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Experimental Research

The contribution of wet labs in the education of ophthalmologists

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ABSTRACT

Background: The need for pre-training in experimental eye surgery is considered necessary. It is an essential way to assess trainees in ophthalmology based on their instrument and tissue handling and skills. This article aims to underline this necessity and demonstrate the ocular health professionals' opinion on this issue.

Methods: 74 participants (45 females and 29 males) were included in the study. Ophthalmology residents, ophthalmologists participated in the wet lab session. The evaluation of the contribution of the wet labs were provided by filling a new questionnaire form. In this way, an interactive questionnaire was developed.

Results: Regarding trainees' grading of wet labs' significance as a first step for guiding their surgical career, it was positively correlated with their subjective view of labs' utility to both improve their surgical skills ($p = 0.001$) and maintain pre-existing ones ($p < 0.001$). We should also note that all of them (100%) stated that wet labs were necessary during residency, especially in repeated sessions, and that they would recommend them to their colleagues.

Conclusion: The surgical skills improved significantly after participation in a wet lab, according to participants, who rated the experience as highly educational. Wet labs can reduce the learning curve of difficult surgical techniques, accelerate the rate for trainees to achieve surgical competency, and treat patients safely and effectively.

1. Introduction

Due to the specificity of the visual organ, it is not easy for the trainees to enter a normal operating room without pre-training. Traditional surgical training, as a sole method, is considered to be of increased risk for the patient. Thus, the need for training in experimental surgeries is considered a prerequisite. The training provided in Experimental Surgeries needs to be evaluated by experienced ophthalmologists to become more effective. There is also a need to create tools to assess the contribution of wet labs to the education of ophthalmologists.

Repeating specific surgical procedures can successfully permit a trainee to acquire and maintain a high level of skill [1]. Therefore, wet labs have been considered as a successful and fundamental strategy for trainees to achieve surgical proficiency [2,3]. Wet labs give the possibility for practicing novel surgical techniques and instruments. Skill transfer is also an essential component for trained surgeons to preserve, update, and acquire new skills. The role of program directors is crucial to the success of the wet lab training. Understanding the importance of training may help to overcome any difficulty.

Real-time surgical training is complicated by the fact that the teaching surgeon primarily acts as an observer rather than directly performing the procedure. As a consequence, wet labs are utilized to reduce the learning curve of beginners, which establishes tissue awareness, dexterity, and muscle memory. They may also become familiar with early signs of intraoperative complications and their management.

Furthermore, it becomes necessary to develop a complementary tool for the evaluation of the contribution of wet lab training. It was judged that a novel questionnaire is the most appropriate tool for conducting this research.

The preparation of the novel interactive questionnaire is considered crucial for the success of the study. The questionnaire contains a number of structured questions, which are presented in a specific order and to which the trainee is asked to answer and demonstrate the ocular health professionals' opinion regarding the contribution of experimental surgeries in the training of ocular surgery.

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Questionnaires as a means of evaluation have some advantages. For instance, they can be sent to a large number of recipients, at no cost. Moreover, the researcher cannot influence their answers, as there is no direct contact between them.

The study aims to underline the necessity of pre-training in experimental surgery.

This article presents the feedbacks from the questionnaire as an evaluation tool from ophthalmic wet lab courses.

2. Materials and methods

The study was conducted from January 2019 to August 2020 in the Laboratory of Experimental Ophthalmology in the School of Medicine of Aristotle University of Thessaloniki. 74 Participants were included (45 females and 29 males, Fig. 1). Ophthalmology residents, as well as ophthalmologists, participated in wet lab sessions from August 2015 to August 2020.

The wet lab stations were equipped with an operating microscope, television monitor, machines, set of instruments, porcine eyes, and a variety of specialized instruments used during the complex anterior segment and cataract surgery. The wet lab courses are topic-based and designed in a skill transfer format. Topics that were included in the courses were the following: 1) Corneal: Epithelial removal, suture of simple wounds, suture of complicated wounds 2) Cataract surgery: Intra, ECCE, Phaco 3) Glaucoma: Trabeculectomy, valves 4) Vitrectomy, 5) Intravitreal Injections. Trainees were exercised in all sessions. The following figure (Fig. 2) demonstrates the preferences of participants for the specific topics.

