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ORIGINAL ARTICLE

Role of Wet Laboratory Training for Residents of Ophthalmology

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Abstract

Background: In current residency programs, surgical skill acquisition relies on observation and incremental practice, often due to limited surgical opportunities, potentially lowering learner confidence and impacting patient outcomes. To counter this, mandatory wet lab training has been introduced to enhance surgical exposure. **Aim:** To evaluate the role of wet laboratory training for residents of Ophthalmology. **Material and Methods:** Thirty-two postgraduate residents participated in three supervised sessions, practicing small incision cataract surgery (SICS) on goat eyes. Faculty evaluated their performance using the SICS Ophthalmic Simulated Surgical Competency Assessment Rubric (Sim-OSSCAR:SICS) scale. Residents provided feedback through a pretested questionnaire. **Results:** Significant improvement in mean scores across sessions (16.094 ± 5.449 after exposure 1, 22.188 ± 4.948 after exposure 2, and 29.094 ± 5.384 after exposure 3, $p < 0.001$) was seen. Qualitative analysis indicated high relevance of wet lab training (71.9%), with residents acknowledging its usefulness (68.7% strongly agreed, 31.3% agreed) and confidence boost (75% strongly agreed, 25% agreed). Most residents found ease in performing different (93.7%) and subsequent (96.9%) steps during wet lab training. **Conclusion**: This study emphasized the importance of wet lab training is crucial, as it significantly contributes to enhancing patient care quality by allowing residents to refine surgical skills in a safe environment.

Key Words

Wet laboratory training, Surgical skills, Sim-OSSCAR, SICS, Stereoscopic view.

Introduction

With evolving practice dynamics and residency programs, the teaching and training of postgraduate residents in ophthalmology have been significantly affected by limited surgical exposure and the absence of simultaneous feedback from mentors, as patients are under local anesthesia and remain alert during the procedure. Literature indicates a correlation between insufficient surgical training and elevated complication rates among novice ophthalmic surgeons.[1] To mitigate such challenges and enhance surgical skills, mandatory wet laboratories are globally adopted across various surgical disciplines.[2] On the other hand, ophthalmic surgery, characterized by its intricate hand-eye coordination demands, poses a distinctive challenge due to the microanatomy and delicate structures of the eye, which allow minimal room for error.[3]

Given that real-time surgical training often confines teaching surgeons to observer roles, wet labs play a pivotal role in accelerating beginners' learning curves.[4] Wet lab training fosters mastery of stereoscopic vision, hand-eye coordination, and microsurgical skills in a non stressful environment, promoting self-awareness and skill refinement among residents with a reduced rate of complications and better visual outcomes.[5] By providing

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a platform for early error recognition and management, it reduces surgical morbidity and trauma risk, as they become aware of early signs of intraoperative complications.[6] Moreover, it cultivates dexterity, tissue awareness, and muscle memory, critical for proficient surgical performance by providing an interactive, three-dimensional educational experience that clarifies intricate anatomical relationships that is otherwise unattainable.[7] Thus, this study intends to evaluate the role of wet laboratory training for residents of Ophthalmology, with the objectives of providing a simulated environment to the residents for the surgical steps of small incision cataract surgery (SICS) without the risk of failure or complications, to shorten the learning curve for acquiring surgical skills for residents and to help residents to master stereoscopic vision, hand eye coordination and microsurgical skills in a non-stressful laboratory setting.

Material and Methods

The study comprised post graduate residents of the Department of Ophthalmology, Government Medical College, Jammu. This study was performed in accordance with the tenets of the Declaration of Helsinki and was approved by the Institutional Ethics committee vide number: IEC/GMCJ/2022/1086; dated 06/06/2022.

The study started with core team brainstorming which included all the faculty members. After that, to enhance the educational quality, faculty was sensitized for the wet lab training, followed by sensitization of residents using some curricular and some extracurricular activities. A proper schedule and timeline of wet lab training sessions was designed during the focus group discussion (FGD) by the faculty. Wet lab training involved 32 residents for participation, who under the supervision of the faculty attended mandatory wet lab training. For this purpose, their informed written consent was taken.

The residents were made to perform the steps of small incision cataract surgery (SICS) under supervision on the goat's eyes. A total number of three exposures were given to residents in three months from April 2023 to June 2023, each exposure was given every Monday of the month as per the preformed schedule in the batches of 8-9 and they were allowed to complete the surgical steps irrespective of the time taken.

