Eye (2022) 36:1129–1130
https://doi.org/10.1038/s41433-021-01590-2

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CORRESPONDENCE

Frugal retinal laser training simulation eyes

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Received: 9 April 2021 / Revised: 15 April 2021 / Accepted: 28 April 2021 / Published online: 11 June 2021

To the Editor:

Simulation based training (SBT) is increasingly being integrated into medical apprenticeships [1]. This process has been accelerated by the COVID-19 pandemic. The advantages of being able to progressively train and assess competency on potentially hazardous procedures in a safe and controlled environment as well as reduce face-to-face contact are of clear benefit to patients, trainees and trainers alike. Retinal lasering has been identified as a procedure that would particularly benefit from SBT [2]. Most simulation tools are however expensive and impractically so for those training in low- and middle-income settings where the need is greatest to deal with the emerging epidemics of blindness from diabetes and premature birth [3]. Here we describe a recently developed simulation eye adapted for retinal laser training and assessment (Fig. 1) [4]. We have included a video of the simulation eye being 'treated' with laser on PASCAL 532 nm laser (Video 1).

There are a number of features of this simulation eye that contribute to its high fidelity as well as potential for wider adoption and implementation. The optics is based on a 'reduced' model eye. Despite having a radius 1.76 times larger (Fig. 1b) than an emmetropic eye, the field of view, magnification and relative position of anatomical landmarks are identical to the examination of a real eye. This is independent of the device (slit lamp biomicroscope or direct and indirect ophthalmoscope) or lens design and power being used. The three-dimensional fundi (Fig. 1a) are created from traditional wide-field flat images using a reverse sinusoidal map projection approach which are then printed with a domestic colour printer on a matte photographic paper. This approach, despite being inexpensive, creates high resolution anatomically accurate ora to ora fundi. Importantly when lasered they respond similarly in appearance (Fig. 1d) to that of a real retina. At lower fluence faint blanching develops but as power increases white marks are seen progressing to 'pigmented' burns with supratherapeutic fluences. In addition, the fluence values required to create appropriate laser burns are similar to therapeutic settings. Mounting a pair of eyes in a typical anatomical position to a laser slit lamp (Fig. 1c) is also simple and quick using an ultra-low cost pre-formed foam template.

The simulation eye has been assessed by our local NHS laser protection advisor and has been approved to be safe for use as a training and assessment tool for retinal laser.

In conclusion, the attributes of this simulation eye offer the opportunity to widen access to risk-free teaching and objective competency assessment of a range of retinal lasering skills. These include panretinal photocoagulation, retinopexy, macular focal, and grid laser as well as binocular indirect laser for the treatment of retinopathy of prematurity. The frugal design approach reduces costs (4GBP per eye) and consequently, for the first time, a high fidelity yet affordable simulation tool suitable for the COVID-19 era is available to allow safe acquisition and assessment of laser competency even in lower resource settings where the need is greatest [5].

Author contributions OK designed the simulation eye, designed the study, gathered the data, and drafted the manuscript. BS, JLU and ST gathered the data and helped with the study design. JE and AB helped with simulation eye design and study design. All authors critically appraised the manuscript for scientific content.

Supplementary information The online version contains supplementary material available at https://doi.org/10.1038/s41433-021-01590-2.

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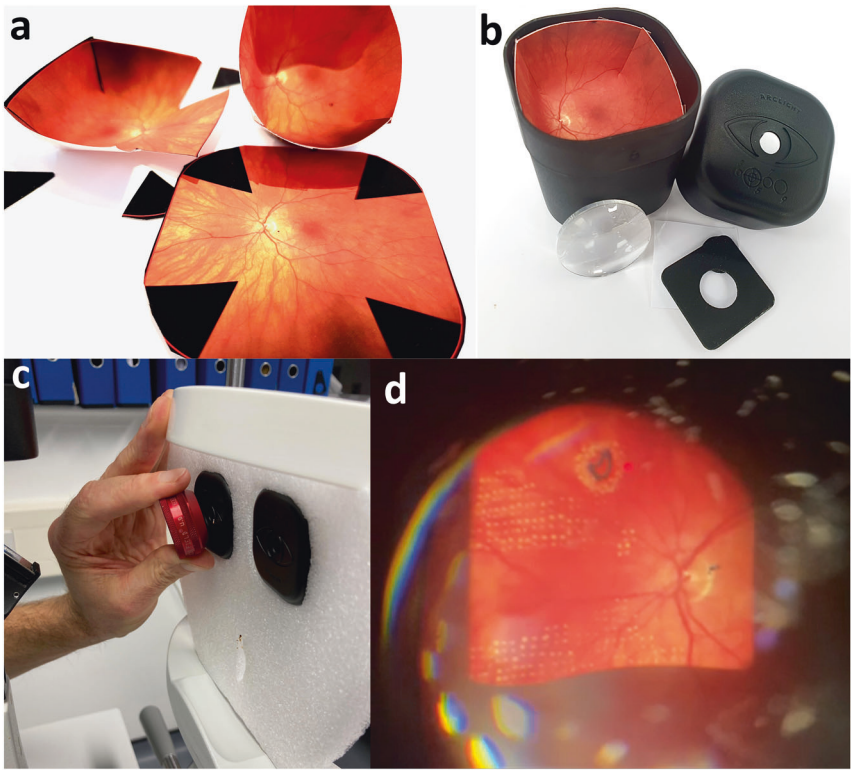

Fig. 1 Frugal retinal laser simulation eye. a Three-dimensional fundus. **b** Simulation eye elements. **c** Mounted on slit lamp. **d** Appearance of the simulation eye during treatment.

Compliance with ethical standards

Conflict of interest AB is seconded to the University of St Andrews from NHS Fife. The University owns a social enterprise subsidiary company, for which AB acts as an unpaid adviser. The social enterprise business sells the Arclight devices to users in high-resource countries with all profits being used to fund distribution and education exercises of the device in low-income countries via the Global Health Implementation team at the University of St Andrews. The other authors have no conflict of interest to declare.

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