What came first: the egg or the microsurgery training? An ophthalmic model for developing basic skills in microsurgery

O que veio primeiro: o ovo ou o treinamento microcirúrgico? Um modelo oftalmológico para desenvolver habilidades básicas em microcirurgia

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ABSTRACT

Purpose: To describe a new accessible model of ophthalmological training using chicken eggs.

Methods: With the aid of a spherical drill, the external calcified layer and the cuticle of the chicken eggshell were removed in a 2cm diameter circle. Using a video-magnification system, the film was dissected and cut to approximately 1.5 cm diameters. The film was removed and repositioned to make interrupted 12-0 nylon microsutures. The parameters analyzed were: cost, facility of acquisition and handling, time for making the model and the microsutures and number of possible uses.

Results: In all simulators, it was possible to carry out separated and equidistant micro-sutures in the egg membrane, without the need for reintervention.

Conclusion: The new chicken-egg model for ophthalmic surgery training is low-cost, easy to acquire and handle, and viable for the development of basic microsurgery skills.

RESUMO

Objetivo: Descrever um novo modelo acessível de treinamento oftalmológico com ovo de galinha.

Métodos: Com o auxílio de uma broca esférica, a camada calcificada externa e a cutícula da casca do ovo de galinha foram retiradas em um círculo 2 cm de diâmetro. Mediante um sistema de videomagnificação, a película foi dissecada e cortada em formato aproximado de 1,5 cm de diâmetro. A película foi removida e reposicionada para a confecção de microssuturas interrompidas com nylon 12-0. Os parâmetros analisados foram: custo, facilidade de aquisição e manuseio, tempo para confecção do modelo e para a confecção das microssuturas e número de utilizações possíveis.

Resultados: Em todos os simuladores foi possível realizar microssuturas separadas e equidistantes na membrana do ovo, sem necessidade de reintervenção.

Conclusão: O novo modelo com ovo de galinha para o treinamento de cirurgia oftalmológica é de baixo custo, fácil aquisição e manuseio, além de ser viável no desenvolvimento de habilidades básicas em microcirurgia.

INTRODUCTION

Several ophthalmic surgical procedures that use microsurgical approaches – such as the reconstruction of the eyeball and corneal transplants – require years of training in traditional medical residences.[1-5] Many microsurgeons in training use controlled environments to replace direct surgical practice[6] due to gains in professional safety and, mainly, in the reduction of errors and losses to patients.[5-8]

Recently, training centers have used ophthalmic surgery simulators that reconstruct eye tissues and improve manual skills, which are manufactured by industry sectors worldwide. However, the high cost of the simulators is the major obstacle to most institutions: estimations show that it takes between 10 and 34 years for institutions to recover their investment in an eye simulator.[9] This caused a trend in research centers for the development of low-cost simulators.

In this context, current experimental research works according to the ethical principles of the 3 R's – replacement, reduction, refinement – translated into research tests that replace animals with inanimate tools and technologies,[10,11] or that reduce the number of animals tested by the refinement of the technique.[12] The chicken egg symbolizes these principles in reality: a material of low cost, easy to acquire and similar to the human tissues; characteristics already used in simulations in other specialties and potential for ophthalmology.[12,13]

The egg is composed of the yolk and albumen, similar to the vitreous humor, covered by membranes, cuticle and a calcified layer.[1,3] The composition of the membranes consists of collagen and glycoproteins, which form a film similar to the human cornea which may be used to simulate the sclerocorneal tissue of the human eye, possibly useful to simulate sutures of ophthalmic microsurgery.[1,3] Therefore, this study aimed to describe a new accessible model of ophthalmological training using chicken eggs.

METHODS

The training model for ophthalmic microsurgery was developed at the Experimental Surgery Laboratory of the State University of Pará (UEPA). The research followed the rules of the Brazilian Animal Care Law (Law: 11,794/08), based on National Institutes of Health Guidelines, and followed the rules of the ethical code of the Council for International Organizations of Medical Sciences for animal experimentation and the European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes. To build the model, ten raw chicken eggs of the species *Gallus gallus domesticus* obtained from a properly regulated local market were used.

Initially, the eggs were placed in a common bowl with the largest curvature facing downwards, in order to promote stability for the making of the model. After that, a circle of 2cm diameter was drawn with the aid of a permanent brush on the apical surface of the egg, delimiting a training area. Then, with the aid of a 4mm spherical drill coupled to an axis (Dremel 225 series) of a micro-rectifier (Dremel 4000), removal of the external calcified layer and cut of the shell was carried out, in order to expose its membranes (Figure 1).

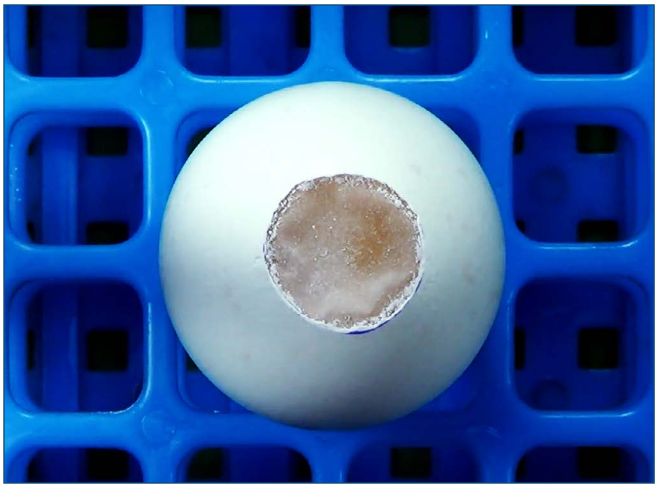

Figure 1. Complete training model.

