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Poster Session
Thu. Jul 18, 2024 4:30 PM - 6:30 PM Room P

[PO-08] Numerical Analysis of Steady Flows in a porous and permeable scaffold.

*LABIN KIM[1], SEONG HOON JEONG[1], KYUNG EUN LEE[1] (1. Department of Mechanical Engineering, Inha University)

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Numerical Analysis of Steady Flows in a porous and permeable scaffold.

Labin Kim*, Seong Hoon Jeong*, Kyung Eun Lee*
Corresponding author:bfmec@inha.ac.kr
* Department of Mechanical Engineering, Inha University, Michuholgu, Incheon, 22212, Republic of Korea

1 Introduction

Atherosclerosis is a significant global cause of mortality, with severe stenosis often treated using prosthetic bypass grafts (1). However, there have been instances of bypass graft failure and stenosis recurrence (2). This research aims to investigate the impact of porosity and permeability on scaffold walls to enhance prosthetic artery performance. The ultimate goal is to apply this knowledge to improve the patency of prosthetic arteries.

2 Methods

Three types of scaffold were modeled, each with a different surface treatment: a non-porous and non-permeable rigid wall (Model I), a regular cubic porous and non-permeable wall (Model II), and an irregular porous and permeable wall (Model III, Figure 1). Flow simulations were conducted in these prosthetic arteries using a finite volume method with finite difference discretizations (Fluent v.2021R). Assumptions for this study included laminar flow, incompressible Newtonian flow, and a rigid vessel wall with no elasticity. Velocity, pressure, and wall shear stress were computed by solving the continuity and Navier-Stokes equations.

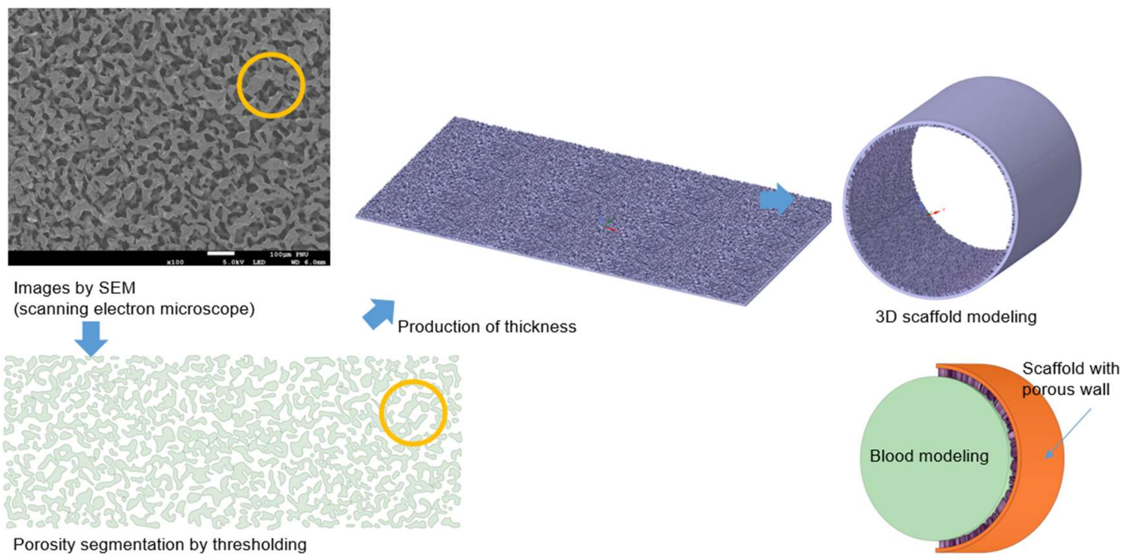

Figure 1: An irregular porous model from scanning electron microscope

3 Results

Fully developed flow patterns were observed in all three models, but slower flows penetrated the porosity near the porous walls in Models II and III. Recirculation of flows was noted in the porous regions of Models II and III. Figure 2 illustrates the distribution of wall shear stress in Models I, II, and III. In the porous regions of Models II and III, lower wall shear stress values and flow recirculation were observed, which could potentially contribute to atherosclerosis (3).

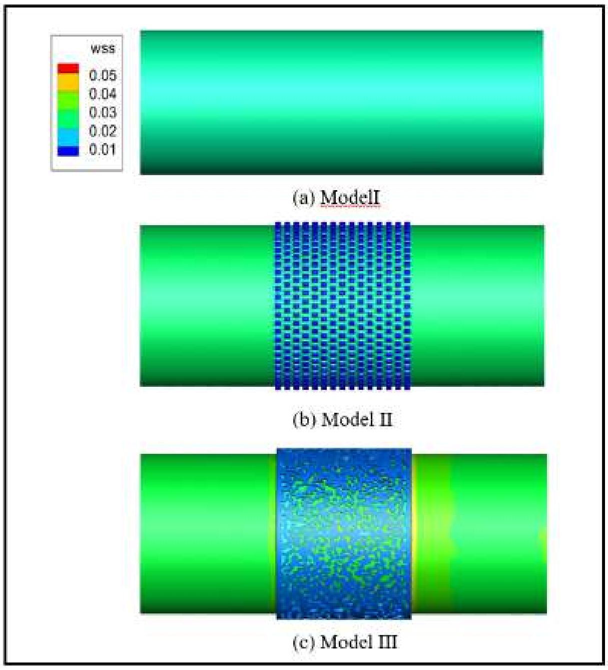

Figure 2: Wall shear stress distributions in Model I, II, and III.

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