

Retinal evaluation efficacy of a scanning laser ophthalmoscope (Optos P200) compared to a digital retinal camera

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Case study

Patient 40 showed an operculated hole with the **optomap**®. The hole was not detected with the camera. The patient was asymptomatic and later treated with laser.



Camera image



optomap® image

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Purpose: To determine the effectiveness of the two imaging devices used for screening purposes to gauge the clinical significance of any deficit in image characteristics.

Methods: All patients over the age of 50 who presented for a routine eye health check exam were imaged on both the Optos P200 and the Canon CR-DGi on the same day. If any pathology was detected during review of the images from either device, the patient was enrolled in the study.

Main Outcome Measures: Number and type of pathologies detected with either of the imaging techniques.

Results: The doctors detected a total of 82 pathologies with one or both devices. Of the 82 pathologies, 81 (98.8%) were detected by using the **optomap**® Retinal Exam, and 45 (54.9%) were detected using the Canon CR-DGi fundus camera.

Conclusions: The optometrists at White Rock Optometry Clinic are convinced that the **optomap**® Retinal Exam is more clinically effective for retinal screening compared to the Canon CR-DGi fundus camera, demonstrated by the fact that 44% more pathology was discovered through the **optomap**® Retinal Exam than with the fundus camera.

Introduction

In every line of business, changes that increase efficiency or improve the quality of service are welcomed, and it is relatively easy to improve one or the other. It is certainly more challenging however to make changes that improve both.

In a clinical environment, quality of service is of greater importance since it relates to the well-being of patients. For the optometrist looking to improve efficiency, it is paramount that a watchful eye is employed to ensure that the quality of the eye health check exam is maintained. How can this be achieved?

This paper draws from two sources; **1.** From the experience of the doctors at White Rock Optometry Clinic, B.C., who in 2002 integrated an ultra-widfield scanning laser ophthalmoscope (SLO), the Optos P200, and its **optomap**® Retinal Exam procedure, into their eye health screening process. **2.** From a study that was completed at White Rock Optometry Clinic that compared what pathology could be visualized with the **optomap**® Retinal Exam and a digital fundus camera when both were used to image the same patient on the same day¹.

The study described was an independent study and the views contained herein are those solely of White Rock Optometry Clinic and not necessarily those of Optos, plc.

Background

While the **optomap**® Retinal Exam is utilized in approximately 2500 practices in North America (at time of writing) and has proven to be a valuable addition in the great majority of those practices, there exists some question about how the effectiveness of Optos' technology compares to that of a digital camera when both are used for screening purposes. The question from a clinical standpoint is what is more advantageous in a screening environment, central pole resolution and narrow field of view, or a simultaneous view of the pole and periphery with adequate resolution of the pole?

To investigate the question of the effectiveness of the **optomap**® Retinal Exam compared to that of a digital retinal camera, a study was performed that compared images taken of the retina of the same patients on the same day using a Canon CR-DGi fundus camera and an Optos P200 SLO. The objective was to determine which of the imaging devices visualized more pathology and to gauge the clinical significance of any deficit in image quality in the central pole that the Optos P200 images had when compared to the camera images.

Methods

The Optos P200 scanning laser ophthalmoscope (SLO), and its associated procedure, the **optomap**® Retinal Exam uses collimated laser beams to scan the fundus and capture, in 0.25 second, a single, high resolution digital color image of virtually the entire retina (200°), without contact with the cornea or high levels of illumination. The ability to image through a 2mm diameter pupil means that dilation is rarely required, unless medically indicated.

The Canon CR-DGi Non-Mydriatic Retinal Camera captures a digital 45° field of view and is able to image through a 4mm diameter pupil. The camera utilizes a 2 step alignment and focus process to facilitate high resolution image capture. Light levels required are 75%-90% lower than on previous Canon products².

During April and May of 2006, patients over the age of fifty who presented for a routine eye health check exam were imaged on the Optos P200 and the Canon CR-DGi per White Rock Optometry Clinic standard protocol. If pathology was detected during review of the images from either device, the patient was enrolled in the study. All patients were imaged on both devices on the same day (38 of the 40 patients were imaged on the second device within the hour).

Results

The doctors detected a total of 82 pathologies with one or both devices. Of the 82 pathologies, 81 (98.8%) were detected by using the **optomap**® Retinal Exam, and 45 (54.9%) were detected using the Canon CR-DGi fundus camera (Appendix. Table 1). Of the 45 pathologies detected using the Canon CR-DGi image, 15 had limited views and 30 could be seen entirely.

With the Canon CR-DGi 30 pathologies were missed by the doctors because the pathology was located outside of its 45° field of view. More surprising, according to the doctors, was the fact that the Canon CR-DGi also missed 7 pathologies located in the

vitreous, which can be attributed to a greater depth of focus associated with the Optos P200 (Appendix. Table 2). The doctors missed one pathology with the **optomap®** Retinal Exam, an epiretinal membrane (although this pathology was detected in another patient), which was detected with the Canon CR-DGi. (Appendix. Table 3).