The surgical skills of the residents were assessed and then scored by the two designated faculty using SICS Ophthalmic Simulated Surgical Competency Assessment Rubric (Sim-OSSCAR:SICS) during each session which included the 20 parameters with 14 steps of SICS from scleral fixation to IOL insertion and 6 global indices, in which score of 0 was given to Novice, 1 to Advanced Beginner, and score of 2 to Competent.[8] This helped them to identify areas of focus to work upon. For the sake of uniformity, residents were evaluated by the same faculty members during all the three exposures. Each exposure was followed by simultaneous feedback and debriefing. In the end, feedback of the residents was taken using a semi structured pretested questionnaire for qualitative assessment. The pre-formed questionnaire was validated and had the value of Cronbach alpha of 0.761.[9] The residents were asked to grade their experience on the Google forms, on the basis of the preformed questionnaire. Likert scale was used to grade the answers obtained from the above questionnaire.[10] "Suggestions, if any", was regarded as an open-ended question .

Statistical Analysis

The data was entered in MS Excel spreadsheet and analysis was done using IBM SPSS Statistics for Windows, Version 25.0. Categorical variables were shown in number and percentage (%) and continuous variables as mean ± standard deviation. Analysis of Variance (ANOVA) was applied for the comparison of mean score and Chi-Square test for the comparison of categorical data. The correlation of each exposure was calculated using Pearson Correlation. A *p*-value of <0.05 was considered statistically significant. The open ended feedback in the questionnaire was analyzed by using thematic analysis.

Results

The total number of residents participating in the study were 32, 6 were males and 26 were females. The marks scored by the residents after each exposure are given in *Table 1.* All the residents scored a score of more than 20 after exposure 3 except 1 resident.

The mean marks obtained after exposure 1 were 16.094 ± 5.449; after exposure 2 were 22.188 ± 4.948 and after exposure 3 were 29.094 ± 5.384 (*Table 2*). Pairwise comparison of each exposure was statistically highly significant ($p<0.001$, ANOVA). Correlation of each exposure was significant at the 0.01 level (*Figure 1*).

Intraoperative complications during each exposure were shown in *Table 3*. After comparison among three exposures, it was observed that exposure 1 had a higher rate of complications (87.5%) as compared to exposure 2 (46.9%) and 3 (21.9%) which is statistically significant (p *value* < 0.001).

The qualitative analysis of the data obtained from the feedback forms is depicted in *Table 4&5*. 71.9% of the residents found the wet lab training to be extremely relevant. 68.7% of residents strongly agreed and 31.3% agreed that the wet lab training was useful and 75% strongly agreed and 25% agreed that wet lab training boosted their confidence. 93.7% of the residents reported

Table 1: Marks Obtained by Residents after Exposure 1, 2 and 3 as per Sim-OSSCAR:SICS.

Marks Obtained	Number of Residents (%)		
	Exposure 1	Exposure 2	Exposure 3
0-10	6 (18.75)	1 (3.125)	0 (0.0)
11-20	17 (53.125)	8 (25)	1 (3.125)
21-30	9 (28.125)	23 (71.875)	19 (59.375)
31-40	0 (0.0)	0 (0.0)	12 (37.5)

Table 2: Pairwise Comparison of Exposure.

Estimates		Pairwise Comparisons						
		Exposure (a)	Exposure (b)	Mean difference (a-b)	Std. error	Sig.	95% Confidence Interval for Difference	
Exposure	Mean						Lower Bound	Upper Bound
1	16.094	1	2	-6.094	0.470	0.000	-7.282	-4.905
			3	-13.000	0.512	0.000	-14.296	-11.704
2	22.188	2	1	6.094	0.470	0.000	4.905	7.282
			3	-6.906	0.309	0.000	-7.688	-6.124
3	29.094	3	1	13.000	0.512	0.000	11.704	14.296
			2	6.906	0.309	0.000	6.124	7.688

