How to Teach and Evaluate Learners in the Operating Room

Kimberly Kenton, MD, MS

Division of Female Pelvic Medicine and Reconstructive Surgery, Departments of Obstetrics and Gynecology and Urology, Loyola University Medical Center, 2160 South First Avenue, Maywood, IL 60153, USA

You cannot learn to play the piano by going to concerts.

Increasing financial and medicolegal demands paired with limited resident work hours have forced a change in the apprenticeship model of surgical training. Mounting literature supports a shift to outside of the operating room as the primary site of resident surgical training [1–5]. Several advantages accompany this paradigm shift, which have been addressed elsewhere in this issue. Ultimately, however, surgical competency must be obtained in the operating room. A survey of United States obstetric and gynecology residency program directors assessed how surgical skills are taught and 100% of residency programs reported teaching surgical skills in the operating room [6]. Eighty-eight percent also used lectures, whereas only 68% used bench procedures or models, and 54% practiced procedures on animal models. Only 29% of residency programs had a formal surgical skills curriculum. Furthermore, whereas some cognitive and technical skills can and should be practiced outside the operating room, no laboratory or simulator can ultimately duplicate the operating room experience. Unlike surgical simulators and laboratories, each patient and case is unique and the young surgeon must learn to adapt, problem solve, and retain their composure in real-life circumstance.

Little data exist on actual teaching in the operating room. Most academic surgeons rely on expert opinion and experience for effective teaching and

E-mail address: kkenton@lumc.edu
evaluation techniques. Attending surgeons and residents do not always agree on which factors are important for teaching in the operating room. A postal survey of 89 attending physicians who were members of the Chicago Gynecologic Society and 38 obstetric and gynecology residents in Chicago identified 10 factors as important for teaching in the operating room, including attending surgeon’s knowledge of anatomy, attending surgeon’s willingness to teach, ability of attending surgeon to show the resident how to do the case, good exposure, formative feedback, lighting, letting the resident do the case, attending surgeon’s patience and calm temperament, and observing a skilled surgeon [7].

Of the listed factors, the top three items valued by the attending surgeons were (1) knowledge of anatomy, (2) exposure, and (3) skill of attending surgeon. In contrast, the top three items ranked by the residents were (1) the attending surgeon’s willingness to teach, (2) knowledge of anatomy, and (3) letting the resident do the case. Significantly more residents than attending surgeons rated the following as important: the supervising surgeon’s willingness to teach ($P < .0005$); the supervising surgeon’s willingness to let the resident do the case ($P < .0005$); and a supervising surgeon with a calm temperament ($P = .03$) and patience ($P = .026$).

Developing into a competent surgeon requires acquisition of both cognitive and motor skills. Spencer [8] proclaimed that 75% of surgical competency is related to decision making, whereas only 25% is related to technical skills. Many aspects of both cognitive and motor skill development can be achieved outside the operating room. Surgical anatomy can be mastered using surgical atlases and cadaveric dissections. Steps of the procedure, instrumentation, and problem solving can be memorized and drilled by the resident alone and in preoperative conferences. Motor skills can be practiced in surgical skill laboratories. Outlines for mastering technical skills include development of both cognitive and motor skills [9–11]. Kopta [9] described one program that lists three steps to develop technical competence: (1) perception, (2) integration, and (3) automatization. First, learners develop a perception or mental image of the task to be performed. The mental image is then integrated with motor or surgical skills with active effort on the part of the learner. Finally, over time, the young surgeon is automatically able to perform each portion of the operation.

Although many aspects of Kopta’s [9] program can be taught outside the operating room, certain components must be learned in the operating room. A variety of techniques are used to develop a mental image of the skill to be learned including surgical atlases, cadaveric dissections, and surgical videos. Direct observation of more senior surgeons in the operating room is essential, however, to form an accurate mental image. Direct observation combined with opportunities for surgical practice have been shown to be more beneficial than either alone [12]. Only by seeing visual and spatial relationships, exploring tissue planes and textures, and observing surgeon-assistant interactions during real cases can the trainee fully develop a solid mental image of the skills to be learned.

Cardinal motor skills, including knot tying, suturing, and clamp placement, are probably the easiest surgical skills to learn outside the operating room and can be
practiced in skills laboratories. Models and simulators can be used for more complex skills. Essential components, however, such as the way tissues feel when the surgeon is in the correct surgical plane, must be mastered in the operating room. The final step in surgical competency, automatization, also ultimately requires real operating room experience and repetition. The ability to do a case start to finish, adapt to the particulars of that case and patient’s anatomy, and direct surgical assistants and other operating room personal all require operating room experience. It is only through experience that one confidently learns to manage all aspects of the surgery competently.

