4 Robotic Surgery Training

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In December of 2009, the US Food and Drug Administration approved the use of the da Vinci Surgical System for transoral robotic surgery (TORS). Prior to that, most surgeons in training or already in practice had not been exposed to the surgical robot or to the techniques for TORS. Training programs have since been created to bridge gaps in knowledge and technical skills. Over time, these programs have grown and progressed to incorporate evolving technology and surgical techniques that have accompanied the widespread adoption of TORS.

Prior to the advent of TORS, other surgical specialties including urology, general surgery, and gynecology had been using the robot for a variety of surgical procedures. These specialties have developed surgical training programs, several of which have laid the early foundations for the robotic training labs for TORS. Over the past several years, various otolaryngology departments have developed structured curricula for training head and neck surgery residents and fellows in robotic surgery [1–3].

As with other surgical training programs, a stepwise approach to skill acquisition should be taken. A well-designed robotics training program should therefore have three components: access to didactics materials, access to an inanimate or simulated robotics training environment, and a sufficient number of TORS operative cases for surgical console training [3]. Ideally, this TORS training should occur during residency or fellowship with the supervision of a TORS-experienced surgeon in a structured environment with stepwise progression. An alternate program is also discussed for head and neck surgeons in practice below (see Fig. 4.1).

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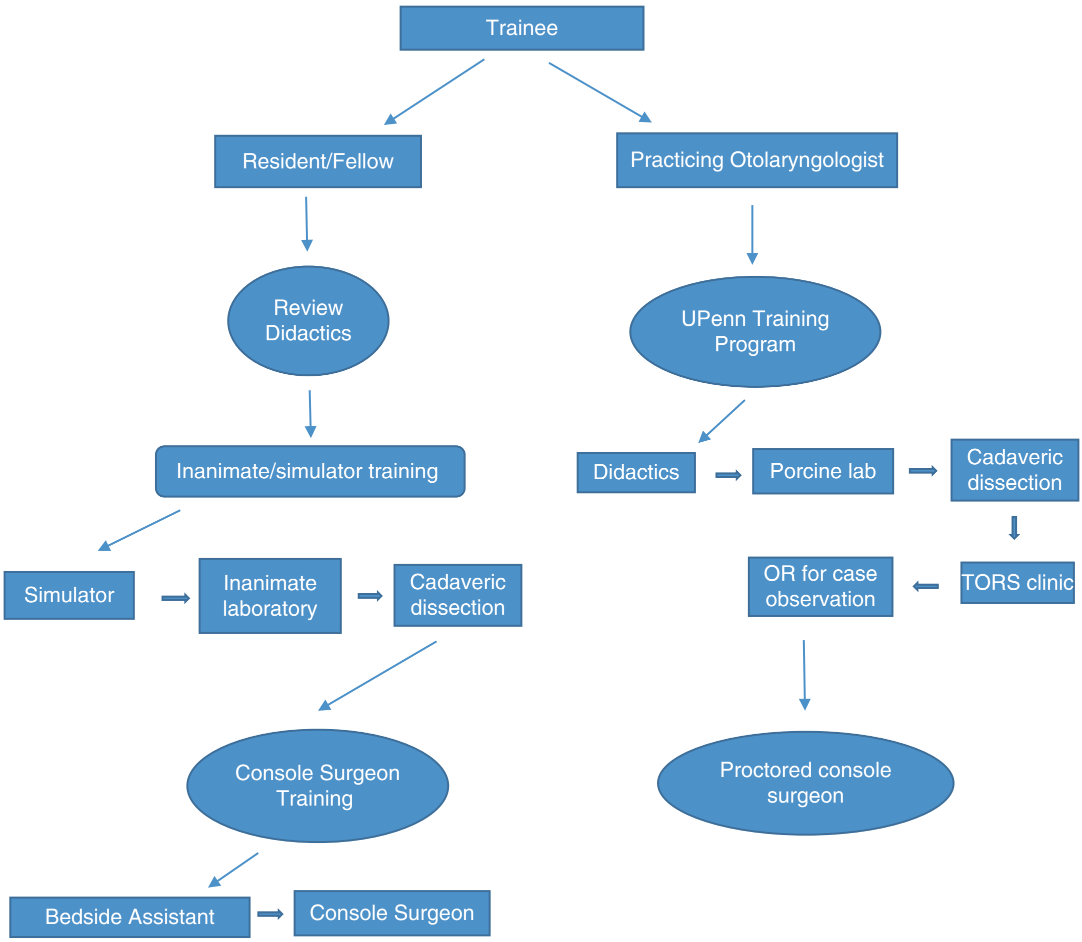

Fig. 4.1 Diagram of the pathway to robotic training

4.1 Didactics

Most otolaryngologists are not familiar with the robotic system and therefore need an introduction to the technology. There is a learning curve involved with understanding and utilizing the technology and equipment. It is important for trainees to familiarize themselves with the technology, its advantages, and limitations. Further, trainees also have to familiarize themselves with the indications for using the robot in head and neck cases. Although beyond the scope of this chapter, a thorough understanding of the indications for TORS is critical to the success of the surgical procedures. As with other surgical procedures, appropriate mentorship is of great benefit in creating a working knowledge of surgical indications.

