Face and content validity of the SimulEYE A-Vit model for anterior vitrectomy

The ability to perform a successful anterior vitrectomy is a necessary skill for any cataract surgeon due to the nontrivial rate of posterior capsular rupture (PCR). PCR has been reported to occur in up to 5.2% of recent North American phacoemulsification surgeries, though estimates as high as 8.9% have been reported for inexperienced practitioners.[1–3] PCR causing vitreous loss is associated with increased risk of complications, including retinal detachment, cystoid macular edema, and endophthalmitis.[4,5] These vision-threatening complications can be reduced by early recognition of PCR by the surgeon, immediate cessation of intraocular maneuvers to avoid enlarging the tear, and diligent subsequent management to minimize vitreous migration into the anterior chamber.[1] Thus, hands-on practice performing anterior vitrectomy procedures can prepare surgeons to more calmly and adeptly manage PCR and ultimately provide better outcomes to patients. Additionally, with the recent rise of competency-based medical education, it is becoming increasingly important to develop reproducible, validated training models for education and assessment purposes.[6]

The SimulEYE A-Vit model (InsEYEt, Westlake Village, CA) is one of a line of ophthalmic surgical training models designed to simulate eyes for common surgical procedures as an alternative to cadaveric specimens, which—despite high content and face validity—have ethical, cost, safety, and availability concerns associated with their use.[7–9] The artificial model features a synthetic vitreous in the posterior chamber, a viscoelastic substitute in the anterior chamber, and a membrane representing the ruptured posterior capsule. In each model, vitreous has entered the anterior chamber through a tear in the posterior capsule membrane, simulating an intraoperative PCR (see Fig. 1). To mimic intraoperative vitreous staining with triamcinolone acetonide, reflective particles are embedded in the synthetic vitreous.[10] At US $50 per disposable unit, the SimulEYE A-Vit may be a valuable training tool for inexperienced practitioners and a means of practice for experienced surgeons who may encounter PCRs too infrequently to remain skilled at their surgical management. Despite these potential benefits, no validation of this model has yet been performed. In this study, we aimed to assess the SimulEYE A-Vit model, including for face and content validity.

Forty respondents were given an 18-response survey (Appendix A) assessing face validity, content validity, and other aspects of the SimulEYE A-Vit model immediately after a 90-minute hands-on training session at the 2019 Canadian Ophthalmology Society annual meeting. Definitions of face and content validity were derived from McDougall,[11] and the statements for assessment of the model were adapted from Alzahrani et al.[12] In general, face validity assesses the realism of the simulator, whereas content validity judges the appropriateness of the model for teaching purposes.[11] Participants were introduced to the anterior vitrectomy technique with a short presentation (without description of the A-Vit model, to avoid bias), followed by hands-on practice with appropriate surgical instrumentation and instruction. Participants were seated 2 to a table, each with their own complete simulation setup. Instructors provided guidance to each pair of participants on how to perform the procedure. Course instructors and participants were then surveyed immediately after completion of the session to minimize potential group bias from interaction with other participants. Responses to statements addressing the model were recorded on a 5-point Likert-type scale ranging from 5 (strongly agree) to 1 (strongly disagree). Respondents also self-reported their lifetime and past year experience performing anterior vitrectomy surgeries and were given opportunity to provide general comments. The Mann–Whitney *U* nonparametric analysis was performed to determine whether expertise in performing anterior vitrectomy surgeries (≥30 cases/lifetime; n = 13) or being a course instructor (n = 10) had a significant influence on responses compared with nonexpert participants (<30 cases/lifetime; n = 24), and noninstructors (n = 28), respectively. Statistical analysis and graph generation was performed with GraphPad Prism 8.2.0.

Survey respondents included 10 instructors, 28 participants, and 2 unspecified individuals with diverse experience. The majority of respondents (n = 25) had performed between 1 and 10 anterior vitrectomies in the past year, and only 4 respondents had never previously performed the procedure before the course and survey. The self-reported experience performing procedures by respondents is shown in Table 1.