How does one teach once in the operating room? Few attending physicians have formal training in education, and little peer-reviewed literature exists to guide surgical teaching practices. Most academic surgeons accomplish surgical teaching based on their own educational experiences by incorporating what worked when they themselves were trainees and discarding what did not work. With paradigm changes in surgical training programs, methods used in the past, which were based on large volume repetition, may be less effective in ensuring competency than they were in the past.

At Loyola University, several techniques are used to improve teaching in the operating room and patient safety. Expectations are set before each case, so that each member of the team knows for which portion of the procedure they are responsible. All teams function better when everyone clearly understands his or her role. This is true in athletics, business, education, and surgery. When team members (and students) know what to expect, they can mentally and physically prepare for the task ahead. This optimizes everyone’s performance and dramatically reduces miscommunication and frustration, which decrease both trainee learning and patient safety. Immediately before the case what each member of the surgical team does is reviewed. For example, the medical student knows he or she places the Foley catheter, the resident opens and closes the abdomen with the fellow, and the fellow performs the sacrocolpopexy. This way, each surgical team member knows what to expect during that case. This facilitates efficiency by cueing team members when to rotate positions at the operating table and identifying who should take charge of which portion of the case (call for instruments, direct assistants, and so forth). It also decreases disappointment and frustration, which can lead to decreased efficiency.

“Forward motion” is the term for efficiency in the operating room, and it is taught actively. Most surgical education programs focus on development of cognitive and technical skills, but fail to teach the practical aspects of intra-operative management. At Loyola University, it is stressed to residents and fellows that they should never be standing around in the operating room. Anesthesia induction time is used just before the case: to position the lights so they are aimed at the appropriate parts of the pelvis or vagina and can be easily adjusted during the case; and to position the patient in dorsal lithotomy and to review proper limb placement in stirrups to avoid neural injuries. Equipment and suture pulled for the procedure is checked before the case begins to avoid unnecessary waiting and delays during surgery.
At Loyola University, an algorithm for surgical struggling was also developed, which all residents and fellows are encouraged to memorize and use (Fig. 1). As most surgical educators have realized, human nature seems to dictate, “if I just keep trying eventually it will work.” Many have watched residents try to place a stitch four or five times without adjusting their technique. Knowing that if you did not get it done with the first or second attempt that you are probably not going to get it done the third or fourth without changing something is not intuitive to most trainees. As a result, residents are actively taught to go through the algorithm when they are struggling. Often, the problem the trainee is struggling with falls on the list. Before the resident can run the checklist himself or herself, the attending physician prompts them through the list in the operating room. Then, when the residents are familiar and comfortable with the list, they can

**STRUGGLING**

↓

**How is my lighting?**
Do I need to readjust the lights?
Do I need a head-lamp?
Would a lighted retractor improve visibility?

↓

**How is my exposure?**
Is my retraction optimal?
Would a different retractor work better?
Do I need to repack?

↓

**How is the table height?**
Is the table to high?
Is the table to low?

↓

**How are my instruments?**
Do I need longer or shorter instruments?
Would a different shaped clamp work better here?
Do I need pick-ups with teeth instead of smooth?

Fig. 1. Algorithm for surgical struggling.
Before a gynecology or urology resident is allowed to participate in a Burch urethropexy, he or she must display certain cognitive knowledge, then a series of technical skills. This typically occurs over several conferences and cases.

1. In the weekly preoperative conference, the resident must be able to list indications and alternatives for the procedure, review important anatomy and landmarks, discuss intraoperative and postoperative complications, and dictate the steps of the procedure. If he or she can do this well, he or she is ready to move on to step 2.

2. At the scrub sink just before the first case, the resident again must review the steps of the procedure (suture, instruments, and so forth).

3. First case: The resident is taught to open the retropubic space on their side. They are then asked to identify important anatomic and surgical landmarks (bladder, Cooper’s ligament, obturator notch and neurovascular bundle, and arcus tendineus fascia pelvis). If they are able to meet all of these requirements, then they advance on their next case.

4. Second case: The resident again opens the retropubic space and identifies anatomic landmarks, reinforcing what they learned in the first case. The resident is also allowed to pass the suture arms through Cooper’s ligament after the primary surgeon places the vaginal stitches. Some residents are not proficient rotating their wrist and using Heaney needle drivers and struggle here. If they cannot do this easily, then they are not ready to place the vaginal sutures on the next case. During postoperative review of the case, most residents who have had difficulty are able to identify it and electively do not move on in the next case. The resident also places his or her hand in the vagina, while the Burch sutures are tied, to begin learning where to place the urethrovesical junction and how tight to tie the sutures.

