Modular e-learning for a practical skill in vascular surgery

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Abstract:

Introduction: Working Time Regulations in Europe allied with the endovascular revolution require vascular surgeons to be innovative in achieving competence during their training period. We evaluated the feasibility of eLearning to teach the use of OsiriX for sizing and planning endovascular aortic aneurysm repairs.

Materials and Methods: Eight blended learning modules were constructed, consisting of instructional PDFs, demonstration videos, CT angiogram downloads for individual practice and online support forums. These were delivered online over a nine-week period. The learning material encompassed an introduction to the OsiriX interface, the basic skills to use OsiriX for sizing and planning of aneurysm repairs and advanced techniques for reconstruction and online communication relating to imaging.

Results: The course was successfully delivered and produced positive feedback from registered users. A high rate of dropouts occurred during the early phase. The design and implementation of a fully web-based course by full time clinicians utilising multimedia and user forums to teach vascular surgeons the performance of a practical skill is feasible.

Conclusions: A modular instructional course offered online by vascular surgeons is feasible in teaching clinicians the use of OsiriX for 3D reconstructions of CT angiograms of aortic aneurysms. Shortening course duration may improve compliance. The instructional model is effective and well received by compliant learners.

Keywords: online training, education, e-learning, distance learning, vascular surgery

INTRODUCTION

Since 2009, the European Working Time Directive (EWTD) limits doctors working within the European Union to a 48-hour working week[1]. The implementation of this regulation has coincided with both the endovascular revolution and an exponential increase in the skills and knowledge that vascular surgical trainees must acquire during their training period. Ingenuity and the application of new methods of learning are necessary to achieve competence and maintain clinical standards.

e-learning (eL) is being increasingly applied for educational purposes in medical and surgical specialties[2,3]. The formal definition of eL is very broad; its most familiar representation is in the form of delivery of educational content using the electronic medium of the Internet[4]. eL eliminates the need for travel and all related expenses; provides the user with more time and flexibility for the planning of individual learning[5]; minimizes the running costs of the instructional course[6,7]; facilitates the receipt and recording of feedback and suggestions[8] and enhances the ergonomy of repeating the teaching course. Appropriate instructional design is an essential requirement to successfully deliver these significant benefits to the user. In the case of practical skills relating to a surgical specialty, such design and delivery require significant input from practising clinicians.

The eL team of the European Society for Vascular Surgery (ESVS) researched the feasibility of eL provided by clinicians to target a specific learning need inherent to the endovascular revolution. Our study describes the development and implementation of a fully online instructional model to teach vascular surgeons how to interpret and utilise cross-sectional imaging to size and plan aortic aneurysm repair using the OsiriX 3D reconstruction platform.

OsiriX (Pixmeo SARL, Switzerland) is a Picture Archiving and Communications System (PACS) and 3D reconstruction platform that processes Digital Imaging and Communications in Medicine (DICOM) data produced by imaging equipment. It

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enables instantaneous conversion of 2-dimensionally stored axial imaging into 3-dimensional representations that facilitate planning and implementation of surgical interventions. OsiriX is available online for download and allows surgeons to readily and independently plan and size endovascular aneurysm repairs from their personal Apple Mac desktop or laptop computers running MacOS X.[9]

There is not an official electronic instructional manual for OsiriX, although some free training materials are available online through the official website.[10] A free Portable Document Format (PDF) electronic textbook has been published in 2008.[11] The "OsiriX: The pocket guide (2nd edition)" published in 2009 by the developers of the OsiriX software is in classic textbook format with no interactive elements.[12] There are two wiki sites for online OsiriX support and documentation, but one has not been updated for a long period of time.[13] A textbook on an older version of OsiriX has been published in 2011 by Maki Sugimoto; it is in Japanese and therefore inaccessible to international readers[14]; the same applies to a similar publication in Italian. One of the primary authors of our eL course has been tutoring OsiriX courses in the past at the national level and has published a descriptive paper on his experience[15].

MATERIALS AND METHODS

Initially, a task-related eL course on the use of OsiriX was authorized by the Education & Training Committee of the European Society for Vascular Surgery (ESVS). At a later moment, the eL was designed and finally consisted of eight modules prepared by the eL team of the ESVS. The eL course was implemented over two nine-week periods over a couple of years. The ESVS eL OsiriX team consisted of two primary authors, five assisting tutors, three ESVS e-Learning researchers and two medical educationalists. All members of the team were employed primarily either as vascular surgeons or as vascular surgery trainees.

