Unit-5 Ophthalmic Equipment and Ethics in Ophthalmic Practice

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Course Outcome:

- ❖ Classify problems related to ophthalmic instruments and maintaining procedure.

Unit Outcome:

- ❖ Identify part of ophthalmoscope and explain direct and indirect Ophthalmoscopy.
- ❖ Categorized different type of tonometer for finding IOP.
- ❖ Explain fundus camera.
- ❖ Describe procedure to use keratometer machine.
- ❖ Explain phoco-emulsification machine in details.
- ❖ List out common problems found in ophthalmic instruments.
- ❖ Elaborate maintaining procedure of ophthalmic instruments.

Ophthalmoscopy

- Ophthalmoscopy is an examination of the back part of the eye (fundus), which includes the retina, optic disc, choroid, and blood vessels.
- There are different types of ophthalmoscopy.

1. Direct ophthalmoscopy
2. Indirect ophthalmoscopy
3. Slitlamp ophthalmoscopy

Direct ophthalmoscope

- Direct ophthalmoscope is an essential tool for examining the interior structures of the eye.
- A direct ophthalmoscope is a handheld device used by healthcare professionals, primarily ophthalmologists and optometrists, to examine the interior structures of the eye, including the retina, optic nerve, and blood vessels. It provides a direct view of the fundus of the eye.

Components of Direct ophthalmoscope

- **Light Source**: This is often an adjustable halogen or LED bulb situated within the device. It emits a focused beam of light that illuminates the interior structures of the eye.
- **Viewing Aperture**: This is the opening through which the examiner looks into the ophthalmoscope to observe the patient's eye. It may have an adjustable size to accommodate various pupil diameters and to control the amount of light entering the eye.
- **Lenses**: Direct ophthalmoscopes usually have a selection of lenses that can be rotated into position to provide different levels of magnification and focus.
- **Adjustment Controls**: These controls allow the examiner to adjust the brightness of the light source, as well as to focus and align the lenses for optimal visualization.
- **Handle**: The handle of the ophthalmoscope provides a comfortable grip for the examiner to hold the device steadily during the examination.
- **Power Source**: Depending on the model, the ophthalmoscope may be powered by batteries or through a direct connection to a power source.

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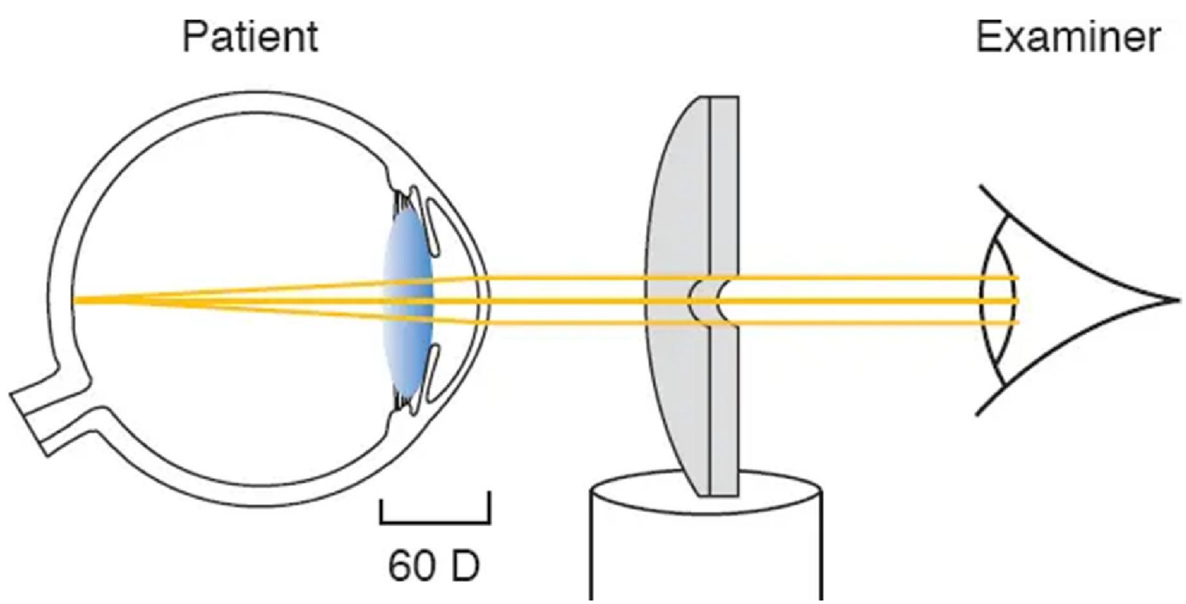
Principle of Direct ophthalmoscope

- Direct ophthalmoscopy operates on the principle of illuminating and magnifying the interior of the eye to visualize its structures. A focused beam of light is directed into the patient's dilated pupil, allowing the examiner to observe the retina, optic disc, blood vessels, and other relevant anatomy.



