

Team 7:
Tracheomatrix

PROJECT:
Hydrogel-Based Drug Delivery System and Airway-On-A-Chip Model for Targeted Treatment of Idiopathic Subglottic Stenosis (iSGS): Advancing Localized Therapy and Disease Modeling

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Idiopathic subglottic stenosis (iSGS) is a chronic inflammatory condition characterized by abnormal wound healing around the subglottis and tracheal region. Excessive fibrosis causes ECM deposition in the area, leading to tissue stiffness and narrowing of the passage. There is no permanent solution and current treatment solutions are surgically removing the scar tissue with topical medication; however, since fibrotic differentiation has a high recurrence rate, patients have to get surgeries regularly. Additionally, since the disease is extremely rare; occurring in 1 in 400,000 people in the United States and primarily affecting menopausal women, testing novel medications becomes hard. Hence, our project involves developing an injectable hydrogel to act as a delivery system to slow fibrosis progression; and testing this in a trachea-on-chip model with the phenotypic features of iSGS. The properties of the former are as follows: easy to load and control release of the drug, maintain structural integrity, and have similar mechanical properties to the trachea. As such, the drugs that are planned to be integrated are glucocorticosteroids, mitomycin C, or TGF-beta inhibitors, which are currently used as medication to inhibit fibrosis. On the other hand, the initial prototype of the microfluidic chip will be designed to have three layers: epithelial cells, porous basement membrane, and ECM with collagen and fibroblasts. Additionally, the latter layer would also have cell media and TGF-beta to promote cell growth and fibrosis respectively. The epithelial and fibroblasts would be seeded to obtain a final ratio of 8:2 respectively. There are no pre-existing models for the latter, hence manufacturing costs are difficult to estimate, however the costs of other chips start at \$22,000. For the hydrogel, costs (including manufacture) range from \$5,924 to \$9,031.