At the beginning of the course, the moderator gives a short didactic session as well as introduces their topic, and outlines specific objectives to be covered at each station. Trainees then rotated through the stations to receive instruction and time to practice on their own. The course coordinator ought to remind trainees and staff members when it is time to switch rotations. This will guarantee equal learning experiences in all issues for all learners and offer assistance to the course to stay on schedule.

The evaluation of the contribution of the wet lab was provided by filling a questionnaire form. Each category was evaluated by a score ranging from 1 to 5, with 1 being most helpful and 5 being least helpful. Trainees also had the opportunity to add specific comments. All participants gave their written informed consent to take part in this study.

2.1. The design process of the novel questionnaire

The compilation of the questionnaire identifies the purpose of the research, as it is based on the formulation of the questions.

The design of the questionnaire emphasized on the technical completeness of the questionnaire, as well as the clarity and therefore the need to cover all aspects of the research. Explanations were also given, for the points that can be misinterpreted.

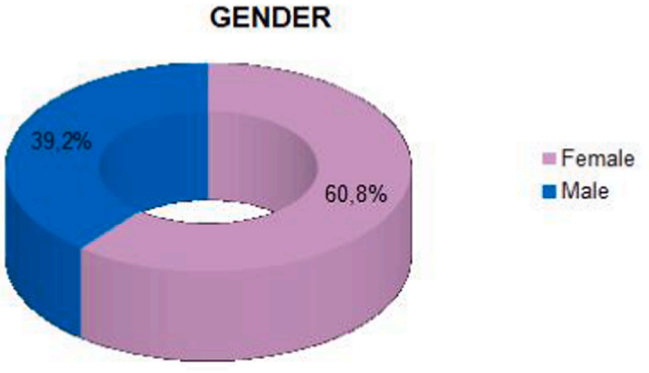

Fig. 1. Gender rates.

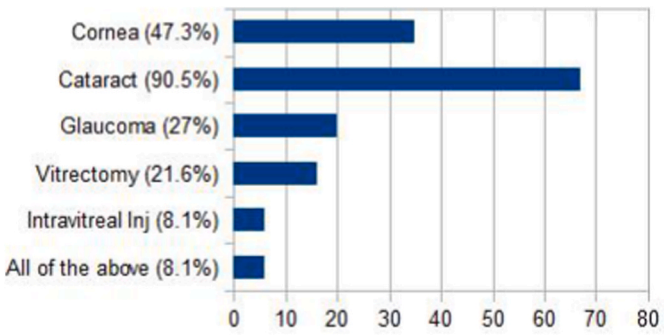

Fig. 2. Preferences on the specific topics.

Another important parameter is the coherence that refers to the need for connection of the individual questions and in addition, a point of critical importance is the appropriateness of the structure that helps to increase the response rate of trained ophthalmologists.

The appearance of the questionnaire from a technical point of view also significantly affects the degree of response, while the use of symbols, guide and facilitate the respondent.

To increase the degree of response and help the respondents, the questionnaire includes brief instructions on how to complete it.

The language of the questionnaire is English. The questionnaire includes a short introductory note, which explains the aims and objectives of the research.

The questions were divided **into 3 sections**. The order of the questions was arranged in the questionnaire as follows: In the **1st section**, the demographic data (gender, age) are mentioned. The **2nd section** includes more specialized questions. The general type questions precede the more specialized, which are the most appropriate to raise awareness and interest in the respondent. **In the 3rd section**, the questions focus on the main goal, ie the contribution of the experimental surgeries (Fig. 3).

