



A Simple Low Cost Laparoscopic Box Trainer Using a 5 Megapixel Web Camera: An Easily Available Training Tool at Home for Residents and Medical Students during COVID-19 Pandemic

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Abstract

Objective: Pelvitainers designed for improving laparoscopic surgical skills have high cost and sophisticated equipment. Virtual reality laparoscopic trainers which are valid tools for laparoscopic skills training have been found to improve laparoscopic clinical competence and they should be implemented in the comprehensive training curriculum in gynecology. Such trainers are mostly unattainable for residents. Homemade webcam systems are comparable in function to the more elaborate video trainer and furthermore, the webcam system also allows instant recording and review of techniques.

Design: Furthermore, complicated laparoscopic trainers have limited access for residents because of time and place limitations so laparoscopic skill cannot be achieved perfectly without having enough time period for training. A simple low cost laparoscopic box trainer has been designed to overcome this handicap.

Conclusion: All the equipment used for this box trainer cost 40 US dollars except computer and laparoscopic instruments. This training system is portable and easy to connect for training purposes.

Keywords: Laparoscopic surgery; Clinical skill; Education; Internship and residency; Box trainer; COVID-19

Introduction

Laparoscopic surgery is increasing its popularity worldwide. Pelvitainers designed for improving laparoscopic surgical skills have high cost and sophisticated equipment. Such trainers are mostly unattainable for residents. A simple low cost laparoscopic box trainer has been designed to overcome the unavailability handicap of sophisticated trainer systems for residents and or teaching purposes. A novel laparoscopic home trainer using a color mini-camera has been described previously [1]. Homemade webcam systems are comparable in function to the more elaborate video trainer and furthermore, the webcam system also allows instant recording and review of techniques [2,3]. Pokorny et al. [4] have used a spy camera mounted on a rigid plastic tube that was used within a translucent plastic training box, obviating the need for an inbuilt light source as a laparoscopic box trainer that cost 200 New Zealand dollars. Virtual reality laparoscopic trainers which are valid tools for laparoscopic skills training have been found to improve laparoscopic clinical competence and they should be implemented in the comprehensive training curriculum in gynecology [5]. Virtual reality trainers like laparoscopic simulators may have some advantages and most users of these trainers felt that inanimate box trainers help more, are more interesting, and should be chosen over virtual reality trainers [6-9]. The aim of this article is to describe the design of a low cost box trainer based on a 5 megapixel web camera assembled to a computer which can establish a closer relationship with the visual and functional perspectives of optics during surgery.

Instrument Presentation

A cardboard package has been designed to resemble abdominal cavity by creating four holes;

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Figure 1: The view of the cardboard package to resemble abdominal cavity by creating four holes; one for web camera, one for light source, two for operating channels.

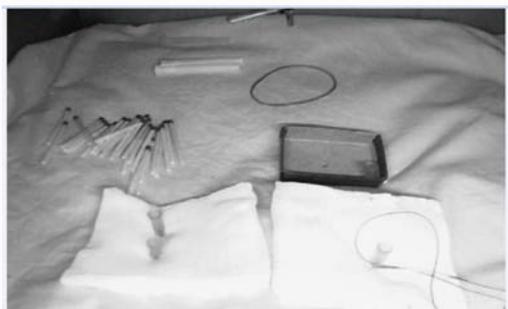


Figure 2: The computer view of the surgery clothes placed to the base of the box; sponges, matchsticks and a matchbox to facilitate training from the upper part of the box by using original laparoscopic instruments.

one for web camera, one for light source, and two for operating channels (Figure 1). Inner part of this box has been covered with soft low weight material to impede trocar displacement. A rod shaped halogen light source originally produced as a notebook light has been assembled to lateral part of the training box as laparoscopic illuminator. A 5 megapixel web camera including extra light source has been adhered to the posterior upper part of the box and connected to a notebook computer arranged to get view from the camera *via* using its software installed before. Surgery clothes has been placed to the base of the box; sponges, a surgical needle, matchsticks and a matchbox have been arranged to facilitate training from the upper part of the box by using original laparoscopic instruments (Figure 2). We exercised to hold the matchsticks one by one with laparoscopic grasper and tried to put them into the matchbox. We also grasped the surgical needle with laparoscopic needle holder and tried to suture the sponge mimicking intracorporeal laparoscopic suturing. These exercises have been successfully completed and repeated at home until satisfactory laparoscopic skills has been gained. The orientation feeling was the same with real laparoscopic surgery except the view of the web camera on the computer showed 1 second delay from the current movements by means of 2-dimensional visual feedback (Figure 3). At first this looked like a deficiency but this delay has not been felt by the operator and various real time skill improving movements in the training box like grasping, cutting and suturing have been made. All the equipment used for this box trainer cost 40 US dollars except computer and laparoscopic instruments.

Discussion

Laparoscopic surgery has become a standard of surgery for due to its minimally invasive nature and unique advantages over laparotomy



Figure 3: The view of the position of rod shaped halogen light source in the box trainer.

including tissue dissection more precisely. Physicians should increase their surgical skills by using box trainers, video trainers and virtual reality trainers before commencing into challenging surgical procedures requiring high expertise. In a meta-analysis which has been performed by evaluation of 31 randomized controlled trials, virtual reality simulation has been found to be significantly more effective than video trainers, and at least as good as box trainers [10]. Virtual reality simulation in laparoscopic surgery is a growing field, and many studies have been published to determine its effectiveness. Virtual reality surgical simulation is a valid tool for training of laparoscopic psychomotor skills and could be incorporated into surgical training programs. They have sophisticated and expensive equipment that results unavailability for medical students and residents. In a randomized controlled trial; a homemade trainer using a tablet for visualization has been compared with standard pelvic video trainer among medical students, residents and experts. All expertise groups, except medical students, have rated the tablet based home trainer as having superior image quality and resolution when compared with the standard pelvic trainer which has been rated higher for overall performance [11]. The authors have emphasized that homemade tablet based trainers can be used for laparoscopic training and developing laparoscopic skills based on several advantages of being inexpensive, portable, and readily available for training at home when compared with standard video trainers. In another expert opinion study; gynecology residents have evaluated a portable box trainer by giving scores from 1 to 5. In consequence, a score of 4 has been assigned by the residents whether the portable box trainer would be effective in training laparoscopic skills in general; in training hand-eye coordination, 3D perception, and tying knots or not [12].

During the Coronavirus Disease 2019 (COVID-19) pandemic; the number of surgeries performed by medical students, residents, and fellows has dropped due to global lock down measures. The importance of maintaining surgical training by using other resources has also increased parallel to the shortage of elective surgeries. Recently published studies have proven that laparoscopic box/video trainers, virtual reality trainers, simulation models, video games and online surgical simulations are beneficial for trainees to develop individual surgical skills [13,14]. Abovementioned studies have shown that box trainers are no inferior in laparoscopic surgical practicing performance when compared with sophisticated and expensive video trainers or virtual reality trainers.

Conclusion

In this study; a homemade training system which provides illumination and visual perspective conditions similar to those of

real surgery using 5 megapixel web cameras has been designed. This training system is portable and easy to connect for training purposes. Its ports allow for various options that help to improve skills. Medical students and residents can obtain the components of this homemade box trainer and assemble it easily by their own. They can work with this low cost trainer to increase their laparoscopic surgical skills during global COVID-19 pandemic.

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