REVIEW ARTICLE JSLS

Transoral Endoscopic Thyroidectomy Vestibular Approach

Gustavo Fernandez-Ranvier, MD, PhD, Aryan Meknat, MD, Daniela E. Guevara, MD, William B. Inabnet III, MD

ABSTRACT

Background: Remote-access thyroid surgery has gained popularity and has advanced significantly over the past two decades, given the patient desire to avoid cosmetically displeasing scarring. It has only been recently that natural-orifice transluminal endoscopic surgery (NOTES) techniques have been geared for thyroidectomies. The transoral endoscopic thyroidectomy vestibular approach has been categorized as a NOTES procedure—given the approach to the thyroid gland via incisions in the oral cavity. Our aim is to provide a review of the current literature on the transoral endoscopic thyroidectomy vestibular approach (TOETVA), to present the worldwide experience of this novel procedure, and to outline whether individual patients have characteristics that would make the procedure feasible for this technique.

Methods: A literature review was done to compile articles detailing the international experience with TOETVA. Our experience combined with what has been published in the literature was used to establish which pathological and patient characteristics make this particular technique feasible for a thyroidectomy.

Results: We detail in the provided tables both feasibility for this surgical technique and the international experience.

Conclusion: TOETVA represents the latest remote-access endoscopic technique for the excision of the thyroid gland. TOETVA is being performed at various international institutions and multiple hospitals in the United States.

Division of Metabolic, Endocrine and Minimally Invasive Surgery, Department of Surgery, Mount Sinai Hospital, Icahn School of Medicine at Mount Sinai, New York, New York, USA (Drs Fernandez-Ranvier and Inabnet).

Department of Surgery, Brookdale University Hospital and Medical Center, Brooklyn, New York, USA (Dr. Meknat).

Department of Surgery, Mount Sinai Hospital, Icahn School of Medicine at Mount Sinai, New York, New York, USA (Dr. Guevara).

Disclosures: none reported.

Conflicts of Interest: The authors have no conflicts of interest directly relevant to the content of this article.

Informed consent: Dr. Fernandez-Ranvier declares that written informed consent was obtained from the patient/s for publication of this study/report and any accompanying images.

Address correspondence to: Gustavo Fernandez-Ranvier, MD, PhD, Garlock Division of Surgery, Mount Sinai Hospital, 1468 Madison Avenue, New York, NY 10029. E-mail: gustavo.fernandez-ranvier@mountsinai.org

DOI: 10.4293/JSLS.2019.00036

INTRODUCTION

Over the past two decades, remote access thyroid surgery has gained popularity worldwide—likely born from a desire to avoid cosmetically displeasing scarring in such an exposed area. Beginning in the mid-1990s, the development of minimally invasive approaches to the thyroid gland went through many trials and tribulations. This process entailed a paradigm shift, away from the traditional transcervical thyroidectomy, toward a more refined technique in an attempt to hide scarring and improve cosmetics in the neck region.[1] Several remote-access thyroidectomy techniques have been developed over the years including the bilateral axillo-breast approach, the transaxillary approach, and the retro-auricular approach.[2–4] Using the bilateral axillo-breast approach, the thyroid gland is approached through four very small incisions made: one in each axilla (the armpit) and one along the breast. The transaxillary technique approaches the thyroid gland unilaterally via a single incision. Finally, in the retro-auricular approach, the gland is approached through incisions made behind the ear. While all of these approaches have cosmetic improvements from the traditional approach, with the scar transferred from the neck to other less visible areas of the body, cutaneous scarring remains inevitable along with extensive tissue dissection to reach the thyroid gland.[1,3]

More recently, there has been development of a technique known as the transoral endoscopic thyroidectomy vestibular approach (TOETVA). This novel remote-access endoscopic technique for the excision of the thyroid gland has been categorized as a natural orifice transluminal endoscopic surgery (NOTES) procedure—given the approach to the thyroid gland via incisions in the oral cavity.[5,6] TOETVA applies the benefits and avoids the drawbacks of the other remote access procedures. There is less tissue

dissection and distance to reach the target gland, and there is complete avoidance of a skin incision (with incisions hidden in vestibular mucosa).

