Chapter 3

Voluntary Autonomous Simulator Based Training in Minimally Invasive Surgery, *Residents' Compliance and Reflection*

Pieter J. van Empel, M.D., Mathilde G.E. Verdam, MSc., Magnus Strypet, M.D., Lennart B. van Rijssen , Judith A. Huirne, M.D., Ph.D., Fedde Scheele, M.D., Ph.D., H. Jaap Bonjer, M.D., Ph.D., Wilhelmus J. Meijerink, M.D. Ph.D.

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Abstract

Background

Knot tying and suturing skills in minimally invasive surgery (MIS) differ markedly from those in open surgery. Appropriate MIS training is mandatory prior to implementation into practice. The Advanced Suturing Course (ASC) is a structured simulator based training course which includes a six week autonomous training period at home on a traditional laparoscopic box trainer. Previous research did not demonstrate a significant progress in laparoscopic skills after this training period. This study aims to identify factors determining autonomous training on a laparoscopic box trainer at home.

Methods

Residents (n=97) attending one of 7 ASC courses between January 2009 and June 2011 were consecutively included. After six weeks autonomous training a questionnaire was completed. A random subgroup of 30 residents was requested to keep a time log. All residents received an online survey after attending the ASC. We performed outcome comparison to examine the accuracy of individual responses.

Results

Out of 97 residents, the main motives for non compliant autonomous training included a lack of (training) time after working hours (n=80, 83.3%), preferred practice time during working hours (n= 76, 31.6%), or another surgical interest than MIS (n=79, 15.2%) . Previously set training goals would encourage autonomous training according to 27,8% (n=18) of residents. Thirty participants submitted a time log and reported an average 76.5-minute weekly training time. All residents confirmed that autonomous home practice on a laparoscopic box trainer is valuable.

Conclusion

Autonomous practice should be structured and inclusive of adequate and sufficient feedback points. A minimally required practice time should be set. An obligatory assessment including corresponding consequence should be conducted. Compliance herewith may result in increased voluntary (autonomous) simulator based (laparoscopic) training by residents.

Introduction

Minimally Invasive Surgery (MIS) is an increasingly popular approach in surgical, urologic and gynecologic surgery. MIS has demonstrated to reduce blood loss and postoperative pain, improve cosmetic results, decrease hospital stay and accelerate postoperative recovery[1;2]. Current residency curricula mandate all residents to be able to adequately perform basic laparoscopic procedures. An increasing number of studies indicate that prior experience in open surgery only displays minor correlation with laparoscopic performance[3-5].

MIS skills differ markedly from those in open surgery. Distinct psychomotor skills, altered depth perception, video-eye-hand coordination and diminished tactile feedback characterize MIS[6]. Furthermore, rigid operating room (OR) schedules, condensed surgical training curricula and an increasing awareness of patient safety have made the OR undesirable as a primary teaching environment for the acquisition of surgical (MIS) skills[6-13].

Various simulation based educational methods have therefore been developed, including virtual reality (VR)- and augmented reality (AR)- simulators, box trainers, and training on cadaveric or animal models. Skills acquired outside the OR have shown to be transferable to the OR[14-16]. Unfortunately, training in MIS has shown to be inadequate at times. Particularly, voluntary autonomous training by residents during working-hours is disappointing[17;18]. Training on a voluntary basis may address this problem, additionally conforming to decreasing working hours. Furthermore, and voluntary autonomous training may result in increased skill-retention[19].

To educate and stimulate training in basic laparoscopic procedures, the general surgery and gynecology departments at our hospital introduced the Advanced Suturing Course (ASC) in Belgium and The Netherlands. The ASC consists of two training days in laparoscopic surgery in-between which a six week autonomous training period is located. Multiple studies have demonstrated distributed interval training preferable above continuous ‘mass’ training[20-23]. The ASC makes use of standard laparoscopic box trainers, which several studies have found to be favorable above VR simulators[24-26]. To our knowledge this is the only curse providing a complete box trainer setup at home. Previous research demonstrated no significant improvement of MIS skills after six weeks autonomous training[27]. The aim of this study is to identify factors determining autonomous training on a laparoscopic box trainer at home and explore possible solutions to address encountered issues.

Materials and methods

Participants

Participating residents in general surgery, urology and gynecology at 7 Advanced Suturing Course (ASC) courses between January 2009 and June 2011 at 3 different academic centers and 2 large regional training hospitals in The Netherlands and Belgium were voluntarily enrolled. Residents at any postgraduate year may attend the ASC as basic laparoscopic and open skills trainings programs have been completed.

