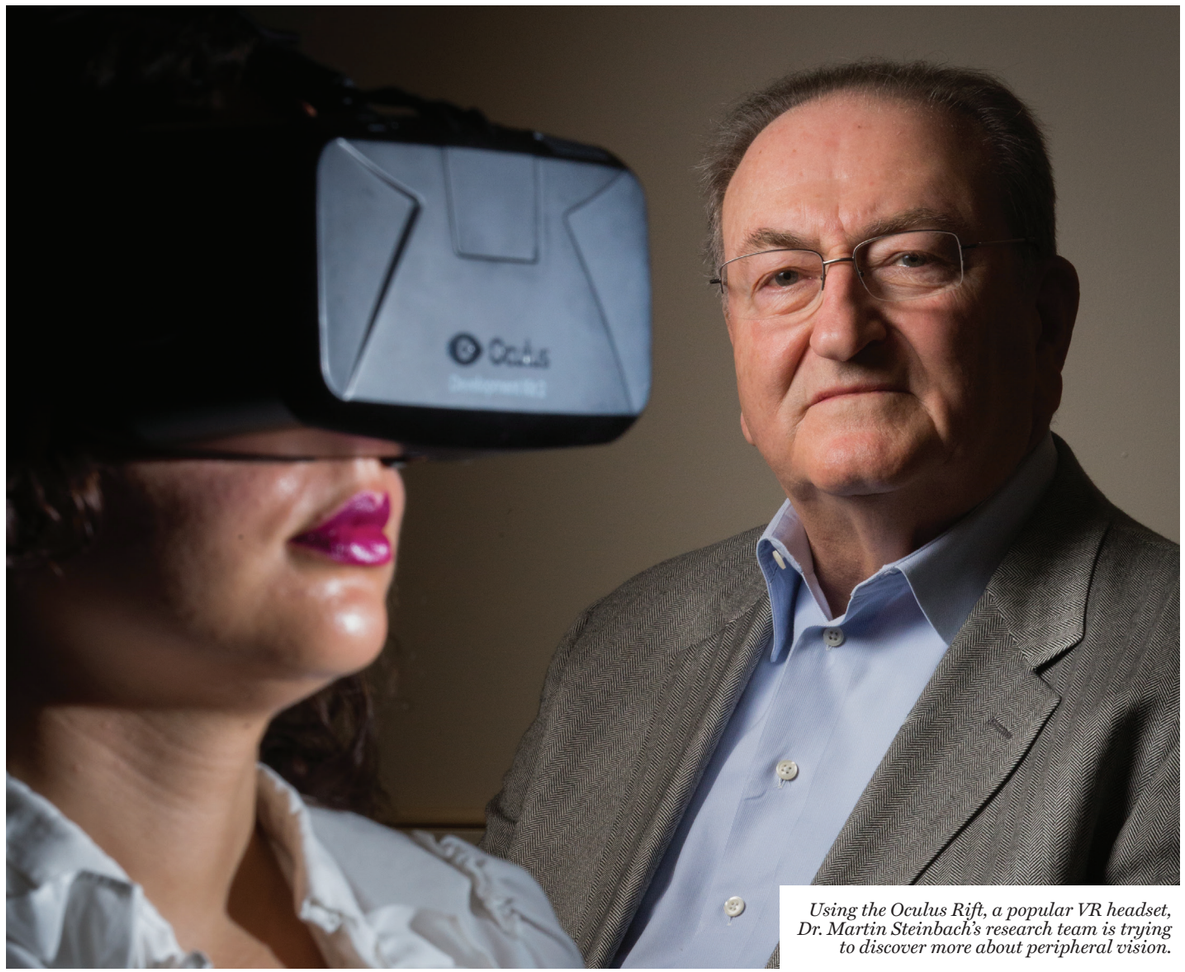

Using the Oculus Rift, a popular VR headset, Dr. Martin Steinbach's research team is trying to discover more about peripheral vision.

Using virtual reality to spot glaucoma

A Krembil researcher is deploying digital VR to find early signs of disease

David Israelson

To safeguard our vision, eye experts usually recommend putting aside virtual reality (VR) devices and looking away from computer screens, but Dr. Martin Steinbach has his patients doing just the opposite.

Dr. Steinbach's vision tests started with the use of a large projector screen measuring about two square metres – the size of a TV monitor in an upscale sports bar. The viewing sensation, he says, would be similar to watching an IMAX movie.

