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Corneal epithelial cell responses to compressive force

The cornea is the anterior most portion of the eye which provides refractive power and protection. The shape of the cornea is maintained by its mechanical property and intraocular pressure. In keratoconus (KC), weakened mechanical property and high intraocular pressure lead to protrusion and a conical shape of the cornea, which result in high astigmatism and impaired vision. Several clinical studies have revealed that mechanical stimuli, such as eye rubbing, can trigger KC-like changes in cornea including altered expression of enzymes, inflammation and oxidative stress. However, studies on the response of corneal epithelial cells (HCEpCs) to mechanical stimuli have been limited We hypothesize that mechanical stimuli including compression, tension and shear force could lead to a keratoconus-related progression of HCEpCs. To evaluate how compression could contribute to the development and progression of KC, cyclic compressive forces were applied on HCEpCs monolayer with different incubation time. Since HCEpCs would start forming tight junction after 7 days of culture, our investigation was focused on cells after 6 days and 10 days incubation, respectively. Cellular responses including cell viability, calcein AM-fluorescein uptake, cytoskeleton rearrangement, apoptosis, Zonula occludens-1 (ZO-1) expression and E-cadherin expression were analyzed. Increased cell death and fluorescein uptake were detected after compression. F-actin rearrangement was detected within 6 hours after compression. Change in apoptosis, ZO-1 expression and E-cadherin expression were also observed. High compressive force (10.53 g/cm2) led to significant cell death on monolayer before tight junction formation; however, interestingly, the high compressive force was well tolerated without cell death on monolayer with tight junction formation. Thus, we concluded that HCECs are sensitive to compressive stimulus, which may shed light on the understanding and prevention of keratoconus.