Machine Parts:

- **Light Source**: The direct ophthalmoscope incorporates a light source, typically powered by batteries, which provides the illumination necessary to visualize the eye's interior.
- **Optical System**: It comprises lenses and mirrors that focus and direct the light onto the retina, while also magnifying the observed structures for detailed examination.
- **Viewing Head**: This part houses the eyepiece through which the examiner views the illuminated retina. It often includes various apertures or filters to optimize visualization and enhance contrast.
- **Handle**: The handle of the ophthalmoscope is ergonomically designed for ease of use and manipulation during examinations. It may also house controls for adjusting light intensity and focus.

Applications:

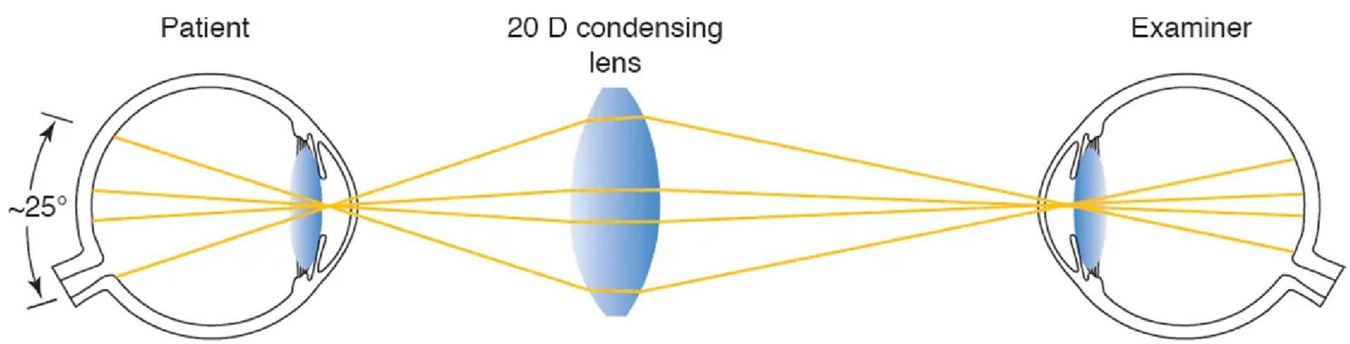
- **Diagnosis of Retinal Disorders**: Direct ophthalmoscopy is invaluable in diagnosing a wide range of retinal disorders, including diabetic retinopathy, hypertensive retinopathy, retinal detachments, and macular degeneration. By examining the retina's appearance and vasculature, clinicians can identify abnormalities indicative of these conditions.
- **Monitoring of Ocular Health**: Regular ophthalmoscopic examinations are essential for monitoring the progression of ocular diseases and evaluating the effectiveness of treatment interventions. Changes in the appearance of the retina or optic nerve over time can provide valuable insights into disease management.
- **Detection of Systemic Diseases**: Ophthalmoscopy can reveal signs of systemic diseases that manifest in the eye, such as hypertension, diabetes, and certain neurological conditions. Changes in the retinal vasculature or the presence of characteristic lesions can alert clinicians to underlying systemic health issues.
- **Assessment of Optic Nerve Function**: Direct ophthalmoscopy allows for the evaluation of optic nerve head appearance, which is crucial for assessing optic nerve function and detecting conditions such as optic neuritis, glaucoma, and papilledema.

Indirect Ophthalmoscopy

Indirect ophthalmoscopy is a vital clinical procedure used by healthcare professionals to examine the retina and other internal structures of the eye.

