

New glaucoma culprit is found

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Acute angle closure glaucoma of the right eye (intraocular pressure was 42 in the right eye). Credit: James Heilman, MD/Wikipedia

Glaucoma, a leading cause of irreversible blindness, is associated with elevated pressure in the eye. This elevated pressure essentially is due to a plumbing problem. Fluid builds up in the eye, increasing pressure and eventually damaging the optic nerve. For nearly 150 years, researchers have been trying to understand what causes the blockage that prevents the eye from draining properly.

In a unique study of human ocular cells, a multi-institution research team led by a biomedical engineer at Northwestern University has found a new culprit. Glaucoma appears to be a consequence of mechanical dysfunction of [endothelial cells](#)—a thin layer of cells that is the final barrier to fluid entering Schlemm's canal, from which fluid then drains from the eye.

The researchers found that these endothelial cells from eyes with glaucoma are stiffer than cells from healthy eyes. This stiffness limits the cells' ability to deform and allow a fluid called aqueous humor to cross the endothelium and drain into Schlemm's canal. This increased flow resistance is responsible for the elevated pressure associated with glaucoma.

The findings were published this week in the online early edition of the journal *Proceedings of the National Academy of Sciences (PNAS)*.

"There is no cure for glaucoma, which affects more than two million Americans," said Mark Johnson, the senior author of the study. "Our work shows that cells of this endothelial layer act as mechanical gates. Therapeutic strategies that alter the stiffness of these cells potentially could lead to a cure for this debilitating disease."

Johnson is a professor of biomedical engineering and mechanical engineering at Northwestern's McCormick School of Engineering and Applied Science and a professor of ophthalmology at Northwestern University Feinberg School of Medicine.

Both Schlemm's canal and the clear aqueous humor it drains from the eyeball are vital to the eye's health and function. The aqueous humor nourishes the eye and maintains its proper pressure. Aqueous humor from the eye's anterior chamber (located between the iris and cornea) collects in the canal from which it then flows into the vascular system. If the endothelial cells lining Schlemm's canal are too stiff, it is difficult for them to form pores that allow the aqueous humor to pass through this thin layer and drain into the canal. Pressure then increases in the eye and eventually causes damage to the [optic nerve](#) at the back of the [eye](#).

"The work appears to be one of the first times that the methods of mechanobiology—the study of the mechanical characteristics of [cells](#)

—have been used to show that dysfunctional cell mechanics lies at the heart of a disease process," Johnson said.

More information: Altered mechanobiology of Schlemm's canal endothelial cells in glaucoma, *PNAS*, www.pnas.org/content/early/2014/09/15/1410602111.abstract

Provided by Northwestern University

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