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The utilisation of VERT™ in the training of Image-Guided Radiotherapy for therapeutic radiographers

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Original Article

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Abstract

Aim: The overall aim of this study was to evaluate the use of Virtual Environment for Radiotherapy Training Image-Guided Radiotherapy (VERT™IGRT) as a teaching and assessment tool for 3D image matching competency within the radiotherapy clinical setting and explore radiographer perceptions, experiences and integration of VERT™IGRT as an imaging tool.

Materials and methods: A mixed-methods study was utilised to measure clinical image matching competencies in the first quantitative phase through means of a workbook and imaging assessment. Phase II used qualitative semi-structured interviews to explore radiographer perceptions.

Results: Workbooks enabled participants to prepare for image assessments. Interview findings were highlighted in three distinctive themes: (1) The need for supervision, guidance and feedback; (2) Experience and practice leads to confidence and competence and (3) Technology supports process but not evaluation.

Findings: VERT™IGRT provides a sound platform for training therapeutic radiographer image matching skills, but needs to be delivered with continuous feedback to develop individual decision-making skills. The technology provides opportunities for staff to increase confidence in utilsing image matching technology, but analytical and evaluation skills require supervision and continuous feedback which should be embedded in any educational training programme.

Introduction

Education in health care has benefitted from the introduction of simulation and has altered the way in which we apprehend reality. The use of virtual patients in simulation technology is an expanding market demonstrating extensive growth in the last decade.[1]

Virtual platforms provide opportunities for educators to develop, customise, innovative and unique simulation activities that facilitate learning using a constructivist approach. Simulation is an established and effective method of providing a safe, risk-free environment where adult learners can practice new skills and apply new knowledge without posing a threat to actual patients.[2–4]

Background

There is a need for education strategies within the clinical setting to monitor and reflect on the high-paced changing clinical environment within oncology to ensure the radiotherapy workforce are equipped with the necessary skills and knowledge to operate within these parameters. Studies have shown that the use of simulation as an educational tool influenced learning and students were able to gain knowledge and develop skills through simulation-based learning.[5–6]

The implementation of a Virtual Environment for Radiotherapy Training (VERT) has demonstrated to be a viable and engaging alternative to teaching complex theoretical concepts and principles, by demonstrating radiotherapy practice and techniques in a non-time-pressured environment.[5–6]

VERT has been used in the clinical environment specifically in relation to patient education in the preparation for treatment delivery with great success[7–8]; however, the use of VERT within clinical environments across the United Kingdom (UK) is not consistent. Results from a UK survey have shown that only 62% of UK radiotherapy centres have VERT installed and outlined a range of barriers to the implementation and use such as access, training and access to images.[9]

VERT manufacturers have since developed a new software to assist in the education and training of Image-Guided Radiotherapy (IGRT). A recent study[10] has suggested that the use of VERT™IGRT can facilitate the development of more engaging and interactive teaching

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through the simulation of clinical workflows and hands-on image matching for a range of patient scenarios. This study was conducted within a Higher Education Institution (HEI) training student therapeutic radiographers. Radiotherapy image guidance is vital in managing organ motion in treatment delivery and studies[11] looking specifically at prostate management have shown that changes in volume of the bladder and rectum results in a significant prostate positional shift suggesting that treatment preparation and image guidance protocols are essential in the accuracy of treatment delivery. Therapeutic radiographers require a good understanding of image matching to implement image guidance protocols. A recent study has shown that VERT™IGRT is an important platform for developing IGRT matching skills and decision-making for students.[10] Currently, there is no literature available on the use of VERT™IGRT to educate therapeutic radiographers within the clinical department.

Method

This study is the first to utilise existing virtual technology (VERT) within the clinical radiotherapy department to facilitate the development of IGRT skills for therapeutic radiographers.

A mixed-methods study was used to investigate the use of VERT™IGRT software as a supporting mechanism to develop 3D image matching skills and competencies within the clinical setting.

The specific objectives for both the phases were the following: Phase I (quantitative methodology):

- To evaluate the use of VERT™IGRT as a teaching and assessment tool for 3D image matching competency within the radiotherapy clinical setting,

Phase II (qualitative methodology):

- To explore radiographer perceptions, experiences and integration of VERT™IGRT as an imaging tool within the radiotherapy clinical setting.

This project was run as a collaboration between the clinical oncology department, the VERT™IGRT software providers and the local HEI.

Ethical approval was obtained from the local NHS Trust and HEI. This study proposed the use of VERT™IGRT to be utilised independently by means of a clinical workbook. A pilot study was conducted in both phases to ensure validity of the workbook and credibility in the semi-structured interview guide. A small sample ($n = 5$) of therapeutic radiography staff who were at the stage (Agenda for Change level 5) of developing image guidance competencies within the department were invited to participate. Participant information sheets and consent forms were provided before each phase to gain the agreement of participants.

