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JMIG The Journal of Minimally Invasive Gynecology

Original Article

Effects of Repetition and Inactivity on Laparoscopic Skills Training

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ABSTRACT **Study Objective:** To describe the impact of task repetition and time between practice sessions on time to complete a surgical task using a high-fidelity laparoscopic simulator.

Design: An Institutional Review Board–approved retrospective cohort study of 33 obstetrics/gynecology residents with unlimited access to a high-fidelity laparoscopic simulator over a period of 12 months. Canadian Task Force design classification II-2.

Setting: Academic medical center and obstetrics/gynecology residency training program.

Participants: Obstetrics/gynecology residents.

Interventions: Participation in a high-fidelity laparoscopic training exercise.

Measurements: Residents completed a standardized peg transfer exercise with data collected on the time to completion of the exercise, number of the attempt, and interval since the last day of practice. Data were analyzed using Spearman correlation coefficients and mixed-effects linear regression.

Main Results: A total of 33 residents participated during the 12-month period, completing 484 peg transfer exercises (mean, 16.2 per resident). Each repetition was correlated with a mean decrease in time to completion of 2.28 seconds ($p < .0001$). This correlation was most dramatic in the first 9 completed exercises, in which each repetition correlated with a decrease in time to complete of 7.98 seconds ($p \leq .0001$). The lapse in practice preceding the exercise correlated with a negligible change in time to completion of 0.003 second (SD, 0.06; $p = .90$).

Conclusion: The number of previous completed exercises was significantly correlated with decreased time to completion of this standardized exercise. Lapses in practice did not correlate with slower times to completion, suggesting that repetitive exposure to a simple surgical task has a greater impact on efficiency than lapse in practice. Journal of Minimally Invasive Gynecology (2016) 23, 194–197 © 2016 AAGL. All rights reserved.

Keywords: Laparoscopy; Resident education; Simulation

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Achieving proficiency and excellence in surgery requires repetition, creativity, and decision making skills typically provided to trainees during postgraduate training. With the widespread adoption of minimally invasive techniques and a trend toward nonsurgical interventions for many conditions, resident physicians are tasked with learning and exploring a wide range of technologies with fewer opportunities to refine their skills before graduation.

Simulation-based surgical training aims to shift the early learning curve of a new technology or procedure out of the operating room to a venue where rapid repetition is possible. Several studies have supported the idea that teaching through high-fidelity laparoscopic simulation correlates with operative performance [1–3]. One randomized double-blinded study demonstrated that surgical interns who completed a series of exercises on the Lap Mentor trainer performed with greater speed and accuracy on a porcine model compared with interns without simulator experience [4]. A prospective blinded randomized

Disclosures: None declared.

These findings were presented at the 43rd AAGL Global Congress on Minimally Invasive Surgery, Vancouver, BC, Canada, November 17 to 21, 2014.

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Submitted May 22, 2015. Accepted for publication September 8, 2015.

Available at www.sciencedirect.com and www.jmig.org

http://dx.doi.org/10.1016/j.jmig.2015.09.008

controlled trial conducted in Denmark compared the technical performance of first- and second-year trainees in performing laparoscopic salpingectomy with or without simulator training. Trainees exposed to the simulator completed 28 sessions and approximately 7 hours of practice on average. These trainees demonstrated proficiency equivalent to having completed 20 to 50 laparoscopic procedures, whereas those without training performed as if they had completed fewer than 5 laparoscopic procedures. In addition, their operative times were halved [5].

Fewer studies have sought to learn more about how simulated learning occurs. In a study by Sheth et al [6], gynecology trainees of all levels demonstrated improved efficiency in repeating simple tasks 10 times each on a robotic skills simulator. The authors noted that trainees reached a plateau in time to complete the exercise between the sixth and ninth repetitions. Actual resident education occurs over time, however, and few studies have explored whether trainees experience a degradation of skills during periods of inactivity. Burchard et al [7] found that hysteroscopy operative times were longer at 6 months after residents completed a simulation exercise. This certainly suggests that residents experience attenuation of skills over time, but does not tell us how quickly these skills degrade and what time intervals are ideal for maintaining surgical skills. As simulation becomes an increasingly important part of the residency curriculum, we need to better understand how skills are maintained, to optimize resident surgical training.

