Original Article

Effect of Simulation Based Education in Reduction Error and Achieves Skills in Medical Radiation Technologist Students

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Abstract

Background and Purpose: This study was designed to investigate of simulation based education in achieves skills proficiency in medical radiation technologist students.
Methods: The students randomly were divided in two groups, A (n=25) and B (n=22) that received a routine course and simulation based education respectively. The chain of experiments was concerned to evaluate of skills proficiency and reduction error in clinical situation. These experiments includes, time and quality of iso-center setup for linear accelerator, geometrical error in patient positioning, time and accuracy for radiation axis and gantry angle. All experiments were designed in a human phantom. Statistical analysis were performed as the mean and standard deviation with a significance level of p-value <0.05.
Results: The duration time for iso-center setup in group A and group B was 4.17 ± 0.76 min and 2.45 ± 0.80 min respectively. The geometrical error in group B was smaller than the group A (p<0.05). The time average for selection of radiation axis in group B was less than 15 sec (81.8% (n=22)) versus 15 -25 sec (75 %(n=25)) in group A (p<0.01). The tasks correctness for group B was better than the group A (p<0.05). Also time duration for gantry angle in prone and supine position for group B was smaller than the A group, 72.7% less than 1.5 min (n=22) versus 16.7% (n=25) respectively.
Conclusions: The results show that the simulation based education is useful in reduction errors and achieves skills proficiency in medical radiation technologist students in clinical situations.
Keywords: SIMULATION BASED EDUCATION (SBE), REDUCTION ERROR, SKILL PROFICIENCY, MEDICAL RADIATION TECHNOLOGIST, RADIATION THERAPY.

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Introduction

Simulation is an important methodology in bridging the gap between theory and practice in sciences and technology. Simulation-based education (SBE) provides a structured, learner-centered environment in which novice, intermediate, and advanced practitioners can learn or practice skills without causing harm to patients. A range of systematic reviews indicate that simulation-based medical education can improve knowledge and skills and, increasingly, improve patient outcomes (1, 2). The advantages and benefits of simulation are reflected in its increasing global use as a learning methodology in medical school and in continuing medical education (3). For example, in the field of radiation therapy, due to use of ionizing radiation for treatment cancers, the minimum medical or technical error in clinical situations can be very important for patients and staffs (4). Because the inappropriate use of ionizing radiation can be have severe side effects on human's organ (5). So, the simulation based education in curriculum of radiation therapy technologists and other related fields is very important. On

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the other hand according to curriculum course in more universities in my country, common education for medical radiation technologists is based on theoretical education which not suitable for students who wanted inter to practical educational course. Therefore, the base of education in some course of radiation therapy such as: treatment planning lesson, radiation protection, radiation dosimetry and so on required simulation based education for achieve skills proficiency and staff error reduction. The goal of this study was to investigation effect of simulation based education in achieves skill proficiency and reduction error in clinical situation for medical radiation technologist students.

