Abstract Title: Surgical Methods to Place a Novel Refillable Ocular Microelectromechanical Systems (MEMS) Drug Delivery Device

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Purpose: Drug therapy plays a major role in the management of many ocular diseases. Current routes of treatment (topical, systemic or intraocular injections) may have limited efficacy due to physiologic barriers and potential side effects. To circumvent these issues, a new refillable ocular MEMS drug delivery device (DDD) has been developed to provide controlled drug delivery with potentially fewer side effects.

Material and Methods: First generation devices are manually and electrically-controlled. The manually-controlled device, composed of a refillable reservoir, cannula and check valve, was constructed of molded silicone. The electrically-controlled device also includes an electrolysis pump fabricated on a silicon substrate. Work is in progress to develop the second generation of the electrically-controlled DDD. Sham devices with rounded edges, refillable reservoir, refilling port, and a cannula were fabricated to provide a surgical model for refining the feasibility of procedure. After partial peritomy in rabbit eye, the cannula was inserted into the anterior chamber through a scleral tunnel incision. The device was sutured to the sclera. Under controlled lighting, baseline pupillary diameter was recorded. The left eye acted as the control. The reservoir, filled with phenylephrine solution (1.5%), was depressed and pupillary changes were noted. Rabbits have been followed for 1 month so far.

Results: Both first prototypes dispensed dye and phenylephrine solution in to the eye. In the phenylephrine *in vivo* test using sham devices, pupillary diameter increased by 2.5 mm after dispensation. In follow-ups, mild corneal edema and anterior chamber inflammatory reaction were observed in one rabbit on first postoperative week. There were no more adverse effects noted in fluorescein angiography.

Conclusions: This new MEMS drug delivery device with refillable reservoir and controlled release of drug shows potential advantages over the current methods of ocular treatment. Experiments are underway to develop next generation devices.