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Surgical training in ophthalmology: Role of EyeSi in the era of simulation-based learning

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SHORT REPORT

Surgical training in ophthalmology: Role of EyeSi in the era of simulation-based learning

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Abstract

Recent advancements in surgical training methods have escalated the need for simulators. The EyeSi simulation has played a major role in Ophthalmology training by providing opportunity to the novice residents to grasp the surgical steps of the procedure and master the skill by repeated attempts. Participants were assessed on single level of cataract module and their consecutive scores were assessed with each attempt. It was found that repetitive practice on simulator can help develop proficiency in the desired steps that can ultimately prepare the surgical trainees for real life surgery.

Keywords: Virtual reality, Simulator, Surgery, training, Ophthalmology, Oph-thalmologic surgical procedure, Surgical Specialties.

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Introduction

The expanding era of virtual reality has led to the evolution of simulators that have been a desirable machine in achieving perfection at a given task in various fields. Ophthalmology has an edge of short and quick procedures that require manipulation in limited space mandating the need for prior practice before performing on to a patient in real life. The EyeSi Surgical Simulator (VRmagic, Mann-heim, Germany) is the predominant simulator used for training in both cataract and vitreoretinal surgery in ophthalmology.[1]

The module comprises of levels with increasing difficulty that cover all steps of a basic cataract surgery and vitreoretinal surgery. Several studies have extensively studied the predictive and construct validity of the Cataract surgery module.[1-4] Various other factors have been studied that include complication rate in cataract surgery following simulation learning.[5]

With the EyeSi simulation facility available at our setting, the aim of this study is to identify consistent or improving scores following a repetition of the same level in a cataract surgery module on EyeSi simulator. This was performed by various participants, with different levels of experience on EyeSi and real-life surgery, which could help assess the learning curve.

Methods and Results

The study included 8 participants that involved consultants, residents, and re-search fellows with varying level of real-life surgical hands-on experience. The identity was kept anonymous while the scores were gathered. Evaluation was based on a single step of capsulorhexis performed on EyeSi system available at the Aga Khan University Hospital Karachi, Pakistan. The data was obtained between 2nd-31st August 2021.

A single level of Cataract module labelled as "Capsulorhexis-High tension without guiding elements" was selected and a complete central curvilinear capsulorhexis was performed using any instruments of the participant's choice. Each participant was given 6 attempts, 3 consecutive attempts on day 1 and then 3 consecutive attempts after one week. Probability of achieving high scores or consistently improving scores were assessed. Machine has default criteria that scores the roundness, centering, deviation of rhexis radius from 2.5mm, maximum radial extension of capsulorhexis and local irregularities (spikes). It also scores on efficiency, instrument handling and tissue treatment.

The passing criteria set by the EyeSi programme is at 70% and requires 3 consecutive attempts. However, each attempt was independently recorded to document progression or decline in our participants with repetition of same level. Our hypothesis relied on a probable increasing score with each attempt thereby excluding any high scores that may have occurred by chance secondary to partially met criteria which doesn't fulfill the ultimate target.

The mean score of all participants in first attempt was 51.25 ± 34.6 as compared to the final attempt which was 78.75 ± 9.98 (Table). There was an increase of 27.5 points

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Table: Mean results of 8 participants undertaking 6 attempts of high tension capsulorhexis.

	1st Attempt score	2nd Attempt score	3rd Attempt score		4th Attempt score	5th Attempt score	6th Attempt score
High Tension without guiding elements							
A	67	94	86	One week interval	74	66	66
B	0	90	94		0	23	89
C	0	14	0		84	38	62
D	75	90	0		73	67	79
E	75	39	62		96	94	81
F	36	48	94		86	86	79
G	83	82	88		86	88	85
H	74	0	0		75	93	89
Mean	51.25±34.6	57.125±37.2	53±45.0		71.75±30	69.37±26.6	78.75±9.98

