Research Article

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# Mobile phones for fundus photography in Ibadan, Sub Sahara Africa

## Abstract

**Back ground:** Fundus photography is essential for documentation, patient education and monitoring follow up treatments in patients with retina diseases. The equipment for fundus photography is expensive for most ophthalmic facilities in Sub Sahara Africa. Mobile technology is a cheaper alternative, as this will enhance telemedical services in the region.

**Aim:** The aim of this study was to investigate the use of iphone 5 in combination with a 20D lens to capture retinal image. The iphone 5 was also compared with the cheaper Android phone Techno phantom A+.

**Methods:** We selected consecutive patients attending the retinal clinic of the University College Hospital Ibadan for the study. Informed consent was obtained before the study. Five patients each with retinal diseases affecting the posterior pole within the field of view of the 20D lens were enrolled to either iphone 5 plus 20D lens or Techno A+ plus 20D lens after full pupillary dilatation. The setup is used as a binocular indirect ophthalmoscope. The eye of the patient, the 20D lens and the flash/camera of the mobile phone must be on the same axis. The 20D lens captures the image of the retina which is viewed by the examiner on the screen of the mobile phone. The Application Filmic Pro improves stability of image capturing in the iphone system. The two systems were compared for ease of use, resolution and clarity of pictures.

**Results:** The iphone 5 system and the Techno system showed comparable results. The iphone 5 produced fewer glare with clearer pictures.

**Conclusion:** The mobile technology described is a cheaper alternative to standard fundus photography in Sub Sahara Africa.

**Keywords:** mobile phones, fundus photography, retinal disease, patient education, telemedicine, sub-Sahara Africa

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## Introduction

The Ophthalmoscope was developed by Von Helmotz. He published his work in1851.[1] The direct ophthalmoscope has since being further developed and re-engineered. However the field of view is limited to about 5 degrees. Most physicians are reluctant to use it and patient education was not possible with it as only the doctor sees the retina. In 1945, Charles Sheepens developed the indirect ophthalmoscope.[2] This provided a wider field of view and helped in the examination of the peripheral retina. However, it has a difficult learning curve and too bulky for the general physician. Subsequently, mirrors were attached to the indirect ophthalmoscope to provide a teaching platform. Still patient education was limited to retinal drawings and sketches made by the doctor. Many years later, video camera attachment to the indirect ophthalmoscope was developed. This improved teaching and patient's education. The equipment came at a price not affordable to physicians in the poor resource countries. Fundus camera was later developed. It was bulky and the cost was too high for physicians in the developing countries. Attempts were made to develop portable fundus camera. The available ones are still expensive for our environment in Sub Sahara Africa. Recently portable devices such as the iexaminer in which the iphone was attached to the panfundoscope were developed.[3] The device though less expensive and portable still has sub optimal field of view. Other devices were developed with similar field of view.

Recently, workers at Massachusetts published their work on the use of iphone and the 20D lens to capture retinal images likened to an indirect ophthalmoscope.[4] The field of view was satisfactory and the iphone 5 gave an image with good resolution comparable to the conventional fundus camera. The workers recommended the use of an App- Filmic pro to stabilize the image and reduce glare. They recommended the device for developing nations with poor resources. It is cheaper and more portable than conventional fundus camera and can be used in developing nations for telemedicine where images can be uploaded to email by resident doctors, physicians and GPs. The fundus pictures can be sent via email to ophthalmologist for review and suggestions concerning management. The aim of this study was to investigate the use of iphone 5 in combination with a 20D lens to capture retinal image. We also compare with the cheaper Android phone Techno phantom A+.

## Methods

We selected consecutive patients attending the retinal clinic of the University College Hospital Ibadan for the study. Informed consent was obtained before the study. Five patients each with retinal diseases affecting the posterior pole within the field of view of the 20D lens were enrolled to either iphone 5 +20D lens or Techno A+ + 20D lens. We compare the two systems for ease of use, resolution and clarity of pictures.

## Techniques

For the iPhone 5, the filmic pro app is launched with the continuous illumination of the camera flash set to the lowest possible to reduce glare. The examiner holds the 20D lens with his dominant hand and the phone in the other hand. The flash of the mobile phone produces the illumination. The setup is used as a binocular indirect ophthalmoscope. The eye of the patient, the 20D lens and the flash/camera of the mobile phone must be on the same axis. The 20D lens captures the image of the retina which is viewed by the examiner on the screen of the mobile phone (Figure 1). The video recording mode is activated to capture the video of the retina examination. After the examination, using the iphone editing software, still images or frames can be captured with a snapshot and saved into the picture gallery of the mobile phone for editing. For the Android phone Techno phantom A+, the Led light app is downloaded from the google play. This will keep the flash on in recording mode. With the 20D lens, the set up is used similarly as an indirect ophthalmoscope. The recording mode is also activated. An application, video to picture app from google play is used to extract selected frames. The selected frames are edited as above.