It was also emphasized that the questions were concised so that they

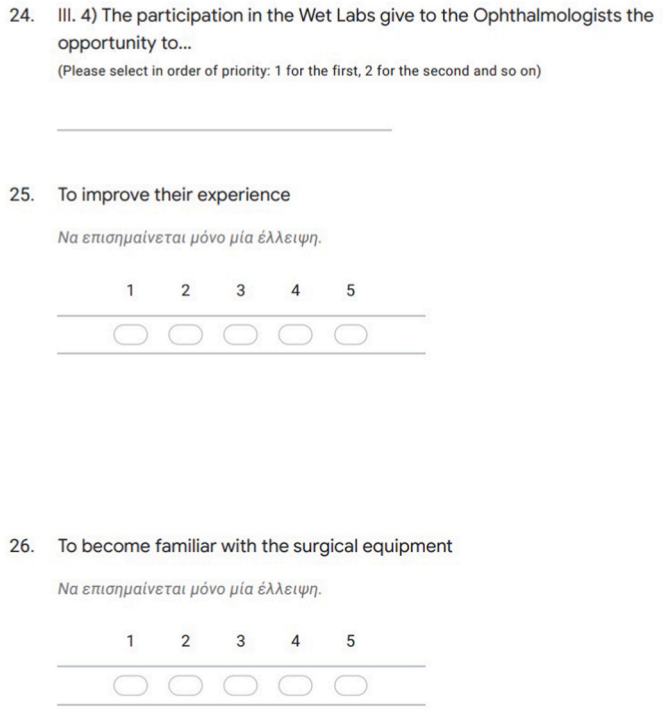

Fig. 3. Extract from 3rd section of the questionnaire.

can be easily completed and the meaningless questions were avoided. Finally, an effort was made to make the questionnaire as less burdensome and time-consuming as possible. The sample consists of ophthalmologists, resident ophthalmologists.

The pilot questionnaire was necessary and was aimed to determine the effectiveness of the "tool" that was designed. The questionnaire was submitted to a limited number of people not exceeding 20 participants. At this stage, the degree of understanding and interpretation of the questionnaire was measured. The pilot application of the questionnaire attempted to determine whether: the order of the questions and the way of formulating the questions allow the collection of the desired data and whether the scope of the questionnaire is appropriate or too extensive to cause the indifference or irritation of the respondents.

Following the corrections resulting from the pilot survey, the final questionnaire was completed through the "Google Docs" service. The application enables the creation of an electronic questionnaire, as well as the easy sending of electronic mail, which is addressed to respondents who are familiar with technologies. In addition, it provides the possibility of an immediate summary of the answers, as well as the extraction of the results in statistical data analysis. This electronic interactive is an important tool for the evaluation considering how much the wet labs contributed.

2.2. Statistical analysis

Statistical analysis was made using IBM SPSS Statistics Version 21. Qualitative variants, such as various evaluations, were compared with Mann-Whitney non-parametric test, whereas the Chi-square test of independence was used to examine the association between bicategorical variables, such as gender and origin. Comparisons between quantitative variants in the final part of the questionnaire were executed with the Wilcoxon test. Correlations were made with Spearman's non-parametric test. The level of statistical significance was set at $p < 0.05$. Bonferroni adjustment was applied for multiple comparisons among questions in the final part of the questionnaire.

3. Results

First of all, there was a positive correlation between academic title and age ($p = 0.04$), and, secondly, between the year of residency and surgical experience ($p = 0.02$), as well as participants' opinions about the range of difference between wet labs and real-time surgery ($p = 0.01$). However, there was a tendency, though not significant, for most male participants to come from Greece ($p = 0.053$). The origin of participants is demonstrated in Fig. 4.

Evaluation of trainers' supportive role was significantly positively correlated with trainees' assessment of wet labs' contribution to the improvement of their surgical skills (0.04), to the guidance of their future surgical career ($p = 0.005$), and as a means of maintaining their surgical skills ($p = 0.001$). It was also very significantly positively correlated to pig eye's evaluation as a good substitute for exercise ($p = 0.001$).

Personal evaluation of wet labs' role in maintaining surgical skills had also a very strong correlation with the evaluation of pig eye as a surrogate for practice ($p < 0.001$), as well as with the evaluation of wet labs' utility to both improve participants' skills ($p = 0.002$) and constitute the first step for their future career ($p < 0.001$). However, it was negatively correlated with pre-existing surgical experience ($p = 0.005$).

