

Original Article

Use of Box Simulators for the Improvement of Laparoscopic Skills in the Field of Gynaecology

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Abstract

Objective: To determine the use of box simulators to improve laparoscopic skills in the field of gynaecology.

Study design

Methodology: It is a prospective, blinded, comparative and quantitative study was conducted in gynae unit-I, Holy Family hospital, Rawalpindi Medical University, Rawalpindi from March 2017 – March 2019. Six hands-on training workshops were conducted. Each workshop was of twelve working hours. The participants were divided into two groups: one group went to laparoscopic theatre and assisted the surgeons, the second group went to skill lab and performed the following six tasks on box trainers; camera navigation, instrument navigation, peg transfer, ball transfer, pattern cutting and suture drill. They were given 60 minutes to practice each task. Each batch has the equal number of participants either novice or already performing the diagnostic procedures. On day two, the participants performed the above-mentioned tasks on the virtual reality trainer. The data were collected on the structured proforma.

Results: The group who have spent the first day in skill lab performed the same tasks on virtual reality trainer in less time and more accurately as compared to the group who had spent the day one in theatre. 88% found the exercises done on box trainers very useful. Although 64% wanted increase in training time on the box simulators.

Conclusion: The box trainer is an effective low- cost solution to improve the laparoscopic skills in a low resource country like Pakistan.

Key Words: box simulator, exercises, laparoscopic skills.

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Introduction

Minimal invasive surgery has gained much popularity during the past few decades. To achieve competence and excellence in this specialty, the learners need simulators. The developing country the box simulator is a cost-effective option than a virtual reality system.

Laparoscopy is need of the day for management of almost all problems related to gynaecology. It is a psychomotor skill with a long and slow learning

curve. Secondly, it is different from learning an open surgery. Moreover, there are financial and time constraints along with limited learning opportunities.¹ The challenges faced by trainees while passing through the early phases of learning are that they don't get enough chance to assist or perform laparoscopic surgeries. Therefore, they are less confident. To learn the skill and gain competence, the use of simulator plays an

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important role.

Among the available simulation options, box trainer is a low-cost solution especially feasible for public sector hospital of a low resource country. It gives chance to the trainees to improve their skill and later transfer it to real patients while performing surgeries. In laparoscopy, the hands coordination, hand eye coordination and instrument navigation play vital role and eventually decreases the operation time. Moreover, the laparoscopic surgeons will get opportunity to perform safe surgeries in safe environment thus building the confidence and speed of learning.^{2,3}

Another benefit of box trainer is that the supervisor can assess the trainee and give constructive feedback while performing different exercises specially regarding the force used while pulling the thread or tremors observed or negotiating with the depth of the operating field in comparison with the length of instrument. Simulation helps trainees to perform the same task repeatedly to achieve the perfection and automation.⁴

Methodology

It is a prospective, blinded, comparative and quantitative study. Six hands-on training workshops were conducted at Holy Family hospital, Rawalpindi from March 2017 – March 2019. Each workshop was of two days with twelve working hours. A total of 72 gynaecologists participated but in this study, only 40 participants who were familiar with basic laparoscopic procedures but not doing independently were included. The participants were divided into two groups: one group went to skill lab and performed the following four tasks on box trainers; camera navigation, instrument navigation, peg transfer, ball placement. They were given 60 minutes to practice each task. The second group went to the laparoscopic theatre and assisted the surgeons. Each batch has an equal number of participants. On day two, the participants performed the above-mentioned tasks on the virtual reality trainer. The final course evaluation form was completed, on a scale of 1-10 (1 – abominable, 2 – very poor, 3 –

poor, 4 – very unsatisfactory, 5 – unsatisfactory, 6 – satisfactory, 7 – more than satisfactory, 8 – good, 9 – very good, 10 – excellent).¹⁸ The data were collected on the structured proforma.

Results

A total 40 candidates were enrolled and equally divided into two groups, their mean age was statistically insignificant as the mean age of group I was 26.70 ± 4.05 years and group II 27.10 ± 3.62 years ($p=0.469$). Mean work experience of group I was 2.96 ± 1.52 years and of group II was 2.99 ± 1.23 years ($p=0.809$). Table I

The results showed a difference in time for completion of task between the two groups. The group I who has performed in the skill lab has performed better than the group who has observed or assisted II, 6.15 ± 1.98 ($p=0.001$). Figure .1

Table I: Comparison of two groups regarding mean age and work experience (n=40)

Demographic information	Group 1- (n=20)	Group 2- (n=20)	p-value
Age (mean \pm SD)	26.70 ± 4.05 years	27.10 ± 3.62 years	0.469
Work experience (before workshop) (mean \pm SD)	2.96 ± 1.52 years	2.99 ± 1.23 years	0.809

