In Vivo Studies Demonstrating Feasibility and Biocompatibilitya of a MEMS Ocular Drug Delivery System

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Targeted drug delivery to diseased intraocular tissues, in particular the retina, has been ineffective by current delivery methods (oral, topical, injections, and sustained release implants) due to the space limitations and physiological barriers preventing delivery at therapeutic levels. We seek to address these limitations with a polymer-based MEMS (microelectromechanical systems) intraocular drug delivery device capable of providing sustained and targeted delivery for management of ocular disease. This subconjunctival implant includes a valved transscleral cannula having an outlet aimed directly at the treatment site (anterior or posterior segment). This device specifically addresses patient comfort and is refillable unlike current sustained release implants. Thus, this device paradigm has broad drug compatibility and is capable of addressing many chronic ocular diseases. Furthermore, by virtue of the refillable design, only a single surgical intervention is required following which chronic and adaptable drug delivery regimens are possible. The valved cannula regulates fluid flow into and out of the device thus providing protection from events such as accidental dosing and backflow of bodily fluids into the cannula. We present chronic *in vivo* studies featuring mechanically-operated, functional surgical models for optimization of device design, development of practical surgical implant procedures, and development of a refill protocol via customized syringe needles. Material selection and engineering design as they pertain to inflammatory responses are also discussed.