Translation of a Novel Microstructured Tissue Fastener into a Coronary Stent

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Coronary stents play a crucial role in cardiovascular care, but face challenges like stent recoil (SR), which refers to contraction of the stent after implantation, and in-stent restenosis (ISR), characterized by tissue overgrowth over top the stent. Both challenges lead to compromised blood flow and heightened susceptibility to ischemia due to reduced lumen size. Draper's Mechanical Adhesion to Tissue (MANTIS) technology uses hook-shaped microstructures to create a velcro-like system for tissue adhesion. Our goal is to integrate MANTIS microstructures onto a drug eluting stent to reduce the rate of SR by adhering the stent to the artery and to reduce the rate of ISR by inhibiting tissue proliferation through an immunosuppressant coating. To test our hypothesis, we employed two methodologies, mechanical testing evaluating MANTIS adhesion to bovine coronary artery tissue for SR and drug delivery testing using MANTIS microstructures coated with PLGA and Rhodamine B in alginate hydrogels for ISR. Mechanical testing confirms MANTIS's efficacy in tissue adhesion with a singular microstructure demonstrating maximum tensile forces of 13.6 mN, which is over three times stronger than the control. Drug delivery results found that using a 0.1M concentration of calcium chloride with a 2% sodium alginate solution resulted in the formation of an optimal tissue surrogate gel. Moreso, coated MANTIS coupons with PLGA and Rhodamine B in the hydrogels were imaged, showing promising results of drug diffusion. Moving forward, we aim to conduct further drug delivery and mechanical tests and finalize a coronary stent prototype incorporating MANTIS.