Introducing In Vivo Dissection Modules for Undergraduate Level Trainees: What Is the Actual Benefit and How Could We Make It More Efficient?

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Abstract Essential Skills in the Management of Surgical Cases (ESMSC) is an international wet lab simulation course aimed at undergraduate students. It combines basic science workshops, case-based lectures and ex vivo skills modules,

as well as in vivo dissections using a swine model. This study aims to evaluate the effectiveness of high-fidelity In Vivo Simulation-Based Learning for undergraduate level trainees. Also our goal was to compare the skill-based performance of

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final year students vs. more junior-level ones. Forty undergraduate delegates at clinical rotation level (male = 28, female = 12, mean age = 23.12, 22–24, SD = 0.69) attended this 2-day course in Athens. $N = 1$ (2.5 %) was year 3, $N = 4$ (10 %) were year 4, $N = 23$ (57.5 %) were year 5 and $N = 12$ (30 %) were year 6. $N = 30$ (75 %) came from Hellenic universities, $N = 8$ (20 %) from the UK and $N = 2$ (5 %) from Germany. $N = 20$ (50 %) attended the in vivo dissections module first, and then the ex vivo one (type A rotation), whereas $N = 20$ followed the reverse training sequence with the ex vivo dissection first, followed by the in vivo one (type B rotation). The mean global rating scores for type A rotation were better in both the in vivo by 0.10 (2.40 vs. 2.30) and ex vivo modules by 0.15 (2.85 vs. 2.70), though it did not reach statistical significance ($p > 0.05$). Furthermore, the mean improvement of performance, in the laparoscopic skills station for the type A rotation, was better compared to type B by 0.351 (2.00 vs. 1.65, $p = 0.003$). Year 6 students performed better in the laparoscopic station (2.00 vs. 1.75, $p = 0.059$), whereas years 3, 4 and 5 performed better in the in vivo (2.42 vs. 2.16, $p = 0.157$) as well as the ex vivo dissections (2.78 vs. 2.75, $p = 0.832$), though none of those comparisons reached statistical significance. Delegates seemed to appreciate and enjoy the in vivo dissections as reflected in the feedback (8.67/10, min = 6 and max = 10, SD = 1.79). Although medical students seem to appreciate in vivo dissections modules, currently, further evidence is needed to support their recommendation in the undergraduate level. Surgical skills should be part of the undergraduate curriculum to improve final year students' performance in the theatre.

Keywords Surgical education · Wet lab · Undergraduate · Surgical science · In vivo · Ex vivo · Simulation

Introduction

Surgical education has always been focused on the development of a safe and more efficient generation of future surgeons [1, 2]. There have been multiple challenges that the surgical curriculum has to deal with, in order to provide high-quality standards for training. Recent changes implemented by the European Working Time Directive (EWTD) could act as a limiting factor, which can potentially impact on the time available for exposure to training opportunities [3]. During the last two decades or so, introduction of novel technologies, i.e. laparoscopic or, more recently, robotic surgery, has significantly increased the need for a structured and

more efficient curriculum, in order to meet the requirements of a steep learning curve.

Simulation in surgical education has undoubtedly increased the quality of training, and nowadays, it has been an integral part of surgical curriculum throughout the surgical journey [2]. Wet lab courses are a classic example of simulation-based learning (SBL), which have gained wider acceptance especially in higher postgraduate training [4–6]. There have been multiple references in the literature, where various models are offering excellent learning opportunities, which reflect on good learning outcomes. Although wet lab modules are generally deemed as high-fidelity simulation models, the biggest challenge that researchers have to deal with is the significant cost [7], especially if this module involves in vivo experiments. While in vivo modules are generally justified in higher postgraduate training, as they can certainly have a positive influence on advanced skills, as well as increase the confidence and dexterity of senior trainees, there has been a question regarding their role in the level of undergraduate or junior surgical training [2, 4–6, 8].

