Regarding fundus imaging with a mobile phone: A review of techniques

Dear Sir,

We read with interest the article by Shanmugam et al. while most articles in literature describe the technique using the iPhone (Apple Inc., Cupertino, USA), we would like to share our experience using Samsung S3 and Note 3 android mobile phones (Samsung Electronics Ltd., Suwon, South Korea) as fundus imaging devices. Compared to iPhone, android phones cost less, but have similar functionality.

One difficulty highlighted by the authors is that the flashlight not being continuously on while capturing the images in the still photography mode. Using the “assistive light widget,” preloaded in most android phones, the flash can be kept on in still photography mode. This improves the quality of images as the still photography mode gives better resolution compared to a video image. Likewise, iPhone has newer camera Apps (Camera Plus by Global Delight Technologies, Udupi, India) with similar options like the assistive light.

Following modifications are suggested:

• Use a 28 diopter lens instead of the 20 diopter lens: A smaller, lighter lens with shorter focal length is easier to handle
• Zoom to the maximum and fill the entire screen with the fundus image to get a better focus of the retinal details
• Moving closer to the condensing lens improves the focus of the fundus image
• Use the “touch focus” option if available. With this feature, one can touch the screen over the area of interest focusing that area better. An android camera App similar to the one described by Haddock et al. is Camera FV-5 (http://www.camerav5.com) and the user can control numerous functions of the camera with this App, improving the overall quality of the photograph
• Reducing the exposure to −1 or −0.5 gives adequate exposure levels
• After the capture, crop the selected images and adjust the image quality using the Image Editing Software on the phone itself before it is transferred to the computer or shared wirelessly using Bluetooth, E-mail or using a cross-platform messaging software like WhatsApp (WhatsApp, Inc., Mountain View, CA, USA).

We have used the mobile phone to photograph the fundus changes in retinopathy of prematurity (ROP) and found it useful in documentation, educating parents, for follow-up and in tele-ophthalmological consultations.

We have documented peripheral retinal changes, which are not accessible with the standard fundus camera. Excellent quality images could be obtained in postoperative cases as well. It is also possible to take stereo images by slightly offsetting the 2 images.

As mentioned by the authors, this technique is cost effective, especially in outreach centers where a dedicated fundus camera may not be available. This technique can play a significant role in tele-ophthalmology, especially in ROP as the available
methods for fundus documentation are beyond the reach for most practitioners.

Improvement in camera functions and innovations like an attachment of the miniature fundus camera optical system\(^\text{[3]}\) to the mobile phone are exciting developments in the offing, which will make this technique more acceptable.

**Biju Raju, Raju N S D**

Vitreoretinal Services, \(^1\)Cataract and Anterior Segment Services, Vasan Eye Care Hospital in Association with Ranjini Eye Hospital, Vyttila, Kochi, Kerala, India

**Correspondence to:** Dr. Biju Raju, Vasan Eye Care Hospital in Association with Ranjini Eye Hospital, Near Powerhouse, Tripunithura Road, Vyttila, Kochi - 682 019, Kerala, India.
E-mail: drbijuraju@gmail.com

**References**

1. Shanmugam MP, Mishra DK, Madhukumar R, Ramanjulu R, Reddy SY, Rodrigues G. Fundus imaging with a mobile phone: A review of techniques. Indian J Ophthalmol 2014;62:960-2.

2. Haddock LJ, Kim DY, Mukai S. Simple, inexpensive technique for high-quality smartphone fundus photography in human and animal eyes. J Ophthalmol 2013;2013:518479.

3. Maamari RN, Keenan JD, Fletcher DA, Margolis TP. A mobile phone-based retinal camera for portable wide field imaging. Br J Ophthalmol 2014;98:438-41.