Principle of Indirect Ophthalmoscopy

Indirect ophthalmoscopy relies on the use of a condensing lens and a light source to create a magnified, inverted image of the retina. The examiner views this image through a biomicroscope or a special indirect ophthalmoscope. By illuminating and magnifying the retina, indirect ophthalmoscopy allows for a detailed examination of its structures.



Machine Parts:

- **Condensing Lens**: This lens is held in front of the patient's eye and functions to converge light onto the retina, creating a highly magnified image.
- **Light Source**: A bright light source, often in the form of a handheld flashlight or a slit lamp, is used to provide illumination during the examination. The light is directed towards the lens and reflected onto the retina.
- **Indirect Ophthalmoscope (Optional)**: While a traditional indirect ophthalmoscope may not have complex machine parts, modern versions may include features such as adjustable light intensity, filters, and ergonomic design for enhanced usability.

Applications:

- **Retinal Examination**: Indirect ophthalmoscopy is primarily used to examine the retina and optic nerve head. It allows clinicians to assess the health of these structures and detect abnormalities such as retinal tears, detachments, vascular changes, and optic nerve pathology.
- **Vitreoretinal Surgery**: Indirect ophthalmoscopy plays a crucial role in vitreoretinal surgery, where surgeons use it to visualize the retina and guide surgical interventions. It provides a wide-field view of the retina, facilitating precise surgical maneuvers and ensuring optimal outcomes.
- **Pediatric Ophthalmology**: In pediatric ophthalmology, indirect ophthalmoscopy is often preferred due to its ability to provide a larger field of view compared to direct ophthalmoscopy. It is used to evaluate the retina and diagnose conditions such as retinopathy of prematurity (ROP) and congenital retinal abnormalities.
- **Emergency Medicine**: Indirect ophthalmoscopy is also employed in emergency medicine settings to assess patients with acute vision-threatening conditions such as retinal detachments, vitreous hemorrhages, and ocular trauma. Rapid and accurate diagnosis facilitated by indirect ophthalmoscopy is crucial for timely management and preservation of vision.

Tonometer

- Tonometry is a diagnostic test that measures the pressure inside your eye, which is called intraocular pressure (IOP).
- A tonometer is an essential tool in ophthalmology used to measure the pressure inside the eye, known as intraocular pressure (IOP). Elevated IOP is a significant risk factor for glaucoma, a leading cause of irreversible blindness. By accurately assessing IOP, tonometry aids in the early detection, diagnosis, and management of glaucoma, helping to prevent vision loss.

Different type of tonometer

Here are different types of tonometers categorized based on their method of measuring IOP:

- **Applanation Tonometers**:
  - Goldmann Applanation Tonometer
  - Perkins Tonometer
- **Non-contact (Air-Puff) Tonometers**:
  - Non-Contact Tonometer (NCT)
  - Ocular Response Analyzer (ORA):
- **Rebound Tonometers**:
  - iCare Tonometer:
  - Pulsair Tonometer:
- **Indentation (Schiotz) Tonometers**:

Different type of tonometer

- **Applanation Tonometers**:
  - **Goldmann Applanation Tonometer**: Considered the gold standard for measuring IOP. It involves applying a small, flat prism to the cornea after instilling a fluorescein dye. The pressure required to flatten a specific area of the cornea is directly proportional to the IOP.
  - **Perkins Tonometer**: Similar to the Goldmann tonometer but designed for handheld use, often in situations where a slit lamp is not available.
- **Non-contact (Air-Puff) Tonometers**:
  - **Non-Contact Tonometer (NCT)**: This type of tonometer measures IOP by emitting a quick puff of air onto the cornea. The device calculates IOP based on the amount of corneal deformation caused by the air puff.
  - **Ocular Response Analyzer (ORA)**: Combines air-puff tonometry with corneal biomechanical properties assessment, providing additional information about corneal hysteresis and corneal resistance factor.

