

*Restoring Endothelial Cell Mechanostimulation by Shear Stress in Chronic Wounds Models Using Glycocalyx-Mimicking Nanoparticles*

Chronic wounds, especially those associated with diabetes, pose a significant medical challenge due to their persistent nature and poor healing outcomes. These wounds often exhibit chronic inflammation, impaired angiogenesis, and dysfunctional endothelial cells, which are cells lining the blood vessels. These complications partly arise from defective mechanosensing and mechanotransduction, processes through which cells detect and react to mechanical forces. Existing treatments do not effectively address these underlying issues, highlighting the need for new research and approaches in this area.

This project investigates the use of nanoparticles designed to mimic the endothelial glycocalyx, a protective layer on endothelial cells, to enhance their sensitivity to mechanical forces, improve blood vessel growth, and reduce inflammation in chronic wounds. The research aims to understand how these nanoparticles can restore endothelial cells' ability to detect and respond to fluid flow and consequently shear stress. Moreover, project assess interactions of nanoparticles with cells, and investigate the cellular mechanisms affected. The main goal is to gain a deeper understanding of how enhancing endothelial cell sensitivity to mechanical forces can aid in healing chronic wounds. The hypothesis is that these specially designed nanoparticles can vary in how they interact with endothelial cells based on the mechanical forces, improve the cells' sensitivity to these forces, and effectively mimic the protective properties of the natural glycocalyx, leading to better wound healing outcomes.

The expected impacts of this research are substantial. By deepening our understanding of how mechanical forces influence cellular behaviors, the project could spearhead advancements in regenerative medicine. Ultimately, this project seeks to uncover the biological principles underlying the replication of natural processes through nanotechnology, aiming for effective treatment of chronic wounds.