5. Third case: Once the resident has achieved the technical competence easily to pass sutures through Cooper’s ligament, he or she is ready to place the vaginal sutures. First, he or she again opens the retropubic space and identifies landmarks. Then, with their nondominant hand in the vagina, the resident places the vagina stitches.
typically run the checklist and identify the problem in a matter of minutes, which decreases their frustration and improves patient care.

Finally, an ordered set of criteria has been developed for each surgical procedure, which is shared with the residents at the beginning of the rotation. This re-enforces expectations, helps faculty evaluate the resident’s cognitive and technical skills in a structured format, and ensures patient safety by not letting a resident advance until they have mastered the basics. Several examples are shown in Boxes 1 and 2.

This clear, stepwise approach to teaching in the operating room has improved the educational experience for residents and fellows, decreased tension in the operating room, and ensured the safety of patients. It also facilitates attending-

---

**Box 2. Intraoperative cystoscopy**

Residents are taught routinely to perform intraoperative cystoscopy to evaluate the lower urinary tract. Again, they must meet several criteria outside and inside the operating room before doing this portion of the case.

1. **Preoperative conference:** The cystoscopy is used as a method of reinforcing residents’ knowledge and evaluation of lower urinary tract safety during pelvic surgery. During preoperative conference, the resident must be able to discuss the indications, risks, benefits, and complications of cystoscopy, and go through the entire intraoperative work-up of lower urinary tract injuries. They also must display knowledge about instrumentation (types of telescopes, degree of lens, and so forth).

2. **First case:** The resident learns to assemble the cystoscope, choose between a 30- and 70-degree lens for diagnostic and operative cystoscopy, and identify different types of bridges. They then observe a more senior surgeon performing the cystoscopy, while the senior surgeon explains what they are doing.

3. **Second case:** The resident is asked to select and assemble the appropriate telescope. If they can do this, they are allowed to start the cystoscopy concentrating on finding the dome, trigone, and ureteral orifices. A more senior scans the urothelium and checks for foreign bodies.

4. **Third case:** The resident again assembles the scope and checks for ureteral patency. When they can do this easily, they are taught to check the entire urothelium for abnormalities or foreign bodies.
residential feedback during and after the case, by having a set-learning objective for the case, which can be focused on and reviewed.

Evaluation and feedback on operative performance are the final components of teaching in the operating room. Evaluation and feedback should be given in several forms (formative during and after the case and summative at the middle or end of the rotation). When teaching motor skills, it is commonly accepted that feedback should be given as close to the actual performance as possible [13]. Some feedback should even be given during the case to aid the resident and protect the patient; however, this type of feedback should be limited in quantity because resident learners can become overloaded. Feedback during the case needs to be non-personalized and focused on the skill or action to be changed. It is also helpful to identify if the resident is a visual or verbal learner because this affects what forms of communication work best. The feedback should be concrete. For example, instead of saying, “take a bigger bite, more laterally,” which is nonspecific, say “rotate your needle driver 180 degrees, so the needle enters the tissue at a right angle. Then, place your stitch 1.5 cm lateral to the bladder.” Frequently, this simple, concrete instruction enables the resident to make the correction. If he or she is still unable to make the correction, they may be a visual learner. Visual learners benefit from observation, so demonstrate exactly what you want them to do. In addition, if you and the resident have mutually agreed on expectations before the case, they are often more responsive and respond less defensively to intraoperative feedback.

Feedback immediately after the case is equally valuable and is the evaluative component most often neglected. After each case, the author conducts a 5- to 10-minute session with the resident to review what went well and areas for improvement. She frequently starts by asking the resident how they think they did. What went well? What could have gone better? What areas did they identify for improvement? Did they meet the objectives agreed on before the case? Typically, the astute resident can identify most areas themselves, which facilitates the discussion and decreases tension. It also teaches them the life-long skill of self-assessment, so they learn to evaluate their performance after each and every case to improve. During this session, the trainee is also encouraged to develop a “practice plan” before the next case. Maybe they need to practice suturing, removing clamps with their nondominant hand, review anatomy or the steps of the procedure. Finally, summative feedback should be given at the completion of the rotation. This summarizes the resident’s strengths and identifies area for continued improvement. If appropriate and effective formative feedback was given during the rotation, the summative evaluation should never be a surprise.

Although the operating room remains the most widely used format for teaching surgical skills, the number of hours residents spend in the operating room continues to decrease. In addition to developing other formats for teaching cognitive and technical surgical skills, there is a need to maximize the time spent in the operating room. Several teaching and evaluation techniques that the author found useful have been reviewed. Little scientific data exist as a guide, however, emphasizing the need for high-quality multicenter educational research.
References