Didactics for TORS include textbook chapters from transoral surgery books such as this one, procedure and device educational videos available online (davincisurgerycommunity.com), device manuals, and procedure guides [4, 5]. Lastly, trainees must also review head and neck surgical anatomy from a transoral approach. This requires learning “inside-out” anatomy from the transoral approach, as most head and neck surgeons are used to an “outside-in” approach from the neck. This anatomic understanding is critical for performing safe and effective TORS and for recognizing contraindications to the surgery.

4.2 Inanimate or Simulated Robotics Training Environment

The da Vinci Skills Simulator provides familiarity with the da Vinci console and the three-dimensional environment. The simulator includes a series of exercises that consist of tasks that the surgeon completes using the console controls, geared toward improving general robotic surgery skills. Studies in other specialties have shown that the da Vinci Skills Simulator scores correlate with surgeon experience and that simulator training improves robotic surgery skills [6–8]. Simulator tasks help to develop skills such as camera movement, clutching, and wrist motion skills. While the simulations are not designed for transoral robotic surgery specifically, they allow for mastering basic skills behind the console that are applicable to TORS. Additionally, simulators are widely available, easy to use for trainees, and affordable for teaching institutions.

Trainees can practice basic robotic skills in an inanimate laboratory with simple tasks using the surgical robot. The laboratory allows trainees to use the same robot used in surgery, familiarizing them with the operative setup and instrumentation. Several institutions have shown the beneficial use of the inanimate laboratory for transoral surgical training for residents [2].

The final step of inanimate training is cadaveric dissection performed with the surgical robot. This allows for teaching of the inside-out anatomy, progression of surgical steps for transoral procedures, and hands-on training of the complex and advanced maneuvers performed during TORS.

4.3 Console Surgeon Training

When learning TORS for live patients, the first step involves working as the bedside assistant. TORS is based on a four-handed technique and is dependent on a good assistant. Being an active assistant allows the trainee to learn the anesthesia techniques, equipment positioning, room setup, and patient positioning necessary for efficient implementation of TORS. This also helps the trainee learn mouth retractor placement, arm and camera positioning, and control of bleeding with clip application. Much like the rest of surgical training, an astute bedside assistant is able to anticipate the console surgeon’s next step in the surgical procedure and the retraction of tissues needed. This enhances the trainee’s understanding of the procedure.

The second step is as the console surgeon with the TORS mentor being either on the other teaching console, at the bedside, or actively observing using the interactive screen. This allows the mentor to step in if the trainee is struggling through a step or if there are any critical structures at risk of injury. Training behind the console adheres to a stepwise progression of experience with proficiency in the first steps being required before advancing to the next steps. Various TORS procedures have been organized into a structured curriculum from the University of Pennsylvania, which can be considered a prototype for a console surgeon training program [3].

4.4 Training for Head and Neck Surgeons in Practice

An alternate training program is used for practicing otolaryngologists. Since 2009, the only place to obtain complete TORS training for practicing otolaryngologists has been at the University of Pennsylvania.

The training program includes porcine lab training, cadaver dissection, time in clinic to learn TORS indications, and live observation of one to three cases in the operating room. Furthermore, there are didactics given by the faculty at the University of Pennsylvania during the weeklong training program and also available through the da Vinci website.

Following this training, the trainee may require assistance by experienced proctoring surgeons during their first da Vinci procedures. The number of proctored procedures is dependent on a hospital's training and credentialing requirements, and intuitive surgical has established proctoring networks for otolaryngology.

It is recommended that for the first few cases, the surgeon plan on doing relatively simple procedures such as lingual tonsillectomy or T1 tumors prior to more complicated cases. The minimum number of cases needed for competency is not established presently and is dependent on the hospital's requirements.

4.5 Learning Curve in Robotic Surgery

What should the trainee expect as he/she gains experience in TORS? One study found no differences in room setup time, operative time, and total time in the room, comparing the initial 20 TORS cases to the following 20 cases [9]. The longest study to date was a 4-year experience from the University of Alabama. The authors found that the mean operative time decreased by 47%, and hospital stay decreased from 3 to 1.4 days from the first year to the last year. There was also noted to be a decrease in postoperative bleeding and airway edema as experience was gained. However, they did not find any difference with more experience between frequency of negative margins, number of tracheostomies or feeding tubes, and number of aborted cases [10].

Minimum case numbers for establishing resident/fellow competency have not been established, and different individuals may achieve competency at different rates. The learning curve is steepest behind the console with hands-on training much like the rest of surgical training. This is aided by the dual-console system, which allows for resident and fellow training while ensuring patient safety. Currently, at the author's institution, the minimum goal for training is participation in 20 cases as a console surgeon.

Conclusion

Training in robotic surgery is a worthwhile undertaking for the experienced head and neck surgeon as well as the otolaryngologist in training. As the indications for the use of the robot expand due to advancing technology and surgical knowledge and improved outcomes, the robot will become a more common tool for the ot olaryngologist in training as well as in practice.

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