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Vasreactor

Tabitha Boeringer
Florida Institute of Technology

Alvin Estacio
Florida Institute of Technology

Joan Hyland
Florida Institute of Technology

Andrea Theus
Florida Institute of Technology

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Tabitha Boeringer, Alvin Estacio, Joan Hyland, Andrea Theus

Faculty Advisors: Dr. Bashur and Dr. Mitra, Dept of Biomedical engineering, Florida Institute of Technology

Introduction

Heart disease is the leading cause of death in the United States. There are numerous issues with finding healthy blood vessels in such patients, with them often having to return to surgery due to bypass failure. Bioreactors serve as a solution to this problem by providing viable and healthy arteries to bypass the occluded cardiac artery. However, these systems can be very costly and complicated in use and assemblage (especially in the loading of specimens).

Objectives

This design seeks to create a bioreactor system that

- Improve ease and efficiency of loading small diameter vascular grafts
- Maintain or improve graft viability
- Reduce overall system cost using a minimalistic approach

Design Considerations

The major aspects to be addressed in this design were increasing loading efficiency, increasing cell viability, promote tissue integration, using pulsatile flow to simulate in vivo, and keeping the system low cost.

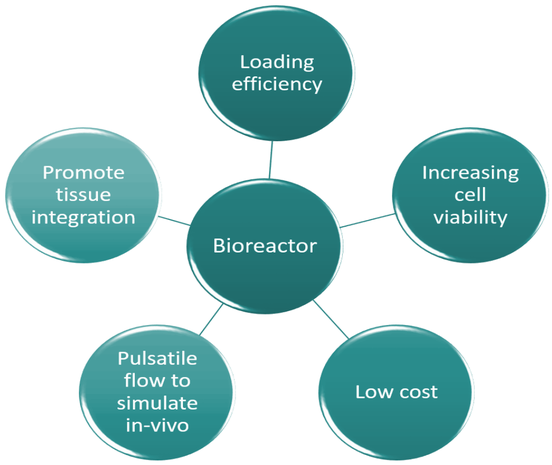


Figure 1. Five key issues that needed to be addressed when designing a bioreactor system.

Final Design Components

The Chamber

The chamber was milled and cut into a rectangular box that was compact and simple to build. The main piece was made out of opaque PTFE that is biocompatible and sturdy. Clear polycarbonate covers were attached using screws to the bottom and top of the PTFE piece with the top piece being removable. This allowed for easy viewing of the graft. All chamber materials are autoclavable. Two sample ports were made to allow for simultaneous testing of multiple samples. This combination is novel and useful because it allows for a collectively economic chamber that allows for simultaneous testing, with easy visibility that is structurally sturdy.

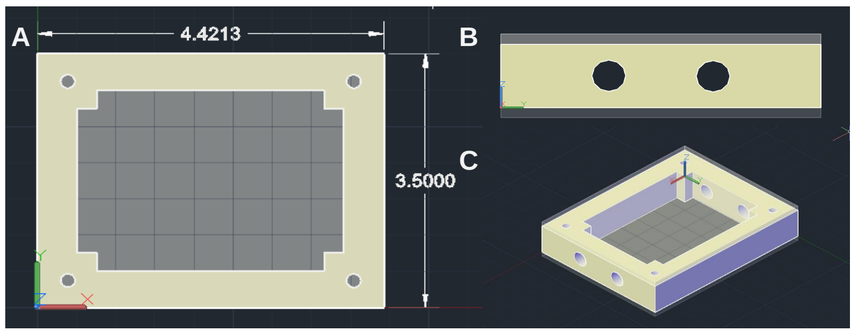


Figure 2. CAD drawings of PTFE and polycarbonate structures of chamber. A) Top view B) Side view C) Full view with polycarbonate covers attached

Pump System

A peristaltic pump was chosen to produce the peristaltic flow desired to nourish the graft by mimicking conditions of the *in vivo* environment[2]. Special silicon tubing and connectors were used for attaching the various components, with a composition that allowed for autoclave sterilization.

Figure 3. MasterFlex pump head and peristaltic pump used for bioreactor system

Loading Mechanism

To anchor the sample, a special clamp was modified with tubing in order to grip the samples to prevent slippage, and then the barbed connectors were attached to the magnets to allow for easy insertion and removal of the grafts. This is novel and significant because it allows for seeding outside the chamber.

The magnets, the only non autoclavable part of the chamber system, are sterilized with ethanol before use. Research on the effect of the low magnetic field on cell growth was conducted with the general conclusion being that constant low level magnetic fields will not alter cell growth.

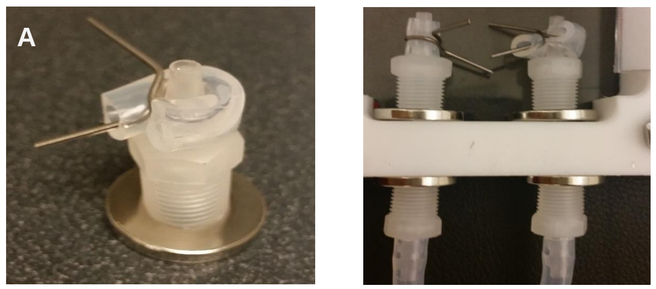
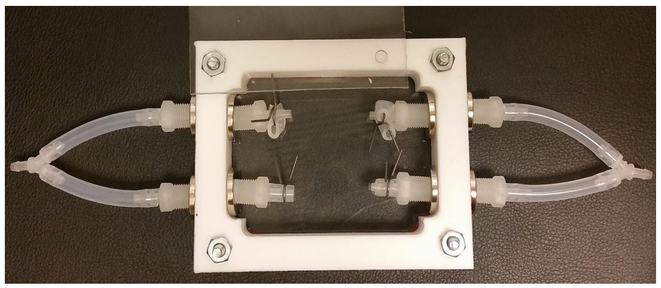


Figure 4. Barbed connector pieces attached to magnets to act as the mechanism for loading the graft into the chamber.

Final Product Design



Future Design Improvements

- Variable graft length capabilities
- Loading system with only one fixed side
- Use of more specialized magnets and clamps

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