A total of 288 hours was invested in writing the PDF textbook (which was later divided into eight modules) and 13 hours in creating and editing the eight video presentations. The group of seven tutors spent a total of 73.8 hours in 1288 online sessions, lasting a mean of 3 minutes 26 seconds per online session. This time was allocated to editing uploaded course material, responding to forum questions, updating content, evaluating students' performance and providing feedback. These estimates do not include the time spent in data upload, particularly for the larger sized files, as that was an automated process not requiring the presence of a dedicated operator. The time durations involved in PDF and video construction are approximations by the authors and not a logged record of working hours. All other times relating to course delivery and online interactions have been calculated based on computer generated server logs.

The project was titled "Planning And Sizing With Osirix For Vascular Surgery" and was primarily aimed at vascular surgeons and trainees. The course was devised utilising readily available software programmes, with an emphasis on intuitive instructional design. The planning, delivery and evaluation of this course have been guided by two vascular surgeons; a Professor and a PhD researcher in medical education. The course fee was €120 per participant, payment of which generated individual login details to access the online resources.

Each module consisted of three components; a Portable Document Format (PDF) text covering conceptual theory; explanatory videos created with Screenflow™ (Telestream, USA), introducing main concepts and demonstrating all practical steps involved in the module; and appropriate DICOM CT angiography files to download and practice upon while using OsiriX. Discussions and comments on each module were supported on an online forum. Six expert instructors took turns to monitor online traffic and manage the helpdesk inbox. Each week's curriculum concluded with a mandatory online self-assessment multiple choice question quiz and an optional, anonymised feedback page hosted at SurveyMonkey (surveymonkey.com; USA).

The topics incorporated into the eight modules ranged from basic technical issues (installing OsiriX, importing DICOM files, organising an image library, etc.) to advanced Abdominal Aortic Aneurysm (AAA) measurement and 3D reconstruction techniques. The course design was intended to help users gain familiarity with the OsiriX interface, understand the use of routine OsiriX commands, record exact AAA measurements in orthogonal planes, create volume and surface rendering and produce, present and interrogate orthogonal, multiplanar and curvilinear reconstructions. An online assessment at the conclusion of the course tested participants' ability to size and plan repair of an authentic AAA case. Successful candidates would receive a certification of completion with the seal of approval of the ESVS.

RESULTS

117 individuals registered for the course. 52 (44.4%) participated in all eight modules, completed the final assessment quiz and provided feedback using the online survey form.

A mean of 6 participants (range 2-10) per module utilised the online forum provided and posted a mean of 4.5 (range 1-9) questions in individual forum threads. The discussion forums were utilised by participants for clarifications relating to course requirements (e.g. deadlines for submitting an assessment quiz) or additional OsiriX features not included in the course syllabus (e.g. importing/exporting password protected DICOM series).

The participant feedback obtained at weekly intervals for each module was consistently positive with modules scoring higher than 4/5 (1 - detrimental, 5 - excellent) in all fields apart from one; details are provided in the next section. The final assessment quiz was successfully completed by 98% of participants who attended the entire course, with a mean grade of 7.98/10. Twelve out of these 52 learners scored the highest possible mark; 10/10. There was a high rate of withdrawals (55%) from the course; this is analysed in further detail below. (Fig.1)
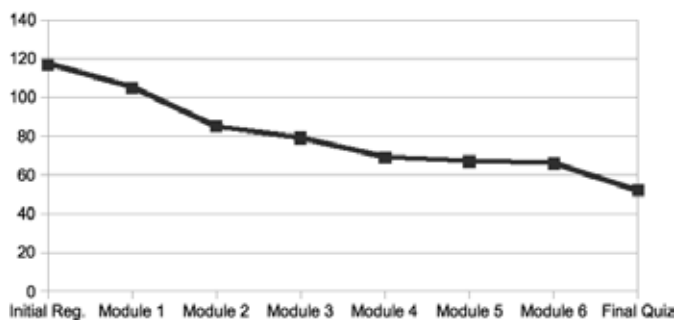
Figure 1.

PARTICIPANT FEEDBACK

Anonymised voluntary feedback was obtained during all modules. Direct feedback was obtained from the participants through an online questionnaire comprising structured responses and free text replies to questions. Feedback was also obtained from the online forum set up for each module, although its main role was to complement tutor-student communication.

We standardised responses to enable comparative scoring between modules on a modified Likert scale. Scores of 4, 3, 2, 1, and 0 were allocated for *excellent, good, satisfactory, unsatisfactory* and *detrimental* effects for each item respectively. The aggregate score attained by all respondents for each scoring item in a module was divided by the maximum achievable score for that item; this value was then expressed as a fraction of 5. Text analysis was performed upon free form responses and summarised as outcome points. The standardised scores allocated for each evaluated outcome measure are indicated in Table 1.