Our aim is to provide a review of the current literature on TOETVA (as detailed in **Figure 1**). We will examine the history of remote-access surgery, outline the patient characteristics that make the transoral endoscopic approach feasible, detail the surgical technique, and will provide an overview of the global experiences to date.

A History of Transoral Thyroidectomies

The first transoral thyroidectomy was performed using a sublingual approach. This approach entailed the surgeon making an incision and subsequent dissection through the floor of the mouth (behind the teeth).[6–8] This route has been largely abandoned due to complications related to the violation of the floor of the mouth.[5] Early complications from this approach, as well as never-before-seen complications via the vestibular approach have lead to misguided unpopularity. The main concerns and critique, to this point, have been aimed at never-before-seen complications and the steep learning curve associated with this technique.[9–11] This technique is technically demanding and requires expertise in conventional thyroid surgery, laparoscopic and endoscopic procedures—as prerequisites for safe introduction.

Early on there were high rates of mental nerve injury manifesting as postoperative numbness and/or paresthesia around the lower lip and/or chin that persisted for more than 6 months after surgery.[1,12,13] Then, in 2014, after conducting several cadaver dissections, Dr. Anuwong started performing a modified version of the vestibular technique on humans.[3,5,14,15] The problem was addressed by adjusting the placement of the lateral 5-mm ports. The two vertical incisions for the 5-mm ports were repositioned to the vestibular mucosa lateral to the level of the canines and just in the inner aspect of the inferior lip, to avoid contact or at least injury to the mental nerve. The evolution of this approach has seen significant improvement as a result of the ease of the dissection, the excellent view of the surgical field afforded by the camera passing anterior to the mandible, and the avoidance of a sublingual incision with its inherent complications.[16,17]

Patient Eligibility for Transoral Thyroidectomy

It is important to be clear that not every patient or any thyroid pathology is amenable to the transoral approach. Uniform indications and contraindications for the transoral endoscopic thyroidectomy vestibular approach (TOETVA) have not officially been established.[2,20,21] Here we present a compilation of inclusion and exclusion criteria. The following recommendations are structured based on our anecdotal experience and all published experiences to date.[1,4,9,12,21,22] Instead of outlining the "indications" for the transoral thyroidectomy, we determine whether individual patients have "favorable features" for this technique to assess feasibility of the procedure. In a similar manner, patients with a disease process of the thyroid gland or having characteristics where there is controversy or contraindications for surgery would be considered to have "nonfavorable features" for a transoral thyroidectomy. Ultimately, the approach of the surgical procedure is based on the patient's preference after details of their clinical findings, risks, and benefits as well as the technical aspects of the transoral technique have been discussed thoroughly with the patient. **Table 1** summarizes patient characteristics that are suitable for the TOETVA approach. More important than cosmetics is the correct management of the patient's thyroid pathology. Therefore, guidelines set forth by the American Thyroid Association should coincide with the recommendations we laid out, when deciding to utilize the TOETVA.

Surgical Technique

This section will describe the standard technique used in TOETVA worldwide, with minor variations. It is our practice that the patient's oral cavity is disinfected with a mouth rinse solution (chlorhexidine 0.12%), immediately prior to entering the operating room—though there are not data to suggest that this will lower incidence of surgical-site infections. The patient is then placed in a supine position on the operating table with the feet toward the monitor. General anesthesia is administered, with naso-

Figure 1. Evolution of TOETVA over the past decade.[6–9,14,15,18,19] *Combined sublingual and vestibular approach.

Table 1.
Patient Eligibility for TOETVA

Favorable features	Patient's own motivation to avoid a cervical scar
	Symptomatic benign nodules ≥6 cm. (Benign nodules >6 cm or <10 cm is possible but may require surgical expertise in TOETVA)
	Cytologically indeterminate nodules (Bethesda 3 or 4 lesions) <6 cm
	Estimated thyroid diameter ≤10 cm on ultrasound
	Estimated gland volume ≤45 mL on ultrasound
	Symptomatic Hashimoto's thyroiditis
	Grave's disease (euthyroid, if possible)
	Differentiated thyroid cancer <3 cm without extrathyroidal extension or lymph node metastasis on preoperative ultrasonography
Not favorable features	Substernal goiters
	Previous neck and chin surgery
	Previous neck radiation

