Ziv Rotfogel

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Biography

Ziv Rotfogel, is an ophthalmologist at Kaplan Medical Center, Israel, specializing in cornea and cataract surgery. He holds MD and PhD degrees, leads eye-research innovation, and advances technologies such as mitochondrial transplantation and ophthalmic medical devices.

Mitochondria Transplantation Promotes Corneal Epithelial Wound Healing

Abstract:

Purpose: The integrity of the corneal epithelium is essential in maintaining normal corneal function. Conditions disrupting the corneal epithelial layer range from chemical burns to dry eye disease and may result in impairment of both corneal transparency and sensation. Identifying factors that regulate corneal wound healing is key for the development of new treatment strategies. Here, we investigated a direct role of mitochondria in corneal wound healing via mitochondria transplantation.

Methods: Human corneal epithelial cells (hCECs) were isolated from human corneas and incubated with mitochondria which were isolated from human ARPE-19 cells. We determined the effect of mitochondria transplantation on wound healing and proliferation of hCECs. In vivo, we used a mouse model of corneal chemical injury. Mitochondria were isolated from mouse livers and topically applied to the ocular surface following injury. We evaluated the time of wound repair, corneal re-epithelization, and stromal abnormalities.

Results: Mitochondria transplantation induced the proliferation and wound healing of primary hCECs. Further, mitochondria transplantation promoted wound healing in vivo. Specifically, mice receiving mitochondria recovered twice as fast as control mice following corneal injury, presenting both enhanced and improved repair. Corneas treated with mitochondria demonstrated the re-epithelization of the wound area to a multi-layer appearance, compared to thinning and complete loss of the epithelium in control mice. Mitochondria transplantation also prevented the thickening and disorganization of the corneal stromal lamella, restoring normal corneal dehydration.

Conclusions: Mitochondria promote corneal re-epithelization and wound healing. Augmentation of mitochondria levels via mitochondria transplantation may serve as an effective treatment for inducing the rapid repair of corneal epithelial defects.