Commercial Video Laparoscopic Trainers versus Less Expensive, Simple Laparoscopic Trainers: A Systematic Review and Meta-Analysis

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Abbreviations and Acronyms

PGY = postgraduate year

RCT = randomized, controlled trial

SLT = simple laparoscopic trainer

SMD = standardized mean difference

VLT = video laparoscopic trainer

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Purpose: Advancements in laparoscopic surgical simulation have led to technologically sophisticated but generally more costly surgical trainers. Given that higher costs can limit training institutions, an exploration of cost-effective alternatives is a worthwhile endeavor. We compared commercial video laparoscopic trainers and less expensive simple laparoscopic trainers to evaluate how they differ in facilitating the acquisition of laparoscopic skills in surgical trainees, as measured by laparoscopic task completion time.

Materials and Methods: We performed a comprehensive, systematic search of the literature, which yielded 1,091 citations after excluding duplicates. Ten articles were fully reviewed and 5 were included in the final analysis. Articles were reviewed to ensure that a comparison of video and simple laparoscopic trainers was present and laparoscopic tasks were examined. Quality assessment of studies was completed using a comprehensive checklist. We examined continuous data with calculation of the standardized mean difference. Performance times were pooled using a random effects model and the chi-square test for heterogeneity. Meta-analysis was done to compare post-training performance times between video and simple laparoscopic trainers for the 2 laparoscopic tasks of suturing and object transfer.

Results: We found no statistically significant difference in task completion time for video and simple laparoscopic trainers. Meta-analysis of the 7 laparoscopic tasks assessed by others favored video over simple laparoscopic trainers but this was not statistically significant (standardized mean difference –1.82, 95% CI –0.61–0.02, p = 0.07).

Conclusions: Video and simple laparoscopic trainers are equally proficient for facilitating the acquisition of laparoscopic skills, suggesting that simple laparoscopic trainers may be a cost-effective alternative.

Key Words: urology; laparoscopy; clinical competence; cost-benefit analysis; education, medical

Laparoscopy is no longer a technique that is used by few and admired by many. As an important part of urological surgery, it is widely used for various urological ailments. Urologists are well aware of the thoroughly documented advantages of laparoscopy over traditional open surgery, including decreased pain, morbidity and hospital stay, while maintaining similar surgical outcomes.[1,2] Surgical educators face the challenge of incorporating laparoscopic training into curricula in a safe, efficient manner.[3] Considering the

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difficulty of becoming accustomed to spatial orientation in a 2-dimensional environment, decreased tactile feedback, manipulation of longer instruments and the fulcrum effect,[4] acquiring laparoscopic techniques requires an approach tailored to its unique skill set.

The natural progression of laparoscopic simulator development has been toward more sophisticated, technologically advanced models. Generally, these advancements are accompanied by higher costs.[5] In the current fiscal climate, which encourages stringent budgets and careful spending, it is beneficial to reevaluate available laparoscopic bench model training options. Financial decisions in laparoscopic training programs must be further balanced with the surgical skills program objectives of providing safe, effective and yet high quality training. Ideally, laparoscopic trainers should minimize spending without jeopardizing effective skill acquisition. Lower costs are typically associated with less sophisticated models.

For the purposes of the current review we arbitrarily categorized lower cost models, including commercial mirror trainers and homemade box trainers, as SLTs. Commercial mirror trainers, such as the SimuView® Suture Trainer, are simplified 2-dimensional laparoscopic simulators that use a reflective imaging system. Homemade box trainers are constructed from various low cost materials that are easy to access.[6]

VLTs allow trainees to practice technical skills under the view of a video camera with the simulated image displayed on a computer screen. These commercial products are significantly more expensive and less portable than commercial mirror trainers and homemade box trainers. It is unclear whether VLTs are more effective for acquiring surgical skills than SLTs.

We performed a systematic review and meta-analysis of published studies comparing VLTs and SLTs. We hypothesized that that we would detect important differences in how these devices facilitate the acquisition of laparoscopic skills by surgical trainees.

MATERIALS AND METHODS

We performed a systematic electronic search of MEDLINE® from 1946 to June 2011, EMBASE® from 1947 to June 2011, the Cochrane Database of Systematic Reviews from 1998 to June 2011 and the American Urology Association (AUA) conference abstract database from 1992 to 2011. For database searches we used a combination of key words and MeSH® terms, including laparoscopy, surgical procedures, minimally invasive, educational model, structural models, medical staff, medical education, curriculum and competency based education with no limits placed on language (supplementary figure, http://jurology.com/).

A total of 1,212 citations were found from the combined database searches, which were narrowed down to 864, excluding duplicates. The AUA abstract search yielded 227 citations. Reference lists of the studies selected for full text review were examined to identify relevant studies that were missed during the search but this yielded no additional material. The supplementary figure (http://jurology.com/) shows our search strategy.

One of us (TN) screened the citations based on titles and abstracts to select articles suitable for full text review. Our study inclusion criteria were that 1) the publication examined laparoscopic procedures or tasks and 2) it included a direct comparison between a commercial VLT and a less expensive, less sophisticated SLT, and 3) the focus of the comparison was to determine which trainer was superior for improving laparoscopic skills in trainees. Since studies were required to prospectively assess laparoscopic skills, narrative reviews, retrospective series, surveys and historical reviews were excluded from analysis.

Three independent reviewers (EDM, LHB and TN) completed the full text screening and applied the inclusion criteria. Disagreements were settled by group discussion until 100% consensus was attained. After the full text review of 10 articles, we identified 5 full text publications that met our eligibility criteria. No abstracts met our criteria.

Quality assessment of included publications was performed by one of us (TN) using a quality assessment instrument adapted from Elyas et al[7] and modified to fit our study objectives (table 1). We defined participant training as the period that trainees practiced on the trainer(s) before final assessment. Task completion time and the quality of the completed task were outcomes

Table 1. *Quality assessment of included publications*

	Yes	No	Unclear	Not Applicable
Study design:				
RCT	5	0	0	0
Cohort	0	5	0	0
Case series	0	5	0	0
Quality items:				
Was study randomized?	5	0	0	0
Was baseline assessment performed?	2	3	0	0
Were groups similar at baseline?	2	1	2	0
Did participants lack previous laparoscopic experience?	3	1	1	0
Was a priori sample size calculation reported?	0	5	0	0
Did all participants complete experiment?	3	2	0	0
If not, was reason given for patients withdrawing/dropping out?	1	0	0	4
Was/were statistical test(s) reported?	5	0	0	0
Was p value reported?	5	0	0	0
Was 95% CI reported?	2	3	0	0
Interventions:				
Were simulators being compared adequately described?	4	1	0	0
Were tasks being assessed adequately described?	5	0	0	0
Did all participants receive same instruction?	2	0	3	0
Did all participants train for same amount of time?	3	0	0	2
Outcomes:				
Was quality of task completion (eg accuracy) assessed?	4	1	0	0
Were quality assessors blinded?	2	3	0	0
Were quality assessors experts?	2	0	3	0