Does Size Matter? A Prospective Histopathologic Study Measuring Free Flap Vessel Size

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Study Objective: Determine if the histopathologic characteristics and cross-sectional area of arteries immediately adjacent to free flap anastomosis would correlate with free flap failure.

Design: IRB-approved prospective cohort study.

Methods: Collection of donor and recipient artery segments for each head and neck free flap reconstructive cases between December 2020 and November 2021. A total of 68 patients were enrolled in the study in this time period. No patients declined to enroll in the study, however 17 cases had vessels that were not collected due to lack of consent prior to anesthesia or forgetting to send specimens to pathology. Arterial intralumenal dimensions were measured under a microscope. This was done by measuring the diameter at the largest dimension and then also at a complete perpendicular dimension. These numbers were each divided by 2 to get radius measurements and then multiplied by each other and 3.14159 to estimate and area calculation.

Results: The mean intralumenal dimensions and luminal area for the donor (free flap donor site) arteries was larger than that of the overall average luminal area of the recipient arteries within the neck ($0.913mm^3$ vs $0.679mm^3$, p=0.45). The average luminal area of all arteries in successful free flaps was $0.788mm^3$, while the average luminal area of all arteries used in cases where there was either partial or complete free flap failure was $0.576mm^3$, p=0.39). The difference in vessel luminal area between recipient and donor vessels was greater in cases where there was free flap failure, $0.914mm^3$, versus the difference in luminal area between recipient and donor vessels in successful free flap cases, $0.147mm^3$, p=0.38). While none of these measurements reached statistical significance, it should be noted that in cases of free flap failure (partial or complete) the arteries utilized for microvascular anastomosis were smaller and showed a greater disparity between donor and recipient artery sizes.

Discussion and Conclusions: It is intuitive that successful free flaps are more likely to have larger recipient and donor arteries. The larger luminal size should theoretically make it more difficult for a completely occlusive thrombus to form and cause ischemic injury. It also seems logical that the anastomosis between donor and recipient arteries would ideally include two similarly sized arteries. Unfortunately, our study hinted at these points, but was not powered well enough to show statistical significance. Our study had multiple limitations. First, the sample size was not large enough to draw any definitive conclusions. Second, there are many variables that go into free flap success. A multivariate analysis taking in many different demographic and clinical factors would be most appropriate to assist in showing any correlation. Also, multiple different people were involved in the tissue fixation and paraffin embedding process for sample analysis. If the vessels were prepared differently or cut at slightly oblique angles, that would affect the final measurements. With more complete data on the horizon, the authors hope to corroborate these findings with further histopathologic analysis and larger sample sizes.