Essential Skills in the Management of Surgical Cases (ESMSC) [9] is an international combined applied surgical science and wet lab course. It is addressed at the level of undergraduate, well-motivated medical students and aims to teach them the basic principles of how to approach a surgical case, as well as basic surgical skills. It also aims to act as a transition tool between a well-skilled medical student and an effective and efficient assistant in the theatre, who would feel ready to safely perform fundamental steps in simple procedures [5, 6]. Medical students around Europe have applied to attend this course and have done so in high numbers, and the overall feedback, during the last three courses, has been really encouraging [9].

Undoubtedly, there has been a question about using a high-fidelity, in vivo (swine) model, in order to teach undergraduate level trainees fundamental surgical skills [4, 7, 10–12]. Therefore, in this study, we mainly aimed to evaluate the role and impact of in vivo dissections on the delegates' ability to accumulate skill-based knowledge.

Aim

The aim of our study was to assess the benefit and the effectiveness of using a high-fidelity simulation model (in vivo swine dissections—IVSD) at the undergraduate level. Also, to see whether exposing students at similar ex vivo stations (ex vivo graft suturing—EVGS) prior to relevant in vivo modules (IVSD) would impact their actual performance in the latter. Another goal was to examine whether combination of open surgical skills'

stations (IVSD or EVGS) have any impact on the delegates' ability to accumulate skills, during the laparoscopic station (fundamental laparoscopic skills—FLS). Finally, we compared the performance between end year medical students vs. the rest, as well as between international and Greek students.

Materials and Methods

ESMSC consists of three main cores, which cover basic science (acid base balance, principles of shock, resuscitation of the surgical patient), applied surgical knowledge in a case-based learning manner and teach fundamental surgical skills using *ex vivo* and a high-fidelity *in vivo* swine model. *Ex vivo* modules include suturing, open reduction internal fixation (ORIF), tendon repair, wound debridement, primary repair of perforation and anastomosis using grafts (EVGS), as well as FLS. *In vivo* modules include basic dissections, i.e. bowel perforation and repair, primary anastomosis of bowel loops (IVSD), open and closure of the abdomen, demonstration of swine anatomy and insertion of a chest drain. A second animal is used for live heart transplant, in which students get a deeper understanding of cardiopulmonary physiology and get introduced to the principles of transplant surgery [9].

Forty medical students from European universities attended the course. $N = 28$ (70 %) were male, and $N = 12$ (30 %) were female. The mean age was 23.12 (min = 22, max = 24, SD = 0.69). All the students were at clinical rotation and $N = 1$ (2.5 %) was year 3, $N = 4$ (10 %) were year 4, $N = 23$ (57.5 %) were year 5 and $N = 12$ (30 %) were year 6. $N = 30$ (75 %) were students from Hellenic universities, $N = 8$ (20 %) from the UK and $N = 2$ (5 %) from Germany.

The selection process took place via an online portal (esmsc.gr), and delegates were invited to submit an application providing basic demographic information on university or year of studies, language (English) dexterity, prior exposure to similar courses and publications or presentations at conferences or other events. They also submitted a supporting statement of 150 words which summarizes their expectations from this course as well as their overall commitment towards a surgical career. Two independent senior assessors evaluated the 150 received applications and shortlisted 60 based on the criteria above. Following this, they selected 40 applications with no previous exposure to relevant courses; hence, we assumed that homogeneity was assured [9].

The delegates, subjects of the study, attended a 2-day intense course and were assessed throughout the modules by consultant or specialist registrar (StR) level trainers, as defined by the UK national training system.

Direct Observations of Procedural Skills (DOPS) forms [13], validated from the Intercollegiate Surgical Curriculum Program (ISCP) [14], were used to assess delegates throughout the modules (Appendix I). Instruments' use, tissue handling, time and speed as well as confidence and dexterity were assessed using a 3-level scale (N/0 for not performed or not observed, D/1 for development needed and S/3 for satisfactory completion). Global rating of each candidate was performed, using a 5-level scale (0–5), representing the overall impression of performance. Background knowledge of the delegates was assessed with an MCQ exam before and following completion of the course, which consisted of 25 single best answer (SBA) questions.

