

The Impossible Anastomosis: Intima-to-adventitia Suture Technique for Microanastomosis of Severely Calcified Arteries

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Summary: Microsurgery in patients with advanced atherosclerosis is challenging. Calcified vessels can hinder microanastomosis, which precludes free flap reconstruction in those patients. We present a case of a female patient with stage 4 peripheral artery disease who had undergone mastectomy because of invasive breast cancer. During autologous breast reconstruction with a muscle-sparing transverse rectus abdominis free flap, we experienced difficulties during microanastomosis due to complicated plaques in an extremely calcified inferior epigastric artery. Also, the intima presented completely detached from the media, leading to a collapse of the vessel lumen. To prevent curling of the intima and prolapse of the atherosclerotic plaques into the vessel lumen, the intima was sutured to the adventitia by interrupted stitches. This maneuver led to eversion of the intima and facilitated the otherwise unfeasible anastomosis. The reconstructed breast showed adequate perfusion during the postoperative course. We present a technique to facilitate microanastomosis in severely calcified and fragile arteries. (*Plast Reconstr Surg Glob Open* 2021;9:e3866; doi: [10.1097/GOX.0000000000003866](https://doi.org/10.1097/GOX.0000000000003866); Published online 18 October 2021.)

Advances in microsurgical techniques have led to an increase in free tissue transfer in the past years.¹ Particularly, breast reconstruction experienced a continuous development. Nowadays, the deep inferior epigastric perforator or muscle-sparing transverse rectus abdominis (msTRAM) flap represents the gold standard in autologous breast reconstruction.^{2,3} However, certain patient risk factors, including atherosclerosis, might complicate microanastomosis and lead to flap failure or preclude the use of a certain flap.⁴ There have been several proposals to overcome the burden of anastomosing a calcified vessel especially in the field of head and neck surgery. These include choosing a site relatively free of plaque formation, smoothing the arterial end before anastomosis, using venous bypass grafts, using a round needle while limiting the number and the tension of microsutures, directing the

bites from the inside to the outside, and eversion of vessels during anastomosis to prevent the adventitia from getting caught in the lumen.^{1,5-7} We present a case of severe atherosclerosis of the inferior epigastric artery, making microvascular transplantation of an msTRAM flap for autologous breast reconstruction unfeasible with the above-mentioned conventional techniques. A novel microvascular suturing technique was established to salvage the microanastomosis of the calcified and extremely fragile inferior epigastric artery.

CASE REPORT

A 52-year-old female patient had undergone mastectomy of her left breast due to invasive breast cancer. This was followed by chemotherapy and radiation therapy. An infection of the port led to endocarditis of the aortic valve. The patient received aortic valve replacement and subsequent life-long anticoagulant therapy with phenprocoumon. Her medical history included insulin-dependent diabetes mellitus and stage 4 peripheral artery disease, leading to toe amputation several years ago. After an inconspicuous follow-up period of 7 years, the patient desired autologous breast reconstruction. A CT angiography showed adequate perforator vessels originating from the left inferior epigastric artery and a sufficient left internal mammary artery (IMA) despite the prior cardiac surgery. Thus, we planned for an autologous reconstruction of the left

