Nep-Endotrainer: A cost-effective home-made laparoscopic simulation tool

Uttam Laudari[1], Deepak Mahat[2], Rosi Pradhan[3], Suyog Bhandari[4], Deepak Raj Singh[5]

Abstract

Introduction: Laparoscopic surgery is an established treatment modality worldwide. Opportunities to acquire this skill using expensive simulation at workplace are not always feasible due to cost, time and accessibility constraints. Nep-Endotrainer is a cost effective homemade laparoscopic simulation tool built in Nepal.

Methods: Nep-Endotrainer was built using plastic manikins easily available in market. Nine apertures were created with a drilling machine, four on each side of umbilicus and one at the epigastric region. These apertures were covered by thick piece of rubber of vehicle tire with apertures in them. Logitech® C270 HD webcam was fixed interiorly with metal screws. The base of the manikin was fixed to a wooden board with hinge joint. Five different interchangeable training modules were assembled in 10×10 cm^2 size wooden boards. The LED light was fixed interiorly near the web camera. The camera USB can be easily connected with laptops, tablets and mobile phones. We used discarded hand instruments from laparoscopic centers to reduce the cost of the endotrainer.

Conclusion: Nep-Endotrainer is accessible to any personal budget and can be readily constructed. It allows more frequent practice at home, outside the venue and hours of surgical departments.

Keywords: Endotrainer; Laparoscopy; Simulation.

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Disclosures:

Ethical Clearance: Not applicable

Conflict of interest: None

Financial aid: None

How to cite this article:

Laudari U, Mahat D, Pradhan R, Bhandari S, Singh DR. Nep-endotrainer: A cost-effective home-made laparoscopic simulation tool. J Soc Surg Nep. 2020 Dec;23(2):52-55.

DOI:

https://doi.org/10.3126/jssn.v23i2.35839

Introduction

Laparoscopic surgical skills acquisition is an essential part of surgical training. The learning curve of laparoscopic surgeries can be decreased by significant practice using simulation tools.[1,2] Commercially available laparoscopic simulation tools in our part of region are expensive, and only available in designated simulation laboratories. Such set up may not be accessible to trainees and surgeons during working hours. We here describe how we constructed a cheap and mobile endotrainer that was successfully incorporated in "Buddha Minimal Access Intervention Center Portoscopic Training program". Our endotrainer is reproducible and can be used in universities, training centers and also for self-directed practice at home.

Methods

Nep-Endotrainer was constructed using manikins made from plastic which is readily available in the market. The dimension of the half body manikin was 0.10×0.14×0.28m^3 (**Figure 1**). The base of the manikin (when laid supine) was cut to place practicing modules. A total of nine apertures were created with a drilling machine; four on each side of umbilicus and one at the epigastric region. The apertures were covered by thick pieces of rubber made of vehicle tire the mid parts of which were cut in a cruciate manner to create aperture for instrument placement. This helped to imitate the elasticity of skin. Three small apertures were created in triangular fashion just in front of the webcam to mimic single incision surgery port (SILS port).

We used Logitech® C270 HD webcam and fixed it interiorly with metal screws to focus on the practicing modules. Six different interchangeable training modules were made in 10x10 cm size wooden block, viz: thread transfer, precision cutting, snaring, peg and ball transfer, extracorporeal knotting device, intracorporeal suturing module with sponge bicycle handlebar grips (**Figure 2**). The LED light was fixed interiorly near the web camera for better illumination. LED light can be connected to any power device for illumination. The software of the camera was installed in a laptop and mobile phones (**Figure 3**). The base of the manikin was fixed with screws to a wooden board with hinge joint such that lifting the box is possible when required. The Nep-Endo trainer was then integrated into the first Portoscopic skill training program at Buddha Minimal Access Intervention (MAI) Center, Kalimati, Kathmandu with other commercially available endotrainer (**Figure 4**). The participants found the Nep- Endotrainer effective for training. The final result of prospective observational evaluation is yet to be published.