Discussion

Viewing the retina after best corrected acuities are determined can be time consuming without retinal health information. The capability of the P200 to provide images of the far periphery and central pole in one image has meant that the doctors at the White Rock Optometry Clinic can in most cases discover what pathologies may be present and to make decisions regarding additional testing to assess ocular health at the start of the exam. This, allied with the ability to perform targeted ophthalmoscopy (see adjacent description of targeted ophthalmoscopy), has been enabled by the ultra-widefield view of the retina that the **optomap®** Retinal Exam offers.

The doctors believe that the results of the study demonstrate that the advantages the **optomap®** Retinal Exam has over digital camera technology easily compensate for any perceived advantage that camera technology has over the **optomap®** Retinal Exam in central pole resolution. The capability of the P200 to image in excess of 80% of the retina in one image (Reference 3) allowed the doctors to detect 44% more pathology with the **optomap®** Retinal Exam than on the camera images. (Refer to the selected case study images which demonstrate the unique clinical value of the superior field of view provided by the Optos technology).

This key advantage allied with greater depth of field allowed doctors using the **optomap®** Retinal Exam to detect 7 pathologies in the vitreous that were missed by the camera. A greater scope for patient education and the ability to examine different layers of the retina suggests that the **optomap®** Retinal Exam is extremely effective in a screening environment.

Integration of the P200 in White Rock Optometry Clinic

At White Rock Optometry Clinic both technologies are utilized to their unique advantages. The principal advantage of the **optomap®** Retinal Exam is that it provides demonstrated screening capability for most patients, showing greater than 80% of the retina in one image. This is optimal for discovering pathologies and abnormalities which may remain hidden from the field of view of other technologies.

The P200 provides a quick and easy ultra-widefield view of the retina prior to dilation which enables efficiency in patient flow throughout the doctors' day. Targeted ophthalmoscopy can then be used to develop the differential diagnosis for pathologies detected by the doctor using the **optomap®** Retinal Exam. The digital camera, showing approximately 11% (REFERENCE 3) of the retina centered around the central fundus is a more specialized tool for photo documentation of the central retina.

Conclusion

Based on the results achieved, the optometrists at White Rock Optometry Clinic are convinced that the **optomap®** Retinal Exam is more clinically effective in helping to assess the retina initially compared to the Canon CR-DGi fundus camera. The benefit for using the **optomap®** Retinal Exam for screening was demonstrated by the fact that 44% more pathology was discovered by doctors through the **optomap®** Retinal Exam than with the digital retinal camera images. In their opinion, ultra-widefield scanning laser ophthalmoscopy and central digital photography are two different and useful tools to examine and photo document the health of the retina and that both play an important role in the care of patients.

The doctors at White Rock Optometry Clinic have found that as a result of installing the P200, they have benefited from increased efficiency *“The **optomap®** Retinal Exam is a great starting point for my ocular health exams because it gives me the big picture and helps steer the rest of my exam. If I see pathology, I know right where to look for it with the other instruments I have available,” said Dr. Tracey Curry. “I could never look at just a digital fundus image and feel that the patient had been adequately screened.”*

This paper began by asking how clinical efficiency and the quality of the eye health check exam in an Optometry practice could be improved. The experiences of the doctors at White Rock Optometry Clinic and the results from the study performed there clearly indicate that by integrating the **optomap®** Retinal Exam and targeted ophthalmoscopy into their working practices they have been able to maintain high clinical standards while driving process efficiencies.

References

1. *Review of pathology found on patients imaged on the same day with the Optos P200 SLO and Canon CR-DGi Fundus Camera - Final Report Sept 29th '06.*
Paul Donnelly BEng.
2. *Canon CRDGi Non Mydriatic Retinal Camera - Product brochure.*
3. *Imaged Area of the Retina - Alastair Atkinson, BSc, MSc, MIEE, CEng & Christophe Mazo, BSc, MSc, and MPhil. (Data on file).*

Comparison of study devices and their capabilities

Field of view (Single Image) - Up to 200° field of view provided by the **optomap®** vs. up to 45° with the Canon CD-DGi. The greater field of view enabled the doctor to detect 44% more pathology than when the doctors utilized the the Canon CR-DGi in the White Rock Optometry study

Focal depth - P200's confocal capability allows views of vitreous and lens abnormalities while the retinal camera is a single plane focus of the retina only.