Phase I: A clinical workbook was developed in consultation with the clinical practitioners, the software developers and the HEI. The clinical workbook enabled the therapeutic radiographer to undertake image-guided skill development utilising the VERT™IGRT software independently and away from the treatment unit in a safe non-patient environment. Staff attended a demonstration session and were then provided with the workbook to guide them through the image production and process, with step-by-step learning opportunities and reflection points. The workbook focused on prostate-specific image matching. After a 4-week period, the participants were then assessed by radiographer imaging, which leads to determine their competence in image matching. The evaluation consisted of a supervised image evaluation practical and viva.

Phase II: On completion of the imaging assessment, the participants were asked to engage in a semi-structured interview. The interview guide was developed by the lead researcher to explore participant experience and perceptions of virtual education and training for image guidance. Interviews were conducted in the clinical department in a private room, at a convenient time. Interviews were audio recorded and transcribed. Participants were thanked and debriefed. Data from the interviews were analysed thematically.[12]

Results

Phase I: Only four participants were able to complete the training, assessment and interview. Of the $n = 4$ participants, only two were successful in the assessment. The image evaluation observation length ranged from 18 to 38 minutes. There was no correlation in the length of time and successful outcome. The viva questioning time ranged from 4 to 9 minutes, with those participants who were not successful in taking less time. Overall assessment times ranged from 22 to 47 minutes. The completed workbooks were reviewed retrospectively by the researcher from the HEI showing that the majority of participants ($n = 3$) answered the questions from each Learning Opportunity within the workbook; however, the reflection components were only completed by $n = 1$ participant. None of the participants utilised the opportunity to review their answers with the radiographer imaging lead prior to assessment.

Phase II: Interview results are presented in three overarching themes which are outlined below.

Theme 1—the need for supervision, guidance and feedback

The following codes have contributed to the findings in this section: Teamwork, Support, Supervision, Feedback and Expectations. Participants shared their experiences of working autonomously. Even though they enjoyed the opportunity to undertake independent learning, most participants were concerned that they did not have supervision during the practical sessions and highlighted their lack of confidence as seen by participants below:

> *You know, very happy with self directed learning, I love it, I love online sessions and stuff, so I was okay, but then for me it's easier, like on the set, when you have time at the end of the day, to do it offline with some colleagues. P2*

> *And you are querying—questioning—yourself, 'Am I doing this right?' So there's no live feedback, which is, kind of, a little bit unnerving: 'Are you doing the right thing?' that kind of thing. P3*

Most importantly, participants were not able to determine if they were undertaking the task correctly or if they were reviewing the correct elements in the image matching activities.

> *It's difficult because I wasn't really sure as I was doing it how well I was doing, obviously some guidance on where to start would have possibly sent me in the right direction, but also I didn't . . . I wasn't 100% either way, when I'd done what I'd done and I felt that I was happy with it, whether or not it was even right, because I, like I said, still had no idea really what I was looking at, so I was just sort of making the best of it as I could, but still it's . . . yes, I don't know, it's challenging to do it on your own. P4*

Overall, participants expressed that they would value more time to practice using the VERT system to enable them to develop their image matching skills as well as additional guidance to enable them in their decision-making processes.

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So we would probably have more time to practise. So it would probably be definitely easier. I feel like, definitely, what's needed is just the guidance on what we need to do. P1

Theme 2—experience and practice leads to confidence and competence

The following codes have contributed to the findings in this section: Protocol, Practice, Confidence, Experience, Competence and Emotion. Participants' experiences on image matching prior to the study varied, but mostly they had limited experience in observing image matching as shown by participant 3 below:

But, most of the time, I'd say the . . . we don't do that many CBCTs so I've not seen that many on set. Because they generally take a longer time anyway and I don't get the chance to practise on set. It would usually be the two people that can actually sign it off that will be doing the imaging. So I'm just watching, trying to pick up what they're seeing. But, when they're moving the mouse, it's quite hard to follow sometimes. P3

Mostly, participants agreed that image matching was an essential skill required when working on the treatment unit and highlighted how their lack of skill could potentially delay treatment.

It makes me a little more . . . I don't like to use this word but 'useful' in terms of on set, because obviously I'm limited at the moment in terms of the imaging capacity I have, and so if patients do require imaging then I have to go and find somebody else currently to have a look, so that would be . . . it would be better to be signed off, obviously, to avoid that eventually. P1

Participants were able to share how their confidence in relation to image evaluation has improved using the workbook and VERT technology, however, they were not confident enough to perform the image evaluation independently as shown by all participants below:

Honestly, if it was just the VERT—if I hadn't asked anyone—I don't think I would have been able to do it. P4

I definitely would have not felt confident being an authorised person to sign off a CBCT. So I've definitely learnt stuff. I feel more confident but I definitely don't feel confident enough to be that second person. P3

Theme 3—technology supports process but not evaluation

The following codes have contributed to the findings in this section: Workbook, Quality, Imaging, Knowledge and Understanding, Challenges. Participants commented positively on the use of VERT™IGRT as an additional tool to develop their image matching skills. They were familiar with the technology, but found the workbook most useful in guiding their practice.

