Simulated versus traditional therapeutic radiography placements: A randomised controlled trial

Introduction

Therapeutic Radiography Training

Therapeutic Radiography (TR) students, like other Allied Health Professional (AHP) students on pre-registration programmes in higher education (HE), experience a wide range of learning and assessment opportunities. A significant aspect of their training is clinical learning facilitated by placement in clinical therapeutic radiography departments. TR students typically spend around 50% of their learning time on clinical placement blocks ranging in length from a fortnight up to 10 weeks. Learning on placement provides students with the opportunity to develop a wide range of clinical skills and is essential to satisfy professional and regulatory body requirements for pre-registration TR education programmes.[1,2] Clinical placement is designed to consolidate students' academic learning, to develop their professional skills and to gain competence in clinical procedures appropriate for a Band 5 therapeutic radiographer.[2]

Embedding clinical placement blocks into TR curricula aims to support students in the application of their academic learning. During Year One the first clinical placement provides orientation to the clinical environment, and facilitates initial development of broad clinical skills, professionalism, communication, team working and basic radiotherapy technical skills. As the course progresses, students increase their confidence, knowledge and skills enabling them to solve problems and work more autonomously as members of the therapeutic radiography team. Their skills are assessed in order to determine their competence across a range of core radiotherapy tasks, with the ultimate goal of meeting the Health and Care Profession Councils (HCPC) Standards of Proficiency (SOPs).[1]

While undoubtedly the clinical environment is an unparalleled source of rich and relevant learning opportunities, there are a number of factors that present a challenge to the implementation and support of these clinical learning experiences. Therapeutic radiography departments face increasing workloads with high patient throughput, strict targets, training and implementation challenges with complicated equipment and techniques, and reduced staffing levels.[3,4] This pressure is further compounded by the current demand for more trained therapeutic radiographers in the UK and the introduction of new training pathways.[5] These considerations highlight the potential role of simulation in providing effective clinical preparation remote to the clinical environment itself. Simulation within pre-registration training offers an opportunity for optimisation of the clinical placement experience by allowing students to prepare and gain skills away from the hospital setting.[6]

Simulation in Radiotherapy

Simulation is a core aspect of health care profession training and encompasses a wide range of learning and developmental activities.[7,8] It has been widely accepted as a valuable method of developing clinical skills in a safe environment without fear of judgment or impact on patients.[9] The controlled environment enables valuable learning to take place, which can safely include learning from errors, while also supporting problem-based and team-based learning approaches.[6] There are many simulation resources available within the field of radiotherapy including the Virtual Environment for

Radiotherapy Training (VERT),[7,10] specialised clinical treatment planning software,[11] and role play with trained actors.[12] A wide range of evidence supports use of a variety of simulation resources and activities, yet it is recognised that there is a need to further explore innovative ways of using these to develop student clinical skills.[7,10] It should also be noted that most published studies relating to simulation in therapeutic radiography rely on data drawn from student self-assessment of perceived learning and development or simple survey designs. A common finding in the literature is the stated need for more evidence arising from controlled quantitative studies to support increased use of simulation.[13,14] The paucity of more robust data perhaps explains reports[15] of under-usage of VERT and spare capacity in simulation centres.[8]

Simulated Placements

It is evident that there is a disparity in how well simulation is integrated throughout the range of all pre-registration health profession education programmes.[16] Recent reviews of simulation education in radiation oncology[17] and medical imaging[8] both highlight the short-term nature and sporadic use of simulation activities. It is clear, however, that other professional groups have devised more sustained and integrated simulation activities, culminating in week-long simulated placements. These simulated placements included a range of simulation resources to provide students with an experience as closely matched to clinical placement as possible. Simulation placements have been used to great effect in occupational therapy,[18] physiotherapy,[19] osteopathy,[20] and nursing and midwifery[21,22] training programmes. Table 1 summarises the studies evaluating simulated placement use arising from a literature search for "simulated placement". It can be seen that simulated placements have been used as partial replacement for clinical placement weeks without compromising student learning and in some cases enhancing learning. It should be noted that out of the six papers only three based their evaluation on clinical outcomes. Similar studies have not yet been reported in the medical radiation professions, although a 2011 paper[23] highlighted resistance from clinical staff regarding the potential use of simulation for placements within medical imaging. There are no reported studies related to simulated placements for therapeutic radiographer training.