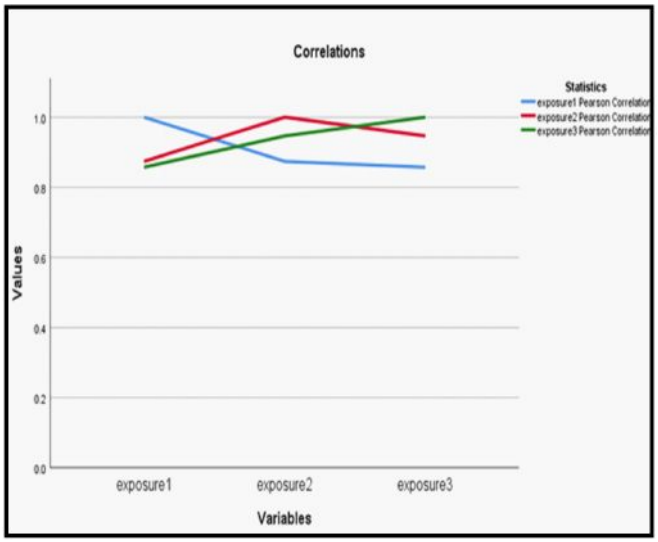

Fig 1: Correlation Among Exposures

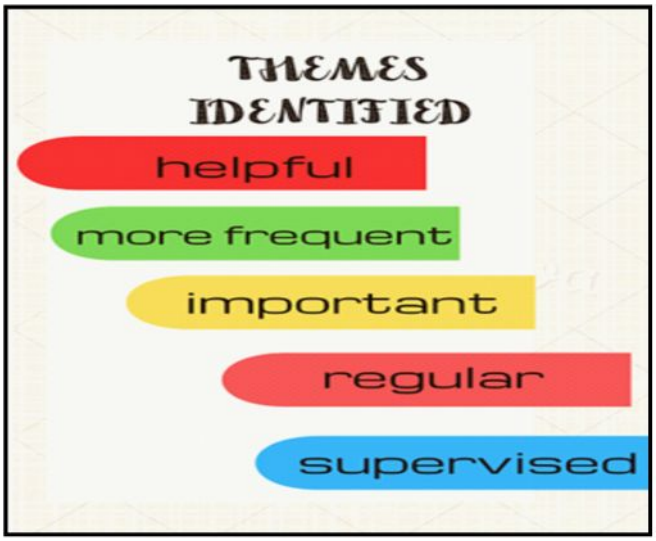

Fig 2: Themes Identified by Thematic Analysis

Table 3: Number of Complications after Each Exposure.

Intraoperative Complications	Number of Complications (%)		
	Exposure 1	Exposure 2	Exposure 3
Total intraoperative complications*	28 (87.5)	15 (46.9)	7 (21.9)
Button holing	16 (50)	2 (6.3)	0
Premature entry	16 (50)	8 (25)	3 (9.4)
Iris prolapse	3 (9.4)	2 (6.3)	0
Iris tear	2 (6.3)	0	0
Iridodialysis	5 (15.6)	2 (6.3)	0
Descemet Detachment	4 (12.5)	1 (3.1)	0
Posterior capsular Rent/Vitreous loss	18 (56.2)	8 (25)	7 (21.9)

28 eyes in Exposure 1, 12 eyes in Exposure 2 and 3 eyes in Exposure 3 had more than 1 complication.

Table 4: Qualitative Assessment of the Feedback given by the Residents on Likert Scale.

	Number of Residents (%)				
QUESTIONS	LIKERT SCALE				
	1	2	3	4	5
	Strongly disagree / Far below standard	Disagree / Below standard	Neutral / Meet standard	Agree / Above standard	Strongly agree / Far above standard
Does the Wet lab training seem to be relevant?	0 (0.00)	0 (0.00)	6 (18.7)	3 (9.4)	23 (71.9)
Is the conduct of the activity systematic, comfortable and well organized?	0 (0.00)	0 (0.00)	18 (56.3)	6 (18.7)	8 (25)
Quality of the working ambience	0 (0.00)	0 (0.00)	8 (25)	14 (43.7)	10 (31.3)
Importance of the Trainer/Evaluator	0 (0.00)	0 (0.00)	2 (6.3)	8 (25)	22 (68.7)
Comportment of the Trainer/Evaluator	0 (0.00)	0 (0.00)	2 (6.3)	9 (28.1)	21 (65.6)
Overall usefulness of the ongoing activity	0 (0.00)	0 (0.00)	0 (0.00)	10 (31.3)	22 (68.7)
There is Boost in the level of Confidence while executing the steps	0 (0.00)	0 (0.00)	0 (0.00)	8 (25)	24 (75)
Satisfaction after completion of the steps of SICS in the Wet lab.	0 (0.00)	0 (0.00)	0 (0.00)	10 (31.3)	22 (68.7)

Table 5: Qualitative Assessment of the Feedback given by the Residents on Feedback form.

