Eye on the Prize: Simulating Corneal Foreign Body Removal Training for Emergency Medicine Residents using Hard-Boiled Eggs

Charles Wyatt MD[1], Hyunjoo Lee MD[1]

[1]Stony Brook University Hospital Department of Emergency Medicine

Background

Prevalence of Eye Complaints: Nearly 12 million Emergency Department (ED) visits annually involve ophthalmologic complaints, with 7 million related to trauma (e.g., foreign bodies, contusions).

Importance of EM Physician Training: Proficiency in ophthalmologic exams and procedures, including corneal foreign body (CFB) removal via slit lamp, is essential to prevent complications like scarring or infection.

Lack of Formal Ophthalmologic Training: Fewer than 20% of U.S. medical schools mandate an ophthalmology rotation and EM residents receive <10 hours of dedicated training.

Need for Standardized CFB Removal Training: Despite its clinical importance, no standardized teaching approach exists for CFB removal in Emergency Medicine (EM) training programs.

Simulation-Based Training Benefits: Various materials (e.g., cow eyes, agar plates, grapes, parafilm) have been used for CFB removal simulation, improving residents' confidence and skills.

Research Gap in Simulation Models: No studies have explored easy to obtain, low-cost alternative of hard-boiled eggs as a potential simulation model for teaching CFB removal.

Significance of Further Investigation: Identifying effective, accessible simulation methods can enhance EM resident training and improve patient care.

Research Question and Objectives

Research Question: *Does the use of hard-boiled egg simulations for corneal foreign body removal significantly improve EM residents' procedural proficiency, confidence, and overall skill performance compared to traditional training?*

Additional Objectives:

- Explore the feasibility of using this low-cost, widely available model in resource-limited medical training programs.
- Provide data on simulation-based learning to inform curriculum design and teaching strategies in EM training programs.
- Analyze differences amongst Postgraduate Year (PGY) classes to determine if simulation-based procedural sessions can be an effective training tool.

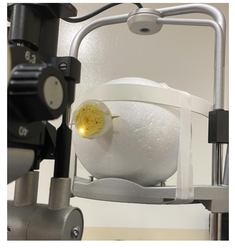
Materials and Methods

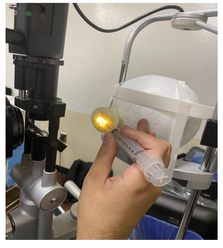
Materials: Slit lamp, 6-inch diameter Styrofoam ball, hardboiled egg, pencil lead shaving, toothpick, hollow-gauge needle

Inclusion Criteria: Emergency Medicine Residents at Stony Brook University Hospital

Methods:

- Pre-procedure *Qualtrics* survey to determine baseline exposure to using a slit lamp and CFB removal
- Residents performed the CFB removal procedure using the simulation model attached to slit lamp
- Post-procedure *Qualtrics* survey
- Statistical data analysis – Quantitative analysis and t-tests (paired, two-sample assuming unequal variances) on *Microsoft Excel*





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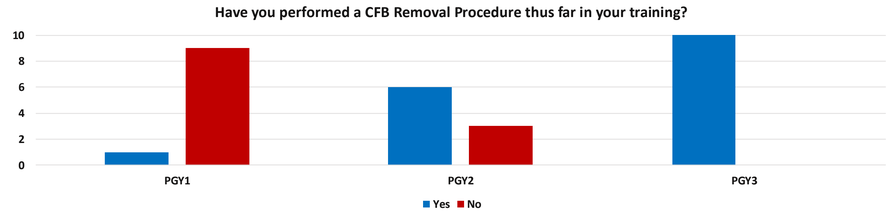

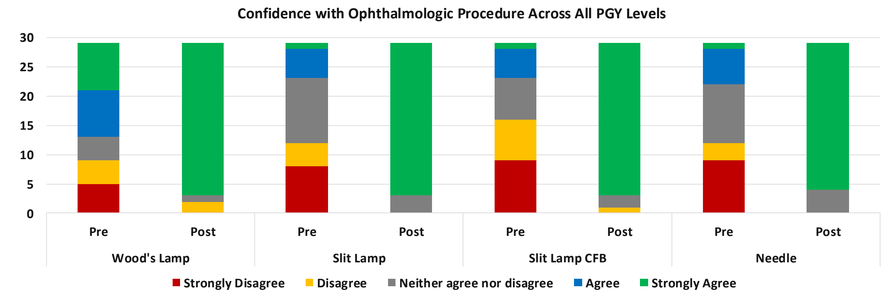

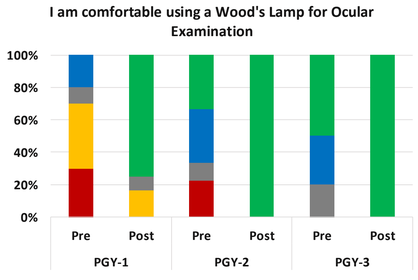

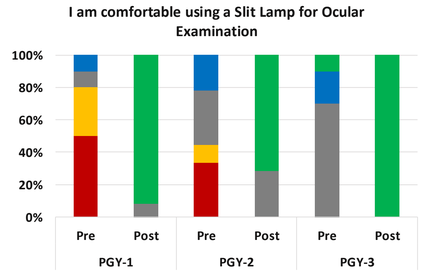

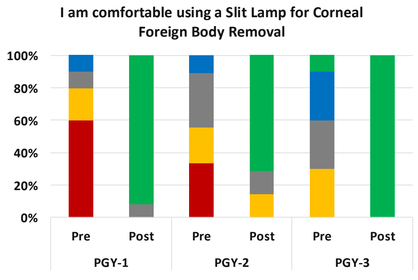

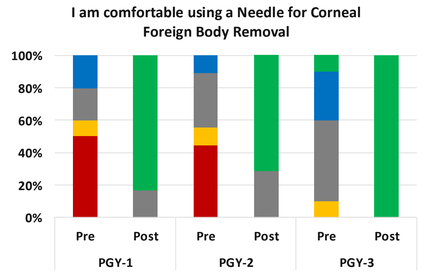

Limitations

Simulation Effects: Difficulty embedding pencil lead shavings into the egg white due to structural properties, leading to the use of the egg yolk instead, resulting in reports of tactile differences. Unable to replicate key portions of the procedure such as patient cooperation and eyelid manipulation.

Single-Center Study: The study was conducted at one institution, limiting the generalizability of the findings to other training programs with different resources and structures.

No Control Group: Without a comparison to other training methods (e.g., video-based or mannequin-based), the effectiveness of the hard-boiled egg model cannot be directly assessed.

Subjective Outcome Measure: The primary outcome, confidence, was based on self-reported Likert scale responses, which may not accurately reflect actual skill improvement or procedural proficiency.

Unequal Survey Responses: There was an unequal distribution of responses between PGY1 and PGY2 residents in the post-simulation survey, potentially introducing bias in the analysis of confidence improvements across different training levels.

Sample Size: 29/45 residents took part in the study, thus reducing sample size and decreasing the study's power

Conclusion

The use of hard-boiled egg simulations significantly improved EM residents' confidence in corneal foreign body removal. This low-cost, accessible model proved to be a practical tool for procedural education and was shown to be effective across all PGY levels, supporting its inclusion in EM curriculum. However, further research is needed to assess how well this simulation-based training translates to patient care and encounters.

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