DEVELOPMENT OF TISSUE ENGINEERED VASCULAR GRAFTS

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The success of all new engineered products depends strongly on the initial design specifications. A tissue engineered vascular graft should be specifically designed to enhance the healing and functional capabilities of the graft for long term performance in vivo. The basic design criteria then become critical for the success of a tissue engineered vascular graft. From analysis of normal arteries, the graft should have mechanical strength, optimal shear stress, and allow for cellular healing with a natural architecture.

This analysis suggests that several popular approaches may not be the only answers to a tissue-engineered vascular graft. The criteria do not require biodegradability. The criteria do not require a specific scaffold for cells. The criteria do not require external cells at all. The criteria do require mechanical strength - early and late. The criteria do require shear stress analysis for optimized performance. The criteria do require biological testing for thrombosis and chronic rejection. The criteria do require handling and suitability testing by vascular surgeons.

The bioengineering team at Georgia Tech is pursuing several alternative approaches to develop a tissue-engineered vascular graft which will function like a normal artery. Specific performance testing requirements will be discussed as well as preliminary tests on a new biomaterial.

GEOMETRY AND FLOWFIELD AT ARTERIAL BYPASS GRAFTS: EXPERIMENTAL STUDIES

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Arterial bypass grafting is widely performed, but loss of graft patency, mainly caused by intimal hyperplasia, remains a serious problem. The research to be reported is concerned with experimental studies of the relationship between the geometry at model end-to-side arterial bypass grafts and the local flowfield. It complements our computational studies on this subject.

The mechanisms which underlie intimal hyperplasia are incompletely understood, but a body of evidence links the severity of the process to the local flowfield and specifically to the local wall shear stress. We have proposed that the geometry at arterial bends and branches is commonly non-planar, and associated with an asymmetric, swirling flow and a relatively uniform distribution of wall shear stress.

There has been extensive study of the relationship between the geometry at end-to-side arterial bypass grafts and the local flowfield. However, most studies appear to have been confined to planar configurations. We have found that rendering the geometry at model end-to-side arterial bypass grafts non-planar significantly alters the local flowfield.