Respondents rated all statements regarding the SimulEYE A-Vit model with a median response of 4 (agree) to 5 (strongly agree). The Mann–Whitney *U* nonparametric

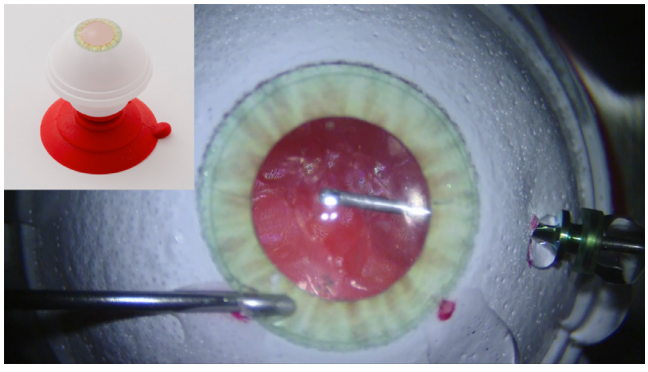

Fig. 1—The SimulEYE A-Vit model for anterior vitrectomy.

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Table 1—Respondent's self-reported experience performing anterior vitrectomy procedures before the SimulEYE A-Vit training course and survey

Range	No. of Procedures Past Year	No. of Procedures Lifetime
0	11	4
1–10	25	14
11–20	1	6
21–30	1	5
31–40	0	3
41–50	0	1
51–60	0	1
61–70	0	0
71–80	0	0
81–90	0	0
91–100	0	0
>100	0	3
Count (n)	**38**	**37**

analysis did not reveal a significant difference in responses for expert versus nonexpert and instructor versus noninstructor respondents for any of the survey statements (see Appendix B for a full table of values and comparative statistics). The SimulEYE model received highest ratings for utility in novice skill acquisition before performance on patient, and increased accessibility and ease of preparation compared with human cadaveric models. Lowest ratings were received for evaluation of the SimulEYE model's realism compared with human cadaveric models and whether success with the model indicates readiness to perform successful patient procedures (see Fig. 2).

Respondents rated all statements specifically regarding face validity (statements 1–3 in Appendix A) with a median response of 4 (agree), with only a single "disagree" response for the statement addressing whether the A-Vit model was free of manufacturer defects/malfunctions. Statements specifically addressing content validity (statements 6–10, 15, and 16 in Appendix A) similarly received a median response of "agree" or higher, though with more respondents disagreeing with each.

Overall model-specific comments by respondents were generally positive. Specific critiques of the SimulEYE A-Vit model included comments regarding the relative stiffness of the capsule and cornea, and a resultant difficulty making corneal incisions to begin the procedure on the model.

The SimulEYE A-Vit model was generally regarded highly by respondents with all levels of experience performing anterior vitrectomy procedures, including the specifically addressed features of face and content validity. As could be expected, the anatomical accuracy compared with a human cadaveric eye—