Methods

Course content included the routine and virtual simulation based education according to curriculum of treatment planning lesson for medical radiation technologist students. The students randomly were divided in two groups, group A (n=25 person) that received a routine course of education and group B (n=22 person) that received a virtual simulation based education according to curriculum of treatment planning lesson. At first, the pretest examination was performed for measurement of background participants and who students rejected with high background in the course. Group A educated according to routine curriculum and course duration 34 hour in one trimester that include 20 hour theoretical and 14 hour experimental education. On the other hand, group B received education according to same curriculum but replaced 14 hour experimental education by 14 hour virtual treatment planning system software (Isogrey TPS software, DOSISOFT,Version 4.1, French) Figure 1. The duration time of course is same for two groups (34 hours). After the course, to evaluate of achieved skills practitioner and reduction error in clinical situation, the items of accuracy, precision, duration of the task and quality of set up for human phantom in different experiments were evaluated. Experiments includes: time and quality of iso-center setup in human phantom; geometrical error in patient positioning; time and accuracy selection correct of radiation axes for expose of radiation toward of treatment volume in the human phantom; time duration in doing tasks, quality of practices and finally appropriate of gantry selection angle. The human phantom positioned on the table of radiation therapy system that was a linear accelerator in clinical situation or, in the condition in which a patient seems to be treatment but in fact is not (Linac, Elekta,UK). For each of experiments, several subtests were selected. These subtests for Iso-center setup includes: time average needed for complete test, setup precision in term of measurement position error in milliliters and step by step implementation of the protocol. For selection of correct radiation axes test, the subtests includes, time average needed for selection and select the appropriate axis and finally for gantry selection angle, the subtest were select the appropriate gantry angle in supine and prone position and just select the speed of action in minutes for two positions on the whole body human phantom. Statistical analyses were done using the Fisher's exact, Mann-Whitney and t-test with SPSS V.11 software (SPSS/PC Inc., Chicago, IL, USA). Summary statistics for all normally distributed quantity variables are presented as the mean and standard deviation for each group. Numerical values are assigned in accordance with a qualitative scale e.g. in coding a questionnaire for computer analysis, the responses 'very good', 'good', 'median', 'poor', 'very poor' are coded '5' ,'4', '3', '2' and '1' respectively.

P-value < 0.05 was considered significant.

Results

In the test of iso-center setup the time average require for complete test in group A and group B as mean and standard deviation was 4.17 ± 0.76 min and 2.45 ± 0.8 min respectively Table 1. This results shows that the time require for group A is higher than the time for group B. Receiving training in group A require a longer time for complete test ($p<0.001$).

Figure 2 shows that the geometrical error in setup of human phantom positioning per millimeters for participants in group A is higher than the group B. For example 54.6% (n=22) participants in group B have the range error in setup positioning between 1- 3 millimeter. This percent is lower for group A (4.2%).These are significantly different ($p = 0.0001$).

