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Surgical Methods to Place a Novel Refillable Ocular Microelectromechanical System (MEMS) Drug Delivery Device

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Abstract

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

Methods: First generation devices are manually and electrically-controlled. The manually-controlled device, composed of a refillable reservoir, cannula and check-valve, is constructed of molded silicone. A one-way check-valve is integrated at the cannula tip to prevent backflow. The reservoir is sutured to the sclera, with the cannula entering the anterior chamber through a scleral tunnel incision. Drug dispensation occurs with pressure on reservoir. Dye was used initially to visualize delivery, while later phenylephrine provided physiological evidence of ocular drug effect *in vivo*. Under controlled lighting, baseline pupillary diameter was recorded. Changes were noted after phenylephrine dispensation. Left eye acted as control. The device was repeatedly dispensed and refilled via 30g needle through the side wall. The electrically-controlled device consists of a reservoir, cannula and electrolysis pump on a silicon base. Dye was dispensed in to the eye due to pressure of accumulated gas in the reservoir.

Results: Both devices dispensed dye into the porcine eye under test conditions. In the phenylephrine *in vivo* test, pupillary diameter increased by 1.5 mm after dispensation. Repeated refilling of the device showed no functional damage. Check-valve successfully functioned with repeated dispensation.

Conclusions: This new MEMS drug delivery device with refillable reservoir and controlled release of drug may have potential advantages over current methods of ocular treatment. Further experiments are needed to develop these devices .

Key Words: development • anterior chamber • drug toxicity/drug effects