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Transoral Endoscopic Thyroidectomy Vestibular Approach (TOETVA) for Thyroid Nodules: A Series of the First 10 Patients in a Single Institution

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ABSTRACT

Objective: To present the perioperative data of patients with solitary or multinodular goiter and/or papillary thyroid carcinoma who underwent Transoral Endoscopic Thyroidectomy Vestibular Approach (TOETVA) in a single tertiary medical center.

Methods:

Design: Case series

Setting: Tertiary Government Hospital

Participants: Records of 10 patients who underwent TOETVA from June 2018 to July 2019 (9 thyroid lobectomies, 1 total thyroidectomy) were reviewed. Outcomes and measures included conversion to open surgery, operative time, intraoperative blood loss, size of the thyroid gland, postoperative hospital stay, visual analogue pain scores (VAS), and postoperative complications.

Results: None of the 10 patients were converted to an open procedure. The average preoperative thyroid size was 4.73 cm in widest diameter using thyroid ultrasound (±1.88 cm, range 3.6 to 6.5 cm). Mean operative time for thyroid lobectomy and total thyroidectomy was 4 hours and 29 minutes and 4 hours and 15 minutes, respectively. Mean intraoperative blood loss was 140 ml (±47.96 ml, range 80 to 200 ml) for thyroid lobectomy and 100 ml for total thyroidectomy. The average intraoperative size of the thyroid gland measured in widest diameter (larger lobe for total thyroidectomy) was 4.48 cm (±0.919 cm, range 3 to 5.5 cm). Median postoperative hospital stay was 2 days (±1.55 days, range 2 to 12 days). Mean VAS pain scores for postoperative days 1, 2, 3, and 7 were 5, 3, 2, and 0, respectively. Transient recurrent laryngeal nerve injury (of 3 months duration) occurred in 1 patient. Two cases had surgical site infection, 2 had wound dehiscence, 1 had seroma and 1 had skin burn as a complication. None had hypocalcemia or mental nerve injury in the series.

Conclusions: TOETVA was replicated in the local setting and a presentation of the perioperative data of all the patients who underwent this novel technique, the indications, as well as surgical and patient outcomes, were described.

Keywords: *TOETVA; thyroidectomy; transoral; endoscopic; minimally invasive*

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Thyroidectomy is a surgical procedure that has become the universally accepted technique for selected tumors of the thyroid gland and is one of the most common surgeries performed worldwide.[1,2] The standard technique involves a curvilinear incision over the anterior neck, leaving a noticeable scar that is considered disturbing by a majority of patients.[1-4] Natural Orifice Transluminal Endoscopic Surgery (NOTES) was developed as a minimally invasive technique where procedures done through natural body orifices leave no scar, producing superior cosmetic results, greatly decreased postoperative pain, as well as decreased hospital stay and decreased intraoperative bleeding compared to conventional open surgeries.[4] Thyroid surgery has applied NOTES via a transoral approach and Transoral Endoscopic Thyroidectomy Vestibular Approach (TOETVA) was developed in 2015, utilizing conventional laparoscopic instruments via the oral vestibule.[3] This technique has largely replaced other NOTES for thyroid surgery and is a relatively new procedure that could be a promising alternative to standard thyroidectomy.[1-5]

However, data on this technique is still accumulating, and further reports on surgical and patient outcomes of TOETVA in the local setting may prove to be a significant contribution to the global literature with regards to future developments of this novel procedure.[4] Moreover, a search of HERDIN Plus using the keywords "transoral," "endoscopic," and "thyroidectomy" yielded no local studies on TOETVA.

The objective of this paper is to present the perioperative data of patients with solitary or multinodular non-toxic goiter and/or papillary thyroid carcinoma who underwent TOETVA in a single tertiary medical center. Surgical technique, indications, and outcomes will be described.

METHODS

With Institutional Review Board approval, this case series reviewed records of all patients who underwent TOETVA by a consultant and resident surgeon from the Department of Otorhinolaryngology – Head and Neck Surgery at the Quirino Memorial Medical Center in Quezon City, Philippines, from June 2018 to July 2019. Charts of patients were retrieved from the records section and were considered for inclusion in the study. Informed consent for inclusion in this series and publication of clinical photographs was obtained from all patients.

