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Early Performance on an Eye Surgery Simulator Predicts Subsequent Resident Surgical Performance

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OBJECTIVE: To examine early performance on an eye surgery simulator and its relationship to subsequent live surgical performance in a single large residency program.

DESIGN: Retrospective study.

SETTING: Massachusetts Eye and Ear, Harvard Medical School, Department of Ophthalmology.

METHODS: In a retrospective study, we compared performance of 30 first-year ophthalmology residents on an eye surgery simulator to their surgical skills as third-year residents. Variables collected from the eye surgery simulator included scores on the following modules of the simulator (Eyesi, VRmagic, Mannheim, Germany): antitremor training level 1, bimanual training level 1, capsulorhexis level 1 (configured), forceps training level 1, and navigation training level 1. Subsequent surgical performance was assessed using the total number of phacoemulsification cataract surgery cases for each resident, as well as the number performed as surgeon during residency and scores on global rating assessment of skills in intraocular surgery (GRASIS) scales during the third year of residency. Spearman correlation coefficients were calculated between each of the simulator performance and subsequent surgical performance variables. We also compared variables in a small group of residents who needed extra help in learning cataract surgery to the other residents in the study.

MAIN OUTCOME MEASURES: Relationships between Eyesi scores early in residency and surgical performance measures in the final year of residency.

RESULTS: A total of 30 residents had Eyesi data from their first year of residency and had already graduated so that all subsequent surgical performance data were available. There was a significant correlation between capsulorhexis task score on the simulator and total surgeries ($r = 0.745$, $p = 0.008$). There was a significant correlation between antitremor training level 1 ($r = 0.554$, $p = 0.040$), and forceps training level 1 ($r = 0.622$, $p = 0.023$) with primary surgery numbers.
There was a significant correlation between forceps training level 1 ($r = 0.811$, $p = 0.002$), and navigation training level 1 ($r = 0.692$, $p = 0.013$) with total GRASIS score. There was a significant inverse correlation between total GRASIS score and residents in need of extra help ($r = -0.358$, $p = 0.003$).

CONCLUSION: Module scores on an eye surgery simulator early in residency may predict a resident's future performance in the operating room. These scores may allow early identification of residents in need of supplemental training in cataract surgery. (J Surg Ed ■:■■■-■■■. © 2017 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: ophthalmology education, applicant evaluation, surgical performance, Eyesi, simulator

COMPETENCIES: Patient Care

INTRODUCTION

Surgical simulators have been widely used for training in neurosurgery, gastroentrology, laparoscopic surgery, orthopedics, and ophthalmology.[1-6] There is increasing evidence

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that surgical simulator training improves residents' surgical performance in the operating room (OR) and improves surgical outcomes.[5] It is difficult to predict the potential for the acquisition of surgical skills in a novice surgeon. Although most residents can be adequately trained surgically, the occasional resident may have difficulty achieving surgical competencies within the timeframe of a residency program. In these unfortunate situations, it is not unusual to discover these surgical deficiencies late in residency. Many ophthalmology surgical programs have residents perform most of their surgery in their final year.

The Eyesi simulator has been used to train residents in cataract surgery at many ophthalmology programs including the Harvard Medical School ophthalmology residency. It can generate scores for performance in multiple modules based upon errors made, path length, time taken for different simulator tasks, and other variables. Construct validity for various modules of the Eyesi eye surgery simulator (VRmagic, Mannheim, Germany) has been demonstrated by several authors.[7-10]

To date, there are few formal studies that explore the use of early assessment tools to predict future surgical performance.[11-13] Some general surgeons have proposed that the incorporation of technical proficiency skills, such as visual spatial perception, in residency selection may help identify those candidates with an aptitude for a surgical specialty.[14,15] Although simulators for teaching and assessing surgical skills are become more widely accepted in ophthalmology, there is insufficient evidence as to whether early simulator performance can predict subsequent intraoperative surgical performance.

In this study, we hope to address this gap in the literature, hypothesizing that residents' early simulator performance may predict future surgical skills in the OR. A better prediction method would allow training programs to provide early intervention for residents who will need more teaching and practice than the standard curriculum provides.

METHODS

A retrospective review of Harvard Medical School ophthalmology residents' performance from July 2011 to July 2014 on the Eyesi simulator was performed. The Massachusetts Eye and Ear Institutional Review Board determined that this study was exempt as an educational study. There were 32 eligible residents. One was excluded because of prior experience in ophthalmology residency outside the United States, and the other was because of insufficient information on the Eyesi. We considered early attempts by each resident during the first 3 months of residency in each of the following tasks from the simulator: antitremor training level 1, bimanual training level 1, capsulorhexis level 1 (configured), forceps training level 1, and navigation training level 1. We excluded the first 3 attempts to minimize familiarity with the Eyesi as a variable, reviewing the next 8 attempts for each resident. Eyesi scores were calculated by the trainer software, based on variables such as time, tissue injury, microscope focus, path length, and others. We excluded scores of 0 with instruments in the eye for less than 10 seconds.

Intraoperative performance of residents' cataract surgery was assessed in the following 2 ways:

(1) Global rating assessment of skills in intraocular surgery (GRASIS) forms. In our residency program, faculty complete a validated performance scale called GRASIS[15] during the third-year resident's cataract surgery rotations. We considered the following items from the GRASIS: instrument handling, flow of operation, time and motion, treatment of ocular structures and other tissues, use of nondominant hand, and overall performance. These measures were graded on a modified Likert scale from 1 to 5.

(2) Number of cataract surgeries performed by a resident during all of residency training. We assessed both the total number of surgeries in which a resident participated, and the number of surgeries as primary surgeon. Although there are many factors that influence the number of cases a resident performs as primary surgeon, attending confidence in the resident's surgical skill is a factor in the number of cases in which the resident acts as primary surgeon.

In addition, there was a group of residents whom the residency program director identified as needing extra help in learning cataract surgery based on feedback from cataract surgery faculty. We compared Eyesi and subsequent surgical performance in this group to these parameters in the remaining group of residents.

Statistical Analysis

We eliminated the first 3 attempts in each task on the Eyesi for each resident during the first year of training and we considered the next 8 attempts during the first 3 months of the start of residency. To obtain the mean improvement of scores after each attempt, we calculated the regression coefficient of score versus the attempt number for each task of each resident in early performance evaluation in a linear mixed model. The mean total task score of each resident was calculated for each task during the resident's early performance. Based on these findings, we obtained the Spearman correlation of early simulator performance, total surgeries, total primary surgeries, and mean GRASIS score for each resident. We also determined the Spearman correlation of these variables with the need for extra help in learning cataract surgery. Subsequently, we calculated the