Peek Retina
Usage, evidence and limitations

Peek Retina is a portable smartphone attachment that enables the user to view and capture images of the optic nerve through a dilated pupil. It was sold by Peek Vision from its launch in 2017 until September 2020, when sales were discontinued.

This document outlines how Peek Retina can be used, the evidence that supports it, and its limitations, as a guide for interested parties who may be considering its use in research, educational or healthcare settings.

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Background: why retinal imaging is important

The retina holds more visible information on eye and general health than anywhere else in the body.

A good view of the retina makes it possible to diagnose a range of eye diseases, including glaucoma, macular degeneration, diabetic retinopathy and more. It also makes it possible to detect general health problems including diabetes, hypertension, malaria and more.

The retina is also a very sensitive biomarker and can be used to identify individuals and animals.

The most commonly used tool for retinal examination is the direct ophthalmoscope, which has major limitations:

- The examiner must get very close to their subject
- The examiner needs to interpret what they are seeing as they see it
- It is difficult to use through an undilated pupil due to a narrow field of view

These factors limit users to those with a knowledge of the retina, typically eye health professionals such as ophthalmologists and optometrists.

70% of medical students are unable or lack confidence performing retinal examinations. This inability to be proficient in retinal examinations continues into clinical practice.

The invention of digital cameras and digital retinal cameras has made retinal imaging more accessible globally. Retinal cameras can provide excellent images that can be acquired by technicians (i.e. non health workers) and shared with health workers - or more recently Artificial Intelligence (AI) algorithms - for interpretation and remote decision-making.

The most commonly used retinal cameras in clinical practice are designed to be static and are not cost-effective for portable and remote retinal assessments.

What is Peek Retina?

Peek Retina was designed to provide a low-cost, hand-held alternative to retinal cameras that works like a direct ophthalmoscope and could enable a variety of users to examine the retina who might not ordinarily be able to.
Peek Retina was designed and evolved over a number of years with a number of partners until it was launched as a medically certified product in the UK in 2017.

### Key benefits of Peek Retina

- Intuitive and easy to use, converting nearly any smartphone into a retinal camera in under 30 seconds
- Works in almost any environment from clinical settings to remote rural areas
- Allows users to examine the optic nerve to identify diseases such as glaucoma and swollen discs
- Enables immediate sharing of videos or images captured of the back of the eye with other professionals, transfer to Electronic Patient Records (EPRs) or to show the patient what the user has seen

### Prototype testing: key findings

Prototypes of Peek Retina were tested and validated in clinical studies that have been published in peer-reviewed journals (Mwanansao et al., no date; Bastawrous et al., 2016; Lodhia et al., 2016).

The key findings were:

- Measurements of the crucial optic disc biomarker, the vertical cup-to-disc ratio, through a dilated pupil using Peek Retina by a lay operator were found to have excellent agreement (weighted $\kappa=0.69$; mean difference of 0.02) with that of an experienced retinal photographer using a desktop retinal camera (Bastawrous et al., 2016).
- The solution was found to gain acceptance amongst healthcare professionals, providing a beneficial service, supporting patients’ needs and assisting them in the fulfillment of their role (Lodhia et al., 2016).
- Good agreement (simple $\kappa=0.73$) with a desktop retinal camera was achieved for grading of diabetic retinopathy (Mwanansao et al., no date).

### Clinical validation of the final product: key findings

Independent validation of the Peek Retina product has been conducted by clinical researchers in India, Tanzania, Iran and the United Kingdom (Ho and Morgan, 2018; Talvir Sidhu, Pallavi Shukla, Meenakshi Wadhwani, Parul Jain, Amit Bharadwaj,
Key findings included:

- As was found with the prototype versions of Peek Retina, the production version of Peek Retina yielded images in which the VCDR was in good agreement with those measured from standard desktop fundus camera images (limits of agreement being -0.15 to 0.16 and mean difference of 0.005) (Talvir Sidhu, Pallavi Shukla, Meenakshi Wadhwani, Parul Jain, Amit Bharadwaj, Priyanka Beinwal, Praveen Vashist, Vivek Gupta, Suraj Senjem, Tanuj Dada, Ramanjit Sihota, 11-12 September 2018).