At the Krembil Research Institute, his research team (Dr. Esther Gonzalez, Dr. Lumi Tarita-Nistor and students Taylor Brin, Saba Samet and Henry Liu) now has test participants wearing the Oculus Rift, a popular VR headset that immerses its users in their own personal movie. The Rift is not being used for entertainment here, though. The purpose is to find new ways to detect glaucoma in its early stages by measuring "vection" – the sensation viewers experience when a large part of their field of vision is moving and they feel like they too are moving, even though they are not. In patients with mild glaucoma, vection is impaired or absent.

Dr. Steinbach has been trying to find out more about peripheral vision by putting patients into these virtual reality situations and showing them a moving stimulus that makes them feel like they are also in motion. "We did this study called 'Vection in Patients with Glaucoma' in 2014," he says. "We found, by using that big field of vision, that glaucoma patients responded differently than people with normal vision."

While more work needs to be done, such tests measuring vection in early-stage glaucoma patients could be done in doctors' offices.

"The challenge is that most physicians won't have a giant screen in their office," Dr. Steinbach says. "[But] with a virtual reality device, you can put on a pair of goggles and create a large moving field quite well. That's the project now – to replicate what we've done using a device [that] we can [recreate] in a clinical setting."

Dr. Steinbach's team hopes that the findings of its vection research will make it easier to detect the early signs of glaucoma before too many physical changes have occurred in the eyes of patients with the disease, which is the second most common cause of vision loss in seniors in the country. In someone with glaucoma, the optic nerve is damaged (associated with, but not caused) by high pressure in the eye due to a buildup of excess fluid. More than 250,000 Canadians have chronic open-angle glaucoma.

Other research at Krembil focuses on potential new drug therapies. "All of the current treatments are focused on reducing that pressure [in the eye]," says Dr. Jeremy Sivak, a scientist at Krembil. "It's great to have that option to delay progression of the disease, but what about a treatment that can actually improve things by using drugs? I feel that glaucoma is ready for that kind of change."

According to Dr. Steinbach, detecting the signs of glaucoma early is important because the condition can sneak up on people. Unlike with central vision deterioration – known as macular degeneration – many early-stage glaucoma patients do not experience pain or vision loss.

"Macular degeneration affects fine vision – the part that you use for reading, fine detail and watching television," Dr. Steinbach notes. "That's what gets wrecked, but the periphery still works. [For macular patients], we find out what part of the retina is still working, and [we] retrain people to use that."

People can help preserve their vision by limiting the amount of time spent staring at computer screens. "There are studies that show that a lot of close work affects the development of nearsightness and myopia," he says. "The guidelines say [that] every now and then, [we should] look off into the distance."

Says Dr. Steinbach: "Treating peripheral vision loss due to glaucoma can be more complicated than central vision loss, though. [In glaucoma cases], the centre of the retina works fine. It's the periphery of the retina where the damage is taking place. The problem is that people don't notice it."

If late-stage glaucoma is left untreated, the patient's loss of peripheral vision can develop into tunnel vision or blindness. Dr. Steinbach's research using visual fields is making it possible to detect changes in glaucoma patients earlier, before eye damage occurs.

"Vision is a rich area for study," Dr. Steinbach says. "There is so much you can learn about the brain from patients whose vision is compromised." ■

"Macular degeneration affects fine vision – the part that you use for reading, fine detail and watching television."

– Dr. Martin Steinbach

Bright blue light test sheds light on glaucoma

Glaucoma – an eye disease that is difficult to diagnose and is often without symptoms early on – is one of the top three causes of blindness in the world, affecting hundreds of thousands of Canadians.

At the Krembil Research Institute, Dr. Agnes Wong is leading a study that uses a new procedure to measure changes in the eyes of those with glaucoma, a condition that develops when damage occurs to the optic nerve (the cable that connects the eyeball to the brain), with increased eye pressure being a major risk factor.

An ophthalmologist at Toronto Western Hospital and the Hospital for Sick Children, as well as a scientist, Dr. Wong is employing the chromatic pupillometry technique on the recently discovered intrinsically photosensitive retinal ganglion cells (ipRGCs).

IpRGCs are found in the retina and are now the third type of cells that detect light (photoreceptors), joining rods and cones, which have long been known as the two-unit light traffic team in the eyes.

Chromatic pupillometry uses coloured light that is shone into the eyes to measure pupil size and reaction. Because ipRGCs detect light, they control pupil function, Dr. Wong says. And as she discovered in a previous trial, ipRGCs are activated directly by bright blue light, but not directly by red light.

Using her scientist's palette, Dr. Wong is now applying this new knowledge to the detection of glaucoma, wondering if shining bright blue light into the eyes of those with the condition can provide valuable knowledge.

"Can we monitor ipRGC activity as a biological marker for disease progression in glaucoma?" she asks.

– *Shannon Moneo*