The work reported here aimed to measure the impact that a simulated therapeutic radiography placement has on student clinical learning outcomes compared to an equivalent time spent in a clinical department. The project was not seeking to replace clinical training with simulation entirely, but rather to examine the potential role of simulation in reducing the clinical training burden through optimisation of clinical time. The research question for the project was: Can an integrated simulated placement provide equivalent learning to a 2 week clinical placement for Year One therapeutic radiography students?

Table 1: Summary of evidence regarding AHP simulated placements

Author	Profession	Method	Cohort Size	Evaluation	Outcome
Watson 2012[19]	Physiotherapy	RCT	370	Blinded clinical assessments using the Assessment of Physiotherapy Practice (APP) tool	Equivalence of learning demonstrated. Simulation can replace 25% of clinical time without compromising achievement of student learning outcomes.
Fitzgerald 2017[20]	Osteopathy	Qualitative Case Study	10	Student feedback via Likert questionnaire	Structured simulated activities may build critical practice skills and be utilised as an effective educational tool.
Gough 2013[24]	Physiotherapy	Survey	155	Postal questionnaire	39% of responders use simulation-based education to teach a wide variety of skills.
Imms 2018[18]	Occupational Therapy	RCT	540	Written examination, graded by blinded clinical assessors.	Equivalence of learning demonstrated between 40 hour simulation placement and 40 hour conventional clinical placement.
Blackstock 2013[25]	Physiotherapy	RCT	349	Blinded clinical assessments using the Assessment of Physiotherapy Practice (APP) tool	Equivalence of learning demonstrated. Simulation can replace time in the cardiorespiratory physiotherapy clinical environment.
Dennis 2017[26]	Nursing & physiotherapy	Survey	198	Student feedback	IPL simulation was feasible and valued by participants

Methods

Participants

All students enrolled in Year One of a pre-registration BSc Therapeutic Radiography course were randomised by name drawing from a hat into "Simulation" or "Clinical" cohorts to determine which placement format they would undertake first. This placement was the first clinical experience during their three-year training, and took place following five weeks of academic study (which was completed as an entire group). Students were assigned to a two week placement, followed by a week on campus during which they undertook a formative assessment. Following this week they all undertook the alternative placement format to ensure parity of experience. Cohort demographics can be seen in Table 2.

Table 2: Cohort demographics for first placement

	Clinical	Simulation
Cohort size	13	16
Male	2	3
Female	11	13
Mean age (years)	20.8 (18-32)	20.3 (18-32)
International students	1	3

Intervention

The intervention in this study was a two week integrated simulation placement which was based at an academic campus. This comprised a full timetable of simulated activities using a range of dedicated simulation equipment in combination with actors, service users, clinical staff and academic facilitators. Activities were developed with service user, clinical partner and student representative input. Realistic cases including notes, images and plans were used as a focus and students were expected to comply with all usual clinical protocols; including attendance criteria, professionalism and uniform policy. Students at the host institution are allocated to one of three clinical placement oncology hospitals at the beginning of the programme, and were therefore grouped into clinical site groups for some of the simulation activities in order to access department-specific training and equipment. Activities for both clinical and simulated placements were focussed on orientation to the therapeutic radiography department and workflow, as well as basic interpersonal and skills training. Figure 1 illustrates key examples of these activities within each domain undertaken by students during their placements. The simulation activities were planned to correspond with the typical activities on placement shown in Figure 1, although with simulated patients.

Control

The control comprised the routine two week orientation placement in a clinical department. Typical activities undertaken by students at the clinical sites were used as the basis for the simulated activities seen in Figure 1. However, those students placed at the clinical sites worked with real patients in a clinical setting.