Training

The ASC consists of two training days in-between which a six-week period. Training day 1 focuses on laparoscopic knot-tying skills under the supervision of senior surgeons. The laparoscopic box trainer simulates the abdomen by an aluminum frame and includes a built-in light source and camera coupled to a monitor. Three apertures in a removable cover are used to introduce traditional trocarts and instruments and camera (Lapstar, Camtronics B.V., The Netherlands). After the first training day the box trainer is taken home for 6 weeks autonomous training. At day 2 laparoscopic knot tying techniques are repeated and evaluated, and practice takes place on porcine stomachs and intestines.

Reflection

Participants completed a questionnaire involving 10 questions regarding voluntary autonomous (home) practice. Questions were presented as Multiple Choice (MC) answers on a five-point scale with the opportunity to elaborate on answers. A value of 1, “totally disagree”/”very bad”, to a value of 5, “totally agree”/”very good” was assigned. We categorized scores of 1 or 2 as “ disagree”, 3 as “neutral” and 4 or 5 as “agree”. Participants were also asked to report on their autonomous practice time. To test the accuracy of reported practice time, 30 participants were randomly allocated to keep a time log.

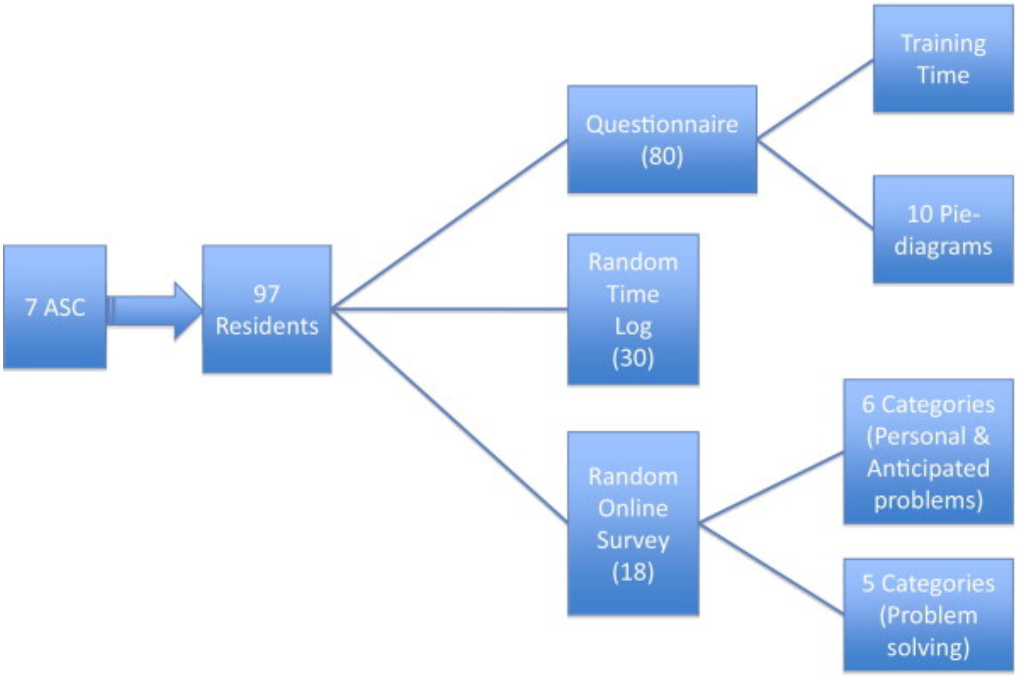
After the second training day, all participants were invited by email to complete an online 3-question survey to explore in more depth problems involving voluntary autonomous home training on the laparoscopic box trainer and possible improvements to encourage voluntary practice at home. The answers to the three open question about problems involving voluntary autonomous home training were categorized into different areas of conflict and were reported as the problems that were encountered by the resident personally and the problems that the resident thought might be encountered by other residents. The answers to the question about possible improvements to encourage voluntary practice at home in the future were categorized into 5 different areas of focus.

Statistics

Statistical Package for the Social Sciences (SPSS) version 15.0.0 (SPSS, Chicago, IL, USA) was used for statistical analyses. Given the normal distribution a student's t-test was used to compare practiced time versus desired practice time. Data were graphically illustrated using pie diagrams. Answers to the questions were presented as frequencies and percentages

Tests were performed 2-sided, p value < 0.05 was considered as statistical significant.

Figure 1 (flow-chart)



Results

A total of 97 residents participated in 7 ASC courses. 80 residents (82.5%) completed the MC survey and 18 (18.6%) residents completed the online survey. Residents (n=72) reported an average 360 minutes practice time during the six week training period. The 30 time logs reported an average training time of 298.5 (SD = 383.1) minutes over the six week training period. No significant difference was found in total average time practiced between residents keeping a time log and residents not keeping a time log (406.5 vs 415.0 minutes, p= 0.96). The average time spent training during six weeks was significantly lower than the reported average desired practice time by the 30 residents, which was 1687.6 (SD= 1225.9, p < 0,05) minutes (=281.3 minutes a week).