Different type of tonometer

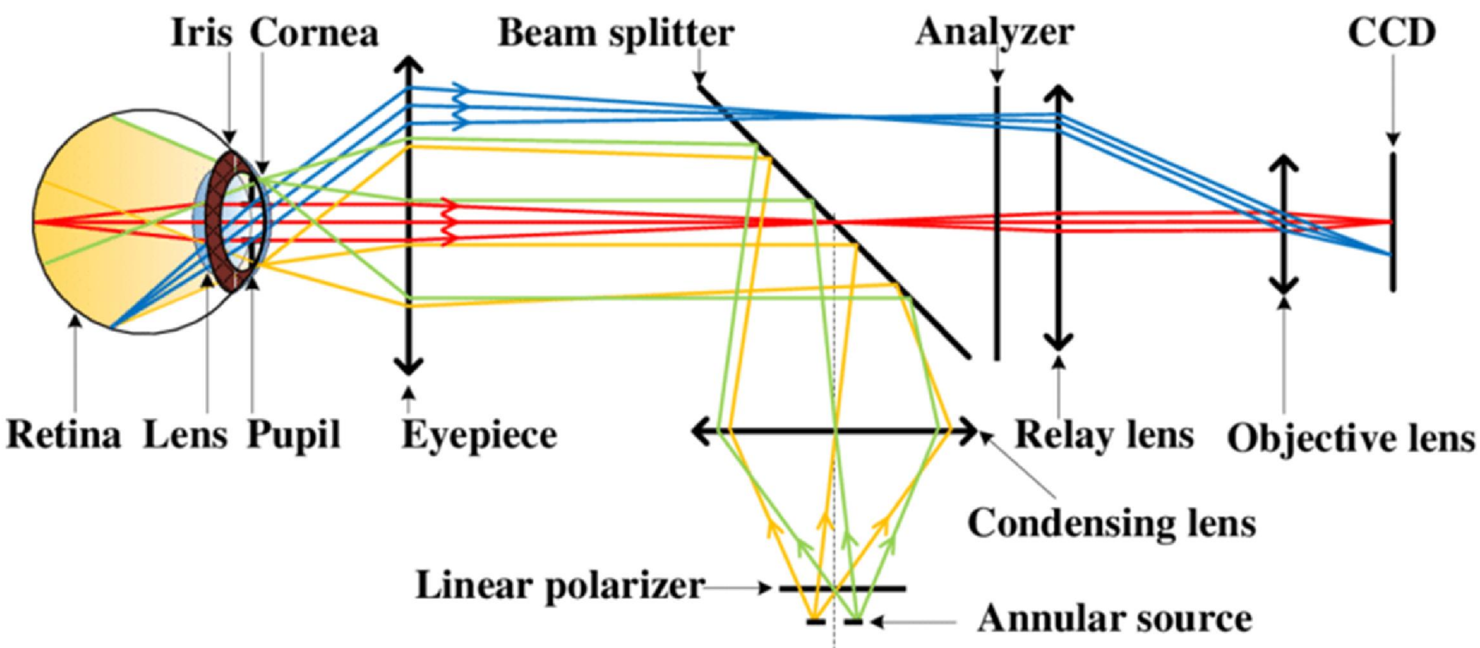
- **Rebound Tonometers**:
  - **iCare Tonometer**: Utilizes a small probe that makes momentary contact with the cornea and then rebounds. The device measures IOP based on the speed of the rebound, which is influenced by the corneal properties.
  - **Pulsair Tonometer**: Similar to iCare tonometer, it uses a rebound mechanism but measures the deceleration of the air puff to determine IOP.
- **Indentation (Schiotz) Tonometers**:
  - **Schiotz Tonometer**: Measures IOP by assessing the depth of indentation produced by a weighted plunger on the cornea. However, it is less commonly used now due to its lower accuracy compared to applanation tonometry.

Fundus Camera:

- A fundus camera is a sophisticated medical imaging device utilized in ophthalmology to capture detailed images of the posterior segment of the eye, particularly the retina, optic disc, macula, and retinal blood vessels.

Principle of Fundus Camera:

- The fundamental principle behind a fundus camera is the utilization of specialized optics and illumination systems to visualize and capture images of the interior of the eye. By directing light onto the retina and employing advanced optical systems, the camera captures high-resolution images of the retina, enabling clinicians to assess its structures and diagnose various eye conditions.



