Chapter 1

General introduction and outline of the thesis

Minimally Invasive Surgery

Minimally invasive – or laparoscopic - surgery is performed through (trocarts) with small incisions in the abdominal wall while the surgical environment is viewed on a video monitor. Benefits of laparoscopic surgery compared to conventional (open) surgery include reduced postoperative pain, a reduced hospital stay and a more rapid return to premorbid functioning[1]. MIS skills differ fundamentally compared to open surgery. Disturbed hand-eye coordination[2;3], loss of tissue contact[4], reduced depth perception, the use of a 2D video monitor[5], lengthy instruments and diminished force feedback (the combination of tactile perception and kinaesthetic perception) make it a difficult skill to master. Sophisticated technical equipment has rendered laparoscopic surgery a complex environment, and therefore prone to error.

Current training in MIS

General consensus reads that education in laparoscopic surgery should be intensified, and competency-based. There is general consensus that an assessment of laparoscopic skill prior to performance of Minimally invasive Surgery (MIS) in the operating room is desirable and even mandatory[6]. Several training models for MIS are available, including: human cadavers, animal models, box trainers, and virtual reality (VR)- and augmented reality (AR)- simulators. All training models aim to shorten the initial MIS learning curve in a safe environment. To master all skills in MIS, each skill should be considered and trained separately[7]. Laparoscopic suturing incorporates all MIS skills and can therefore be considered to be one of the most complex surgical procedures. Of all training methods box trainers are relative inexpensive and employ real instruments and equipment. Assessment of MIS skill on a box trainer is subjective and does not provide automatic instructions and feedback[8;9]. VR simulators do provide automated objective assessment, mostly based on motion analysis parameters – indicative of task efficiency. This is often regarded as parallel, but not proven equal to actual performance quality - as tracked by the simulator. Most VR simulators lacking realistic force feedback[10]. AR simulators provide haptic feedback and objective assessment, however high cost makes it a difficult instrument to deploy globally[11]. Objective assessment is crucial in providing adequate feedback to trainees and examination of the individual learning curve in laparoscopic surgery.

Learning Curve

Many empirical studies link laparoscopic skill acquired on laparoscopic box trainers and virtual reality trainers, to operating room performance[9;12]. Simulator training may (in part) move the MIS learning curve out of the OR. Especially the initial MIS learning curve is known to be associated with an increased rate of complications[13]. Practicing MIS (or any surgical procedure) on patients raises ethical questions and strain current demands on operating room efficiency and finances and press working hour restrictions[14;15]. Also, training fundamental MIS skills outside the OR improves time efficiency of laparoscopic trainees in the OR as focus on other competencies such as anatomy, pathology and procedural aspects is increased[16].

In 2007 a report by the Dutch Health Care (IGZ) inspectorate concluded that actions to prevent complications in MIS were insufficient and that there was no uniform consensus on training in MIS[17]. In an attempt to unify MIS training in the Netherlands and Belgium, we developed the advanced suturing course (ASC). The ASC is a MIS training program consisting of 2 training days with a 6 week autonomous training period in-between. The first training day refreshes basic laparoscopic skills.

Hereafter, laparoscopic suturing is trained on a laparoscopic box trainer under the supervision and feedback of senior surgeons. On the second training day laparoscopic suturing is elaborated in more depth; laparoscopic intestinal anastomoses and repair of perforations is trained on animal small bowels in the laparoscopic box trainer.