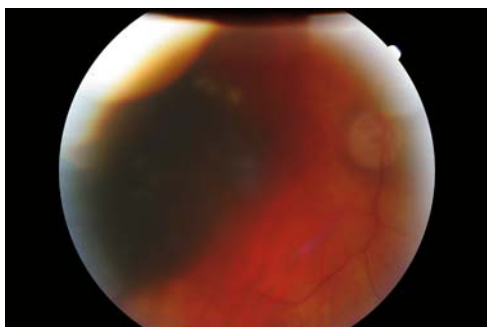
Patient education - P200's ultra-widefield view allows for more pathologies to be imaged and therefore better patient education. Since the retinal camera images only the central pole, patient education is limited if the pathology is beyond the central pole. *"From a patient education standpoint, since I am seeing so much more retina than with a digital fundus camera, I have much more likelihood that I will be able to show the patient what might be of concern," said Dr. Melanie Sherk.*

Central pole resolution - With greater central pole resolution, the Canon CR-DGi is ideal for documenting pathologies around the optic nerve and macula.

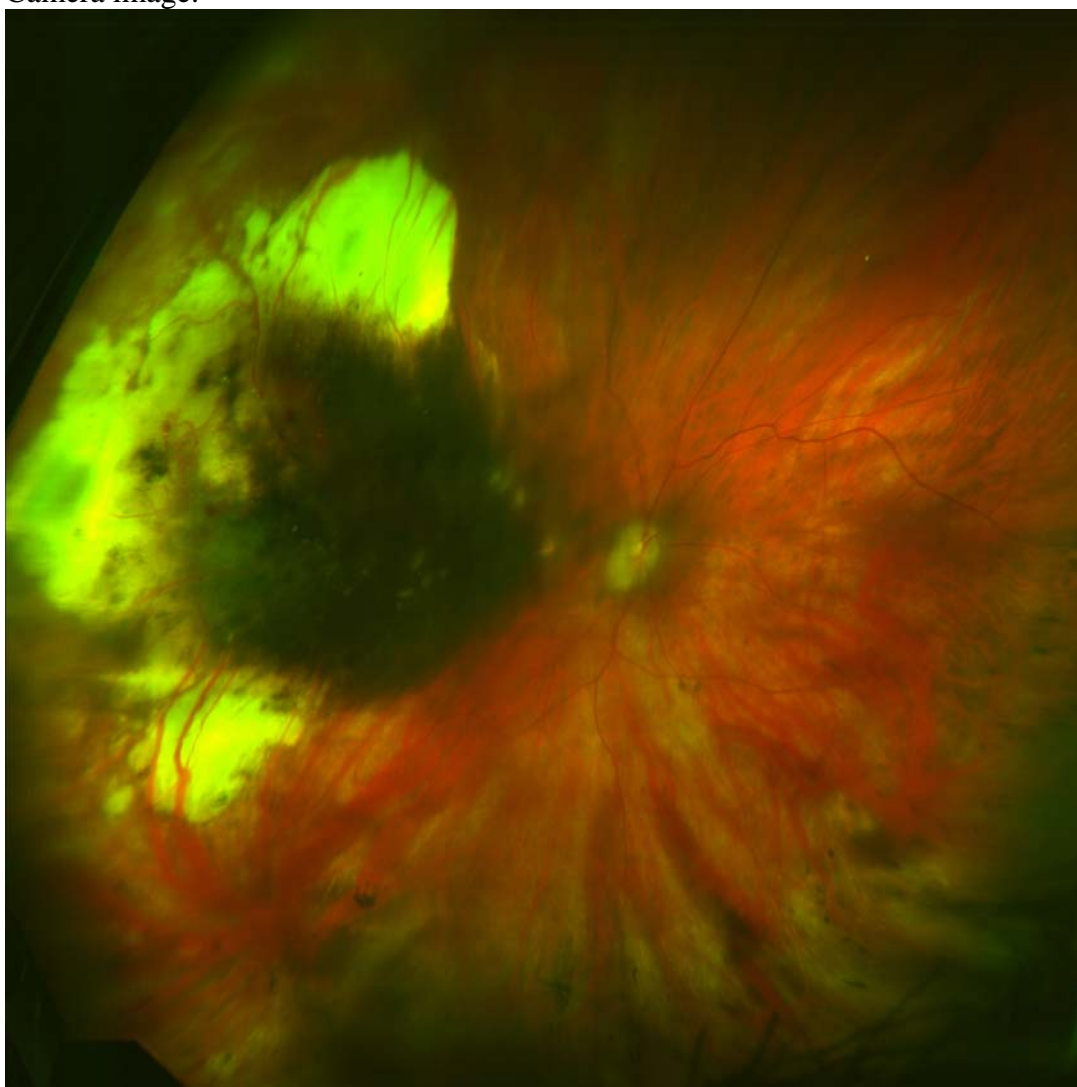
Composite image - The Optos P200 uses a red and a green laser to capture an image. When reviewing, the images generated by each laser can be viewed separately. Because the red penetrates to the choroid and the green to surface layers of the retina, the location and nature of pathology can better be determined. *"I also appreciate being able to look at the red and green laser channels individually so I can determine the likely location of any pathology, thus helping with diagnosis," said Dr. Tracy Ertel.*

Need for Dilation – The **optomap®** is able to obtain retinal images through a 2mm diameter pupil while the Canon CD-DGi requires a 4mm diameter pupil. In this study all patients were imaged with the Optos P200 without dilation while 5 (8%) required dilation to be imaged with the Canon CR-DGi.