Evaluated outcome		Standardized score (out of 5.0)
Ease of access	PDF Textbooks	4.4
	Videos	3.9
	CT DICOM Files	4
Language & Content Difficulty	PDF Textbooks	4.1
	Audio content	3.5
Learning Value	PDF Textbooks	4.1
	Videos	3.8
	Module score	3.8
	Overall	3.9

Table 1. Standardised scores allocated for each evaluated outcome measure

Accessibility

All users reported ease of accessing the modules and interacting with adaptive elements, with mean scores of 9.5/10 and 9/10 respectively. The ease of accessing the three different kinds of resources (PDF textbooks, videos and CTA DICOM files) was reported to be high (4.4/5, 3.9/5, 4/5 respectively) with a mean effect of 4.1/5.

Language and Content difficulty

None of the online instructors was a native English speaker;

this aspect was commented negatively upon in the feedback of five of the participants. Out of the 117 participants, 27 (23%) were either native English speakers or living in an English-speaking country (mainly UK); the majority of the remainder were from Southern Europe. The clarity and language of the PDF textbook scored 4.1/5 and audio quality of the educational videos scored 3.5/5.

Learning value

Participants rated the overall learning value at 3.9/5, giving scores of 4.1/5 to the PDF textbooks, 3.8/5 to the videos and 3.8/5 to the individual modules.

Analysis of withdrawals

52 (44.4%) of the 117 registered participants completed all eight weeks of training and the final assessment quiz. The highest and lowest dropouts occurred between initial registration and first module (12 participants; 10.2%) and between modules 5 and 6, where only 1 participant dropped out (1.49%), respectively (Fig.1.). Following feedback analysis, participants who did not complete the course were contacted via email and asked three questions regarding the reasons for withdrawal; the questionnaire returned a 26% (17/65) response rate. The primary reason identified for withdrawal was that users lacked in personal time for the lessons and / or assessment (>60%). None of the respondents indicated an inappropriate level of difficulty of content or language as a cause for withdrawal. The strongest variable identified by respondents, which might improve compliance with course completion, was truncation of the course to a 4-week syllabus. Details of dropout analysis are summarised in Tables 2 and 3.

Answer	Participants	%
I did not have enough time for the lessons	11	64.7
I did not have enough time for the assessment questions	9	52.9
Problems with my internet access	3	17.7
The content was not useful to me	1	5.9
Problems with the online format in the course	1	5.9
Problems with the English language in the course	0	0
The content was too difficult for me	0	0
I left the course when I had learned enough	0	0
I lost interest so I left	0	0
Other (participant has provided a detailed explanation)	8	52%

Table 2. Answers to "What was the main reason that you did not continue / complete the 2011-12 online OsiriX course from ESVS eL?"

Answer	Participants	%
Shorter course over 4 weeks rather than 8	10	71.4
Restrict course to OsiriX advanced techniques, avoid basic skills	2	14.3
Restrict course to OsiriX basic skills, avoid advanced techniques	1	7.1
Pairing up with another online participant during the course	1	7.1
More one-on-one instruction from online tutors	0	0

Table 3. Answers to "Which of the following would make you more likely to complete an online OsiriX course in 2013?"

DISCUSSION

The ESVS eL OsiriX team successfully devised and implemented a fully online instructional method for 3D sizing and planning of aneurysm repairs, to achieve learning goals for a technical skill in the setting of restricted EWTD for vascular surgeons and vascular surgery surgical trainees. The OsiriX online course was designed and delivered by full time clinicians with a declared interest in medical education. No significant technical problems were encountered during the nine-week courses.

The comprehensive inclusion of OsiriX functions within the syllabus, the modular online instructional design, and the implementation of an evaluation quiz at the end of each module enabled participants who completed the course to achieve and demonstrate competence in sizing and planning for aneurysm repair. Nearly all of the learners who completed the course passed the final assessment and were certified.

There was a high drop out rate from registered participants to the course. The most common reason identified was lack of time to invest. The most common suggestion for improved compliance was to reduce the duration of the course.

Providers of the OsiriX eL course invested a total of 374.8 hours in devising and delivering the instructional material. A team approach and the expert input from vascular surgeons with an interest in medical education enabled a set of full-time clinicians to successfully implement this novel teaching method. The positive outcome from this feasibility study enables subsequent iterations of this online course to evaluate objective learning gains and to make a comparative analysis of its ergonomy and efficiency. Feedback was consistently positive in the course feedback forms and online discussion forums. The online instructors received positive comments, suggestions for future course improvement and inquiries about future course dates. The initial course material has been incorporated into an interactive iBook™ that has been available online.[16]

CONCLUSION

A fully online instructional course with modular weekly design can be successfully implemented by full-time clinicians to teach vascular surgeons and trainees the use of OsiriX for 3D reconstructions of CTA of aortic aneurysms. Users who did not complete the course suggest that shortening its duration may improve compliance. The instructional model is effective and well received by the cohort of learners who comply with the course requirements.

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