Discussion

In this article, we report a cost-effective laparoscopic simulator called Nep-Endotrainer which is made in Nepal. Laparoscopic surgery is a widely established modality of treatment in minimal invasive surgery. The learning curve of laparoscopic surgery is long, with major limiting factors being impaired depth of perception on two-dimensional screen, limited tactile feedback, and fulcrum effect of long instruments that amplifies tremor. A simulation box can decrease this learning curve and improve surgical skills of trainees.[3] Trainee can improve the skills in structured, low pressure environment outside the operating theatre and no any risk to the patient. Simulation laboratories are usually accessible during working hours so trainee has to compromise the time of patient care and duties. During working hours trainee may be fatigued so they may be hesitant for voluntary training at simulation center.[4]

Korndorffer et al in their study compared home training using inexpensive trainer box (<$2000) with simulation

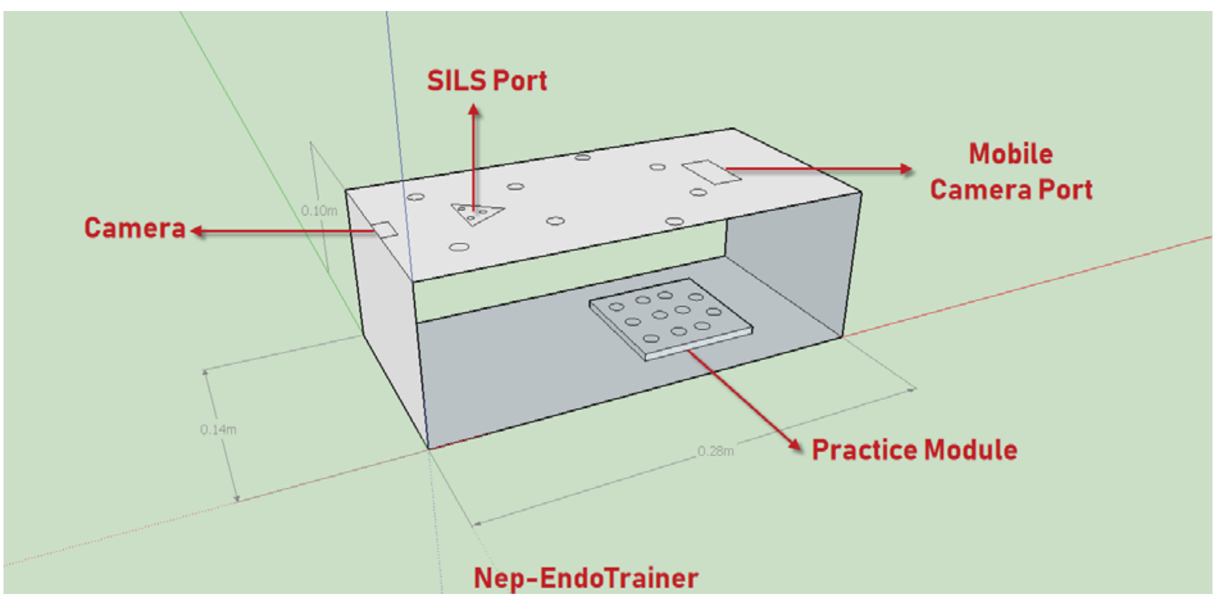

Figure 1. Basic architecture of Nep- Endotrainer

Figure 2. Interchangeable training modules for precision cutting (A), snaring (B), intracorporeal suturing (C), peg and ball transfer (D), and thread transfer (E)

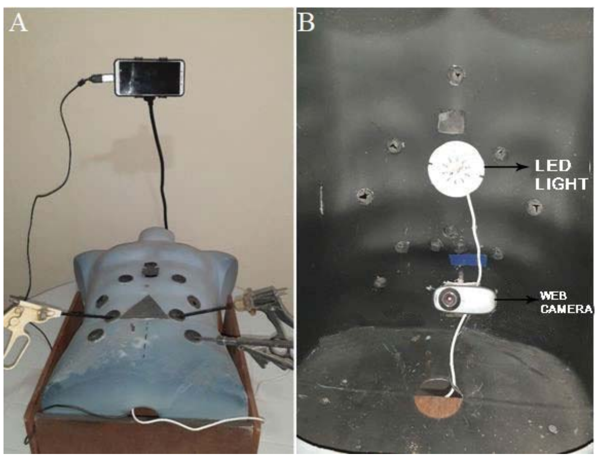

Figure 3. Nep-endotrainer connected to mobile camera (A) and figure (B) showing interior of the box with web camera and LED light