Case study No. 1. Patient 7 was treated over 25 years ago for melanoma. The **optomap®** clearly shows the entire pathology whereas the camera provides only a partial view.



Camera image.

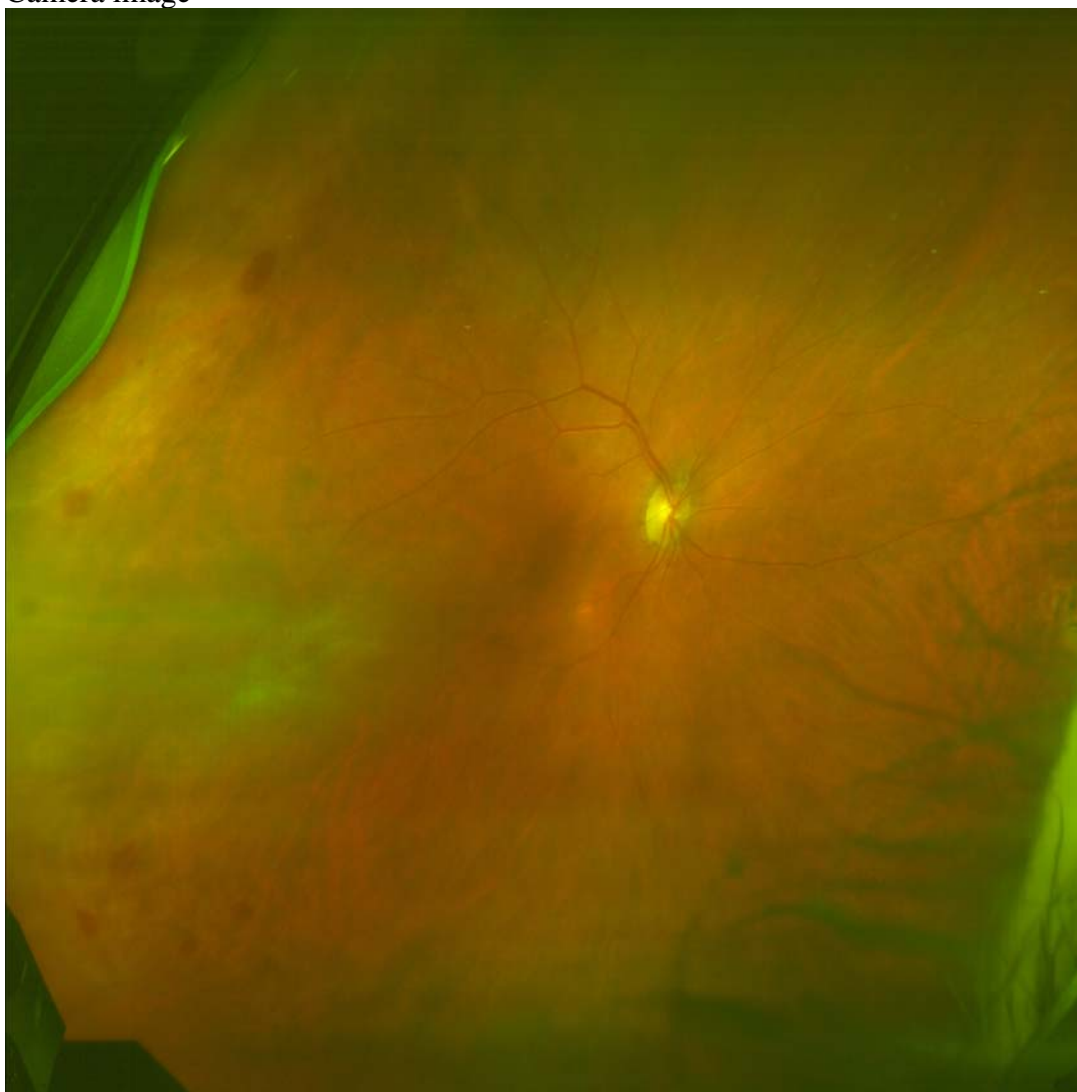


optomap® image

Case study No 2. Patient 29 showed extensive hemorrhages in the right eye with the **optomap®**. The camera provided only a partial view. The patient has no vision in her left eye.