The only exclusion criterion was incomplete data. Indications and operative technique were adopted from the revised pilot study done by Anuwong *et al.*[3] *(Figures 1 and 2)* Indications for TOETVA included those who had a thyroid gland diameter not larger than 10 cm that was (1) a benign tumor, such as a thyroid cyst, single nodular goiter, or a multinodular goiter, (2) a follicular neoplasm, or (3) a papillary carcinoma of the thyroid without evidence of metastasis. The following were considered as contraindications: patients who (1) were not cardiopulmonary - cleared for surgery and (2) had a previously irradiated neck.

All operations in this series were performed by a consultant and resident surgeon who had undergone and obtained training certificates for TOETVA. Preoperative preparation was identical to that of open thyroidectomy. All patients underwent routine investigation including thyroid function tests, thyroid ultrasonography and fine needle aspiration biopsy. Cardiopulmonary clearances were obtained for patients above 40 years old. All patients were informed of the possibility to convert to open surgery should there be difficulties during the surgery such as excessive bleeding or technical issues with the laparoscopic equipment.

Bedside assessment for hypocalcemia included the presence of perioral numbness and by eliciting a positive Chvostek's sign, and if any were present, serum corrected calcium was obtained (serum parathyroid hormone levels were not obtained routinely due to assay unavailability in the institution). Sensation of the lower lip and mentum were examined via light touch sensation and assessed by the presence or absence of numbness. For antibacterial prophylaxis, hexetidine gargle was prescribed for all patients at 10 cc every 4 hours and intravenous clindamycin 300 mg was given every 6 hours for 24 hours and then switched to oral form at the same dosage until 7 days postoperatively.

The VAS pain score was assessed daily until postoperative day 3 and obtained via phone call or short message service (SMS) if discharged. Another VAS assessment was obtained on the first OPD follow-up on postoperative day 7. All of the patients had the same pain medication regimen: 3 doses of intravenous ketorolac 30 mg every 8 hours, followed by celecoxib 200 mg per os around the clock twice daily until 1 week postop. Assessment of RLN function was determined by the presence of postoperative hoarseness, and if present, a video laryngoscopy was performed to assess vocal cord mobility. Recurrent laryngeal nerve injury was noted if there was impaired mobility of the ipsilateral true vocal cord.

Follow-up plans were 1 week, 1 month, 3 months, 6 months, and 1 year post-operatively with a postoperative thyroid ultrasound requested at 3 months follow-up to determine adequacy of removal.

Data Analysis

Study variables (age, sex, specific thyroid condition, preoperative size of the thyroid gland, surgical technique as either thyroid lobectomy or total thyroidectomy, conversion to open technique, operative time, intraoperative blood loss, intraoperative size of the thyroid gland, postoperative hospital stay, VAS pain score, postoperative complications such as RLN injury, hypocalcemia, mental nerve

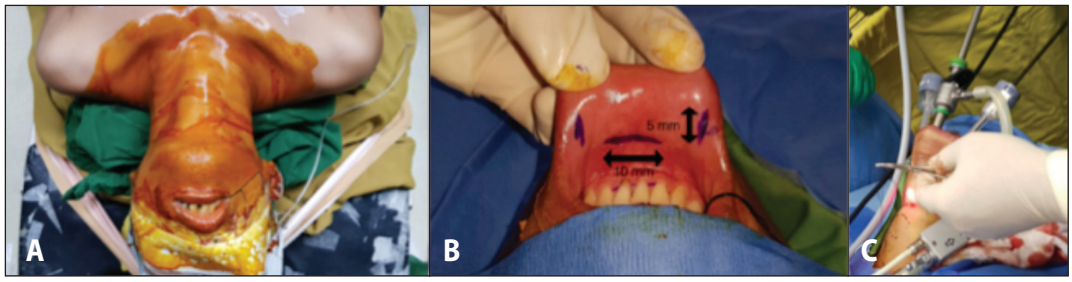

Figure 1. Patient positioning, incision markings, and port placement. **A.** Supine position with neck hyperextension under nasotracheal intubation. Aseptic and antiseptic technique as in open thyroidectomy, extended to upper lip. **B.** Placement of vestibular incision markings. A horizontal 10-mm line was drawn at the center of the lower lip vestibule between the inferior labial frenulum and vermilion border. Two 5-mm vertical lines were drawn lateral to the horizontal markings drawn at a line anterior to the junction between the lower canine and first premolar teeth. **C.** Insertion of a 10-mm port in the horizontal 10-mm incision. A 10-mm 30° laparoscope was used. Two 5-mm ports inserted at the lateral incisions. Laparoscopic instruments were used in the lateral ports.