Machine Parts:

- **Camera System**: This component comprises the digital or film camera that captures the images of the retina. In digital fundus cameras, electronic sensors convert the optical image into digital data for immediate viewing and storage.
- **Illumination Source**: Fundus cameras incorporate various illumination sources, such as white light, green light (for fluorescein angiography), and infrared light (for imaging through media opacities like cataracts). These light sources illuminate the interior of the eye for imaging.
- **Optical System**: The optical system of a fundus camera includes lenses, mirrors, and filters to focus and direct light onto the retina and project the image onto the camera's sensor or film. This system plays a crucial role in capturing high-quality images with optimal clarity and detail.
- **Interface and Controls**: Fundus cameras feature an interface for controlling image capture parameters such as focus, exposure, and image enhancement. This interface allows clinicians to adjust settings to optimize image quality and usability.

Applications:

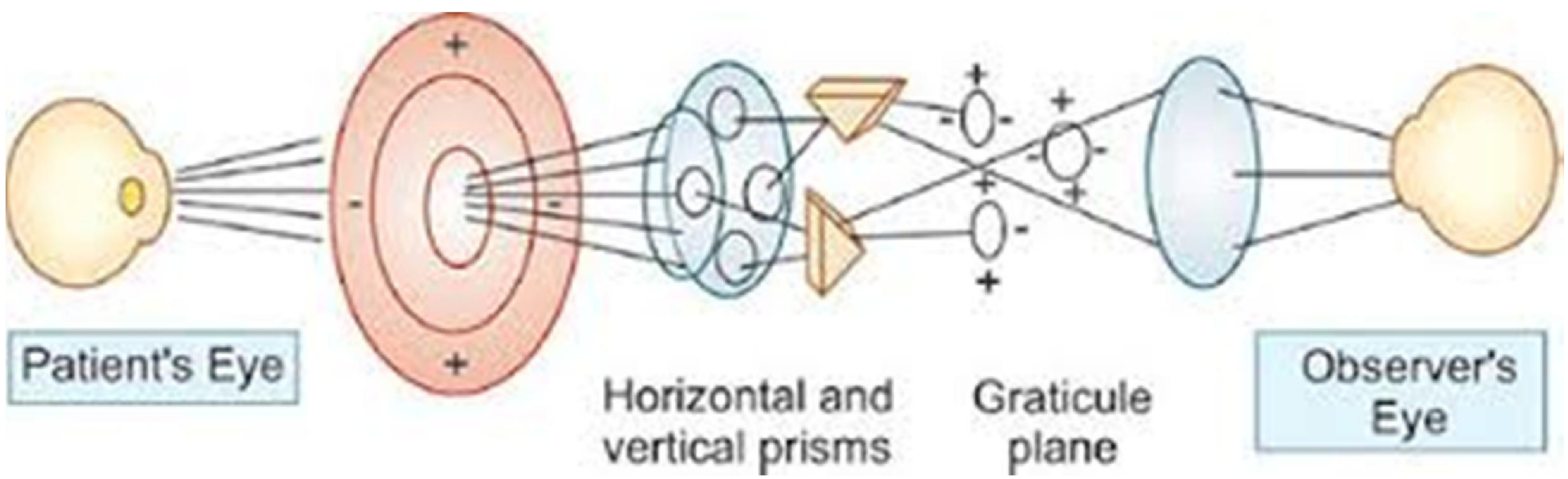
- **Diagnosis and Monitoring**: Fundus cameras are used extensively in ophthalmic clinics and hospitals for diagnosing and monitoring various eye conditions, including diabetic retinopathy, age-related macular degeneration, glaucoma, and retinal vascular diseases. The detailed images obtained aid clinicians in assessing disease progression and treatment efficacy.
- **Screening Programs**: Fundus cameras play a crucial role in screening programs for diabetic retinopathy and other sight-threatening conditions. They enable early detection and intervention, thereby preventing vision loss and improving patient outcomes.
- **Research**: Fundus cameras are valuable tools in ophthalmic research, allowing scientists to study the pathophysiology of ocular diseases, evaluate novel treatments, and assess the effectiveness of interventions. The detailed images captured by fundus cameras contribute to advancing our understanding of eye health and disease.

Keratometer:

- A keratometer is a specialized medical device used in ophthalmology to measure the curvature of the cornea, which is essential for assessing refractive errors and diagnosing corneal abnormalities.

