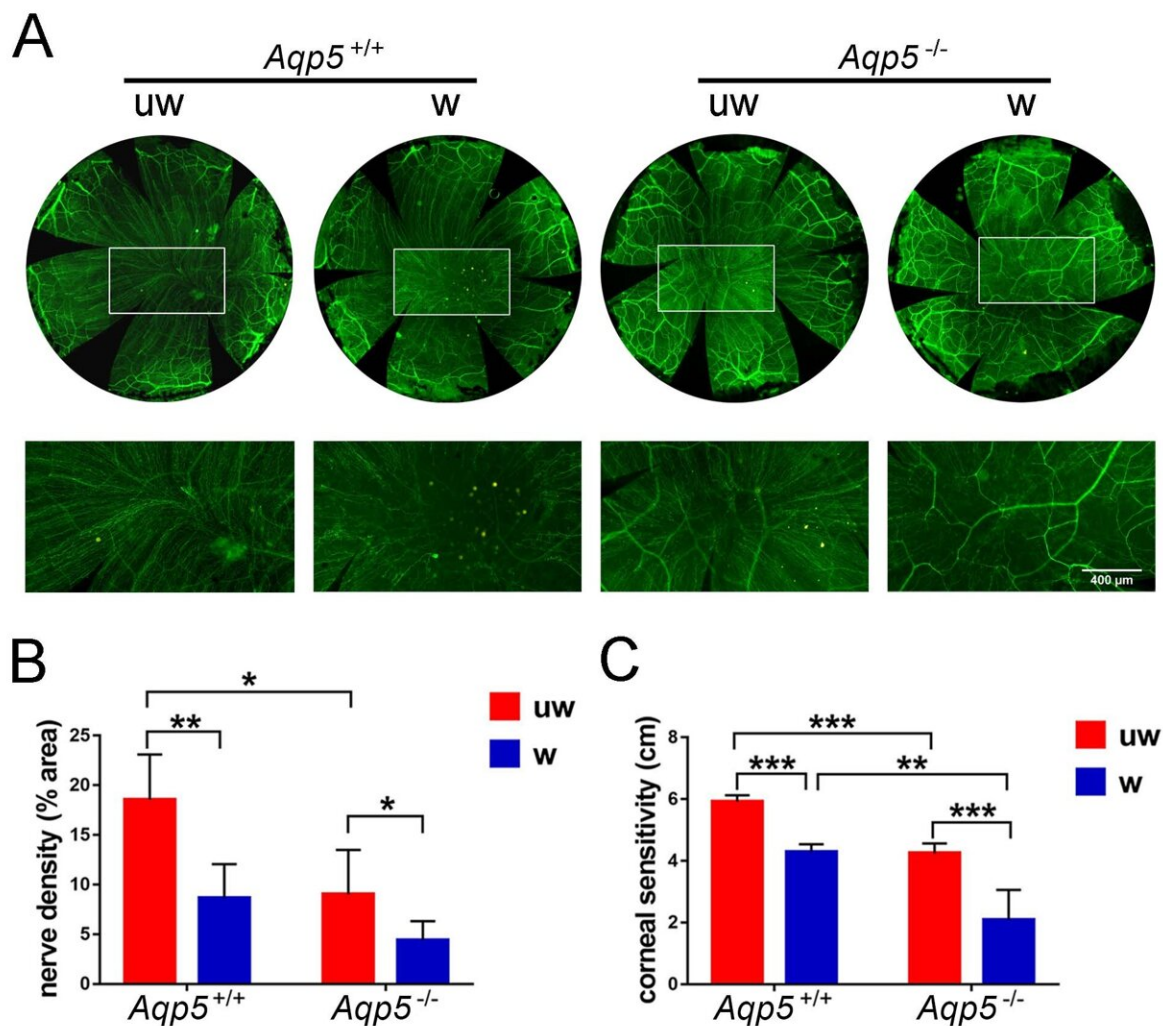


# New study suggests that aquaporin could be key to repairing corneal defects

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(A) Staining for  $\beta$ -tubulin III in *Aqp5*<sup>+/+</sup> and *Aqp5*<sup>-/-</sup> mice before and 48 hours after central corneal scraping. Images of the entire cornea are shown in the top panels, and central cornea images are shown in the bottom panels. Scale bars:

400  $\mu\text{m}$  (bottom panels). (B) Nerve densities of the entire cornea (a, top panels) are calculated on the basis of the areas staining positive for  $\beta$ -tubulin III using Image J software (n=6). (C) Histogram of corneal sensitivity in Aqp5+/+ and Aqp5-/- mice before and 48 hours after central corneal scraping (n=6). uw, unwound; w, wound. \*P *The American Journal of Pathology*

Corneal defects often heal themselves, but serious injuries that are left untreated can result in inflammation, infection, ulceration and even blindness. A new study provides exciting evidence supporting the involvement of aquaporins in corneal cell proliferation and nerve regeneration and suggests aquaporin 5 (AQP5) induction as a potential therapy to accelerate the resurfacing of corneal defects, report scientists in *The American Journal of Pathology*.

The cornea, which consists of transparent tissue in the outermost layer of the eye, acts as a barrier against external stimuli. It also plays a key role in vision.

"As a member of aquaporin family, AQP5 is expressed in cornea, which is related to many eye diseases," explained lead investigator Peng Chen, Ph.D., Department of Human Anatomy, Histology and Embryology, School of Basic Medicine, Qingdao University, Shandong Province; and Institute of Stem Cell Regeneration Medicine, School of Basic Medicine, Qingdao University, Qingdao, China. "If a corneal injury cannot heal in time, it may lead to pathogen invasion and result in corneal inflammation, turbidity, ulcer and even blindness. In previous studies, we found that AQP5 deficiency can cause corneal epithelial punctate defects. There is also increasing evidence that nerve growth factor (NGF) plays a key role in corneal wound healing. AQP5 deficiency can slow down the repair of corneal epithelial injury in mice, but its specific mechanism remained unclear. We hypothesized that

AQP5 plays an important role in one or more stages of corneal epithelial [regeneration](#) and explored the specific mechanism of AQP5."

Investigators generated an *Aqp5* knockout (*Aqp5*<sup>-/-</sup>) [mouse model](#) and performed corneal wound healing on corneas from which [epithelial cells](#) had been scraped away. They used 75 male *Aqp5*<sup>+/+</sup> mice and 189 male *Aqp5*<sup>-/-</sup> mice aged 10 to 12 weeks. Time to corneal epithelial and nerve regeneration was significantly delayed in the *Aqp5*<sup>-/-</sup> mice. To determine the role of NGF in the repair of corneal epithelial injury, NGF was injected in the subconjunctival space after corneal epithelium was scraped off in *Aqp5*<sup>-/-</sup> mice. The epithelial and nerve regeneration rate were significantly promoted in *Aqp5*<sup>-/-</sup> mice with the treatment of NGF, which also improved the recovery of corneal nerve fiber density and sensitivity in *Aqp5*<sup>-/-</sup> mice, accompanied by recovered levels of phosphorylated Akt.

The investigators also administered an Akt inhibitor in addition to NGF in *Aqp5*<sup>-/-</sup> mice to determine the mechanism of NGF regulating the repair rate of corneal epithelial injury. However, the promotion of NGF induced corneal epithelial and nerve regeneration rate and Akt reactivation was reversed by the Akt inhibitor.

"It is exciting to find that *Aqp5* deficiency can affect the [nerve](#) regeneration of [mice](#) by affecting the activation of NGF and Akt signaling pathways, which is not found in previous studies," commented Dr. Chen. "These results need to be confirmed in a [clinical setting](#), but they provide evidence for the involvement of aquaporins in cell proliferation and [nerve regeneration](#) and suggest AQP5 induction as a possible therapy to accelerate the resurfacing of corneal defects."

Aquaporins (AQPs), also called water channels, are channel proteins that form pores in the membrane of biological cells, mainly facilitating transport of water between [cells](#) and are expressed in the corneal

epithelium. Thirteen different types of AQPs have been detected in mammals. As transmembrane proteins, they play a significant role in maintaining cell water homeostasis.

**More information:** Yaning Liu et al, Aquaporin 5 Facilitates Corneal Epithelial Wound Healing and Nerve Regeneration by Reactivating Akt Signaling Pathway, *The American Journal of Pathology* (2021). [DOI: 10.1016/j.ajpath.2021.07.010](https://doi.org/10.1016/j.ajpath.2021.07.010)

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