Assessors underwent a structured debrief on DOPS scoring, prior to the test, the two raters were given succinct, objective instructions on how to evaluate the students. This aimed to ensure equality of the assessments was maintained throughout the course and minimal bias was introduced from that point of view.

Skills modules core (SkCIII) consists of six stations; however, for the purposes of this study, we focused on the following stations: FLS, IVSD and basic surgical skills on *ex vivo* material, i.e. grafts (EVGS). During IVSD, delegates were asked to perform basic bowel handling, such as primary repair of bowel perforation, as well as primary anastomosis following bowel resection. In the EVGS, the participants were asked to perform a similar task in plastic grafts, representing the bowel lumen. The FLS station consisted of basic orientation of the delegates using a 0° camera, as well as moving cubes and placing elastic bands in columns. The final part was dissection of a pre-designed triangle in a mesh-like material, which was firmly attached on a wooden surface.

Delegates attended each station in groups of five people, and the rotation was split into types A and B. Type A were those delegates who attended first the IVSD and afterwards the EVGS, whereas type B were those delegates who attended the EVGS first and then the IVSD. The split between these two types of rotations was mainly based on the year of studies and in the same time, we managed to achieve similar percentage of international and Greek students in each group. This was to achieve equality between the two rotations and minimize bias.

In every group of five, each subject performed the module individually and was assessed in the end.

The FLS station took place for both groups upon completion of IVSD and EVGS. Each station lasted 35 min, and independent assessors were validating the DOPS forms. With regard to FLS station, DOPS forms were filled prior and upon completion of the module, whereas in IVSD and EVGS, DOPS forms were filled upon completion of each module separately.

Statistical Analysis

Statistical analysis was performed using IBM SPSS for Mac (Edition 22, NY: IBM Corp.). Independent and paired *t* tests were performed to reach conclusions. A *p* value of less than 0.05 was set as a limit for statistically significant results.

Results

With regard to IVSD, the mean score for instruments' use was 1.30/2 (min = 1, max = 2, SD = 0.46), for suturing skills was 1.32/2 (min = 1, max = 2, SD = 0.47), for tissue handling was 1.22/2 (min = 0, max = 2, SD = 0.48), for time keeping and speed was 1.25/2 (min = 1.00, max = 2.00, SD = 0.44) and for confidence during the dissection was 1.30/2 (min = 1.00, max = 2.00, SD = 0.46). The mean global rating was 2.35/4 (min = 2.00, max = 4.00, SD = 0.53) (Table 1).

Moving onto EVGS, the mean score for instruments' use was 1.62/2 (min = 1, max = 2, SD = 0.49), for suturing skills was 1.65/2 (min = 1, max = 2, SD = 0.48), for tissue handling was 1.60/2 (min = 1, max = 2, SD = 0.49), for

time keeping and speed was 1.45/2 (min = 1.00, max = 2.00, SD = 0.50) and for overall confidence and dexterity during the module was 1.65/2 (min = 1.00, max = 2.00, SD = 0.48). The mean global rating was 2.77/4 (min = 2.00, max = 4.00, SD = 0.48) (Table 1).

With regard to FLS station, the mean difference in the global rating upon completion minus the rating prior to any instruction (dGR) was 1.82 (min = 1 and max = 2, SD = 0.38). The mean score for instruments' use, before any instruction, was 0.13/2 (min = 0, max = 1, SD = 0.34), and upon completion, 1.47 (min = 1.00, max = 2, SD = 0.51). Prior to any instruction, tissue handling was 0.075/2 (min = 0, max = 1, SD = 0.26), and upon completion 1.22 (mean = 1.00, max = 2.00, SD = 0.42). Concerning time keeping and speed, the mean score prior to any instruction was 0.12/2 (min = 0.00, max = 1.00, SD = 0.33), and upon completion 1.35 (min = 1.00, max = 2.00, SD = 0.48). For overall confidence and dexterity during the module, the mean score prior to any teaching was 0.30/2 (min = 0.00, max = 1.00, SD = 0.30), and upon completion 1.45 (min = 1.00, max = 2.00, SD = 0.51). The mean global rating, prior to any teaching, was 0.57/4 (min = 0.00, max = 2.00, SD = 0.88), and upon completion 2.17 (min = 2.00, max = 3.00, SD = 0.38). The mean