Regarding wet labs' significance evaluation as a first step for guiding trainees' surgical career, it was positively correlated with evaluation of their contribution to the improvement of their skills ($p = 0.001$).

Importantly, the majority of participants answered that the experience they acquired during wet labs contributed to the improvement of their skills "Very much" (44,6%) or "Definitely" (33,8%). Furthermore, they highly assessed the importance of wet labs both as the first step for their future career (55,4% answered "Definite" and 35,1% "Very significant") and as an aid to maintain their skills (60,8% "Very much" and 29,7% "Much"), (Fig. 5). They also highly graded trainers' support (82,4% "Very good") and judged pig eye as an effective model for practice (56,8% "Good" and 32,4% "Very good"). We should also note that all of them (100%) stated that wet labs were necessary during residency, especially in repeated sessions, and that they would recommend them to their colleagues.

In the final part of the questionnaire, trainees were asked to hierarchize from 1 to 5, with decreasing priority, their participation as an opportunity to **a)** improve their experience, **b)** become familiar with the surgical equipment, **c)** improve their technique, **d)** make their first surgical steps and **e)** acquire new skills. 56 of the participants answered this part of the questionnaire (Fig. 6).

Variant **a** tended to correlate negatively to pig eye's assessment as the surgical model ($p = 0.053$). **C** was positively correlated to academic status ($p = 0.04$), Comparing their mean values, **a** (3.35, SD = 1.44) and **e** (3.42, SD = 1.63) were higher (therefore of lower priority for participants) than **c** (2.50, SD = 1.30), though without significance. There was also a tendency for Greek trainees to evaluate higher (with a lower score on our questionnaire) wet labs as an opportunity to become familiar

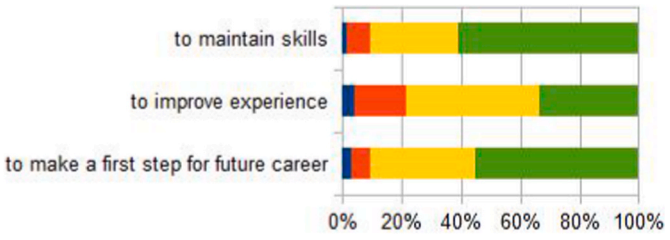

Fig. 5. Percent of trainees' responses to questions about rating the wet labs' contribution.

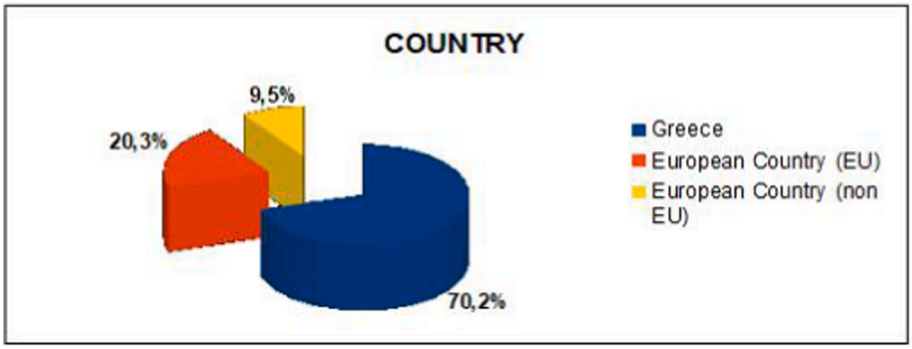

Fig. 4. Origin of participants *in wet labs*.

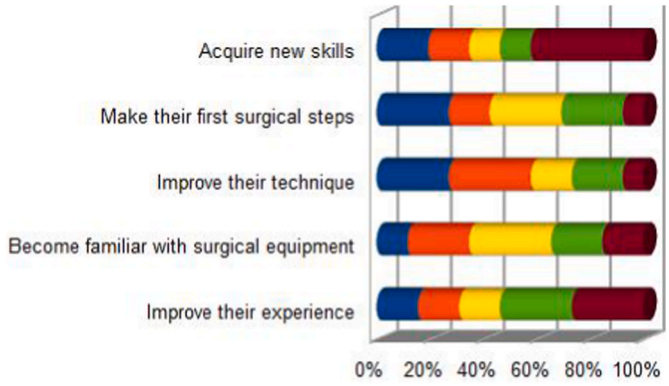

Fig. 6. Percent of trainees' ratings when asked to prioritize (from 1 -higher- to 5) the role of wet labs as an opportunity to improve their surgical status.

with surgical equipment (1.13 vs 1.32, $p = 0.053$), in comparison with their colleagues from other European countries.