Figure 4. Nep- Endotrainer being used in Buddha MAI Portoscopic training program with other commercially available simulation box

center training using standard video trainer. Both groups were encouraged at least one hour per week training. They found that home-trained group trained for significantly more sessions and had higher skill retention. Such short and frequent training sessions allowed trainee to perform task when not fatigued, when they are more focused and effortful and avoiding interruptions due to hospital calls.[4]
The major barriers for simulation training are need for time, expensive simulation tools, and most importantly lack of access.[5] Residents and trainees from low- and middle-Income countries (LMIC) have very less stipend and cannot afford commercially available endotrainer on their own. So, development of affordable DIY (Do it yourself) endotrainer like Nep-endotrainer can increase the accessibility and wide spread use at home and hospital according to own schedule. Use of such endotrainer can definitely improve the overall outcome of simulation-based laparoscopic training program.[5] Westwood et al conducted three days laparoscopic training annually in Nepal. Their six-year experiences showed that the participants found the workshop very useful, was able to increase confidence, and increase skill. Participant have to travel from all over Nepal to designated centers for such training.[6] An optional way of increasing the accessibility in LMIC would be development of such DIY endotrainer in all institutes and dissemination of structured online training module at home and hospital. Training at home should be guided by educational principles and be self-paced, with ability for self- rating by simple score for self-evaluation.[5]

Nep-endotrainer is a cost effective endotrainer that costs around $100. It can be used as a prototype endotrainer in LMIC which can be easily made at home and can be used with mobile phones, tablets and laptops. There are many cost effective laparoscopic endotrainers reported that have used plywood board with digital camera,[7] mirror based,[8] housing of translucent plastic box with USB endoscope video camera,[9] and metallic basket with webcam.[10] Nep-endotrainer is webcam based endotrainer made from plastic manikins which simulates real laparoscopy and is easily reproducible. The commonly available endotrainer so far needs a desktop monitor whereas Nep-endotrainer can be easily connected to laptop, tablets and mobile with USB cable which can motivate trainee and young surgeons for frequent self-directed practice. Connecting endotrainer to laptop may be cumbersome to trainees and surgeons during or just before surgery for short practice sessions in between free time of surgeries. Mobile phone can be easily connected with the USB cable in absence of laptop to increase wide spread use. Mentors may not be available during working hours to see the practice session, Nep-endotrainer can be easily made available around the operating room premises, tea room and lobby where student can be monitored by their colleagues and seniors in between the surgeries and utilize time.

Commercially available endotrainers are expensive, and installed mostly at designated simulation laboratory. The major reason of low cost of our endotrainer is that we have used plastic manikin which is readily available and simulates a real body. Also, we have reused hand instruments that were discarded from operating theatres. Hand instruments like scissors, Maryland forceps, and graspers can be reused from any operating theatre. The cost of needle holder is expensive. However, we were able to mend and use the needle holder. Needle holder for simulation is available in online store at around $30. The cost will be even less if produced in mass by any companies.

Conclusion

Laparoscopic simulation tool plays a vital role in skill enhancement. Nep- Endotrainer is one of the cost-effective simulation tools which can be easily built at home and be used for training purposes in resource deficit regions.

Acknowledgements:
Mr. Hare Ram Malla Thakuri; Operating theatre nurses of Patan Academy of Health Sciences; Yak and yeti enterprises private limited, Lazimpat, Kathmandu; Buddha Minimal Access Intervention (MAI) Center, Kalimati, Kathmandu.

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