden, Stockholm, Sweden) is particularly useful for vessels with somewhat thicker walls than would be suitable for an anastomotic coupler. In our experience, both techniques are able to reduce operative times over sutured anastomoses, without any detriment to surgical outcomes. In 1,000 free flaps in which we used the anastomotic coupler, the mean reduction in time with the use of a ring coupled anastomosis was 15 minutes as compared to sutured anastomosis ($p<0.001$).

The surgical anastomosis itself is just one of several aspects of microvascular surgery that have reaped the reward of technological advances in the field. The ability to preoperatively select the optimal vessels of choice for inclusion in the vascular pedicle has been shown to improve a range of operative outcomes, with techniques that have now been established comprising color duplex ultrasound (5), computed tomographic angiography (6), and magnetic resonance angiography (7). Developing and future techniques include the use of 'virtual' image-guided stereotactic navigation pre- and intra-operatively (8). In addition to preoperative techniques, new techniques in the intraoperative mapping of vasculature have been shown to accurately map the vascular territories of selected vessels, enabling improved flap design and harvest (9). Vascular monitoring postoperatively has also been revolutionized with the use of pedicle monitoring techniques such as the implantable Doppler probe, which has been shown to rapidly identify vascular complications (such as thrombosis, compression or kinking) and potentiate rapid return to theatre and flap salvage (10).

Conclusion

The use of adjunctive anastomotic devices can improve operating times without detriment to free-flap outcomes. With ongoing advances, it is likely that outcomes in free-flap surgery will continue to improve, surgical times continue to be reduced, and this complex surgery will be able to be more widely incorporated into routine clinical practice.

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Conflicts of Interest

None.

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