Subsequently, with the aid of the video-magnification system developed by the research group,[14,15,16] the egg film was dissected using tweezers and microsurgical scissors, in which a circular cut of approximately 1.5cm diameter was made (Figure 2). The dissected film was removed and immediately repositioned for the making of microsutures, using 12-0 monofilament nylon thread. Eight equidistant stitches were performed, according to the single interrupted suture technique used in corneal surgeries, as previously described in the literature.[17] All microsurgical procedures were conducted by surgeons with more than 10 years of practice in the ophthalmic technique.

What came first: the egg or the microsurgery training?

The parameters analyzed were: cost of the model, facility of acquisition, facility of handling, time for making the model, time for doing microsutures and number of possible uses.

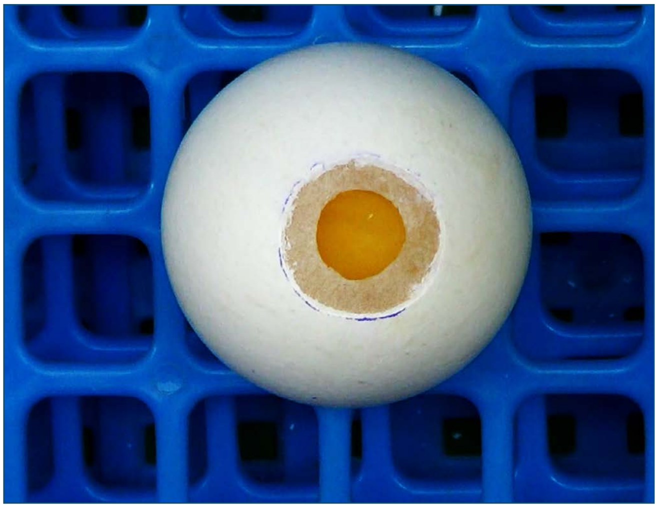

Figure 2. Training model without the egg membrane.

The data obtained were organized in Microsoft Word 2016 and Microsoft Excel 2016 software for the production of tables and image editing.

RESULTS

In all simulators, it was possible to perform separate microsutures on the membrane as proposed (Figure 3). The average time to perform a single stitch was 38±5.6 seconds and the average time to complete the model was 5±1.3 minutes. The cost of each simulator was approximately U$1.60.

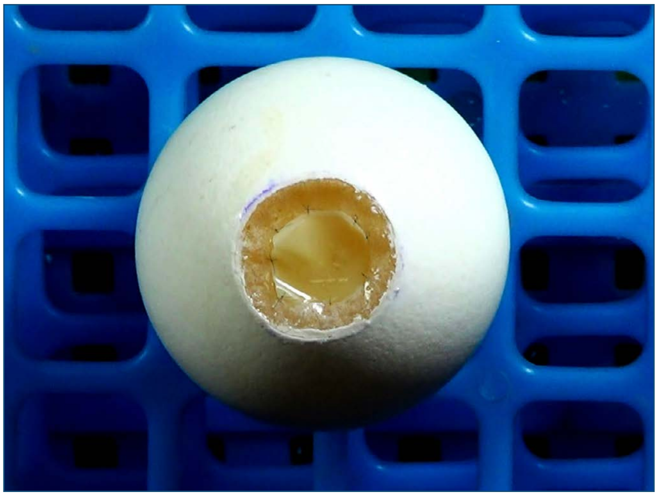

Figure 3. Training model with stitches.

DISCUSSION

Ophthalmic surgeons need to develop several skills, which must be achieved through extensive training and ongoing studies.[18,19] However, due to differences in clinical settings and educational opportunities to which residents are exposed, the need for training models focused on the effective acquisition of specific skills is evident.

The inner membrane was used to simulate the sclerocorneal tissue of the human eye. Therefore, all steps in the preparation of microsutures were performed with similarity to the clinical context, correlating with the surgeon's realistic experience.[10,20] Also, the level of difficulty observed in the making of microsutures, including complications inherent to the technique (perforations, ruptures and displacements of the membrane),[21] can be used in the future for initial training in the creation of surgical access and manipulation of the external eye layer. It was necessary to use 12-0 monofilament nylon to prevent rupture of the membrane, which is friable.

A similar model with a quail egg previously described for simulation of retinal and vitreous surgery was used:[22] its internal membrane was associated with the retina and an artificial silicone prototype was developed to simulate a sclerocorneal "lid". However, the simulator proposed in the present study does not involve any external prototype, preserving the quality of the exercise combined with a low financial cost.

Other models for the training of corneal surgeries use pig eyes[23] and human corneas.[21,24,25] However, the supply of pig eyes is limited and deviates from the ethical principle of replacing the use of animals. Besides that, although the training in human eyes is most reliable, its access is highly restricted and some countries prohibit its use for simulation.[26,27] The chicken egg, on the contrary, is accessible, easy to handle and does not require the use of live animals in research.

Other advantages of the simulator include high portability, overcoming the difficulties of restricting practices to the environment of an ophthalmic training center, and the possibility of varying the membrane area to be exposed and manipulated by the professional, offering scalable degrees of difficulty in the simulation. With this differential, it is possible to record parameters such as execution time, the number of sutures and the quality of the knots performed, translating them into a tangible learning curve. Thus, the main difficulties of the surgeon can be objectively focused on an individualized and personal study model.

Thus, the chicken egg is an effective alternative in terms of cost and practicality for the acquisition of surgical skills. It is desirable that studies with formal validation processes be carried out in the future. Investigations on the enzymatic treatment of the inner membrane should also be considered, varying its resistance and optimizing the accuracy of the simulation.[6]

CONCLUSION

The new training model for ophthalmic surgery with chicken egg is similar to the ocular structures, low-cost, easy-to-make, easy-to-handle and is in line with current ethical principles.

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