

Refillable MEMS Drug Delivery Pump for Chronic Ocular Diseases

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Commerical Relationships: R. Lo, Bausch & Lomb, F; California Institute of Technology, P; P. Li, Bausch & Lomb, F; California Institute of Technology, P; J. Shih, Bausch & Lomb, F; California Institute of Technology, P; S. Saati, Bausch & Lomb, F; R. Agrawal, Bausch & Lomb, F; California Institute of Technology, P; Y. Tai, Bausch & Lomb, F; California Institute of Technology, P; M. Humayun, Bausch & Lomb, F; California Institute of Technology, P; E. Meng, Bausch & Lomb, F; California Institute of Technology, P.

Support: NSF Grant EEC 0310723, Bausch & Lomb

Abstract

Purpose: Develop a refillable ocular drug delivery device for targeted therapeutic delivery.

Methods: Two different approaches to drug delivery, manually- and electronically-controlled pumping with MicroElectroMechanical Systems (MEMS) devices were developed as an alternate treatment method for intraocular drug delivery. Both systems share a common layout, containing a refillable drug reservoir and a cannula. The manually-controlled device contains a restrictor valve that prevents backflow. The device is implanted subconjunctivally with the cannula tip positioned in the anterior or posterior segment. Drug dispensation occurs when the reservoir is depressed by the patient, or due to gas generation associated with electrolysis. Reservoir is refilled with a modified 30 gauge needle. This device allows long-term treatment following a single surgical intervention.

Results: Bench top and surgical tests confirmed one-way bolus dispensation from the valved manually-controlled device. Bolus or continuous dispensation (nL/min), with a fixed or variable rate, from the electronically controlled device was correlated to applied current. Bench top tests demonstrate 229.6nL/min with a standard error of 19.7nL/min at 50μA of applied current. Refillability has been assessed in bench top and surgical experiments. A non-coring 30G needle was used to repeatedly puncture the reservoir material in the same location. After 24 punctures, internally pressurized reservoirs are able to contain fluid below 230 mmHg.

Conclusions: A device capable of intraocular drug delivery with targeted doses to treat chronic ocular diseases is demonstrated.

Key Words: injection • retina • quality of life



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