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breast with a free msTRAM flap. Before surgery, low-molecular-weight heparin was administered instead of phenprocoumon as an anticoagulation therapy. The IMA and internal mammary vein were dissected on the left side after partial rib resection. An ms2TRAM was dissected from the left abdomen, including one medial and one lateral perforator. The inferior epigastric artery was extremely atherosclerotic and altered with calcified plaques, occupying the complete length of the pedicle. In the course of the microvascular transplantation, two pedicle veins were anastomosed to the cranial and caudal internal mammary vein via vein couplers. The flap artery was then anastomosed to the cranial IMA via sutures. The distinct calcifications and plaque formations between intima and adventitia made arterial anastomosis unfeasible due to prolapse of the plaques into the vessel lumen and tearing of the fragile intima, causing thrombosis. The inferior epigastric artery was carefully trimmed and a Prolene 8-0 suture with an EVERPOINT cardiovascular tapered needle (Ethicon, Sommerville, N.J.) was used for interrupted sutures, starting from inside the vessel lumen. Nevertheless, the entire vascular pedicle was full of plaques, deposited between the intima and adventitia, so that there was no chance of choosing a site with less plaques and using a venous bypass as an interpositional graft (Fig. 1). Also, the intima was completely detached from the media, leading to a collapse of the lumen (Fig. 2). Finally, a salvage procedure was performed by fixating the intima to the adventitia with interrupted sutures to prevent prolapse of the plaques into the vessel lumen and to ensure the opening of the vessel lumen, facilitating subsequent anastomosis to the IMA (Fig. 3). Blood flow to the flap was sufficient after that and there were no signs of thrombosis, which was also confirmed by microscope integrated indocyanine green based video angiography tools IR800 and FLOW800 (Kinevo 900, Carl Zeiss, Oberkochen, Germany) (Fig. 4). The following post-operative period was uneventful and anticoagulation with phenprocoumon was continued shortly after the surgery. After a follow-up period of 8 weeks, the reconstructed breast showed adequate perfusion.

Takeaways

Question: How to facilitate microanastomosis in severely calcified atherosclerotic arteries?

Findings: Fixation of the intima to the adventitia via interrupted sutures prevented intima curling and prolapse of plaques into the vessel lumen of an extremely atherosclerotic artery in this case report.

Meaning: This novel technique of intima-to-adventitia suture facilitates an otherwise unfeasible microanastomosis of severely atherosclerotic arteries.

DISCUSSION

Calcified atherosclerosis is a known risk factor for microvascular surgery.^{6,7} Intimal separation or mechanical crush of plaques during passage of transmural sutures represent a great technical challenge during microanastomosis. Even after completion of an anastomosis, prolapsed vessel wall material into the lumen might cause thrombosis, leading to flap failure.^{7,8} With the demographic trend toward aging and rising incidence of metabolic diseases, atherosclerosis and peripheral artery disease represent an increasing burden.⁹ The evolution of microsurgery during the past years has enabled free flap reconstruction even in patients with severe atherosclerosis after proper risk assessment.¹ That includes preoperative imaging like computed tomography angiography and proper flap selection. Generally, flaps based on pedicles from the central parts of the body or upper limbs are rarely involved in vessel pathology.^{1,6} The inferior epigastric artery in particular was reported to be minimally affected by atherosclerosis even in patients with coronary heart disease.^{10,11} A preoperative computed tomography angiography has revealed proper perforators, originating from the inferior epigastric artery, but also showed signs of atherosclerosis in the inferior epigastric artery. We therefore chose an ms2TRAM flap instead of a perforator based deep inferior epigastric perforator flap for autologous breast reconstruction, as the patient presented with adequate abdominal tissue. Intraoperatively, we came

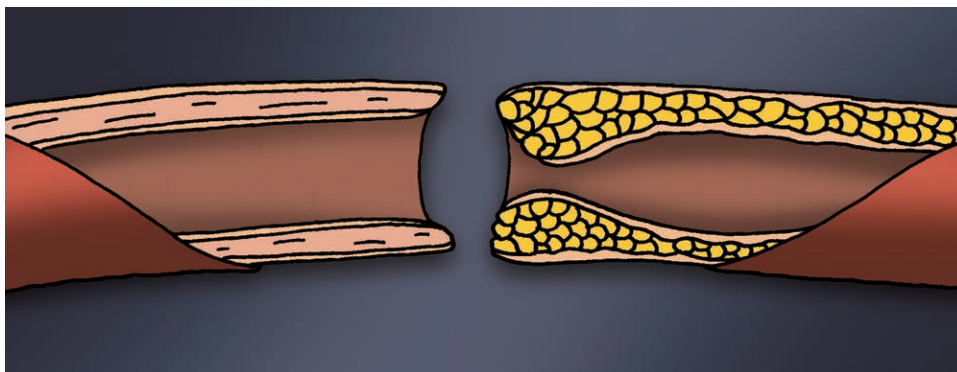


Fig. 1. Schematic illustration of the IMA (left) and an extremely atherosclerotic inferior epigastric artery with calcified plaques between intima and adventitia (right).