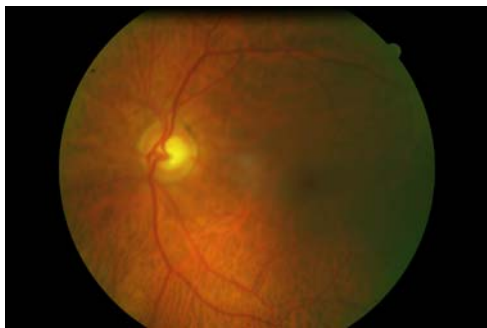


Camera image

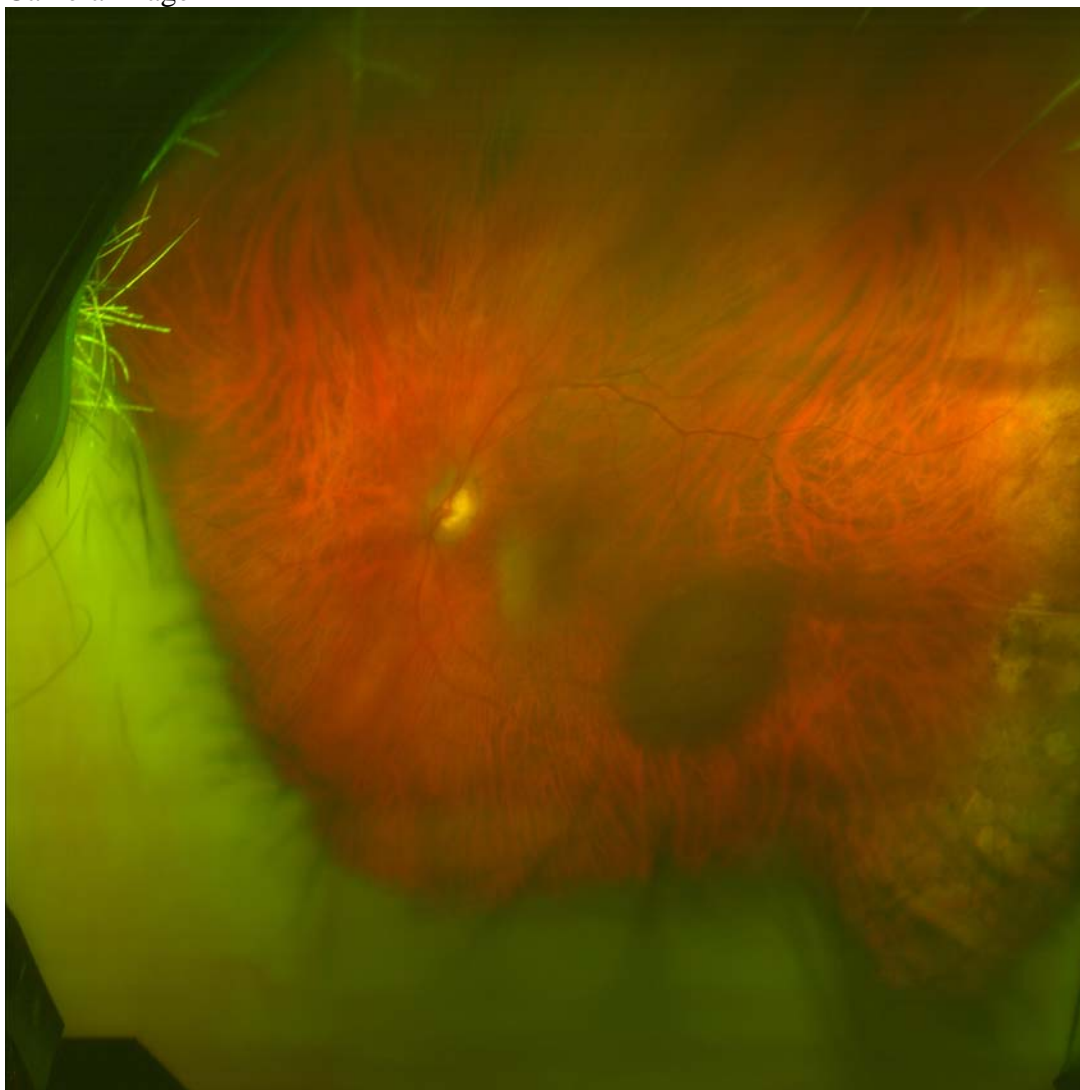


optomap® image

Case study No. 3. Patient 31 showed a choroidal nevus and chorioretinal atrophy with the **optomap®**. The pathology was not detected with the camera.