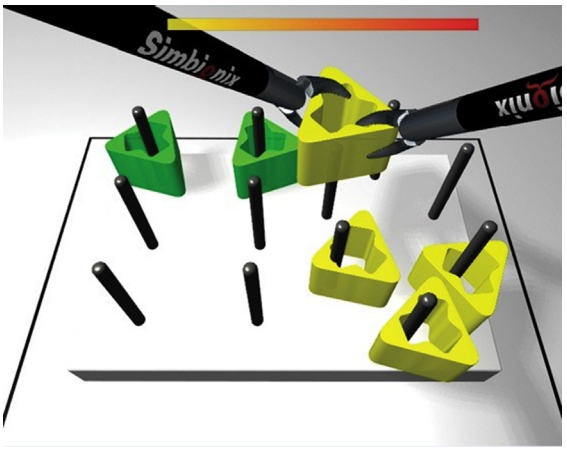
The primary aim of the present study was to describe the rate of improvement in surgical skills with repetitive completion of a basic exercise on a high-fidelity surgical trainer using the standard outcome of time to completion of a task. Our secondary aim was to describe how skills degrade during periods of inactivity so that we may better integrate learning patterns into a more optimal training curriculum.

Materials and Methods

This was an Institutional Review Board–approved retrospective cohort study of obstetrics/gynecology residents at a single institution participating in laparoscopic training using the Lap Mentor simulator (Simbionix, Cleveland, OH) over a 12-month period. The simulator was made available to residents for practice at all hours of the day, and access was unlimited. During the study period, residents did not have any access to any additional high-fidelity laparoscopic simulators. This high-fidelity laparoscopic trainer features various skill modules, including several components of the Fundamentals of Laparoscopic Surgery. We selected the peg transfer exercise as our standardized exercise for analysis because it is a straightforward task for residents of all levels to complete, and the most commonly completed task at our institution. Completion of the exercise requires the user to transfer 6 rings on pegs to a second set of 6 pegs, then back to the first set of pegs. The exercise was completed when all pegs were successfully transferred back to the initial set of pegs (Fig. 1).

Fig. 1

The peg transfer exercise on the LapMentor high-fidelity laparoscopic simulator.



Data were collected directly from the simulator and included participant identification number, residency year, practice session number, exercise number, day of exercise, and the time to exercise completion. The lapse in practice was calculated as the time in days between the last day on which the exercise was completed by that participant and the current day of practice. Analysis was completed with SAS version 9.3 (SAS Institute, Cary, NC). Spearman correlation coefficients were used to describe the association between time to completion and the variables of repetition number and lapse in practice, because these data were not normally distributed. Mixed-effects linear regression was used to isolate the effects of both repetition and lapse on the primary outcome of time to completion, because we anticipated a likely effect of both repetition and time lapse on the time to complete a given exercise.

Results

A total of 33 obstetrics/gynecology residents completed the peg transfer exercise over the 12-month period, including 21 junior-level residents (postgraduate years 1 and 2) and 12 senior-level residents (postgraduate years 3 and 4). A total of 484 peg transfer exercises were completed during this time period (mean per resident, 16.2 ± 18.3, range, 1–72)

Table 1

Completion of the peg transfer exercise by training year

Characteristic	All residents	Junior residents	Senior residents
Number	33	21	12
Exercises completed, mean (SD)	16.2 (18.3)	18.5 (17.5)	12.2 (19.4)
Exercises completed, range	1-72	1-59	1-72
Time to complete, s, mean (SD)	100.7 (57.8)	105.9 (58.9)	85.2 (51.2)