Figure 1: Placement Activities

Orientation & Safety	Technical	Interpersonal
• Orientation to radiotherapy department • Common patient pathways and profiles • Confidentiality and record keeping • Patient experiences • Professional behaviour • Infection control and hand-washing • Use of appropriate terminology • Observation of planning process • Local rules and radiation protection measures	• Safe use of patient transport and transfer devices • Safe use of immobilisation devices • Patient positioning and adjustment • Creation of immobilisation shells • Setup of CT scanner • Safe use of linear accelerator hand controls • Setting up of treatment parameters • Basic interpretation of imaging data	• Talking to patients • Using identification protocols • Asking how patient is • Team interactions • Team-working • Acknowledging limitations of capability

Outcome

Following the first two week placement, all students undertook a formative assessment based on the existing assessment criteria, routinely used to assess clinical practice and associated learning outcomes. Students were taken to an independent therapeutic radiography department that is not currently a clinical placement site and was therefore new to both cohorts. An actor provided a clinical case for them to mimic the delivery and care of a patient undergoing radiotherapy. The assessment was performed by an experienced independent assessor who was blind to student placement format. A standard pro-forma, based on marking criteria grids, was utilised for marking and feedback provision. Marking criteria were provided to the students Marks were assigned for safe practice, communication skills and technical skills. Feedback comments concerning these were provided to students following the completion of both placement blocks, with the aim of improving future performance in summative assessments. Anonymised copies of all marks and feedback were retained for data analysis. Additional data collection measured student perceptions of their placement with regard to their confidence. This was gathered via an anonymous 5-point Likert-style questionnaire at three intervals; immediately prior to the first placement; after the first placement and after the second placement. Students created their own unique, identification code phrase to enable individual student responses to be collated without compromising anonymity.

Ethical concerns

University Research Ethics Committee approval was provided for this project. All students received written information about the evaluation project and were advised that participation in data collection was voluntary and that all data was anonymous. It was also explained that participation status would not be known to the teaching team and would not affect student performance, support or

opportunities. Signed informed consent forms were gathered in relation to use of survey and formative assessment data for evaluation purposes.

Data analysis

Data from the assessment and surveys was transcribed into an Excel spreadsheet and subjected to descriptive and inferential analysis using the inbuilt tools. A non-paired student t-test was utilised with 95% confidence intervals to compare student assessment scores between the two groups. Likert data was summarised in order to identify perceived impact on confidence.

Results

A total of 27 out of 29 students provided clinical assessment data for the study. The results of the clinical assessment can be seen in Table 3 and clearly demonstrate equivalence of learning. It can also be seen that the simulation cohort scored over 10% higher in the communication skills domain with a statistically significant improvement. There were only 26 complete datasets for the confidence level monitoring. Figures 2-5 illustrate the difference in evolving confidence levels between the two cohorts with regard to the different domains. Increased confidence levels can be seen with the simulation cohort.

Table 3: Clinical assessment scores

	Simulation cohort				**Clinical cohort**			
	Safe	Tech	Comm	Total	Safe	Tech	Comm	Final
	60	95	100	85	50	70	70	
	79	70	79	76	39	59	59	
	60	70	100	77	79	65	79	
	75	90	79	81	40	65	79	
	90	100	100	97	59	59	79	
	85	70	100	85	65	59	73	
	59	70	100	76	75	65	79	
	40	60	39	46	59	62	59	
	65	60	60	62	50	95	100	
	40	60	100	67	79	95	95	
	70	50	90	70	70	90	79	
	75	50	90	72	60	85	59	
	39	45	100	61	79	90	75	
	75	59	95	76	-	-	-	-
Mean	65	68	88	74	62	74	76	70
SD	16	16	18	12	14	14	12	10
p-value	-	-	-	-	0.293	0.168	0.028	0.242

Key: Safe = Safe practice, Tech = Technical skills, Comm = Communication skills.

Figure 2: Student confidence (clinical placement orientation)

How confident do you feel about going into clinical placement for the first time?