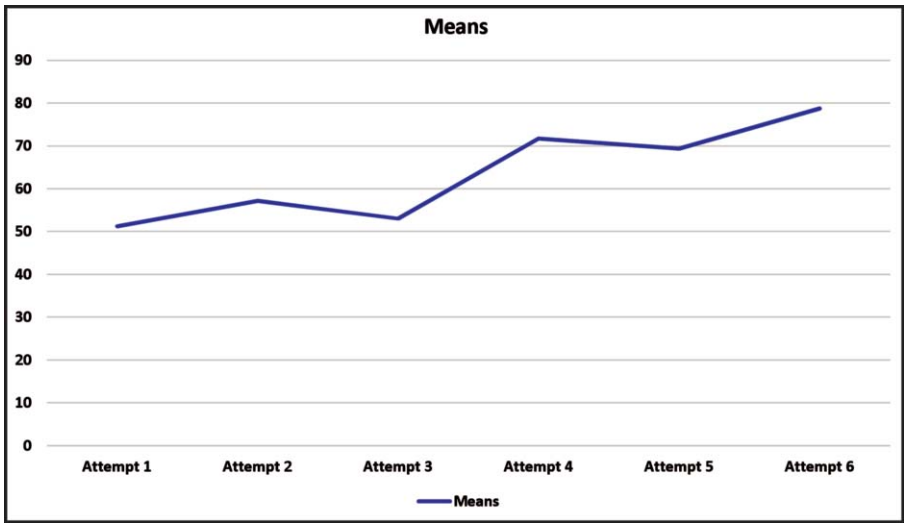

Figure: Graph showing rise in the mean scores with successive attempts.

obtained after repeated attempts which showed an overall improvement (Figure-1). Mean time for rhexis completion noted for all participant attempts combined was 2.34±1.41 minutes varying from maximum 8 minutes to minimum 1 minute. Instrument handling was scored excellent in majority attempts, and injured corneal area was 0 - 2 mm in most cases with only case injuring 5.3 mm of cornea.

The cumulative mean score in first 3 attempts was 53.8, and 73.3 in last 3 attempts. The improvement observed in the 3 attempts done on the subsequent week was drastic in comparison to initial 3 attempts with a difference of 19.5. It was observed that multiple attempts, with a gap in between, lead to better improvement in skill that may help in real life surgery.

Scoring for target achievement is based on roundness, centering, deviation, maximum extension, and irregularities of the capsulorhexis. There were differing scores of target achievement amongst the attempts, including attempts with same score but different individual parameters of the capsulorhexis. In one scenario, attempt score was 90-100, however the maximum radial extension was 2.3 mm which translates into a rhexis of 4.6 mm diameter, which in real life surgery is far from ideal and would not have achieved passing criteria if it was manually scored.

Discussion

The use of simulation nowadays is an integral part of residency training in majority of the hospitals in the developed world. EyeSi simulator has demonstrated construct validity in multiple studies and has shown to decrease complications rates amongst residents in comparison to controls.[6] We report a drastic difference in mean scores of the residents after one week interval with similar learning curve of skill improvement amongst all participants. Studies conducted previously had compared the outcomes of simulation-based learning with the real-life cataract surgeries. Thomsen et al assessed proficiency-based test on the EyeSi simulator with significant correlation to real-life performance, measured by motion-tracking software, of cataract surgical videos amongst 11 cataract surgeons.[7] Another study showed association of prior simulation training with statistically significantly lower difficulty scores on certain tasks performed during cataract surgery.[8] As the cost of acquiring EyeSi simulator falls between 150,000 - 200,000 US Dollars, it might be a difficult proposition to acquire it in a low-income country. Considering its availability, the use of simulator before hands on human eyes not only improves clinical skills but also corroborates patient's safety.

Conclusions

EyeSi simulator was found to have the ability to assess the scoring rate of participants engaging in different steps of cataract surgery. The most important benefit of using such simulation is that one can practice multiple times on this machine without putting any patient at risk.

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