Table 1 Mean scores for EVGS, FLS and IVDS

Modules	N	Min.	Max.	Mean	SD
Instrument handling FLS pre	40	0.00	1.00	0.1250	0.33493
Instrument handling FLS post	40	1.00	2.00	1.4750	0.50574
Tissue handling FLS pre	40	0.00	1.00	0.0750	0.26675
Tissue handling FLS post	40	1.00	2.00	1.2250	0.42290
Time + speed FLS pre	40	0.00	1.00	0.1250	0.33493
Time + speed FLS post	40	1.00	2.00	1.3500	0.48305
Confidence + dexterity FLS pre	40	0.00	1.00	0.1000	0.30382
Confidence and dexterity FLS post	40	1.00	2.00	1.4500	0.50383
Global rating FLS pre	40	0.00	2.00	0.3500	0.57957
Global rating FLS post	40	2.00	3.00	2.1750	0.38481
Difference global rating FLS (post-pre)	40	1.00	2.00	1.8250	0.38481
Instrument handling EVGS	40	1.00	2.00	1.6250	0.49029
Suturing EVGS	40	1.00	2.00	1.6500	0.48305
Tissue handling EVGS	40	1.00	2.00	1.6000	0.49614
Time + speed at EVGS	40	1.00	2.00	1.4500	0.50383
Confidence + dexterity EVGS	40	1.00	2.00	1.6500	0.48305
Global summary EVGS	40	2.00	4.00	2.7750	0.47972
Instruments use IVSD	40	1.00	2.00	1.3000	0.46410
Suturing IVDS	40	1.00	2.00	1.3250	0.47434
Tissue handling IVSD	40	0.00	2.00	1.2250	0.47972
Time and speed IVSD	40	1.00	2.00	1.2500	0.43853
Confidence and dexterity IVSD	40	1.00	2.00	1.3000	0.46410
Global rating IVSD	40	2.00	4.00	2.3500	0.53349

IVSD in vivo swine dissections, EVGS ex vivo graft suturing, FLS fundamental laparoscopic skills

Table 2 FLS paired differences (prior and post completion of the module)

		Mean	SD	SE	95 % confidence interval of the difference		<i>p</i> value
					Lower	Upper	
Pair 1	FLS global rating (post vs. pre)	1.82500	0.38481	0.06084	1.70193	1.94807	0.000
Pair 2	FLS instruments' handling (post vs. pre)	1.35000	0.48305	0.07638	1.19551	1.50449	0.000
Pair 3	FLS tissue handling (post vs. pre)	1.15000	0.48305	0.07638	0.99551	1.30449	0.000
Pair 4	FLS time + speed (post vs. pre)	1.22500	0.47972	0.07585	1.07158	1.37842	0.000
Pair 5	FLS dexterity and confidence (post vs. pre)	1.35000	0.48305	0.07638	1.19551	1.50449	0.000

IVSD in vivo swine dissections, *EVGS* ex vivo graft suturing, *FLS* fundamental laparoscopic skills

improvement for instrument use was 1.35 (SD = 0.48, $p < 0.005$), for tissue handling 1.15 (SD = 0.48, $p < 0.005$), for time and speed 1.22 (SD = 0.48, $p < 0.005$) and for overall confidence and dexterity during the module was 1.35 (SD = 0.48, $p < 0.005$) (Table 2).