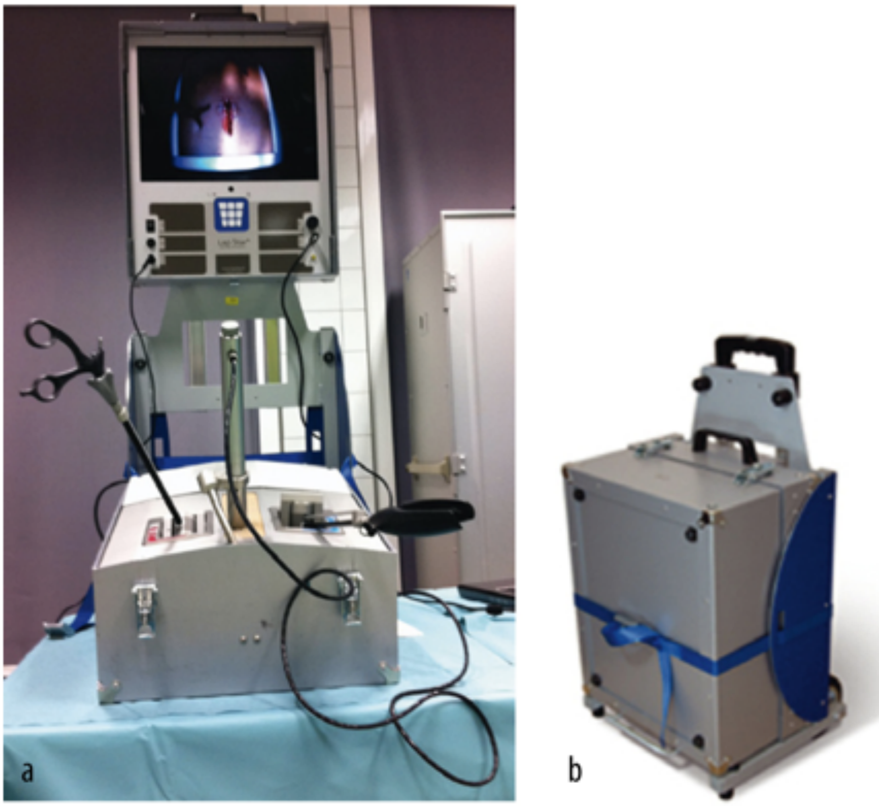

Figure 1 laparoscopic box trainer a. open, b. closed

Assessment

'See one, do one, teach one', the apprenticeship model employing a supervisor's subjective feedback directly provided during surgery, has long been the gold standard in the assessment of surgical skill[18]. However, objective assessments are needed for accurate appraisal in the challenging area of surgical proficiency[19]. Various MIS assessment methods have been developed and typically rely on checklists for various task-specific components, however these are still subjective as based on a supervisor's evaluation, and indicative mostly of procedural performance rather than a measure of technical ability[20-22]. The gold standard in the assessment of surgical skills is currently the OSATS. Validity, reliability and feasibility of the OSATS was established on six technical surgical tasks. However, as explained the OSATS are still subject to inter-observer bias[23]. Various studies suggest objective assessment of MIS skill by use of various laparoscopic simulators although there is little evidence that these systems can assess a residents' individual laparoscopic performance correctly[24]. The ASC assesses laparoscopic skills using the OSATS (Objective Structured Assessment of Technical Skills)[23] and the TrEndo tracking device[25]. The equality of subjective assessment methods to objective assessment methods to rate laparoscopic skills are relatively unknown.

Outline of the thesis

The main aim of this thesis was to examine effective implementation of a laparoscopic training course into a surgical training program. We specifically examined various MIS simulators and their value in such a program, the learning curve on a laparoscopic simulator (the TrEndo) and the implementation of this simulator in a laparoscopic suturing course organized by a tertiary medical center in The Netherlands. The first part of this thesis covers curriculum design in which way residents are able to assess themselves (chapter 2) and acquire skills by self-directed learning (chapter 3). The second part of this thesis focuses on the available

MIS simulators (chapter 5) and suggestions on curriculum design. The outcomes of a simulation based course in minimally invasive surgery, the Advanced Suturing Course are discussed in chapter 4. In chapter 6 the TrEndo, a simulator in laparoscopic surgery is evaluated and validated. The final part of this thesis investigates a learning curve on the TrEndo device (chapter 7) and the added value of objective assessment in MIS compared to subjective assessment (chapter 8). The last chapter 9 identifies new insights in laparoscopic skill training and assessment, and discusses this thesis' results in general. Finally recommendations and potential future research are discussed.

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