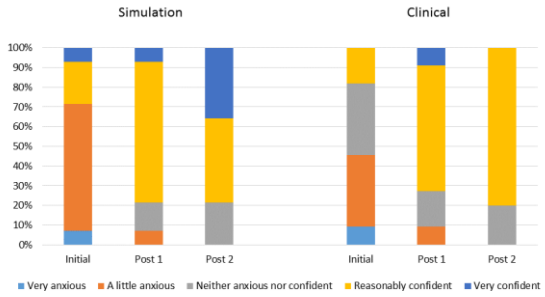


Figure 3: Student confidence (technical equipment skills)

How confident do you feel about using the technical equipment in the radiotherapy department?

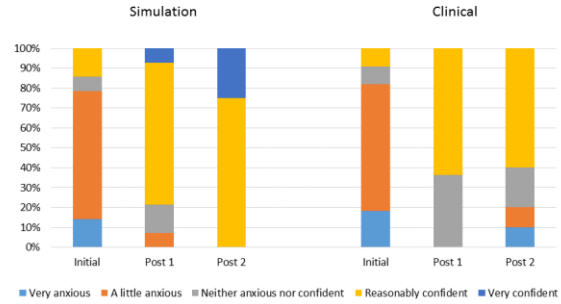


Figure 4: Student confidence (positioning skills)

How confident do you feel about positioning patients in the radiotherapy department?

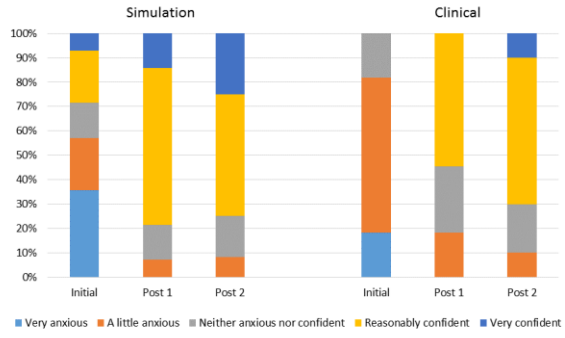
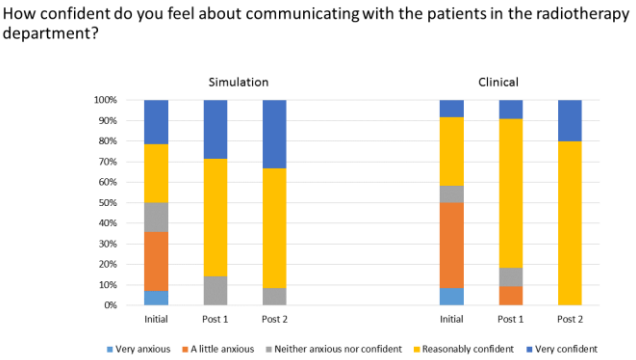


Figure 5: Student confidence (communication)



Discussion

Impact on clinical training

The data from this randomised study confirmed that therapeutic radiography students were able to gain relevant clinical skills from an extended simulated placement. The equivalence of performance in a blinded clinical assessment demonstrated that students were not disadvantaged by working on a simulated placement. More significantly, the improved communication skills scores suggest that simulated placements should play a major role in training students for patient interactions within therapeutic radiography. This evidence adds to the body of existing literature from other health professions and suggests that partial replacement of clinical placements with simulated placement is feasible. This could lead to several key benefits for multiple stakeholders. From the student perspective reduced clinical placement time will reduce the financial and logistical challenges of managing accommodation at two geographical locations. This is likely to appeal to mature students in particular.[5] Reduced numbers of trainees in clinical placements will also benefit clinical departments who are already coping with a high staff training burden due to implementation of new technologies.[27]

Blended simulation activities

Previous work[10] has highlighted a common criticism of software-based simulations such as VERT arising from the lack of patient interaction and feedback. These interactions are integral to the clinical placement experience and the reliance on technical simulation resources perhaps explains the lack of published data concerning simulated placements. The reported simulated placement embedded interpersonal skills training through involvement of actors and service users, who provided students with a diverse range of interaction scenarios. These simulated patients provided context for the technical resources while de-briefing and feedback from tutors, actors and service users engendered a strong patient-focussed experience. An additional limitation of using VR simulators is the inability to manually manipulate the patient position during set-up.[7] Reliance on simulation raises the concern of reduced consideration of the patient in future clinical practice. Use of the VERT system in combination with a patient couch, with an actor portraying the selected patient (as seen in Figure 6) increased immersion in the scenario and enabled students to practice technical aspects while

simultaneously communicating with each other and reassuring and informing the patient of the process.