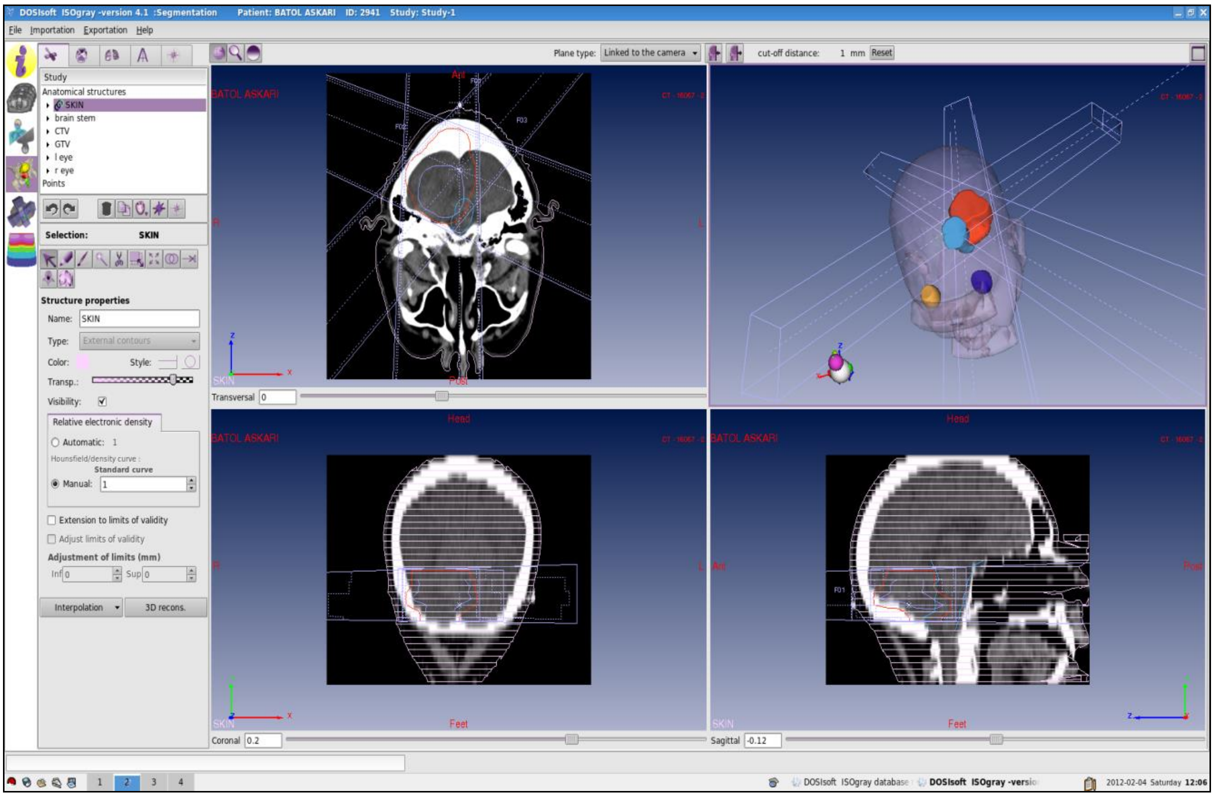

Figure 1. Human phantom setup that simulated by treatment planning software (TPS) in which the participants were trained during course of education.

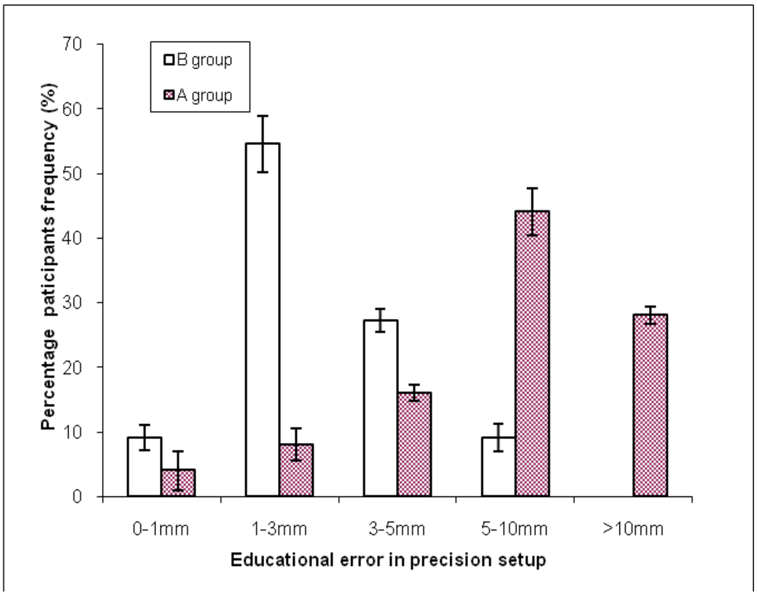

Figure 2. The percent of participants with geometrical error in human phantom positioning for tow educational groups in millimetres.