tracheal intubation, although oral tracheal intubation is a reasonable alternative. The patient is then positioned with the neck in hyperextension and a rolled sheet is placed under the shoulders. The surgeon assumes a position at the head of the patient with full visualization of the oral cavity and the monitor, while one or two assistants are positioned on either side of the patient. After the upper chest, neck, and the lower face are prepped with iodine solution, drapes are placed. A clear drape is placed over the upper face to allow proper visualization of the endotracheal tube. Additional laparoscopic drapes with side pockets are recommended for placement of the instruments. An advanced energy device, electrocautery, suction irrigation, and nerve monitor will be needed during the procedure.

Three incisions are made through the alveolar mucosa of the lower lip vestibule, opposite to the incisors—a 15–20-mm transverse medial incision along with two vertical 5-mm incisions (the two lateral incisions are lateral to the canines and just in the inner aspect of the inferior lip to avoid injury to the mental nerve). Three ports: a central 10–12-mm, and 2 lateral 5-mm ports are utilized. Prior to port placement, a working space is created by tissue dissection in the neck region with the use of electrocautery and/or sharp dissection. A Kelly clamp is used to dissect and create a tunnel through the chin until the submandibular area of the neck is reached. Subsequently, a long Veress needle is used to expose the subplatysmal flap by injecting a solution of 500 cc saline with 1 mg of epinephrine. The Veress needle is advanced centrally until the sternal notch is reached and then the needle is advanced laterally with the goal of opening the flaps laterally. This subplatysmal-working plane is then dilated with a blunt dissector (Anuwong dilator, Kelly Wick tunneler or Hegar dilators).[23] A 10–12-mm port is the first placed, through the central incision and then over the mandible advancing the port about 2 cm distally to the chin, taking care to avoid penetration of mentum skin, and then insufflation with CO_2 is established at a pressure of 6 mm Hg. A 30° 10-mm camera is then placed through the central port. Next, the two lateral 5-mm ports are placed through the lateral incisions for instrument placement. A Maryland dissector and bipolar energy or ultrasonic energy device is used on either side of the camera.[14] Dissection is carried out in the caudal direction toward the sternal notch, always staying beneath the platysma muscle. Laterally, dissecting to bilateral sternocleidomastoid muscles further enhances exposure. Once the strap muscles are visualized they are divided in the midline to expose the thyroid gland. The strap muscles are then retracted laterally by placing stay sutures, after dividing the isthmus. The thyroid vessels are ligated and divided in sequence, starting with the middle thyroid veins and then with the superior thyroid vessels, taking care to avoid injuring the external branch of the superior laryngeal nerve. The superior lobe is then mobilized and the recurrent laryngeal nerve is identified. The use of a nerve monitoring system is encouraged and a good adjunct but not a mandatory tool to perform this procedure. The inferior thyroid vessels are divided and the rest of the lobe is then mobilized. The parathyroid glands are meticulously sought and preserved, along with their blood supply. The same approach and technique is then applied to the contralateral lobe, if a total thyroidectomy is undertaken. The thyroid gland is then pushed anteriorly and berry's ligament is divided. The gland is then placed in an endocatch bag and brought out through the central port.[10,14,20,23,23,24] The strap muscles are approximated with a 3–0 absorbable suture. Instruments and ports are removed. The midline incision is closed in two layers; a 3–0 absorbable suture is used to approximate the mentalis muscle and 5–0 chromic suture is used to close the mucosa. A pressure dressing is placed on the neck and around the chin for 24 hours.

The timing of the discharge of the patient varies widely based on the surgeon's preference and sociocultural fac-

tors, with procedures performed mostly as an outpatient procedure in the United States versus hospital admissions with a length of stay of up to 1 week in some Asian countries. Regardless of their length of stay, patients are placed on a liquid diet immediately after the procedure and are advanced to a soft diet on postoperative day 1 and to a regular diet on postoperative day 2. Patients are discharged with per oral pain medication. The advantages of this technique include the provision of a magnified view of important anatomical structures. For example, the ability to visualize bilateral RLNs as they insert into the larynx, as well the ability to identify the parathyroid glands more clearly. On the other hand, the reduced surgical space and narrowed triangulation of the instruments, secondary to the close proximity of the port sites, leads to limited maneuverability. This is where experience in endocrine and laparo-endoscopic surgery comes into play.