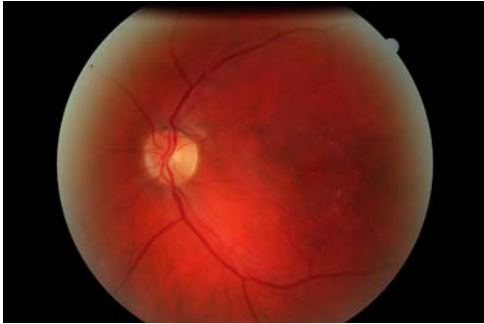


Camera image

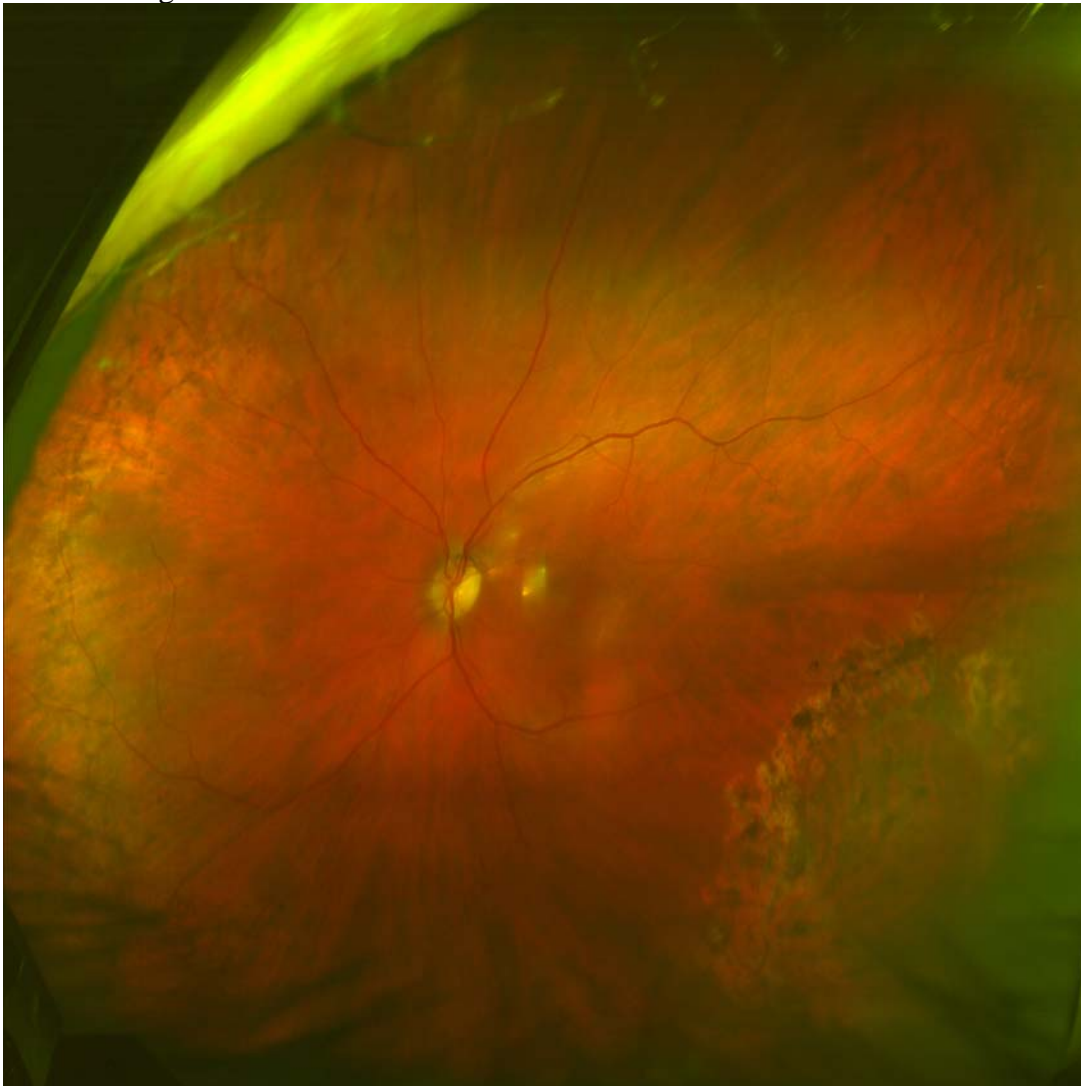


optomap® image

Case study No. 4. Patient 38 showed laser scars from a large retinal tear with the optomap. The year previous, the patient was asymptomatic when the tear was detected with optomap. The treated tear was not detected with the camera.