The mean global rating scores for type A rotation were better in both IVDS by 0.10 (2.40 vs. 2.30, $p = 0.561$) and EVGS by 0.15 (2.85 vs. 2.70, $p = 0.329$), though it did not reach statistical significance. What is more, the mean score (dGR) for type A was also better compared to the type B rotation by 0.351 (2.00 vs. 1.65, $p = 0.003$) (Table 3).

Comparing the performance of year 6 vs. year 3, 4 or 5 undergraduate students, there was no statistical significant difference ($p > 0.005$ for all associations) (Table 4).

Discussion

Surgical skills' teaching is evolving from the traditional paradigm "see one, do one, teach one" towards a more structured curriculum, with well-defined aims and targets. Concerns about patient safety, as well as

limitations enforced by the working time directives (EWTD), emphasize the need for earlier involvement in skill-based teaching [3]. As a result, undergraduate medical education is shifting from the traditional "apprenticeship-based" model to a "competency-based" assessment model [15]. Several medical schools in the USA have incorporated simulation-based learning in their curriculum, aiming to prepare their students for a smooth transition into surgical training, within a "protected" and stress-free environment [16].

Various methods of simulation-based learning have emerged. "Dry lab" models provide a low-cost, low-fidelity model, which is shown to positively improve technical skills that are applicable in the operating room [17]. "Wet lab" model-based learning, despite being demanding in terms of cost and equipment required, generally consists of a more realistic and high-fidelity method for simulation-based learning (SBL), which potentially promotes active and reflective learning. In vivo models are more expensive but have been proven to be more captivating for the trainees, providing an optimal learning environment [18]. On the other hand, ex vivo models are more widely available, have lower operating

Table 3 Comparison of mean scores (EVGS, IVDS, dFLS) for type A vs. type B rotation

		Levene's test for equality of variances		<i>t</i> test for equality of means				
		<i>F</i>	Sig.	<i>p</i> value	Mean difference	SE difference	95 % confidence interval of the difference	
							Lower	Upper
EVGS global summary	Equal variances assumed	7.927	0.008	0.329	−0.15000	0.15174	−0.45719	0.15719
	Equal variances not assumed			0.330	−0.15000	0.15174	−0.45896	0.15896
IVDS global summary	Equal variances assumed	1.841	0.183	0.560	−0.10000	0.17014	−0.44443	0.24443
	Equal variances not assumed			0.560	−0.10000	0.17014	−0.44506	0.24506
Difference FLS (post–pre)	Equal variances assumed	192.111	0.000	0.003	−0.35000	0.10942	−0.57152	−0.12848
	Equal variances not assumed			0.005	−0.35000	0.10942	−0.57903	−0.12097

IVSD in vivo swine dissections, *EVGS* ex vivo graft suturing, *FLS* fundamental laparoscopic skills

Table 4 Comparison between final year vs. junior students

		Levene's test for equality of variances		t test for equality of means				
		<i>F</i>	Sig.	<i>p</i> value	Mean difference	Std. error difference	95 % confidence interval of the difference	
							Lower	Upper
EVGS global summary	Equal variances assumed	3.050	0.089	0.832	0.03571	0.16758	−0.30354	0.37497
	Equal variances not assumed			0.858	0.03571	0.19604	−0.38111	0.45254
IVDS global summary	Equal variances assumed	9.327	0.004	0.157	0.26190	0.18157	−0.10567	0.62948
	Equal variances not assumed			0.104	0.26190	0.15602	−0.05661	0.58042
dFLS global summary	Equal variances assumed	34.200	0.000	0.059	−0.25000	0.12825	−0.50962	0.00962
	Equal variances not assumed			0.006	−0.25000	0.08333	−0.42099	−0.07901

IVSD in vivo swine dissections, EVGS ex vivo graft suturing, FLS fundamental laparoscopic skills

demands but lack high fidelity [19]. Lately, virtual reality simulators have been used to train novel surgeons, improving effectiveness in completing surgical tasks but lacking the authentic stimulus of the wet lab models [20]. For instance, haptic feedback could only be reproduced sufficiently by high-fidelity in vivo simulation modules.