Worldwide Experience with the Transoral Vestibular Approach

TOETVA is being performed at various international institutions and multiple hospitals in the United States. We present data obtained from a systematic literature review (PubMed search), with a summary detailed in **Table 2**. Patients successfully underwent all forms of thyroidectomies including isthmusectomies, lobectomies, subtotal, completion, and total thyroidectomies. Indications for surgery varied from benign symptomatic disease to preoperatively diagnosed malignancy, and also included nodules classified as Bethesda classes 2 through 6. There were 6 (0.007%) reported cases that required conversion to an open procedure, due to excessive bleeding, underestimated preoperative nodular/goiter size, or substernal extension of they thyroid gland appreciated intra-operatively.

The type and duration of antibiotic coverage administered for this procedure have been reported to be highly variable. Some report only giving a single dose at induction while other report providing antibiotics for up to 1 week postoperatively. We have made it our practice to use antibiotics that provide coverage of the polymicrobial flora found in the mouth (e.g., amoxicillin-sulbactam, cefoxitin, or cefazolin plus an anaerobic covering antibiotic [clindamycin or metronidazole]). Reasons for variation could be differences in cultural practices versus differences in hospital policies for coverage of regionally based bacterial resistance. To date there have been 2 reported cases of surgical-site infections.

Postoperative length of stay has been as highly variable as duration of antibiotic coverage—with some cases being managed as same-day surgery and other cases having a protracted course as long as 20 days. Among the reported cases in Table 2, the mean length of stay (in days) ranged from 1 to 7.

Given the new route and dissection plane that the transoral endoscopic vestibular approach requires, there have been new morbidities uncovered that had never been seen before in thyroid surgery. The creation of a dissection plane in the subplatysmal space, over the chin, has lead to cutaneous lesions around the chin and near the commissure of the mouth. Apart from the feared recurrent laryngeal nerve, the initial transoral incision sites and subsequent port placement had left patients susceptible to mental nerve injuries. Otherwise, this new technique has similar risks and complications to the traditional route (i.e., hypoparathyroidism, postoperative hematoma, or surgical-site infection). A randomized trial is still necessary to determine if there's any significant difference in complication rates between this newer technique and the traditional route. **Table 3** illustrates the specific complications that have been encountered and documented in the literature. Despite these new findings, TOETVA has proven to be a safe, effective, and cosmetically pleasing alternative to the traditional open route as well as the other remote access approaches.[2]

No specific guidelines or training have been established to determine who is capable of performing this procedure. However, based on expert opinions, the surgeon should have expertise in thyroid surgery or have adequate thyroid volume, in addition to expertise in laparo-endoscopic surgery. Technical video-resources, case observations, cadaver lab dissection (at least 2), and availability of a preceptor for the first cases is highly recommended. Anecdotally, we found that greater than 15 cases were necessary to develop true proficiency with this procedure. From an equipment standpoint, no more than ordinary laparoscopic instruments are necessary for this procedure. As noted in the surgical technique section, there are no instruments used that could be found outside of a standard laparoscopic tray.

DISCUSSION

TOETVA should no longer be considered an experimental operation or novel technique. There are articles

