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Microvascular vessel preparation: What are we really removing during adventitial stripping?

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Summary *Aim:* Although adventitial stripping has been routinely recommended and practiced during vessel preparation for microsurgical anastomoses, detailed descriptions vary regarding the adequate extent of such maneuver. We aimed to histologically clarify which components of the vessel are removed during adventitial stripping, using arterial samples harvested during microsurgical breast reconstruction.
Methods: Thirteen deep inferior epigastric arteries, nine internal mammary arteries, and four thoracodorsal arteries were evaluated in each step of vessel preparation, which were (1) grossly as a vascular bundle, (2) before vessel preparation, and (3) after vessel preparation under the operative microscope. Histologic components of each sample were evaluated under light microscopy. The combined thickness of the intima and the media and the thickness of the adventitia were measured and compared.
Results: Two distinctive layers of connective tissue were observed outside the media before vessel preparation. Outer loose areolar tissue with coarse fibers was mostly removed during vessel preparation. However, the inner adventitial layer with dense, fine collagen fibers consistently remained after vessel preparation and ostensible adventitial stripping. The average thickness of this layer was comparable with that of the media. Although there was no definitive demarcation between the two differential connective tissue layers, a vasa vasorum layer was distinctly seen between the two layers.
Conclusion: The tissue removed during standard microsurgical vessel preparation or vessel stripping is not the entire layer of the adventitia, and the inner adherent layer of adventitia with fine collagen fibers should be preserved and included in the microsuture with the intima

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and media during anastomosis.

Introduction

With major advances in the field of microvascular surgery over the past four decades, the basic principles and techniques of vessel anastomosis have not changed significantly. This is particularly true with arterial anastomosis where hand suturing is still the gold standard. Adventitial stripping is generally recommended in preparing vessels for microanastomosis in many modern textbooks to secure a clear vision of the vessel end and to prevent thrombosis caused by inadvertent adventitial invagination into the anastomotic lumen. However, detailed descriptions vary regarding the amount and extent of adventitial stripping and vessel preparation. Some authors simply explain that a cuff of loose adventitial tissue should be excised.[1] Others state that the vessel ends should be prepared by stripping the adventitia up to the area that would be included within the microvascular clamps,[2] or that the loose adventitia should be either peeled off or sharply trimmed to a distance of 3—4 mm from the anastomotic site.[3] However, it is also commonly emphasized that overly aggressive adventitial stripping must be avoided, and the bite should incorporate all the layers of the vessel.[3] According to some authors, it has been shown that neither blunt nor sharp dissection removes significant amount of the adventitia, and it is advisable to remove only the adventitia that overhangs the vessel ends, particularly in the case of small veins.[4,5]

Acland,[6] one of the early pioneers in microsurgery, defined the adventitia as the loose fluffy outer layer of white fibrous tissue, and he underlined that it is important to remove the adventitia thoroughly from the vessel end to clearly see the cut edge of the media, which really matters for suturing purposes. However, Daniel and Terzis[7] termed the tissue to be removed as loose areolar perivascular tissue, and they explained that only the adventitial "foreskin" should be removed. They also stated that the radical stripping of the adventitia is rarely indicated, and it is histologically impossible to achieve.[7] We aimed to histologically elucidate which components of the vessel are actually removed during adventitial stripping and which tissue is actually engaged in the microsuture bite, using arterial samples harvested during microsurgical breast reconstruction.

Materials and methods

A total of 26 arterial samples (13 deep inferior epigastric arteries (DIEAs), nine internal mammary arteries (IMAs), and four thoracodorsal arteries (TDAs)) were harvested from 13 patients during microsurgical breast reconstruction using abdominal tissue. Available samples were harvested in each step of vessel preparation, that is, (1) as a vascular bundle (before separating the artery and vein), (2) before vessel preparation, and (3) after vessel preparation under operative microscope for microanastomosis. Three specimens with an ostensible step-off after vessel division were also harvested with the surrounding tissue (cuff), and they were processed for histologic examination (Figure 1).

Harvested samples were fixed by immersion in 4% neutral buffered formaldehyde solution for histologic examination. The specimens were left in 10% neutral formaldehyde solution for 7 days, then dehydrated in ascending alcohol concentrations, and embedded in paraffin. Sections of 5-μm thickness were sliced and stained with hematoxylin—eosin using the Weigert van Gieson technique.

Histologic components of each sample were evaluated under light microscopy. The thicknesses of (a) from the lumen to the outer boundary of the tunica media and (b) from the lumen to the outer boundary of the prepared vessel were measured in five randomly chosen fields without apparent artifact under 200-times magnification. Finally, the thickness of the tunica adventitia was calculated by subtracting (a) from (b). The thickness of the media and the adventitia was compared between vessels, and the thickness of the media was compared with its matching adventitia using the student's *t*-test and the one-way analysis of variance (ANOVA). A *p*-value of <0.05 was considered as statistically significant. The protocol of this study was approved by the institutional review board of the authors' institution.

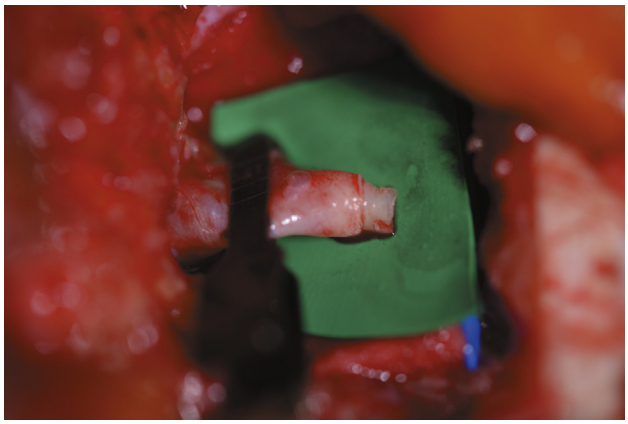

Figure 1 The internal mammary artery (IMA) after severing with microscissors during vessel preparation. The IMA easily separates into layers mimicking a telescope sign when severed with scissors or handled with forceps. Herniated inner glossy layer was harvested obliquely to partly include the surrounding cuff layer, and it was processed for microscopic analysis.