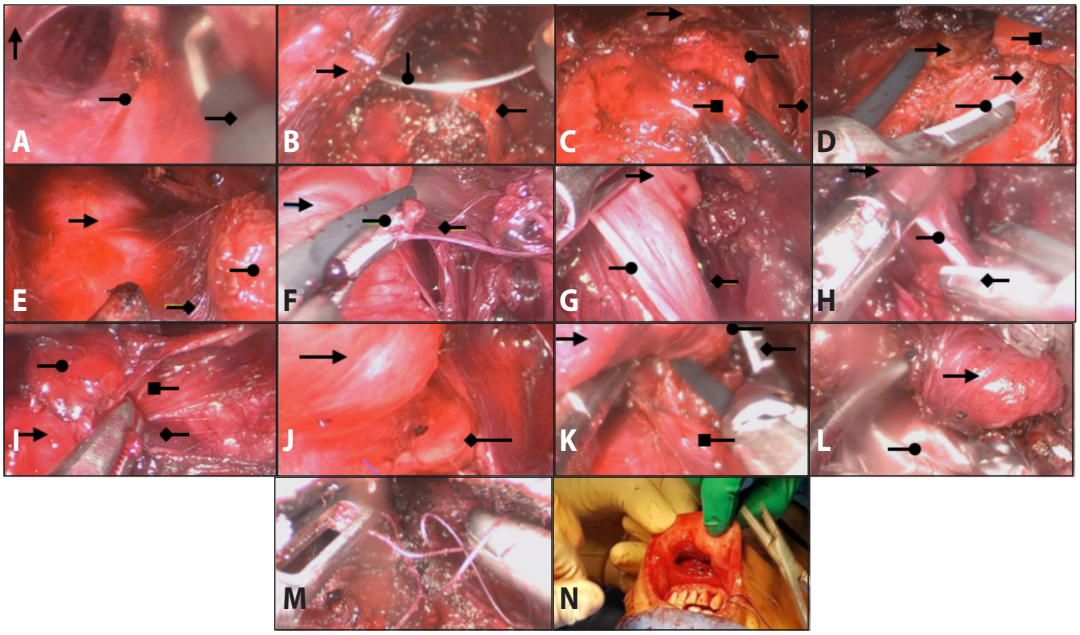

Figure 2. Surgical Technique **A.** Top-down view using 10-mm 30° laparoscope. (Triangle: superficial cervical fascia, Circle: midline, Diamond: L-hook monopolar cautery) **B.** Left strap muscles retracted laterally using an external hanging 2/0 silk suture exposing the trachea. (Triangle: strap muscles, Circle: silk 2/0 suture needle, Diamond: thyroid nodule) **C.** Right strap muscles retracted laterally via external hanging suture. The right thyroid lobe and the inferiorly located mass was exposed. (Triangle: trachea, Circle: thyroid nodule, Square: superior portion of right thyroid lobe, Diamond: retracted strap muscles) **D.** Isthmusectomy done using an ultrasonic device. (Triangle: trachea, Circle: ultrasonic device, Square: right thyroid lobe retracted anterolaterally, Diamond: posterior suspensory ligament of Berry) **E.** Isthmusectomy completed. (Triangle: trachea, Circle: right thyroid lobe retracted laterally, Diamond: posterior suspensory ligament of Berry) **F.** Right thyroid lobe retracted medially exposing its lateral attachments and the superior parathyroid gland. Both were dissected away from the thyroid using an ultrasonic device. (Triangle: right thyroid lobe retracted medially, Circle: superior parathyroid gland, Diamond: lateral attachments) **G.** Exposure of the superior pole of the right thyroid lobe via dissection through an avascular space. (Triangle: right thyroid lobe retracted anteriorly, Circle: superior pole vessels, Diamond: Avascular space of Joll) **H.** Ultrasonic device used to ligate the superior pole vessels. (Triangle: right thyroid lobe retracted anteriorly, Circle: superior pole vessels, Diamond: ultrasonic device) **I.** Exposure of the right RLN. (Triangle: right thyroid lobe, Circle: thyroid nodule, Diamond: cricothyroid muscle, Square: right RLN) **J.** Exposure of the right inferior parathyroid gland. (Triangle: right thyroid lobe retracted medially, Diamond: right inferior parathyroid gland) **K.** Ligation of inferior pole vessels using an ultrasonic device. (Triangle: right thyroid lobe, Circle: inferior pole of the right thyroid gland, Diamond: ultrasonic device, Square: cricothyroid muscle) **L.** Specimen held inside endobag and ready for extraction (Triangle: right thyroid lobe and mass, Circle: endobag) **M.** Approximation of strap muscles using Vicryl 4/0 sutures. **N.** Two-layer closure of lower lip vestibule using Vicryl 4/0 sutures

injury, surgical site infection, wound dehiscence, seroma, and other complications) were abstracted from the hospital charts and frequency distributions and measures of central tendency were computed. Data was summarized and processed using IBM SPSS version 24.0 Released 2016. (IBM Corporation, Armonk, NY, USA).