Table 2.
Literature Review of Experiences with TOETVA

Author	Cases, N	Indications for Thyroidectomy	Surgery Type	Tumor Size, cm, Mean (Range)	Antibiotics	Conversion to Open	Hospital Stay, Days (Range)
Nakajo et al[16]	8	3 FA	TOVANS: Extension NS	NS	3 days	0	4.5 (4–5)
		1 NG					
		3 mPTC					
		1 FC					
Wang et al[13]	12	3 Hyperplastic nodules	TOETVA: Lobectomy and total thyroidectomy	3.2 (1–4.6)	NS	0	4.9 (3.5–6.3)
		3 Follicular nodules					
		4 Colloid nodules					
		2 Follicular adenomas					
Yang et al[18]	41	34 benign goiters	TOETVA: Lobectomy, subtotal or near total resection	3.5 (2.8–4.1)	At induction of anesthesia + 3 days postoperative	0	5
		3 hyperthyroidism					
		4 PTC					
Anuwong et al[1]	60	34 single nodules	TOETVA: Total thyroidectomy, lobectomy	5.4 (3–10)	At induction: Augmentin (1.2 gm)	0	3.6 (2–7)
		22 MNG			Postoperative: 2 days IV abx + 5 days PO abx		
		2 Graves					
		2 PTC					
Pai et al. 2015[2]	1	1 single adenoma	TOETVA: Lobectomy	4	Postoperative oral abx	0	7
Jitpratoom et al[20]	45	45 Grave's	TOETVA: Total thyroidectomy	Thyroid size: 5.41 (4–6.8)	At induction: Augmentin (1.2 gm)	1 (for excessive bleeding-excluded)	3
					Postoperative: 2 days IV abx + 5 days PO abx		
Park JO et al[17]	1	1 FN	TOETVA: Lobectomy	2	Cephalosporin (2nd generation) IV 2 days	0	3
					PO ABX 7 days		
Wang et al[13]	10*	5 Suspicious lesions	TOETVA: Total thyroidectomy, lobectomy + selective CND	0.7 (0.4–1.3)	At induction + 3 days of IV abx	0	4 (3–5)

Table 2.
Continued

Author	Cases, N	Indications for Thyroidectomy	Surgery Type	Tumor Size, cm, Mean (Range)	Antibiotics	Conversion to Open	Hospital Stay, Days (Range)
		1 FN					
		4 PTC					
Zeng et al. 2016	4	4 MNG	TOETVA	5	NS	NS	5
Udelsman et al[23]	7	1 MNG	TOETVA: Total thyroidectomy, lobectomy	4.2 (2.3–5.2)	Yes, N/S	0	1.1 (1–2)
		1 HCN					
		1 Hyperplastic nodule					
		1 toxic adenoma					
		1 mPTC + colloid nodules					
		2 Parathyroids					
Inabnet et al[25]	1	1 toxic adenoma	TOETVA: Lobectomy	2.8	Yes	0	1
Dionigi et al[22]	15	6 FLUS (1 PTC on final pathology)	TOETVA: Total thyroidectomy, lobectomy	1.9 (1.3–3.2)	At induction of anesthesia and 5 days post-op	0	1.6 (1–4)
		2 toxic adenomas					
		5 NG					
		1 Hurthle cell adenoma					
		1 PTC					
Richmond & Kim. 2017[4]	17	5 benign	TORTVA: Lobectomy & CND in 13 cases	1.2 (0.9–2.5)	NS	1 (for a large substernal goiter)	NS
		11 PTC					
Russell et al[21]	14	5 adenomatous nodules	TORTVA (6 cases): Lobectomy	3.2 (1.5–4.3)	Augmentin (875 mg twice daily) 5 days	0	1 pt: SDS
		4 AUS	TOETVA (6 cases): Lobectomy				13 pts: 23-hour admission
		1 HCN					
		1 FN					
		1 PTC					
		2 parathyroids					
Anuwong et al[9]	422	245 single adenoma	TOETVA: Lobectomy & total thyroidectomy	3.8 (1–10)	At induction: Augmentin (1.2 gm)	3 (for excessive bleeding - excluded)	3

Table 2.
Continued

Author	Cases, N	Indications for Thyroidectomy	Surgery Type	Tumor Size, cm, Mean (Range)	Antibiotics	Conversion to Open	Hospital Stay, Days (Range)
		118 MNG			Postoperative: 2 days IV ABX + 5 days PO Abx		
		33 Grave's					
		26 mPTC					
Park & Sun[12]	18	2 AUS	TOETVA:	1.75 (0.5–7.5)	IV 2 days +	0	4 (3–7)
		2 FN	Lobectomy, completion, total thyroidectomy		7 days PO (type NS)		
		1 benign					
		1 completion (FC)					
		1 suspicious					
		11 PTC					
Anuwong et al[10]	200	111 single adenoma	TOETVA: Total thyroidectomy, lobectomy	4.1 (1–10)	At induction: Augmentin (1.2 gm)	1 (for excessive bleeding—excluded)	3.2 (2–5)
		66 MNG			Postoperative: 2 days IV ABX + 5 days PO ABX		
		12 Grave's					
		11 mPTC					
Yi et al. 2018	20	19 PTCs	TOETVA: Total thyroidectomy, lobectomy, and wide isthusectomy	0.8 (0.2–1.4)	At induction: IV 3rd-generation cephalosporin + 7 days of oral Abx (Augmentin)	0	4.7 (3–20)
		1 Follicular neoplasm					
Razavi et al. 2018	1	1 Hurthle cell carcinoma	TOETVA: Completion thyroidectomy	2.0	NS	0	NS
Tesseroli et al. 2018	9	7 benign adenomas	TOETVA: Total thyroidectomy, lobectomy	2.3 (1–4)	24 hours of clindamycin	0	0.8 (0–1)
		2 PTCs					