Group 1= Skill lab

Group 2= laparoscopic theatre

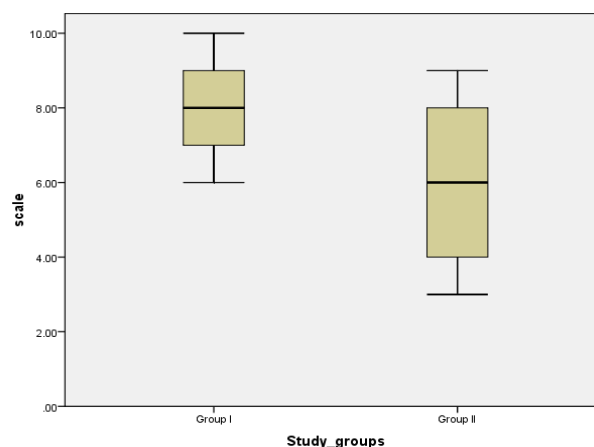


Figure 1: Comparison of Mean (Scale Assessment) between (Study Group)

Mean scale	Group I	Group II	p-Value
Mean \pm SD	8.10 \pm 1.29	6.15 \pm 1.98	0.001
Median	(8.00)	(6.00)	

In the lab skill group, all participants were found with satisfactory, good and excellent performance, while in the surgeon assistant group 35.0 participants were found with poor and unsatisfactory performance, findings were statistically significant (p-0.001). Table II

Table II: Comparison of final work evaluation on scale among both groups (n=40)			
Final work evaluation	Group 1- (n=20)	Group 2- (n=20)	p-value
1-2	00	00	0.001
3-5	00	7(35.0%)	
6-8	12(60.0%)	11(55.0%)	
9-10	8(40.0%)	2(10.0%)	
Total	20(100.0%)	20(100.0%)	

Discussion

Over the last few decades, laparoscopy has gained popularity. Apart from saying this, it is very challenging for the surgeon to master this skill due to financial and time constraints. Cost is considered to be a major barrier especially when we talk about public sector hospital of a developing country. Another barrier for gynaecologists is to manage a load of obstetrical emergencies at the same time and place. Thus, to dedicate fully operational theatre for laparoscopic surgeries is difficult at times. Furthermore, the equipment is costly and procurement of the equipment is a big hurdle.

To perform any psychomotor skill proficiently, repetition is necessary. The use of simulation is an innovation in the field of minimal invasive surgery. Considering patient safety, use of box simulator is recommended as it will provide an opportunity to learn the skill in safe environment then transfer to the real patient setting in a smooth way.⁵

The laparoscopic surgeon during the initial learning phase takes long hours to complete the procedure and the conversion of a laparoscopic procedure to open procedure might be higher. Training on simulators has overcome these

problems and helps in confidence building of surgeon.⁶

Simulation can be either of the following: box simulator, animal model trainer, virtual reality simulator (VR), real procedure system. Box simulator is opaque and in a rectangular shape with camera in the middle of the box which is used as a laparoscope and is attached to monitors. For exercises, instruments or graspers are the same as used in operation theatres thus giving the real essence to the trainee. Tasks practiced on box simulator resemble the skill required for performing the surgeries in real time. VR simulator is expensive but very reliable as it evaluates the task performed by the trainee very accurately and no supervisor is required. VR simulator has gained popularity because of the robotic assisted surgery.⁷

Animal model simulators are in use in India but there are ethical concerns as well as availability and feasibility issues. Full procedural simulators show all the anatomical land marks but cost is too high.

The purpose of using box trainer and performing the exercises like peg transfer, ball transfer is to improve the basic skill of a surgeon. Repetition of these exercises will improve the hand eye coordination, instrument navigation, depth perception and precision. All are very basic components and necessary even for diagnostic laparoscopic procedures.⁸ With further practice, the surgeon can detect his own weak areas and can spend more hours on the simulator to master himself for the same task and perform it more efficiently.

As it is a technical skill thus training will reduce the time and amount of difficulties faced during the procedures.

Role of box simulators in learning the basic laparoscopic skills has been assessed by many researchers at national and international levels. Our results are at par with the study conducted in Pakistan at the department of surgery of Services hospital, Lahore which also showed promising

results that use of simulators has resulted in significant improvement in the skill performance in the intraoperative field. In this study, the authors recommended that with practice and training even the junior resident who usually holds a camera can perform initial dissection of the gall bladder in cholecystectomy.⁹

In our study, the assessment was done of two groups who worked in simulator lab and in theatres on day one. The evaluation of both groups was done by VR simulator, which showed that the group coming from simulator lab performed better hand-eye co-ordination, precision towards target and depth perception.