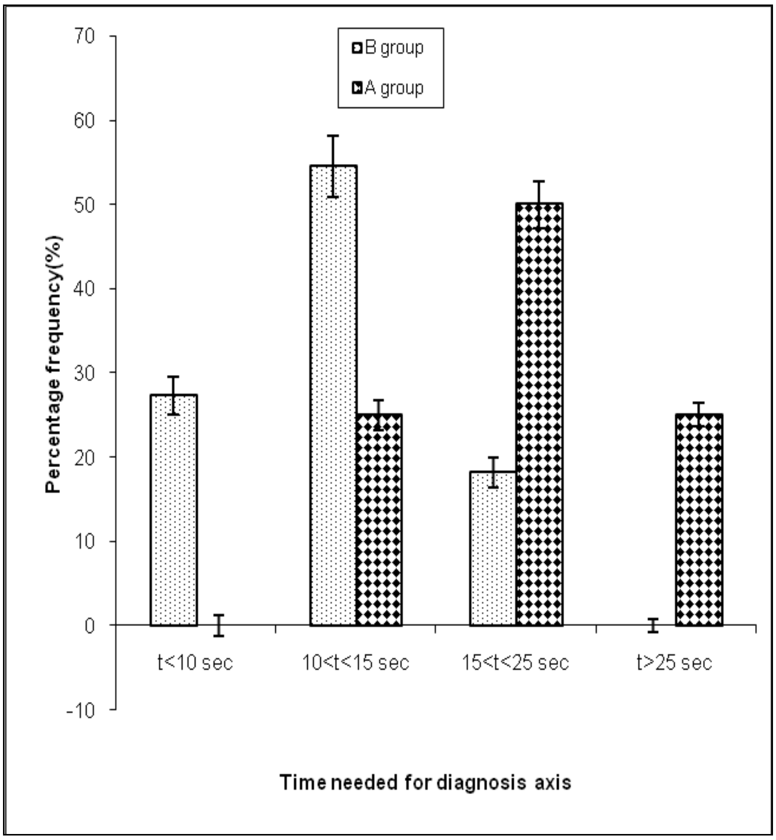

Figure 3. Frequency of participants in time required for complete test of correct selection axis for two groups of practitioners

For accuracy and qualities of protocols implementation, in the iso-center setup test based on four level of qualities includes ‘good’, ‘median’, ‘poor’, ‘very poor’ that were coded by numerical ‘4’, ‘3’, ‘2’ and ‘1’ respectively , 50% and 50% participants in group B were in the quality scales of 4 and 3 respectively (good and median), versus 0% and 54.2% in group A ($p<0.05$).

In diagnosis correct selection axis, the results shows that the time needed for complete test in 81.8% participants in group B was in the range of time less than the 15 second, but in group A 75% participants were in the range of 15 to 25 second. These are significantly different ($p =0.0001$) Figure.

The qualities doing tasks by receiving training for three subtests includes: correct axis selection, correct angle selection in prone and supine positions accordance with a qualitative scales ‘very good’, ‘good’, ‘median’, ‘poor’, ‘very poor’ which coded by ‘5’ ,‘4’, ‘3’, ‘2’ and ‘1’ shows in Figure 4. Greater percentage of participants in group B was in higher quality in contrast group A. This is significantly different for three subtest between two groups ($p =.0001$).

Finally the time require for selection of correct angle in prone and supine position shows that the group B require lesser time than the group A. As shown in Figure 5, approximately the 72.7% of participants in group B require time less than the 1.5 minute for selection of correct angle in prone

Table 1. Time average needed for complete iso-center test in educational groups

Participants groups	A	B
Time (min)	(4.17 ± 0.76)*	(4.17 ± 0.76)*

*Time as minute (min ± SD), n=5.