Figure 6: Blended simulation activity combining VR and actor resources.

Impact on student confidence

With most previous therapeutic radiography simulation studies reliant on self-reported confidence, satisfaction and perceived learning, it was deemed useful to gather confidence data from the students. Figures 2-5 all demonstrate improvements in confidence arising from each placement format. Figure 2, for example, demonstrates identical confidence levels following each placement with the simulation group reporting higher final levels of confidence after both placements. This perhaps confirms the value of simulation as preparation for clinical experience. Figure 5, in particular, suggests that the simulation group had a higher initial confidence with regard to patient communication which could explain the difference in assessment performance. Subsequent analysis of confidence scores in relation to assessment scores in this domain, however, revealed no correlation ($r = 0.08$). This highlights that student confidence is not a reliable measurement of the efficacy of simulated placements.

Comparison with clinical placement

There are considerable demands placed upon therapeutic radiographers as regards delivery of highly technical treatments, whilst at the same time engaging with patients[7] to ensure optimal patient care. The simulation placement immersed students in realistic and challenging situations and allowed them to devise appropriate responses and coping mechanisms in an active and supportive learning environment, whilst also allowing the student to repeat the encounter following feedback. It is inevitable that students will encounter challenges in their interactions within the therapeutic

radiography department, but simulation allows them to experience some of these challenges in a safe environment where they can practice responses and make errors without impacting on patient safety and wellbeing.[28] Another key difference between the placements arises from the serendipitous nature of clinical experience. Traditional placements naturally result in a variety of individual student experiences depending on the range of patients and mentors that the student encounters, as well as the volume of learners on a particular rotation. The simulated placement offered parity of experience for students with exposure to a set range of patient cases, ensuring each student had equality in learning opportunities to prepare them for the clinical environment.

Challenges

The main challenge for the simulated placement arose from planning two full weeks of activities equivalent to clinical placement. The need for small group practice also meant that a relatively high ratio of staff to students was often necessary. Replicating a range of patients and procedures necessitated considerable financial outlay in terms of equipment purchase and personnel costs; and it has been previously acknowledged that high-quality, immersive simulation is expensive.[29] The findings from the project, however, demonstrate clear value of low-fidelity resources for gains in interpersonal skills in addition to high-fidelity simulation equipment. Investment in actors, expert patients and service users ensures that the simulated placement retains a patient focussed approach and leads to improved student interpersonal skills. The simulated placement initially demanded meticulous planning and preparation, however subsequent iterations are anticipated to be less challenging.

Limitations

As with most therapeutic radiography training studies, the cohort size was relatively small, despite all students consenting to participation. In addition, although randomisation was performed, two additional students were assigned to the first simulation group as their mandatory, pre-clinical occupational health or disclosure and barring service checks, were delayed. This was unlikely to have resulted in a significant bias in the results. The use of Year One students who had no previous clinical experience enabled an unbiased perception of each placement. One potential limitation was related to the use of an actor for the assessment which may have provided slight bias in favour of the simulation group.

Conclusions

An integrated therapeutic radiography simulation placement was logistically feasible and enabled students to acquire initial stage clinical skills in a safe, unpressured environment. Incorporating experience with actors and service users within simulation enabled students to integrate interpersonal skills gains with technical practice. These experiences led to significantly higher communication skills scores in the simulation cohort. Use of blended resources should also help to nurture a patient-focussed approach during simulated placements. Partial replacement of therapeutic radiography

clinical placement weeks is feasible and therefore could reduce clinical training burden on both departments and students. Future investigations into the impact of interventions on clinical skills should be based on performance data and not rely on self-reported confidence levels. More work is also needed to identify the role of simulated placements with regard to advanced learners and complex skills development.

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