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An Ex-Vivo Human Corneal Rim Perfusion Model

Purpose: Trabecular meshwork (TM) dysfunction is a primary factor in glaucoma pathophysiology, necessitating reliable models to investigate aqueous humor dynamics. We developed an ex vivo perfusion model utilizing bisected human corneal rims to assess feasibility as an alternative to anterior segment perfusion systems. The paired design minimizes inter-sample variability while maximizing tissue use. Methods: A custom perfusion chamber was designed using CAD modeling and 3D printing. Human corneal rims, obtained under an IRB exempt protocol from tissue discarded after penetrating keratoplasty, were bisected and affixed to the perfusion device using cyanoacrylate glue. Samples were subjected to constant pressure of 8 mmHg controlled by an air compressor and water column. Flow rate and pressure data were collected via CorSolutions Flow Meter Plus and pressure transducer. After 48h perfusion, pressure was changed in increments of 7.5mmHg to 30mmHg, while flow rate was recorded. Outflow facility was calculated at the slope of the pressure–flow relationship.Results: Pressure and flow readings demonstrated stability throughout the constant pressure period. Flow increased with increasing pressure but variability in flow was noted. The experimental outflow facility averaged 22.05-27.57 nL/min/mmHg, significantly lower than the expected 445 nL/min/mmHg, potentially due to tissue degradation or adhesive interference with the TM. Conclusion: Our findings show the feasibility of using a bisected corneal rim as a perfusion model for studying aqueous humor outflow. The paired experimental design offers a platform for evaluating pharmacological intervention while improving tissue utilization efficiency. Observed flow rate variability highlights the need for further methodological refinements. Future work will focus on optimizing tissue preparation, improving sealing techniques, and enhancing data reproducibility to strengthen the model's utility in translational glaucoma research.