Abx: antibiotic; AUS, atypia of indeterminate significance; CND, central neck dissection; FA, follicular adenoma; FC, follicular cancer; FLUS, follicular lesion of undetermined significance; FN, follicular neoplasm; HCN, Hurthle cell neoplasm; IV, intravenous; MNG, multinodular goiter; mPTC, micro papillary thyroid carcinoma; NG, nodular goiter; NS, not specified; PO, per oral; PTC, papillary thyroid carcinoma; SDS, same-day surgery; TOETVA, transoral endoscopic thyroidectomy vestibular approach; TORTVA, transoral robotic thyroidectomy vestibular approach; TOVANS, transoral video-assisted neck surgery.

*All confirmed to be PTC on pathology.

Table 3.
Complications That Have Been Documented in the Literature

Complications		Remarks
Cutaneous lesions	Ecchymosis, full thickness tears, burns	The postoperative bruising and ecchymosis generally resolves in one to two weeks. However, full-thickness injuries or burns may not resolve and can leave a scar.
Nerve Injuries	Mental nerve	Of the reported mental nerve injuries, only a minority had persistent (>6 months) lower lip and/or chin numbness/paresthesia. There was a decrease in incidence after adjustment of vestibular port placement—of the 3 reported, recovery occurred within 4 months.
	Recurrent laryngeal nerve	There has been a low incidence of RLN injury. In all reported cases of injury to the RLN, via TOETVA, a full recovery of vocal cord function was reported within 6 months of surgery.
Hypoparathyroidism	Transient	Transient hypoparathyroidism has been observed in up to 22% of the patients in a series of total thyroidectomies for the treatment of Grave's disease.
Conversion rate	Endoscopic to open or Robotic to endoscopic	A small number of TOETVAs have been converted to open procedures—most commonly as a result of excessive bleeding or greater than anticipated nodular size.
Hematoma	Immediately postop versus days to weeks later	To date, a very limited number of postoperative hematomas have been reported in the literature.
Seroma		Postoperative seromas has been observed in 20 patients from a total of 425 in the largest series published to date. All cases were resolved with simple needle aspiration
SSI	Surgical site infection	There have been 2 reported SSI

RLN, recurrent laryngeal nerve; SSI, surgical site infection; TOETVA, transoral endoscopic thyroidectomy vestibular approach.

being published, from around the world, detailing safe and effective therapy for thyroid pathologies via this approach.

Minor injuries to the skin are common after a transoral thyroidectomy. The most frequently noticed injury to the skin, in the immediate postoperative period, is ecchymosis of the chin and the anterior neck.[13,18] This generally resolves within 1–2 weeks. Full-thickness injuries or piercing of the skin caused by the Veress needle during hydrodissection, electrocautery, or even with the use of clamps during dissection of the superior neck flap have been reported. Other skin injuries include skin tears at the lip commissures from traction or a burn caused by the energy devices used during the procedure.[4,18]

One of the common complications is mental nerve injury, resulting in a postoperative numbness and/or paresthesia in the lower lip and/or the chin. Several studies have reported that this condition persisted for more than 6 months.[16] When this problem was first encountered, adjustments were made to the lateral 5-mm ports.[14] The two vertical incisions for the 5-mm ports were repositioned to the vestibular mucosa lateral to the level of the canines and just in the inner aspect of the inferior lip, in an attempt to avoid tract of the mental nerve. After these adjustments, a study of 425 patients reported only 3 mental nerve injuries with recovery in less than 4 months.[9] In our experience, while transient mental nerve injury continues to occur, there has been full recovery of the inferior lip and chin sensation.