Cadaveric-based skills' learning course, such as microsurgical skills courses [21] or other various basic surgical trainee (BST) courses [22], has been implemented as mandatory requirement during postgraduate surgical training. However, similar workshops are generally offered unofficially during undergraduate training, by motivated societies, aiming at promoting early exposure to skill-based learning, as well as fostering critical thinking and improving their knowledge retention [23, 24]. We have developed an animal model-based simulation course which combines both in vivo and ex vivo stations, specifically targeted at the early exposure of undergraduates to basic and more advanced surgical skills [9]. Our views are based on the fact that students will benefit from a high-fidelity model, as they get familiar with real tissue handling, and have a unique opportunity to be the surgeon, having a senior assistant, who will provide guidance regarding the principles of operating. The main advantage of the ESMSC [9] course is that it recruits students from various universities around Europe, with different perceptions of surgical education.

Didactic learning through teaching and formal feedback, as defined by Miller's pyramid [25], is deemed crucial for improving surgical skill-based competencies. This was reflected during the FLS module, where instrument use ($SD = 0.48$, $p < 0.005$), tissue handling ($SD = 0.48$, $p < 0.005$), dexterity

($SD = 0.48$, $p < 0.005$) and speed ($SD = 0.48$, $p < 0.005$) were all improved following teaching.

One of the interesting points of this study is whether in vivo simulation-based learning offers a step ahead in the undergraduate surgical education. We tried to compare the performance of students who underwent first the in vivo and then the ex vivo simulation module (type A rotation) vs. those who did it in the opposite way (type B rotation). Although the improvement in the students' skills seems to be better in type A rotation, this could not reach statistical significance. A better performance could be either explained by the fact that in vivo simulation-based environment could stimulate, inspire and motivate students more than a lower fidelity setting (ex vivo) and therefore increase their concentration and enthusiasm for further learning in the remaining modules. Nevertheless due to the limited number of delegates in this study, we should interpret these findings as questions for further research. In vivo high-fidelity simulation could be justified for higher postgraduate training. However, in the case of the undergraduate level, our study showed that it could be potentially beneficial, although the limited evidence on that makes it still equivocal.

Interestingly, when looking at the mean improvement score (dFLS) in the FLS station, type A rotation students who performed IVDS first have better scores ($p = 0.003$). This could be explained with the fact that a high-fidelity model promotes better understanding of abdominal anatomy as well as promotes a better perception of the abdominal cavity space itself. Despite the fact that IVDS is mainly an open surgery module, the traditional transition from the classic open surgery techniques to laparoscopic skill-based learning is deemed always easier and faster, if

delegates are exposed to high-quality simulation environment for open surgery. This could obviously be further improved, if undergraduates are exposed to an in vivo laparoscopic setting as well.

Another interesting finding was that medical students, irrespective of their year of training (years 3, 4, 5 vs. year 6), were found to have a similar performance in the vast majority of the modules. This finding suggests that all students found the tasks equally challenging and of similar difficulty. This is an important point, as it indicates that experience gained through undergraduate surgical rotations is probably inadequate.

Medical schools seem to struggle to support upcoming surgeons with the basic skills required to safely perform a simple procedure, or effectively assist in the operating theatre [24]. This further highlights the potential need for the undergraduate medical curriculum to be revisited and incorporate more surgical simulation-based learning as a mandatory requirement [26]. This would ensure that the future generation of surgical trainees would be safer and more prepared to effectively participate and actively learn in a safe environment.

Nevertheless, we recognize some limitations of this study, and these lie into the fact that significant cost of these modules allows only limited number of delegates to attend the course. ESMSC is a novel expensive course, which requires a relatively high number of trainers to achieve its primary goal. The number of delegates that are able to attend the course is directly linked to the capacity of lab where it runs. Although 40 delegates are a limited number, through careful selection of them, we aim to achieve a homogenous sample, which can be a representative. What is more, international students consist of 25 % of delegates, though it is still a significant number to reach conclusions across different EU countries.