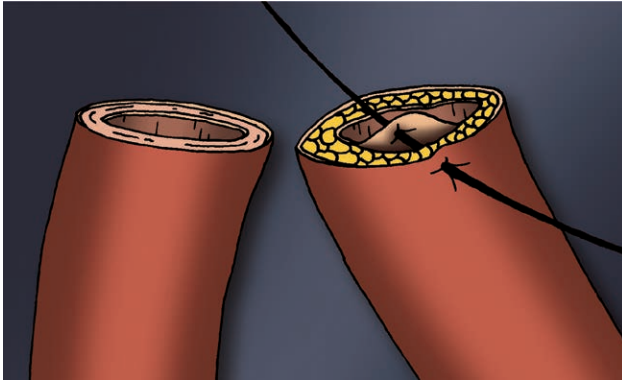


Fig. 2. Schematic illustration of attempted anastomosis between the IMA (left) and the inferior epigastric artery (right), which was not feasible due to prolapse of the plaques into the vessel lumen and tearing of the fragile intima. The intima was completely detached from the media, leading to a collapse of the lumen.

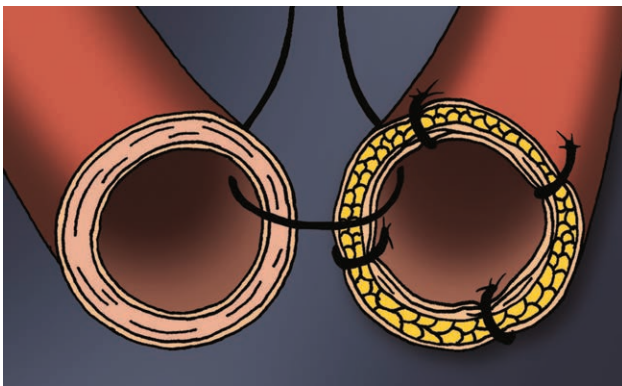


Fig. 3. Schematic illustration of the anastomosis between IMA (left) and the inferior epigastric artery (right) after the intima was fixed to the adventitia with interrupted sutures, facilitating subsequent anastomosis to the IMA.

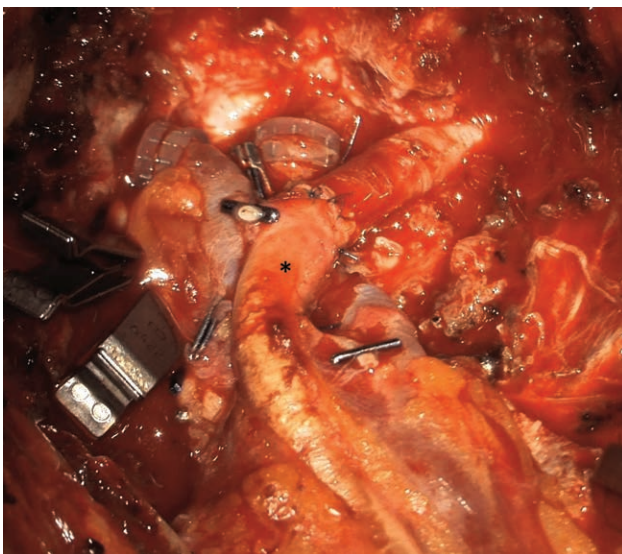


Fig. 4. Intraoperative image of the anastomosis of the IMA with the atherosclerotic inferior epigastric artery (asterisk) obtained under the microscope (left).

across calcified plaques, occupying the entire length of the inferior epigastric artery and complicating arterial microanastomosis to the IMA. After several attempts of suturing the atherosclerotic vessel as described previously,^{1,6} we fixed the intima to the adventitia with interrupted sutures. This maneuver prevented the vessel from intimal delamination and secured the plaques between intima and adventitia so that they would not prolapse into the vessel lumen.

This case report demonstrates a novel and secure technique of microanastomosis in calcified atherosclerotic vessels. This intima-to-adventitia suture procedure facilitated transplantation of a free msTRAM flap in a patient who would have otherwise required a pedicled latissimus dorsi flap for breast reconstruction.

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