Injury to the recurrent laryngeal nerve is a complication that still persists in traditional transcervical thyroidectomies. With advances in the endoscopic vestibular approach technique there has been a low incidence of RLN injury. In all reported cases of injury to the RLN, via TOETVA, a full recovery of vocal cord function was reported within 6 months of surgery.[1,10,23] Inabnet et al., Dionigi et al., and Wang et al. demonstrated intraoperative neuromonitoring in TOETVA operations with promising results.[13,22,25] However, the number of patients in those studies was deemed too limited; larger studies need to be conducted to confirm that neuromonitoring can reduce the rate of RLN injury.

As in traditional transcervical thyroidectomy, hypocalcaemia is more common when a total thyroidectomy is performed. Fortunately, there have been no reports of permanent hypoparathyroidism.[20] Postoperative hematoma is a concerning and not unexpected complication of the traditional transcervical thyroidectomy. To date, a very limited number of postoperative hematomas have been reported in the literature but the underestimation of this complication may be related to the limited cases reported in the literature.

A major concern with the transoral approach has been the risk of a surgical-site infection. The mucosa of the oral cavity is colonized with a diverse bacterial flora, including gram-positive aerobic and anaerobic bacteria.[26] Previously, via the open route, thyroidectomies had a clean wound classification. Because of the violation of the oral mucosa, transoral thyroidectomies are classified as a clean contaminated case; assuming that there is no concomitant infectious process at the time the surgery (e.g., tooth abscess, etc.,).[3] To combat the risk of surgical site infection, appropriate preoperative prophylactic antibiotic coverage is recommended to cover against the polymicrobial flora of the mouth. Amoxicillin-sulbactam or cefazolin + an anaerobic covering antibiotic (clindamycin or metronidazole) would provide adequate coverage.[27] No universal guidelines have been set forth, to date. Fortunately, there have been limited reports of wound infection with the oral vestibular approach.

CONCLUSION

Over the past two decades, there has been a growing popularity for the various remote access thyroidectomy techniques. Its safety profile and efficacy have been proven with limited morbidity. It is a safe and feasible procedure and provides favorable cosmetic outcomes when compared to the traditional thyroidectomy. Compared to the rest of the alternative remote access thyroidectomy techniques, the transoral route also completely avoids cutaneous scarring from the access incisions.

References:

1. Anuwong A. Transoral endoscopic thyroidectomy vestibular approach: a series of the first 60 human cases. *World J Surg.* 2016;40:491–7.

2. Transoral endoscopic thyroidectomy using vestibular approach: updates and evidences—Anuwong—Gland Surgery. Dec 17, 2017. Available from: http://gs.amegroups.com/article/view/14691/15501.

3. Chai YJ, Chung JK, Anuwong A, et al. Transoral endoscopic thyroidectomy for papillary thyroid microcarcinoma: initial experience of a single surgeon. *Ann Surg Treat Res.* 2017;93:70–5.

4. Richmon JD, Kim HY. Transoral robotic thyroidectomy (TORT): procedures and outcomes. *Gland Surg.* 2017;6:285–9.

5. Richmon JD, Holsinger FC, Kandil E, Moore MW, Garcia JA, Tufano RP. Transoral robotic-assisted thyroidectomy with central neck dissection: preclinical cadaver feasibility study and proposed surgical technique. *J Robot Surg.* 2011;5:279–82.

6. Benhidjeb T, Wilhelm T, Harlaar J, Kleinrensink GJ, Schneider TA, Stark M. Natural orifice surgery on thyroid gland: totally transoral video-assisted thyroidectomy (TOVAT): report of first experimental results of a new surgical method. *Surg Endosc.* 2009;23:1119–20.

7. Witzel K, von Rahden BH, Kaminski C, Stein HJ. Transoral access for endoscopic thyroid resection. *Surg Endosc.* 2008;22:1871–5.

8. McHenry CR. Endoscopic minimally invasive thyroidectomy: a prospective proof-of-concept study in humans. *World J Surg.* 2011;35:552.

