Mini-review

Instrumentation and technological future directions for transoral thyroidectomy

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Abstract: Transoral thyroidectomy is made possible with by the use of endoscopic and robotic technology through a novel, scarless approach in the lower lip. As with any new procedure, proper instrumentation and familiarity with all elements of the operation are of paramount importance. In this chapter we review the instrumentation for endoscopic and robotic transoral thyroidectomy and look towards the future.

Keywords: Instruments; transoral thyroid; robotic; endoscopic

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Introduction

While there has always been a desire to minimize the cosmetic impact of thyroid surgery through smaller, less conspicuous incisions resulting in the development of remote-access approaches to the thyroid, transoral thyroidectomy is the only approach that avoids all cutaneous scarring. The evolution of thyroid surgery from a large incision in the neck to remote-access, scarless approaches have in large part been made possible by advancements in laparoscopic and robotic technology. While these tools have been used for remote-access thyroid surgery from various approaches from the chest, axilla, and neck areas, there are unique challenges with the transoral approach that require familiarity with the requisite instrumentation.

The technical details of both transoral endoscopic transvestibular approach (TOETVA) and transoral robotic thyroidectomy (TORT) are described elsewhere in this volume. This chapter will focus on the instrumentation necessary for each procedure. The instrumentation for both TORT and TOETVA is the same with the addition of robotic instrumentation for TORT, noted below. The surgical prep tables with instrumentation is demonstrated (*Figure 1*). Additionally, a conventional thyroidectomy tray is recommended in the room should conversion to an open procedure be necessary.

Positioning and preparation

The patient is placed supine on the operative table and intubated either orally or nasally depending on surgeon preference (*Figure 2*). If oral intubation is chosen, it is recommended to firmly affix the tube (e.g., consider suture fixation to the dentition) to prevent inadvertent dislodgement during the procedure. The neck is slightly extended in the midline. Anesthesia should be positioned near the feet of the patient to allow access to the top and both sides of the head by the surgeon and assistants. Key recommended instrumentation is noted in *Table 1*.

Procedure start and flap elevation

Only a few standard instruments are required to begin the procedure including soft tissue forceps, a scalpel, tissue

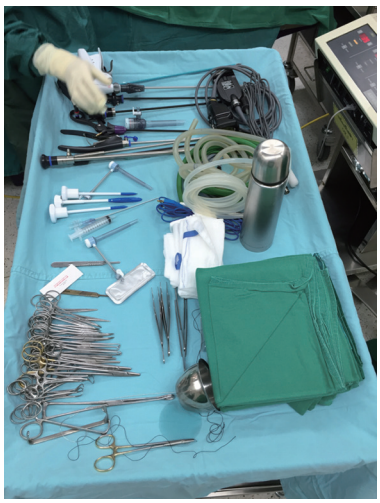

Figure 1 The surgical table with both laparoscopic and standard instrumentation before surgery start.

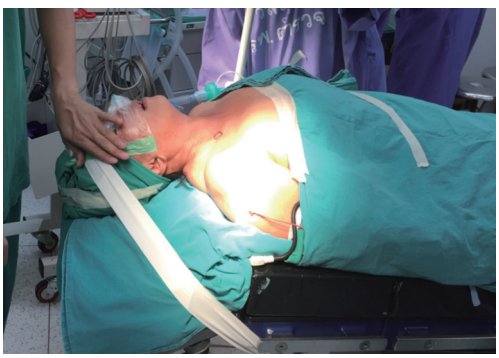

Figure 2 Intraoperative positioning of the patient prior to surgery start.

dissectors and cautery. A standard soft tissue tray contains the necessary equipment. Additional instrumentation required to make the subplatysmal working space in the neck are listed in *Table 2*. Most laparoscopic trays contain all the necessary instrumentation but the required tools are listed below.

Central neck work

Thyroid lobectomy, total thyroidectomy, central neck dissections, and parathyroidectomy may all be completed via the transoral approach, either laparoscopically or robotically. If robotic instrumentation is used (*Table 3*), it is usually docked during or immediately after the creation of the subplatysmal working space. For TOETVA,

Table 1 Key equipment necessary for positioning and preparation

Equipment	Notes
Shoulder roll or balloon	Allows for modest neck extension
Head donut/roll	To stabilize head during manipulation
Nerve integrity monitor endotracheal tube	Strongly recommended
Tooth guard	Optional but recommended for TORT
Adhesive dressing (e.g., Tegaderms)	Avoid skin staples to secure sterile towels
Preparation solution safe for mucosa	Hibiclens, povidine/iodine solution
Rigid eye shields	Recommended for TORT
Varess needle	Used for subplatysmal hydrodissection

TORT, transoral robotic thyroidectomy.

Table 2 Key equipment necessary for procedure starting and flap elevation

Equipment	Notes
Tissue dilators	A blunt tip is necessary; [e.g., custom (*Figure 3*), Pratt or Hegar dilators, Yankuer suction]
Laparoscopic cannulae	5 mm for lateral ports (*Figure 4*); 10 mm for central port; a short trocar is preferred; ridged edging to prevent slippage
Robotic cannulae	5 mm lateral ports; 10 mm central port
Laparoscopic instrumentation	Laparoscopic scope 10 mm O/30 degrees; hook cautery; suction electrocautery; scissors; various tissue graspers; bipolar forceps; maryland dissector; endoscopic clip applier, 5 mm; vision tower, placed at foot of table (*Figure 5*)
Energy devices	Required: Ethicon Harmonic Ace 5 mm × 23 cm; Optional: Ligasure maryland 5 mm × 37 cm; Sonicision 39 cm; Gyrus dissection forceps 5 mm × 33 cm

Figure 3 Custom fabricated soft tissue dissector used to make subplatysmal working space.