MC questions demonstrated that 83.8% of 80 residents felt not to get enough MIS practice time without a box trainer. Not having sufficient MIS training time during residency was reported by 45% of 80 residents. An other interest than MIS was stated by 15.2% of residents. While 42.5% of 80 residents felt to have spent sufficient time on autonomous training at home, 33.8% disagreed to this statement and 37.5% would have liked more time to train. 31.6% of the respondents (n=76) indicated to prefer training in a skills lab during working hours above autonomous practice at home outside working hours while 28.2% of 78 residents stated that the box trainer was not easy to set-up at home.

To encourage voluntary practice 42.9% (n=77) of residents agreed that home training should be obligatory, however only 28,8% (n=80) felt this would encourage training. Yet, 76.6% of respondents (n=77) felt MIS -training should be obligatory before operating on patients.

Tables 1 and 2 depict categorized responses by residents (n=18) to the online survey with open questions. Table 1 demonstrates reported problems for home practice, divided into a residents' individual problems and issues the resident anticipates for other residents. Table 2 lists categorized reported possible improvements to encourage voluntary autonomous home practice on a box trainer in the future.

Table 1. Residents' individual problems (I) for voluntary autonomous training on a traditional laparoscopic box trainer, and anticipated problems (II) for other residents on autonomous training.

	I Self		**II Other**	
	Frequency	%	Frequency	%
Time (at home)	10	55.5	8	44.4
Absence of predefined	2	11.1	3	16.7

goals				
Home capacity	5	27.7	6	33.3
monitor quality	1	5.6	3	16.7
No suturing material			3	16.7
No motivation			4	22.2

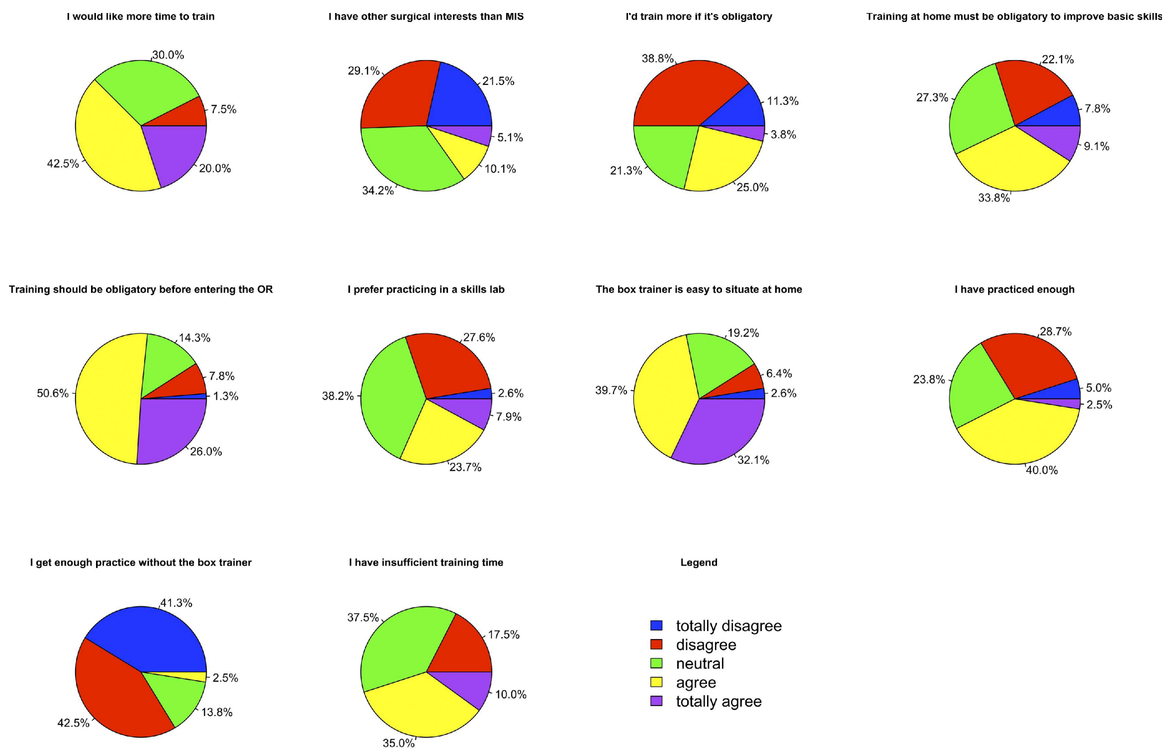
Frequency; number of residents (n=18).