9. Anuwong A, Ketwong K, Jitpratoom P, Sasanakietkul T, Duh QY. Safety and outcomes of the transoral endoscopic thyroidectomy vestibular approach. *JAMA Surg.* 2018;153:21–7.

10. Anuwong A, Sasanakietkul T, Jitpratoom P, Ketwong K, Kim HY, Dionigi G, et al. Transoral endoscopic thyroidectomy vestibular approach (TOETVA): indications, techniques and results. *Surg Endosc.* 2018;32:456–65.

11. Yeh MW. Thyroid Surgery Through the Mouth Might Not Be as Crazy as It Sounds. *JAMA Surg.* 2018;153:28.

12. Park JO, Sun DI. Transoral endoscopic thyroidectomy: our initial experience using a new endoscopic technique. *Surg Endosc.* 2017;31:5436–43.

13. Wang C, Zhai H, Liu W, Li J, Yang J, Hu Y, et al. Thyroidectomy: a novel endoscopic oral vestibular approach. *Surgery.* 2014;155:33–8.

14. Kahramangil B, Mohsin K, Alzahrani H, et al. Robotic and endoscopic transoral thyroidectomy: feasibility and description of the technique in the cadaveric model. *Gland Surg.* 2017;6:611–9.

15. Richmon JD, Pattani KM, Benhidjeb T, Tufano RP. Transoral robotic-assisted thyroidectomy: a preclinical feasibility study in 2 cadavers. *Head Neck.* 2011;33:330–3.

16. Nakajo A, Arima H, Hirata M, et al. Trans-oral video-assisted neck surgery (TOVANS). A new transoral technique of endoscopic thyroidectomy with gasless premandible approach. *Surg Endosc.* 2013;27:1105–10.

17. Park JO, Kim MR, Kim DH, Lee DK. Transoral endoscopic thyroidectomy via the trivestibular route. *Ann Surg Treat Res.* 2016;91:269–72.

18. Yang J, Wang C, Li J, et al. Complete endoscopic thyroidectomy via oral vestibular approach versus areola approach for

treatment of thyroid diseases. *J Laparoendosc Adv Surg Tech A.* 2015;25:470–6.

19. Fu J, Luo Y, Chen Q, Lin F, Hong X, Kuang P, et al. transoral endoscopic thyroidectomy: review of 81 cases in a single institute. *J Laparoendosc Adv Surg Tech.* A. 2018;28:286–291.

20. Jitpratoom P, Ketwong K, Sasanakietkul T, Anuwong A. Transoral endoscopic thyroidectomy vestibular approach (TOETVA) for Graves' disease: a comparison of surgical results with open thyroidectomy. *Gland Surg.* 2016;5:546–52.

21. Russell JO, Clark J, Noureldine SI, et al. Transoral thyroidectomy and parathyroidectomy—A North American series of robotic and endoscopic transoral approaches to the central neck. *Oral Oncol.* 2017;71:75–80.

22. Dionigi G, Bacuzzi A, Lavazza M, et al. Transoral endoscopic thyroidectomy: preliminary experience in Italy. *Updat Surg.* 2017;69(2):225–34.

23. Udelsman R, Anuwong A, Oprea AD, Rhodes A, Prasad M, Sansone M, et al. Trans-oral Vestibular Endocrine Surgery: A New Technique in the United States. *Ann Surg.* 2016;264(6):e13–e16.

24. Dionigi G, Lavazza M, Bacuzzi A, et al. Transoral endoscopic thyroidectomy vestibular approach (TOETVA): from A to Z. *Surg Technol Int.* 2017;30:103–12.

25. Inabnet WB 3rd, Suh H, Fernandez-Ranvier G. Transoral endoscopic thyroidectomy vestibular approach with intraoperative nerve monitoring. *Surg Endosc.* 2017;31:3030.

26. Ambarkova NA. The bacterial flora in a healthy oral cavity. Available from: https://juniperpublishers.com/adoh/pdf/ADOH.MS.ID.555773.pdf

27. Salmerón-Escobar JI, del Amo-Fernández de Velasco A. Antibiotic prophylaxis in Oral and Maxillofacial Surgery. *Med Oral Patol Oral Cirugia Bucal.* 2006;11:E292–E296.