The purpose of training is to master the skill first then transfer on real patients. Assessment of laparoscopic skills is mandatory because patient safety remains the priority always in healthcare. The limitation of our study is that it has not evaluated the participants while performing the laparoscopies, although another study done in SIMS and National hospital, Lahore evaluated the global assessment of laparoscopic surgery for assessing the improvement of intraoperative laparoscopic skills while the surgeons are performing in theatres and the study outcome has shown that it is a valid and reliable tool to measure the intraoperative skills.¹⁰

A similar study conducted at PGMI Lady Reading Hospital, Peshawar. Their results have shown a significant difference in the confidence interval when trainees were assessed at 0 and 1 month after using the box simulators. The time in minutes calculated for completion of the following tasks Peg transfer, ligating endo-loop, intra-corporeal knotting and extracorporeal knotting. Thus, use of endo trainers is important for laparoscopic skills.¹¹

Repetition and doing the same exercise many times has improved the “past-pointing” in our study. A similar outcome has been shown in a study conducted in India. In which the authors assessed the task completion time (TCT) after use of a simulator in the training program of urology. They used the objective tool for assessing the

improvement in skill and published their results showing improvement in TCT.¹²

The results of our study are at par with another study from India, in which the residents were randomized in two groups. One who received training in skill lab and the other with no training. Both groups were evaluated by their psychomotor skill in theatre. The results are in comparison to our study that the training on simulators brings improvement on the skill.¹³

Wilson E and et al conducted in New Zealand, which showed a significant impact or improvement of laparoscopic skills after using take-home box simulators. In this study, the program was run for two years i.e. 2015 and 2016. A take-home box trainer was provided to participants and they were evaluated at the end of simulation-training on VR system. In this study, the median time to complete the task had improved significantly after use of box trainer. Another important point highlighted in this article is that the presence of a supervisor doesn't improve the learning thus more emphasis was on self-directed learning. Availability or access to the simulator improves the learning curve.¹⁴

To in-cooperate the use of box trainer in the laparoscopic training program, its validity has to established. The literature showed that the study published in BJOG in 2011, established the face and construct validity of simple and low-cost box simulator. In this study, the participants performed different exercises like “post and sleeve”, “loops and wire”, “pea on a peg”, “wire chaser (one hand)”, “wire chaser (two hands)” and “zigzag loops”. The objective of practicing different exercises is to train and test various skills, such as hand–eye coordination, manual dexterity, depth perception and interaction of the dominant and non-dominant hand. After establishing the validity of the box simulator, they made a short training program and implemented it. Our goal is also to in co-operate the use of box trainer in the training program of the residents in the department of gynaecology.⁸

Time spent outside the operation theatre on the simulation improves the precision and speed of movement during the surgical procedures thus improves the learning curve. Samia et al also emphasizes in their study that the use of a simulator improves the level of comfort and efficiency of the surgeon in laparoscopic theatre.¹⁵ Literature review supports that repetitive use of simulator has improved the transfer of skill to the real patient.¹⁶

In another randomized, double blinded study Seymour et al have proved that the transfer of skill improves after dedicated use of simulators.¹⁷ Similarly, Stroka et al evaluated the Fundamentals of Laparoscopic Surgery simulator and shown that there is a significant impact of the use of simulator as it has improved the proficiency and skill transfer while doing laparoscopic cholecystectomy.¹⁸

A study conducted in India, the authors emphasized the need for a structured curriculum for basic laparoscopic surgical skills (LSS) with the performance assessment and evaluation methods to be in co-operated as well. In this study during the level-1 LSS course, the trainees were being familiarized with ergonomics, given equal time and opportunities for hands-on training and on endo-trainers. They were being evaluated by the assessor on the structured evaluation form and at the end feedback was taken from the participants. The results of our study are at par with this study as in this study, the participants also demanded an “increase in time to spend on endo-trainers”.¹⁹

Literature shows that the structured training program with the comprehensive evaluation and feedback from the participants in the LSS course helps in the assessment of trainees, the similar feedback by the participants were shown in the result of our study.²⁰

Thus, access to the endo-trainers and time spent on different exercises improves the skills of the surgeon and is beneficial to the healthcare system.

Conclusion

The box trainer is an effective low- cost solution to improve the laparoscopic skills in a low resource country like Pakistan.

Recommendation: It is important to develop the standard and structured curriculum for trainees who are interested in laparoscopy. Use of simulation should be integrated in the curriculum.

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