Table 2. Categorized reported possible improvements to encourage voluntary autonomous home practice on a traditional laparoscopic box trainer.

	Frequency	%
Set learning goals	5	27.8
Improve monitors	2	11.1
Obligatory assessment	4	22.2
Enable working hour practice	2	11.1
Midway assessment	4	22.2

Frequency; number of residents (n=18).

Figure 2 (Pie-diagrams)



Discussion

To our knowledge, this is the first study evaluating voluntary use of a laparoscopic simulator at home. As previously demonstrated, after a six week period of autonomous training residents demonstrated no significant progress in MIS skills compared to day one[27].

On average, residents spent a total average of 49 minutes on voluntary autonomous home practice per week, while approximately 1 hour per working day would be preferred.

A lack of training was mainly due to an overall lack of time (83.8%, n=80) or insufficient space at home space to deploy the laparoscopic box trainer (33.3%, n=18). No interest or motivation in MIS (22.2%, n=18) was followed by uncertainty on the goals of the scheduled training program or autonomous training and the absence of assessment with consequences to the further residency program. Currently we are exploring the implementation of a guideline for residents illustrating average practice time needed to acquire certain MIS skill-levels. 31.6% (n=80) of the respondents believed that autonomous training time should be incorporated in working-time, protected from clinical responsibilities.

There is a correlation between practice and performance in which motivation is an important determinant in the acquisition of new (MIS) skills[28;29]. Experience teaches us that motivation for laparoscopic procedural training is inversely related to laparoscopic experience. Intrinsic motivation, such as personal improvement and interest, varies per person and is difficult to alter. Extrinsic motivation such as assessments, promotions etc. may be influenced by staff and program directors (e.g. by providing compulsory training time during working hours, inter-individual competitions and feedback)[30]. Kusurkar et al. reported that existing research suggests the learning environment also plays an important role in enhancing motivation[31].

Increased independence in surgical skill acquisition may result in decreased demands for faculty teaching time and program costs[32]. We feel provision of protected training-time on a (laparoscopic) simulator in a laboratory setting is currently the most promising method to enhance extrinsic motivation and thus participation in a training program.

Due to the absence of comparable studies in this field we were unable to compare our results. Our findings are limited due to following. First, we constructed our own questionnaire, as a standard validated questionnaire for these research grounds is not available. The online survey was only completed by 18 residents after attending the course which were probably the most motivated trainees and therefore may have been less representative. Second, we could not objectivize time logging by trainees. Timers implemented in the box trainers would conform to this problem. Last, trainees were unable get feedback during the autonomous training period. Although a supplied instructions-DVD included explanations and demonstrations of laparoscopic exercises, adequate proctoring during autonomous training may result in more efficient time use and also enhance motivation. Also, adequate proctoring and feedback on a fixed time schedule during autonomous training might avoid the acquisition of incorrect (laparoscopic) skills. Feedback is essential for skill acquisition[33]. Rogers and colleagues demonstrated that feedback plays an important role in computer-assisted learning[34;35]. Asking residents to provide a weekly time-log will encourage a distributive training mechanism. A laptop connected to the box trainer can instantly record (and play-back) exercise sessions. Using email to send performance metrics for review and summative feedback would facilitate this option[36].

As in other domains such as the military, aviation and ship navigation, an (online) gaming environment may be introduced to encourage voluntarily skills training[37-39]. Verdaasdonk et al. introduced an online competition between surgical residents on a laparoscopic VR simulator. This gaming element enhanced the motivation of surgical trainees to train voluntarily[19]. Inclusion of motion analysis on a box trainer could provide an objective scoring system (to a gaming competition). Rewards could also be directed at individual learning performance in which trainees should keep a portfolio[40]. As is known, proficiency-based training improves motivation and encourages (autonomous) skills training and skill retention as well[41;42].

Assessments have a strong effect on learning in general and the effectiveness of a training program specifically[43]. A fully integrated surgical curriculum including predefined goals, proctoring- and protected time and an objective assessment of skills with defined passing scores is necessary for a reward system to be fair.
The effectiveness of any simulator-based educational program dependents mainly on the quality and functionality of its curriculum. The program described in this study demonstrates that voluntary exercise only succeeds if targets and exams are used as a motivation to encourage practice.

Conclusions

Residents in this study felt to spend insufficient time on laparoscopic simulator based training. Main confounders included a lack of time or a lack of interest in MIS. Autonomous practice should be structured and inclusive of adequate and sufficient feedback points. A minimally required practice time should be set. An obligatory assessment including corresponding consequence should be conducted. Compliance herewith may result in increased voluntary (autonomous) simulator based (laparoscopic) training by residents.

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