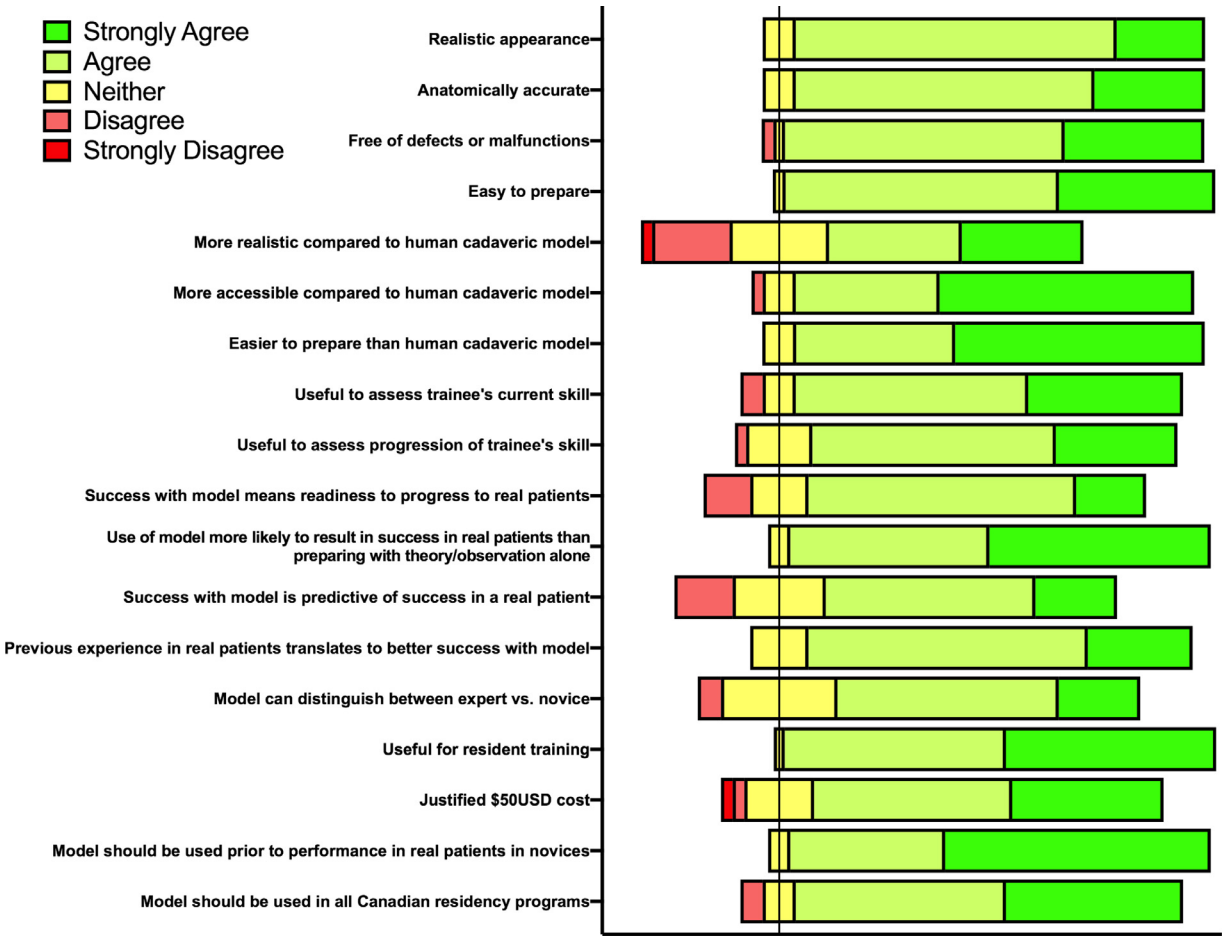

Fig. 2—Diverging stacked bar chart displaying Likert responses to each statement regarding the SimulEYE A-Vit model of anterior vitrectomy by respondents at the Canadian Ophthalmology Society 2019 Annual Meeting after a 90-minute training session.

Table 2—Comparison of advantages and disadvantages of the SimulEYE A-Vit models, human cadaveric eyes, and pig/cow cadaveric eyes as models for anterior vitrectomy

	SimulEYE A-Vit Model	Human Cadaveric Eye	Pig/Cow Cadaveric Eye
Anatomical accuracy	++	+++	++
Setup/cleanup	+++	+	+
Cost effectiveness	++	+	+++
Availability	+++	+	+++
Storage	+++	+	+
Longevity	+++	+	+
Safety	+++	++	++
Ethical use	+++	+	++

although also highly rated—was one of the least positively assessed attributes of the model. However, advantages of the model compared with both human and animal cadaveric eyes may offset this disadvantage for uses in competency-based education and training. The setup and cleanup of these disposable units can be readily performed, and the model does not require the keratoprosthesis required for visualization into the anterior chamber due to the corneal opacification observed in cadaveric specimens.[7,13] The cost of these models is also comparatively inexpensive at US $50. Human cadaveric eyes have been estimated at upward of US$500 per research globe,[14] though animal eyes are significantly cheaper. The additional attributes of ease of storage, longevity, safety, and ethical use also strengthen this model[7–9] (see Table 2 for a comparison of SimulEYE and alternative models).

With the rise of CMBE in Canadian ophthalmology programs and indeed around the world, there is substantial need for accessible, reproducible, cost-effective tools for training and evaluating residents.[15] Although outside the scope of this article, subsequent formal analysis of the construct and criterion validity of the SimulEYE A-Vit model may further strengthen the utility of this model for use in training programs.

Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jcjo.2020.04.006.

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Footnotes and Disclosure

The authors have no proprietary or commercial interest in any materials discussed in this article.