Finally, despite the variation noted, medical curriculums across Europe share the same core of basic sciences modules, followed by clinical rotations in hospitals. The similar performance of students (international vs. Hellenic students 1.86 vs. 1.60, $p = 0.241$) reflects those similarities in terms of skills taught during the undergraduate training.

Conclusions

A culture that fosters interest in surgical training needs to be endorsed early during undergraduate medical training. Animal model-based simulation learning could be a valuable tool to enhance students' motivation and passion for learning throughout the surgical career journey. There is no question

that in vivo high-fidelity simulation can teach effectively all the basic surgical skills, although its high cost and difficult application still make it equivocal for the undergraduate level. Further initiatives should focus on inspiring and motivating students at the earliest stage towards the improvement of their surgical skills.

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Compliance with Ethical Standards

Ethics This study was performed according to the European and National Legislation, Directive 63/2010, PD 56/April 2013 [reference number of the license: Michail Ch. Sideris and Apostolos Papalois 7095/05-11-2014 (revised 884 28/4/2015)].

Authors' Contribution Main contribution—all the authors have approved the current submission.

Michail Ch. Sideris and Apostolos E. Papalois: equal contribution, lead of the project, and designers of the course curriculum, main editors of the manual. MS and AP drafted and edited the manuscript (discussion drafted by KT and edited by MS and AP), and statistical analysis by MS.

Georgios Tsoulfas: faculty of the course, lead for the in vivo dissections (anatomy demonstration of the abdomen), conception and senior author of the study

Korina Theodoraki: faculty member, literature search and editing of the discussion part of the manuscript

Efstratios Koletsis: faculty of the course, lead for ex vivo dissections—ex vivo graft suturing

Panagiotis Dedeilias: faculty of the course, lead for heart and transplant in vivo module

Nikolaos Lymperopoulos and Konstantinos Imprialos: members of the faculty

Savvas Papagrigoriadis: senior advisor of the course curriculum and manual

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Georgios Zografos: senior advisor of the course curriculum and manual, lead of the scientific committee of the course

All the qualified authors have contributed to data collection as well as assessors (workplace-based assessments of the medical students).

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Conflict of Interest The authors declare that they have no competing interests.

Appendix I: Direct Observation of Procedural Skills (DOPS)

Candidate Code:									
Year of studies:									
Medical School:									
FLS ☐ In Vivo ☐ Post FLS ☐ Post In Vivo ☐									
Name of procedure:									
Difficulty of procedure: Easier than usual Average difficulty More difficult than usual									
Module Code: SkC1 Module name: Dissections									
Performed in a simulated setting ☐					Number of times procedure previously performed/taught:				
Rate the domains using the following scale: N = Not observed or not appropriate, D = Development required, S = Satisfactory standard for completion of CCST (no prompting or intervention required)									
Domain								Rating N/D/S	Comments
1. Instrument use									
2. Suturing Skill									
3. Tissue handling / respect the tissue									
4. Time/speed									
5. Confidence and dexterity									
GLOBAL SUMMARY After summarising the discussion with the trainee in the box above, please complete the level at which the procedure was performed on this occasion									Tick
Level 0	Insufficient evidence observed to support a summary judgement								
Level 1	Unable to perform the procedure under supervision								
Level 2	Able to perform the procedure under supervision								
Level 3	Able to perform the procedure with minimum supervision (needed occasional help)								
Level 4	Competent to perform the procedure unsupervised (and could deal with any complications that arose)								
Time taken for observation (mins):					Time taken for feedback (mins):				
Date:		Trainee's signature:			Assessor's signature:				
Not at all 3 4 5 6 7 8 9 10 Highly Trainee satisfaction with CbD 1 2									
Assessor satisfaction with CbD 1 2 3 4 5 6 7 8 9 10									

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Manual of the Course

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Place of the Study

Experimental Research Centre ELPEN
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