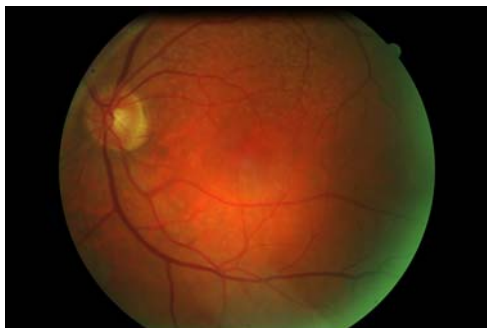


Camera image

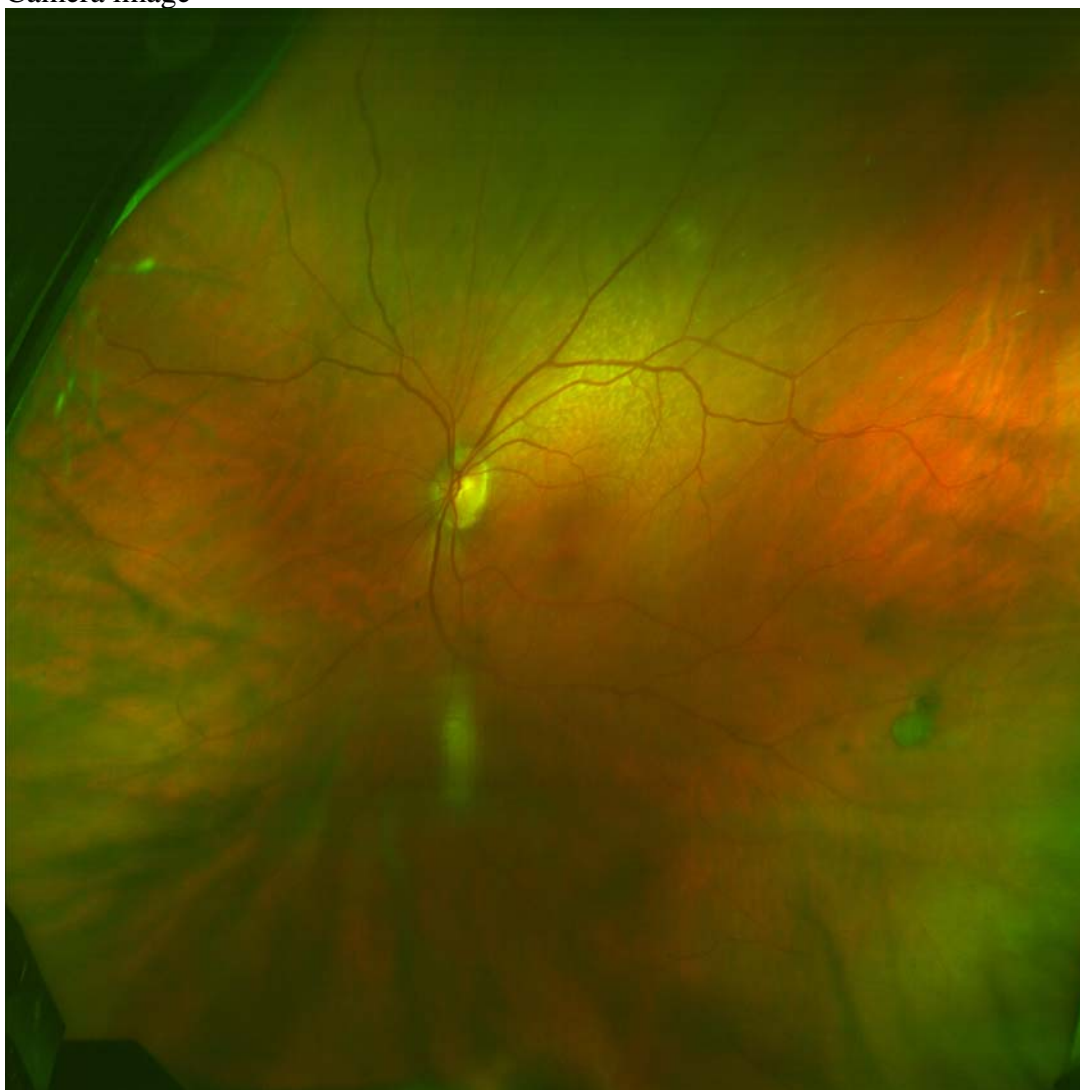


optomap® image

Case study No. 5. Patient 40 showed an operculated hole with the **optomap®**. The hole was not detected with the camera. The patient was asymptomatic and later treated with laser.



Camera image



optomap® image

Table 1. Pathology found and missed on each study device.