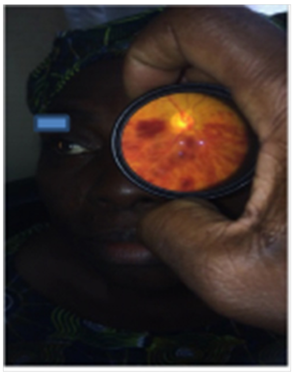

**Figure 1** 20D lens capture of retina image as seen on the screen of the mobile phone.

## Results

i. Pictures from iPhone 5 and 20D system (Figures 1−6)

ii. Pictures from Techno Android phone and 20D (Figures 7−11)

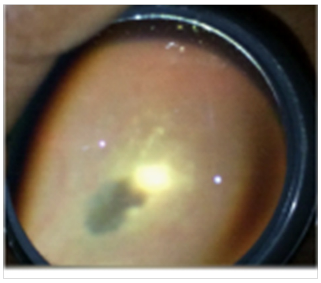

**Figure 2** Toxoplasma chorioretinitis with an active retinitis adjacent to an old scar.

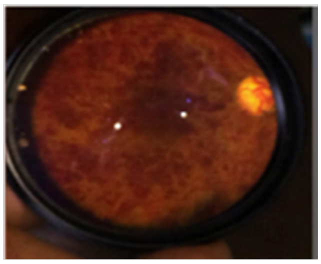

**Figure 3** Central retinal vein occlusion with widespread retinal hemorrhages.

**Figure 4** Macula hole.

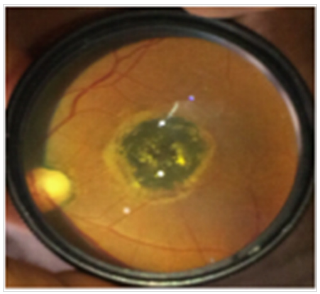

**Figure 5** Macula scar.

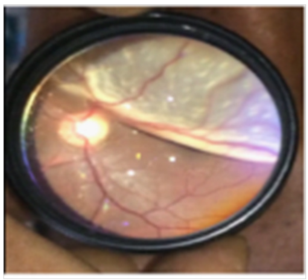

**Figure 6** Superior retinal detachment.

**Figure 7** Choroidal neovascular membrane with sub retinal bleeding (arrow).

**Figure 8** Tilted optic disc.

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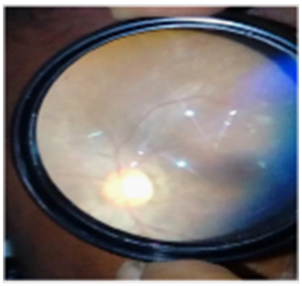

**Figure 9** Retinitispunctata albescence.

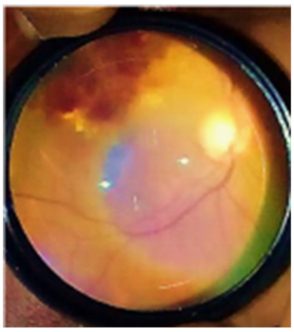

**Figure 10** Supero temporal branch vein occlusion with sectoral retinal hemorrhage.

**Figure 11** Macula hole.

## Discussion

Mobile technology has come to stay. In Asia, its use for telemedical purposes is well reported. Our observation is in support of these studies.[5,6] The method used for image capture has a learning curve. Proficiency in the use of indirect ophthalmoscope is an advantage. Junior residents in ophthalmology can learn to use this method. The two systems described in this study are comparable. The Iphone 5 system has better resolution with fewer glares. The system has a better image stability compared with the Android. The image App, Filmic pro stabilizes the image by offering independent focusing. The light intensity of the camera can be adjusted hence reduction in glare. The snapshot feature of the iphone made image capture relatively easy. Another App video to image is required for the android to capture images from the video. Images obtained are inverted and laterally rotated. Computer editing software can be used to reverse the images. Editing features of both phone systems is adequate. The final image can be uploaded unto e mails for telemedical services.

The success of this method includes its ability to upload images of both anterior and posterior segments of the eye unto our ophthalmology group on social media for discussion between junior and senior doctors. Screening of diseases affecting the posterior pole such as macular disease, optic nerve disease and diabetic retinopathy will benefit from these devices. However, retina lesions in the periphery are difficult to capture. It is hoped that with the development of newer models of mobile phones with better cameras, image acquisition will become better. Both systems are cheaper alternatives to conventional fundus cameras. Documentation, patients' education and follow up of patients will improve with these systems. Ophthalmology residents can easily learn to use these systems and hopefully will improve patients' management.

## Acknowledgments

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## Conflicts of interest

Author declares that there is no conflict of interest.

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