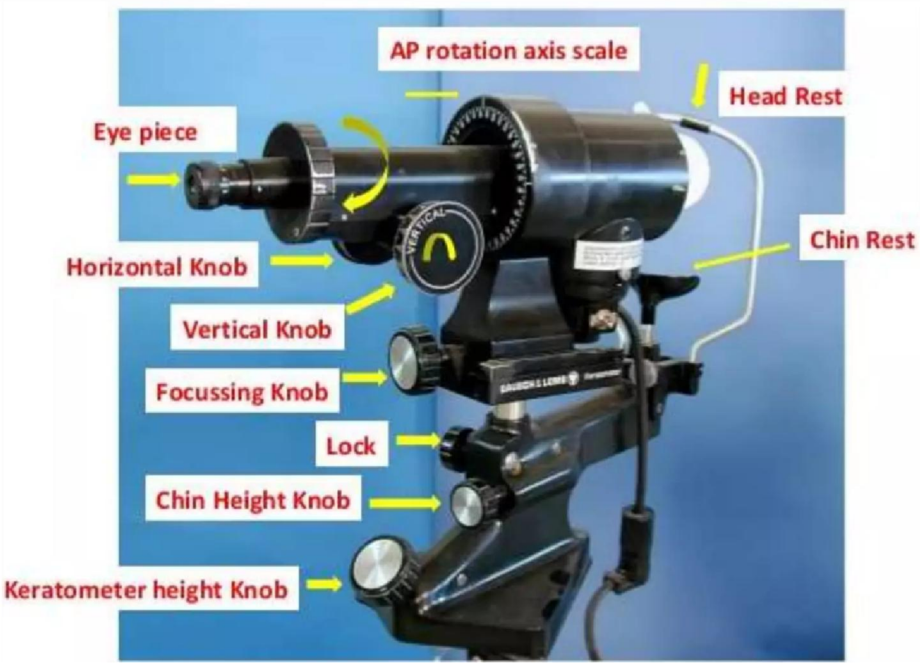
Principle of Keratometer:

- The principle behind a keratometer involves the reflection of concentric rings or mires onto the cornea's surface. By measuring the distortion or curvature of these rings as they are reflected from the cornea, the instrument can calculate the curvature radius of the cornea, expressed in millimeters. This measurement provides valuable information about the corneal shape and refractive power.



Parts of Keratometer:

- **Optical System:** The keratometer consists of an optical system that projects concentric rings or mires onto the cornea and observes their reflection. This system typically includes a light source, lenses, mirrors, and an eyepiece for visualization.
- **Adjustment Knobs:** These knobs allow the operator to adjust the position, size, and orientation of the mires projected onto the cornea. Precise alignment of the mires is crucial for accurate measurements.



Parts of Keratometer:

- **Chin Rest and Forehead Rest:** These components provide stability and proper alignment of the patient's head during measurement. They ensure that the patient's eye is positioned correctly relative to the keratometer's optical system.
- **Measurement Scale:** The keratometer features a scale or display that indicates the curvature radius of the cornea in millimeters. This measurement is essential for determining the corneal refractive power.

Application of Keratometer:

- **Assessment of Refractive Errors:** Keratometry is used to measure the curvature of the cornea, which is a primary determinant of the eye's refractive power. These measurements are crucial for assessing and correcting refractive errors such as myopia (nearsightedness), hyperopia (farsightedness), and astigmatism.
- **Contact Lens Fitting:** Keratometry measurements are essential for fitting contact lenses accurately. By determining the corneal curvature, practitioners can select contact lenses with the appropriate base curve to ensure a proper fit and optimal vision correction.
- **Diagnosis of Corneal Abnormalities:** Keratometry aids in the diagnosis of corneal abnormalities and irregularities such as keratoconus, corneal dystrophies, and corneal scarring. Changes in corneal curvature can indicate the presence and progression of these conditions.
- **Preoperative Evaluation for Refractive Surgery:** Before undergoing refractive surgery procedures such as LASIK or PRK, patients undergo keratometry to assess corneal shape and curvature. These measurements help surgeons determine the treatment parameters and predict postoperative outcomes.

REFERENCES

- https://medlineplus.gov/ency/article/003881.htm#:~:text=An%20ophthalmoscope%20is%20about%20the,in%20a%20semi%2Dreclined%20position.
- https://eyewiki.aao.org/Binocular_Indirect_Ophthalmoscopy
- https://eyewiki.aao.org/IOP_and_Tonometry
- https://www.slideserve.com/chidi/fundus-camera#google_vignette