	Number of Residents (%)		
QUESTIONS	**YES**	**NO**	**MAYBE/ NOT APPLICABLE**
There is Ease of performing different steps in wet lab training	30 (93.7)	2 (6.3)	0 (0.00)
There is Ease of performing subsequent steps in wet lab training	31 (96.9)	1 (3.1)	0 (0.00)
There is Expertise of performing different steps in wet lab training	26 (81.3)	0 (0.00)	6 (16.7)
There is Expertise of performing subsequent steps in wet lab training	27 (84.4)	0 (0.00)	5 (15.6)
Able to complete all the steps of SICS in the given stipulated time	16 (50)	12 (37.5)	4 (12.5)
Able to complete all the steps of SICS with less time taken than previous exposure	12 (37.5)	19 (59.4)	1 (3.1)

ease in performing different steps and 96.9% reported ease in performing subsequent steps in the wet lab training. "Suggestions, if any," as open ended questions were analyzed using thematic analysis and various themes like *helpful, more frequent, important, regular, and supervised* were identified (*Figure 2*).

Discussion

To foster the development of proficient ophthalmic surgeons, it is imperative to provide a stress-free environment during the initial years, allowing learners to progress at their own pace without any undue pressure. Given the meticulous precision and dexterity demanded by ophthalmic surgery, adequate training is crucial to perform procedures accurately. Surgical residents who lack adequate training are more prone to making errors during surgery, with longer surgical times and poorer visual outcomes. Moreover, operating on live patients creates a highly demanding and stressful environment which may impede their proficiency.

In our study, residents' performance significantly improved after each exposure to wet lab training sessions; the mean marks obtained after exposure 1 were 16.094 ± 5.449; after exposure 2 were 22.188 ± 4.948 and after exposure 3 were 29.094 ± 5.384, which was statistically significant ($p<0.001$). In our study, exposure 1 had a higher rate of complications (87.5%) compared to exposure 2 (46.9%) and exposure 3 (21.9%) and the difference was statistically significant ($p<0.001$). Rogers et al.[11] and Ramani et al.[12], also reported a significant decrease in complications and better visual outcomes among residents following structured wet lab training compared to those without prior exposure.

In our study, a majority of residents (71.9%) perceived wet lab training as "extremely relevant," while 68.7% "strongly agreed" and 31.3% "agreed" with the usefulness of the ongoing activity. Additionally, 75% of participants "strongly agreed" and 25% "agreed" that wet lab training bolstered their confidence. Furthermore, 68.7% "strongly suggested" and 25% "suggested" the importance of the trainer in facilitating the wet lab sessions. Similarly, in a study conducted by Almaliotis et al., a notable proportion of participants highlighted the significant impact of wet labs on their skill development, specifically, 44.6% expressed that the experience contributed "Very much," while 33.8% affirmed it as "Definitely" beneficial. Furthermore in their study, participants acknowledged the crucial role of wet labs in their career advancement, with 55.4% considering it a "Definite" first step and 35.1% regarding it as "Very significant." The study also revealed high satisfaction with trainers' support, with 82.4% rating it as "Very good." Notably, all participants (100%) emphasized the indispensability of wet labs during residency training.[6]

In the present study, 93.7% of the residents reported ease in performing different steps and 96.9% reported ease in performing subsequent steps in the wet lab training. Similar findings were also reported by Belyea *et al.* indicating fewer intraoperative complications and shortened learning curves among residents who were trained using surgical simulators.[13]. Similarly, virtual reality simulator training has also proven effective in improving microsurgical skills, as evidenced by studies conducted by Feudner *et al.*[7] and Feldman *et al.*[14]

The University of British Columbia conducted research

on the effectiveness of the Basic Surgical Techniques program, revealing that simulated training using animal models significantly enhances surgical skills.[15] Similarly, in a study conducted by Khanna *et al*., it was concluded that implementing a standardized training protocol leads to improved outcomes across various surgical procedures.[16] In our study also, wet lab training has shown its potential to offer improved surgical performance by residents, leading to lower complication rates and enhanced outcomes.

Limitations of the Study

Limitations encountered during the study included a limited number of exposures and the difficulty of procuring goats eyes for the wet lab. Limited transferability of skills is another limitation of performing wet lab training on goat's eyes, because it is unclear how well the skills acquired by training on goats eyes will translate to real world surgical settings. Also, wet lab training involves practicing only a small subset of steps involved in cataract surgery such as creating the corneal incision, making the tunnel and removing the lens. However, the skills required for managing complications that can arise during surgery such as posterior capsular rent, iris prolapse etc, can best be acquired through hands-on experience with real patients.

Conclusion

Feedback from residents underscored the relevance and utility of wet lab training, with the majority expressing increased confidence and ease in performing surgical procedures. Thus we can say, structured wet lab training offers invaluable hands-on experience that enhances residents' surgical skills and confidence, ultimately leading to reduced intraoperative complication rates and improved outcomes. Investing in such training programs is essential for ensuring the competency and proficiency of future ophthalmic surgeons.

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Conflicts of Interest

There are no conflicts of interest.

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