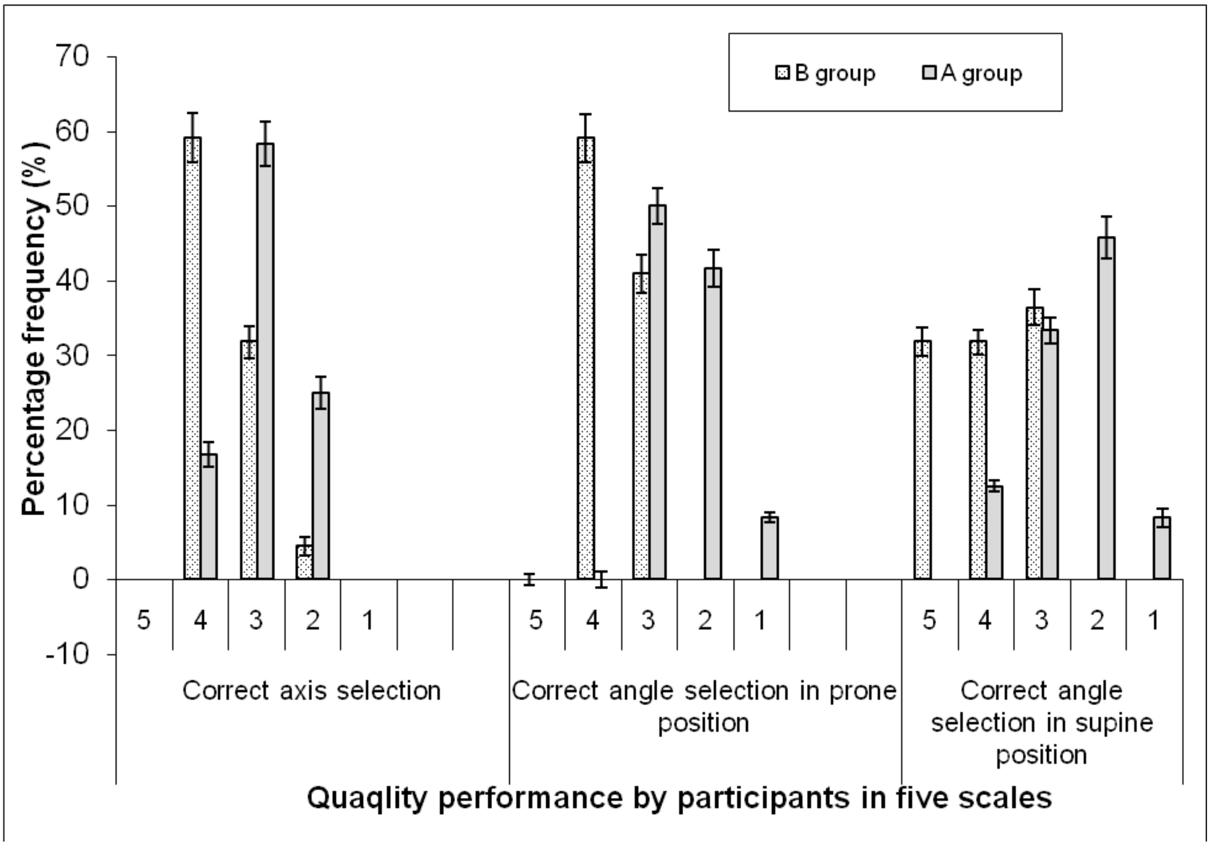

Figure 4. The qualities performance by receiving training for two groups in three subtests.

position. This percent for group A is about 16.7%. In other words the time is longer for group A. These are significantly different (p=0.0001). In supine position the group B require less time than the group A for selection of correct angle but p-value is equal 0.006.

Discussion

Simulation based education in medical sciences have a majority role for doing better tasks in clinical situations (6). This mode of education for certain fields of medicine is very important, because the patient's safety in some fields of medicine is very critical and important. The radiation therapy is one of the fields that the clinical staffs or educational students before started the pre-clinical course, must be place in virtual situation for achieve skills in real clinical situations. The goal of this study was to development and achieves skill proficiency for radiation technologist students in the course of planning with use of simulation based education before incoming to practical course. The overall results from this study in two groups of medical radiation therapy students were very favorable. Participants in two groups achieved different skills in all materials in the stage of experimental tests. Improvement in their skills and reduction error's for group B indicating that engaging with the simulation based education had been effective in real clinical situations. For example, for the test of iso-center setup the time average requires for complete test in group B was very less than the group A. For other test in our study, the qualities and quantities parameters that measured in these two modes of education shows that the educational group in which achieve simulation based education (group B) have the good skills for doing their tasks and reduction error in virtual therapy situation.