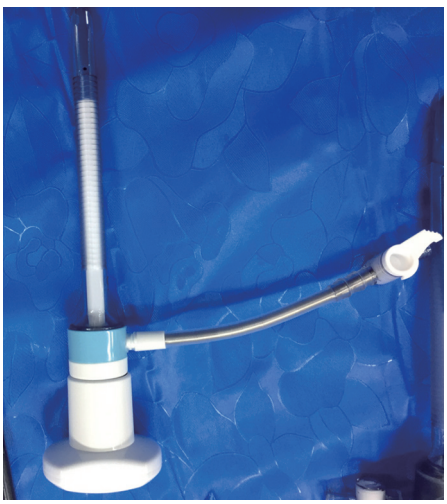

Figure 4 5 mm laparoscopic cannula with side port to allow for venting of vapor plume.

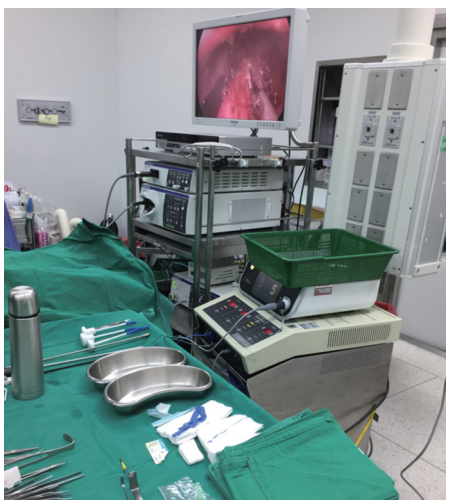

Figure 5 Vision cart is placed at the foot of the patient to allow surgeon, assists, scrub techs, nurses and anesthesia to all view the procedure together.

Table 3 Key equipment necessary for central neck work

Equipment	Notes
Robotic instrumentation	Maryland dissector; Harmonic dissector; Bipolar/hook cautery optional
Long (thoracic) nerve stimulator	To identify and confirm superior and recurrent laryngeal nerve integrity

Table 4 Key equipment necessary for specimen extraction and closure

Equipment	Notes
Endocatch bag	5–10 mm specimen retrieval bag (*Figure 6*)
Locking suture	To re-approximate the strap muscles
Jawbra	Or other compressive dressing

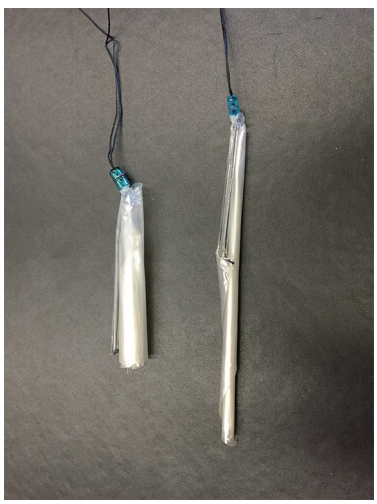

Figure 6 10 mm endo catch bag for specimen retrieval.

instrumentation in *Table 2* is used.

Specimen extraction and closure

Once the specimen has been completely freed it is necessary to remove it atraumatically from the neck through the central lip trocar site. The specimen must be placed in a specimen extraction bag (*Figure 6*) so that it is not torn and does not contaminate the endoscopic tunnel with seeded tissue. Instrumentation for this retrieval and closure are in *Table 4*.

Future directions

TONS is a relatively new procedure that will likely see considerable evolution in instrumentation and technique over the years. The technical feasibility of transoral neck surgery will likely improve as instrumentation is developed specifically for this task. Both the endoscopic and robotic techniques have shortcomings that will hopefully be overcome. TOETVA is limited in that it uses standard laparoscopic instrumentation that is not wristed, requires an experienced bedside assistant surgeon to hold the scope, and has a 2 dimensional view. Each of these limitations will likely be addressed in the near future. Wristed laparoscopic instrumentation is under development (e.g., FlexDex Surgical, Brighton, MI). Wristed instrumentation allows for increased range of motion of the distal arm of the instrument and avoids line-of-site issues that occur while looking down the shaft of rigid endoscopic instrumentation. It is felt to greatly assist with fine dissection and has been touted as critical by those surgeons who prefer the robotic approach. Custom made scope holders will free up one of the hands of the assistant surgeon and prevent fatigue, drift, and tremor which can impact the endoscopic view. Three-dimensional endoscopes will be available in the near future as well and rival the view afforded by the robot.

TORT is hampered by the size and cost of the surgical robot which has been limited to the Davinci Si and Xi (Intuitive Surgical, Inc., Sunnyvale, CA) to date. However, the newest generation single-port (Sp) may provide unparalleled access and maneuverability in the narrow confines of the working space. Furthermore, other surgical device companies are working on smaller and less expensive robots that will likely have applicability in TORT. One example is the Robotic ENT Microsurgery System (REMS) developed by Galen Surgical (Sunnyvale, CA) and Johns Hopkins University (Baltimore, MD). What is certain is that future technologic evolution will continue to lead to novel innovations in remote-access, "scarless" thyroid surgery.

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Footnote

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