ANIMAL MODEL FOR RETINOPATHY OF PREMATURITY
LASER SURGERY TRAINING

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Introduction
Peripheral retinal laser ablation for high risk retinopathy of prematurity (ROP) improves visual outcomes; however the procedure can be challenging to learn. In our previous study we found that most US pediatric ophthalmologists fellows participate in fewer than 5 ROP laser surgeries during their 1-year fellowships.1 Forty-six percent of recently graduated pediatric ophthalmologists believe that their ROP laser training in fellowship was less than adequate preparation for clinical practice.1 Of this group, 74% indicated that that a wet lab training module would enhance ROP laser surgery skill acquisition.1 The purpose of this present study is to investigate use of the rabbit eye as an in vivo teaching model for ROP laser training.

Methods
The present study was approved by the Institutional Animal Care and Use Committee of Cincinnati Children’s Hospital Medical Center. One adult New Zealand white rabbit and one Dutch belted pigmented rabbit (Figure 1) underwent peripheral retinal laser ablation procedure as an initial trial. The laser procedure was performed using the following method: A rabbit was placed under general anesthesia with endotracheal intubation. The pupils were dilated using 2 drops of cyclopentolate 1%. An eyelid speculum was inserted. To visualize the far peripheral retina and ora serrata, the globe was rotated and the sclera was depressed using a lens loop or disposable calcium alginate swab. A near-confluent pattern of photocoagulation was attempted using a diode red (810 nm) laser indirect ophthalmoscope (IRIDEX, Mountain View, California) and a 20 or 28 diopter condensing lens. Five faculty ophthalmologists (not authors) were invited to trial the simulation model and to complete a survey. Costs of rabbits, veterinary anesthesia services and supplies were tabulated.

Results
Rabbit fundi were found to have horizontally oriented myelinated nerve fibers and scant retinal vasculature radiating from the optic nerve head to adjacent retina (Figure 2). The ora serrata could be identified by rotating the globe and depressing the sclera using a lens loop or calcium alginate swab. The globe was soft to palpation as compared with that of a human infant. The New Zealand white rabbit fundus was devoid of pigment. The Dutch belted rabbit fundus pigmentation was more evident in appearance to that of a human fundus.

The procedure was attempted first on the New Zealand white rabbit using a wide range of diode laser settings (energy 200-2,000 mW and duration 100-9,000 ms); however very little photocoagulation tissue effect was observed. The procedure was attempted on the Dutch belted rabbit and photocoagulation was readily observed (Figures 2 and 3) using settings more typically used for ROP surgery in human infants (energy 180-250 mW and duration 100 ms). Costs of were $150 per rabbit, $1 per day boarding, $15 per hour for the veterinary anesthesia service including anesthetic medication and supplies.

Four pediatric ophthalmologists and one pediatric retinal specialist performed peripheral retinal laser photocoagulation on Dutch belted pigmented rabbits. All five participating ophthalmologists completed the survey and rated the Dutch belted rabbit eye as “similar” or “very similar” to the human infant eye for the purposes of a scleral depressed examination and laser photocoagulation. Four of the 5 ophthalmologists rated laser treatment of the rabbit eye as “less difficult” or “much less difficult” than a human infant eye.

Discussion
The adult rabbit eye was selected for this training model study because it is similar in size to the human eyes that require ROP laser treatment. The average axial length of an adult rabbit eye is 15.1 mm whereas the axial length of the human premature infant eye is 15.3–16.7 mm at gestational ages of 32-41 weeks.2,3 The New Zealand white rabbit is the most common rabbit species used for biomedical research at our institution but we found that photocoagulation using the laser indirect ophthalmoscope was very difficult in this species. The lack of tissue response was probably due to the absence of fundus pigmentation. The energy of an 810 nm wavelength diode laser is absorbed primarily by the retinal pigment epithelium and secondarily by chorioid and retina.4 In contrast, the Dutch belted rabbit fundus is pigmented and we found laser photocoagulation to be more similar to that of a human eye using the laser settings typically used for ROP laser treatment. The five teaching faculty surveyed all agreed that this model would be helpful to trainees. Most indicated that peripheral retinal laser surgery would be easier to master on the rabbit eye than on the human premature infant eye. The relative ease of the procedure performed on the rabbit eye is probably due to a widely dilated pupil (8 mm), the absence of media opacity such as tunica vasculosa lentis and the relative ease of scleral depression in the rabbit eye.

Our past study1 indicated that most pediatric ophthalmology fellows are not exposed to many ROP procedures during fellowship. We believe that instruction and practice of peripheral retinal ablation using an adult Dutch belted rabbit eye would be a good first step for trainees to develop skill and confidence before attempting on a more challenging human infant eye. We believe that making use of a training model would permit the trainee to take better advantage of every ROP laser surgery case that presents during a 1-year fellowship. In addition, the teaching faculty ophthalmologists may have additional confidence in permitting a fellow to perform the laser procedure on a patient after observing the fellow’s skills with the training model.

Conclusion
The Dutch belted rabbit is a good simulation model for learning the technique of scleral depression and indirect laser photocoagulation in small eyes.


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