Patient ID	Total number of Pathologies found on both devices	Pathology	Detected by P200? (Yes/No/partial)	Detected by Canon CR-GDi? (Yes/No/partial)
1	1	Chorioretinal atrophy	Yes	No
2	1	Macular drusen	Yes	Yes
3	2	Posterior vitreous detachment	Yes	No
		Posterior vitreous detachment	Yes	No
4	5	Laser tx around operculated tear	Yes	No
		Scattered drusen	Yes	partial
		Reticular degeneration	Yes	No
		Reticular degeneration	Yes	No
		Scattered drusen	Yes	partial
5	1	Scattered pigment	Yes	No
6	1	Asteroid hyalosis	Yes	partial
7	1	Treated melanoma	Yes	partial
8	1	RPE mottling at macula	Yes	Yes
9	2	Myelinated nerve fibers	Yes	Yes
		Myelinated nerve fibers	Yes	Yes
10	1	Scattered peripheral drusen	Yes	partial
11	1	Hypopigmentation	Yes	No
12	2	Posterior vitreous detachment	Yes	No
		Peripheral RPE hyperplasia	Yes	No
13	3	Peripheral drusen	Yes	partial
		RPE pigment	Yes	No
		Peripheral drusen	Yes	partial
14	4	RPE streaks along vascular arcades	Yes	partial
		Hypopigmentation areas by macula	Yes	Yes
		RPE streaks along vascular arcades	Yes	partial
		Hypopigmentation areas by macula	Yes	Yes
15	4	Lattice	Yes	No
		Lattice	Yes	No
		Epiretinal membrane	Yes	Yes
		Previous laser tx	Yes	No
16	1	Posterior vitreous detachment	Yes	No
17	2	macular drusen	Yes	Yes
		RPE mottling / macular drusen	Yes	Yes
18	2	Glaucoma - cupping	Yes	Yes
		PVD	Yes	Yes
19	7	Macular drusen	Yes	Yes
		RPE mottling at macula	Yes	Yes
		Blot hemorrhage	Yes	Yes
		Reticular degeneration	Yes	No
		Macular drusen	Yes	Yes
		RPE mottling at macula	Yes	Yes
		Reticular degeneration	Yes	No

Patient ID	Total number of Pathologies found on both devices	Pathology	Detected by P200? (Yes/No/partial)	Detected by Canon CR-GDi? (Yes/No/partial)
20	2	Chorioretinal scar	Yes	No
		Floater	Yes	No
21	4	AMD	Yes	Yes
		Peripheral drusen	Yes	Partial
		AMD	Yes	Yes
		Peripheral drusen	Yes	partial
22	1	Epiretinal membrane	No	Yes
23	1	Asteroid hyalosis	Yes	No
24	1	Reticular degeneration	Yes	No
25	1	Mylenated nerve fibres	Yes	Yes
26	5	Macular drusen	Yes	Yes
		Drusen	Yes	No
		RPE dropout	Yes	No
		Macular drusen	Yes	Yes
		Drusen	Yes	No
27	2	Peripheral drusen	Yes	partial
		Peripheral drusen	Yes	partial
28	2	Flame hemorrhage	Yes	Yes
		RPE hyperplasia	Yes	No
29	2	Peripheral blot hemorrhages	Yes	No
		Macular scar from treated hemorrhage	Yes	Yes
30	1	Choroidal nevus	Yes	Yes
31	2	Choroidal nevus	Yes	No
		Chorioretinal atrophy	Yes	No
32	2	AMD	Yes	Yes
		Reticular degeneration	Yes	No
33	2	Scattered drusen	Yes	partial
		2 floaters	Yes	No
34	1	CHRPE	Yes	No
35	2	Old laser scars (multiple)	Yes	partial
		Numerous blot hemorrhages	Yes	No
36	1	Drusen	Yes	Yes
37	1	Choroidal nevus	Yes	No
38	3	AMD	Yes	Yes
		Reticular degeneration	Yes	No
		Laser scars from repaired retinal tear	Yes	No
39	2	Lattice	Yes	No
		Nevus	Yes	Yes
40	2	Operculated hole	Yes	No
		Drusen	Yes	Yes
Totals	82	N/A	81 entire	30 entire 15 partial

Table 2. Reasons why the Canon CR-DGi digital camera missed pathology.

Reason why the Canon CR-DGi digital camera missed pathology	Missed Pathology	Incidence in study
Outside of camera's 45° field of view	Reticular degeneration	7
	Lattice	3
	Chorioretinal atrophy	2
	Drusen	2
	Peripheral blot hemorrhages	2
	Choroidal nevus	2
	Laser tx around operculated tear	1
	Scattered pigment	1
	Hypopigmentation	1
	peripheral RPE hyperplasia	1
	RPE pigment	1
	Previous laser tx	1
	Chorioretinal scar	1
	RPE dropout	1
	RPE Hyperplasia	1
	CHRPE	1
	Repaired retinal tear	1
operculated hole	1	
Camera's shorter depth of focus means vitreous anomalies are best visualized on the P200	Posterior vitreous detachment	2
	PVD	2
	Floater	2
	Asteroid hyalosis	1

Table 3. Reason why the Optos P200 SLO missed pathology.

Reason why the Optos P200 SLO missed pathology.	Missed Pathology	Incidence in study
Macular resolution	Epiretinal membrane	1