- Peek Retina has a substantially better diagnostic accuracy than a pen torch when used by ophthalmic nurses for paediatric cataract and ocular media disorder screening (Mndeme et al., 2020).

- Embedded Peek Retina within a cloud-based community eye care mHealth solution, alongside smartphone visual acuity testing, results in higher uptake of eye care services compared to classical eye assessment methods (Katibeh et al., 2020).

- Medical students found Peek Retina significantly easier to use for optic nerve assessment compared to a standard direct ophthalmoscope (Ho and Morgan, no date).

- Peek Retina yields images of the retina which experts find easier to grade compared to certain other smartphone retinal imaging alternatives (‘Retinal Image Quality Assessment: Portable Eye Examination Kit Retina (Peek Retina) Tm Versus 3d-Printed Ophthalmoscope (3dpo)’, 2019).

- However, the good agreement with desktop retinal imaging solutions attained by the prototype versions of Peek Retina could not be achieved with the production unit in African and Asian populations (yet to be published).

- Peek Retina has utility in veterinary medicine as well as human medicine (Huynh, 2019).

Training materials and enhancements

A range of training materials have been developed to support users as well as a unique “training eye” that enables users to test Peek Retina straight out of the box as well as use it to learn about the retina and retinal diseases.
An Android mobile app and recommended settings for iOS users were developed to support optimal image. The app will be available via Google Play store until September 2021.

**Current value and limitations**

The current value of the Peek Retina product is:
- For examining the optic nerve head
- In people with dilated pupils

Our user feedback and market research suggests that Peek Retina in its current form is of most value for:
- Medical education
- Veterinary use
- Research focused on optic disc imaging

This means its key limitations are:
- Examination without dilating eye drops is very limited
- Peek Retina can not confidently be used beyond optic nerve assessment i.e. for conditions like Diabetic Retinopathy

To address the key limitations the following areas of work (and associated investment) would be needed:
- Hardware modifications to:
  - enable non-mydriatic (undilated pupils) retinal imaging (for which we have a proof of concept)
- Enable a wider field of view making examination potentially easier and more useful for conditions such as diabetic retinopathy

- Software development to:
  - Create composite retinal images (image stitching) - proof of concept developed with a partner
  - Automate disc capture and grading (multiple third party applications exist)
  - Integrate with third party retinal grading services or electronic medical records

**What’s next?**

Having carefully examined user feedback, research and the wider market for devices like this, we have reached the conclusion that the resources required for Peek Vision to continue selling Peek Retina are not justified by the impact that it can have in its current form, in the low- and middle-income countries where better eye health resources are most needed.

Peek Retina requires substantial further investment of time and funds to achieve an impact in line with our ambitions. As a small team operating with limited resources, Peek does not currently have the capacity to make that investment.

Since Peek Retina launched in 2017, [Peek Solutions](https://www.peekvision.com/solutions) (our smartphone tools to help eye health services improve) have started to make a substantial global impact. Focusing on Peek Solutions will allow us to make a bigger contribution to achieving our mission than investing in the necessary technical developments, marketing and sales infrastructure needed for Peek Retina to meet its potential.

Nonetheless, we are proud of what we have achieved with Peek Retina, and we hope that its development will inspire other mission-driven eye health organisations to explore the great potential of smartphone-based eye imaging tools.

When Peek Retina launched, it was one of the first smartphone-based eye imaging devices available to the market. The last few years have seen a number of similar devices launch, each with different use cases and features and there are now several options available for practitioners who want to use smartphone-based retinal imaging.

However, we believe that a substantial gap in the market remains for a cost-effective, universal smartphone adapter for retinal imaging that can be used without dilating drops.
We hope that in time an organisation with the necessary expertise and experience in this type of hardware will take on this opportunity, so that the people most affected by the global vision crisis can benefit from the many advantages these types of device offer.

Our focus is to ensure we can deliver on our mission and so we are looking for organisations who would get value from Peek Retina in its current form or would be interested in further developing it. If you are interested in taking the product further we would be happy to speak with you - please email retina@peekvision.org with details of your background and outlining your interest in Peek Retina.
References