4. Discussion

Ophthalmology is a surgical specialty with consistent technological advancements requiring perpetual continued surgical education. The utilization of wet labs and simulation for training in ophthalmology has had to rise to prove enhancement within the result of the trainees [4]. Before the implementation of mandatory training wet labs in the United Kingdom, just over 40% of the trainees with two or more years of training met the Royal College of Ophthalmologists prerequisite of 50 completed intraocular operations [5].

The University of British Columbia has researched the involvement with the Basic Surgical Techniques program and they found that experiencing simulated training in animal models leads to a noteworthy improvement of surgical skills [6]. The integration of the wet lab into the formal residency curriculum is a crucial step in creating a comprehensive educational experience [7,8]. *Several studies have confirmed that such programs lead to a significant reduction in the surgical complication rate* [9,10].

Our study demonstrates the very positive impact of wet labs to participants, who evaluated highly their contribution in matters of improving and maintaining surgical skills, as well as their role as the first step towards future, therefore totally agreeing that their inclusion in residency educational program is essential. The importance attributed to trainers' contribution and pig eye's utility was also remarkable.

However, there are some limitations to our study. First of all, our sample size is insufficient, thus, it would be useful to be applied to larger sample size. The sampling technique is subject to selection bias. Furthermore, there was no adjustment for confounders. The lack of questionnaires in the evaluation of wet labs' contribution is one of the major reasons that the questionnaire was not validated. Nevertheless, its prospective character strengthens our outcomes. Thus, this work could serve as a pilot study to assess the contribution of wet labs. In a future study, our primary objective might be to determine the validity and reliability of this tool.

It is common knowledge that, in our country, the surgical experience offered to residents is inadequate, in the majority of hospitals. Only recently there has been an effort from the authorities to organize and apply the use of logbooks where the surgical progress of trainees can be documented. However, the recent COVID-19 pandemic has remarkably inhibited surgical practice and training, not only in Ophthalmology. Procedures considered to be non-urgent, such as the majority of cataract surgeries, are subject to postponement or cancellation, to avoid possible transmission of the virus and conserve materials and resources [11].

Wet Labs provide a safe, risk-free, and less stressful environment, which offers to trainees the opportunity, inter alia, to gain self-confidence, to try various methods and techniques and select the most appropriate for their convenience, to improve psycho-motor skills, coordination between hands and eyes, as well as ambidextrously, to discuss their questions without time pressure, and learn from their mistakes, without any cost, even learn how to manage possible complications [12]. The high complication rate is attributed to the nature of the teaching hospital where most trainees were in their learning periods [13]. These complications may have an essentially functional and financial impact [14].

To conclude, we also aim to set a basis for future studies on the level of efficacy and quantify the learning curves in the wet lab.

Ethical approval

This research does not require ethical approval, because there are no patients involved.

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Author contribution

All authors contributed to study design and conception, data collection, and interpretation.

Dr Almaliotis wrote the first draft of the article. Mr Athanasopoulos contributed to data analysis. Prof Karampatakis and Ms Almpanidou and Papadopoulou reviewed, critiqued the first draft and contributed to the final version for publication.

Registration of research studies

•Name of the registry: -
•Unique Identifying number or registration ID: -
•Hyperlink to your specific registration (must be publicly accessible and will be checked): -

Due to the educational, rather than experimental, character of our research, it is not registered in any publicly accessible database.

Guarantor

Prof. Vasileios Karampatakis.

Consent

Informed consent was obtained from all participants included in this study.

Provenance and peer review

Not commissioned externally peer-reviewed.

Declaration of competing interest

The Author(s) declare(s) that there is no conflict of interest.

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