It's really detailed in terms of 'How do you open the patient?' and in terms of tips: not tips for how to match it but tips on how to work with the system. So I think that was good. I think the really good thing is the questions throughout the workbook because it makes you think P4

'because the steps in the booklet were great and how to get there and everything, but when I was then presented with the image and had to match it I still didn't really know what I was doing, if that makes sense, because I wasn't really sure what I was looking at. P1

The use of VERT™IGRT technology on its own was not sufficient to enable image matching skill development as outlined by participants below:

If it was the VERT on its own, I don't think I would have actually progressed in any way. Honestly, if it was just the VERT—if I hadn't asked anyone—I don't think I would have been able to do it. P3

It's like a nice bit of animation but, actually . . . If you've never been in a radiotherapy room and you're watching it, maybe it kind of gives you an idea but, at this stage, it's like, 'I know what it looks like to watch a machine go round.' P2

The most common challenge associated with the project was access to the VERT system, which was only available through a booking system. Despite participants being allocated 1 hour per week to utilise the VERT system, due to the logistics of room booking and departmental clinical commitments, it was not feasible for this to always happen with their working hours.

Specifically accessing this room, we have been told we obviously can check one week of access to the room, but sometimes there were days where there were some unscheduled things happening in the room, like interviews and stuff, so it sometimes was difficult, and it's only like one station. P2

Discussion

Results from this study showed that a clinical workbook could be utilised to enable the therapeutic radiographers to undertake image-guided skill development utilising the VERT™IGRT software independently and away from the treatment unit in a safe non-patient environment. The virtual environment allowed radiographers to experience the image matching process with visual and sound-based representations. The use of simulation provided an opportunity for self-directed learning with a workbook, however, results showed that radiographers value the guidance and image matching decision-makings skills of more experienced staff to support their learning suggesting that VERT™IGRT can be used in addition to existing image matching training. Other studies have also suggested that the integration of IGRT theory with hands-on image matching practice using VERT simulation has potential benefits such as increased knowledge and skills in online image acquisition and review of planar two-dimensional images and cone beam computed tomography (CBCT) images.[10]

Findings from this study have highlighted the need for a more collaborative approach to teaching allowing radiographers to gain from peer support and clinical expertise. The use of the VERT™IGRT has allowed radiographers to increase confidence in image matching, but not to the extent where they felt comfortable working independently. Other authors have shown that decision-
making in image matching is highly reliant on the individual's knowledge of the interaction between alignment, target volume and OAR variables plus compliance with the treatment plan.[9] This study showed that theoretical components can be taught through a self-directed workbook, but discussion and critical application is fundamental in the overall development process. Others have highlighted the need for experience in imaging matching skill development.[5] Findings showed that the trainees valued person-to-person interaction and direct supervision for the insight it offers into the tacit and embedded competencies of experienced colleagues.

The familiarity of the IGRT technology is an advantage and allows therapeutic radiographers to ease into using technology, which mimics what they encounter in clinical practice.

Daily CBCT verification is required to ensure accurate treatment delivery,[11] which suggests image matching skills are fundamental in clinical practice. Finding from this study support a more focused education and training approach for radiography staff developing these competencies.

The use of VERT within the clinical sector remains underutilised with oncology centres citing a range of reasons for not fully utilsing the equipment. Results from this study confirm that the

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challenges continue to exist with limited access to the VERT system and heavy workloads without clinical release for training risking potential underuse.[13] The study revealed that staff requires different levels of guidance and support, particularly with the introduction to CBCT image matching, which could explain the failure rate in the assessment. At the onset of the study, it was assumed that all staff were able to utilise the experience gained from initial observations of image guidance on the treatment units. Practice educators need to consider future training to include a detailed introductory exercise for guidance on the CBCT image matching process and expectations

The findings from this study are limited due to a small sample size, however, the rich qualitative findings demonstrate the key elements of training associated with self-directed virtual learning. Future studies should focus on embedding VERT™IGRT into the treatment delivery process enabling staff to gain image matching skills. Challenges with room access might only be noted within UK hospitals however, the increasing provision of VERT™IGRT within the international radiotherapy sector highlights the need for clear educational strategies to lead implementation and use.

Conclusion

VERT™IGRT provides a sound platform for training therapeutic radiographer image matching skills, but needs to be delivered with continuous feedback to develop individual decision-making skills. The technology provides opportunities for staff to increase confidence in utilsing image matching technology, but analytical and evaluation skills require supervision and continuous feedback, which should be embedded in any educational training programme.

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Conflicts of Interest. None

Ethical Standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national guidelines on human experimentation (Society of Radiographers Code of Professional Conduct) and with the Helsinki Declaration of 1975, as revised in 2008, and has been approved by the Institutional Committees of London South Bank University, Health and Social Care Ethics Panel.

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