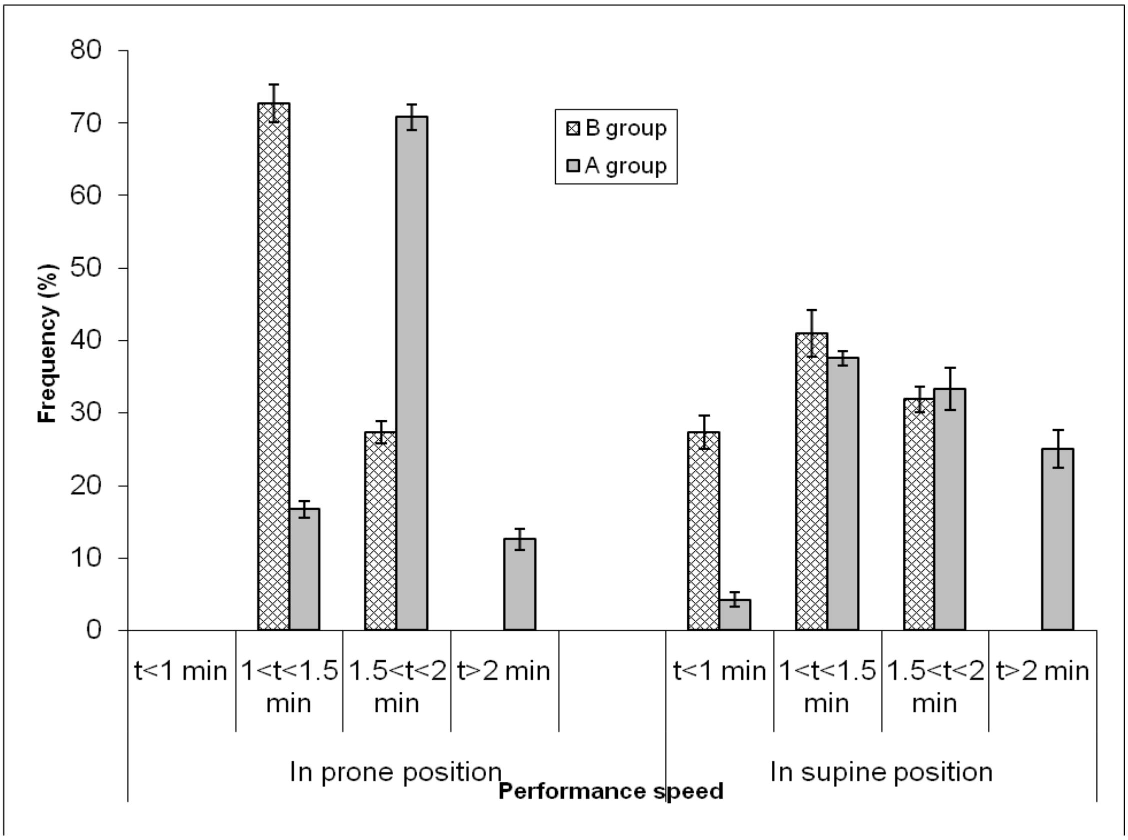

Figure 5. The time require for selection of correct angle in prone and supine position i.

This is shown by other researchers (7-11). It has been demonstrated that medical students achieve better skills in which skills are leaned on models and simulators (11). This fact is important for curriculum design since skills curricula for medical radiation technologists can be instituted in the B.Sc course for medical radiation therapist or radiation oncologist students. Courses designed to prepare students for pre-clinical medical radiation therapy students must be components for achieve skills proficiency. Today the content of the curriculum varies widely from place to place. In all, there is emphasis on the acquisition of technical and clinical skills in environmental simulation. The uptake from EMERALD & EMIT materials on an international scales shows the e-learning and simulation based learning in the field of radiation is also the only way to develop education quality for achieve skills in clinical situations (12). One of the limitations in simulation based education in medical education is that the practitioner ultimately must be placed in real clinical situation. Therefore it is only for achieve skills not substitute completely with real clinical situation. Our results shows that this mode of education can be useful for achieve to this aims.

Conclusion

Simulation based education is effective strategy to enhance skills and reduction error in medical radiation technologist students to incoming the pre-clinical course. On the other hand, this mode of education can be useful in enhancement of patient's safety in radiation therapy departments. Finally, and perhaps most significantly, the educational and curriculum courses in medical universities to prepare for those students whose have interaction with the medications, equipments and or process in which required more precision for doing medication and have a naturally dangerous for patients, must be design for better education and good quality of skills proficiencies and also error reduction by staffs.

Conflict of Interest

The author declares no conflict of interest.

Acknowledgement

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