RESULTS

A total of 10 patients (one male and nine females) underwent TOETVA from June 2018 to July 2019. The mean age was 37 years (± 9.74, range 27 to 56). Patient characteristics and outcomes are summarized in *Table 1*. Of the 10 patients, 7 had single thyroid nodules, 4 of which

Table 1. Summary of patient characteristics and outcomes who underwent TOETVA at QMMC (n=10)

Patient #	Age	Sex	Preoperative diagnosis (FNAB)	Histo-pathologic diagnosis	Unilateral vs Bilateral nodules	Index nodule size by US (cm)	Index nodule gross size (cm)	Extent of surgery (lobectomy vs total)	Operative time (hr:min)	Blood loss (ml)	Post-operative length of hospital stay (days)	Complications
1	30	F	Papillary CA	Papillary CA	Unilateral	3.6	5.2	lobectomy	3:00	120	3	None
2	26	M	Follicular neoplasm	Nodular colloid goiter	Unilateral	6	5	lobectomy	5:40	200	2	None
3	27	F	Nodular goiter	Adenomatoid colloid goiter	Unilateral	4	4	lobectomy	3:55	80	2	None
4	37	F	Nodular goiter	Adenomatoid colloid goiter	Unilateral	6.5	5.5	lobectomy	7:00	200	2	SSI, wound dehiscence
5	51	F	Nodular goiter	Adenomatoid colloid goiter	Unilateral	5.96	3	lobectomy	6:00	140	2	Skin burn
6	36	F	Multinodular goiter	Adenomatoid colloid goiter	Unilateral	3.96	5	lobectomy	4:00	120	2	RLN injury, seroma
7	56	F	Papillary CA	Papillary CA	Bilateral	5.31	5.1	total	4:15	100	12	SSI, wound dehiscence
8	30	F	Nodular goiter	Adenomatoid colloid goiter	Unilateral	5.07	5	lobectomy	3:50	100	3	None
9	25	F	Papillary CA	Papillary CA	Unilateral	3	3	lobectomy	3:40	100	2	None
10	44	F	Multinodular goiter	Adenomatoid colloid goiter	Unilateral	3.9	4	lobectomy	3:20	200	2	None

were benign colloid nodules (57%), 1 was a follicular neoplasm (14%), and 2 were papillary carcinomas (29%), while 3 of the patients had multinodular goiters, 2 of which were unilateral benign colloid nodules (67%) and 1 case was a unilateral papillary carcinoma with contralateral benign colloid nodules (33%).

The average preoperative thyroid size was 4.73 cm in widest diameter using thyroid ultrasound (±1.88 cm, range 3.6 to 6.5 cm). Nine patients underwent thyroid lobectomy and one patient underwent total thyroidectomy. No patients were converted to open thyroidectomy. Mean operative time for thyroid lobectomy and total thyroidectomy was 4 hours and 29 minutes and 4 hours and 15 minutes, respectively (± 1 hour and 14 minutes, range 3 to 7 hours). The overall average blood loss was 121.5 ml (± 44.54 ml, range 80 to 200 ml), with 140 ml (±47.95 ml, range 80 to 200 ml) for those who underwent thyroid lobectomy, and 100 ml for the patient who underwent total thyroidectomy. The average intraoperative size of the thyroid gland was measured in widest diameter (in total thyroidectomy cases, the larger lobe was measured) which was 4.48 cm (±0.919 cm, range 3 to 5.5 cm). Median postoperative hospital stay was 2 days (range 2 to 12 days).

There were no cases of hypocalcemia in this series. In this series, none were noted to have a mental nerve injury. A total of 2 patients developed anterior neck abscesses with purulent discharge, necessitating an incision and drainage procedure in one of the cases, while the other had delayed removal of post-operative neck drain. *(Figures 3 to 6)* Failure of wound closure of the horizontal midline vestibular incision was noted 1 week postoperatively in both cases. A seroma was found in 1 case, which was treated with syringe aspiration using a gauge-23 needle. One of the cases sustained a skin burn secondary to electrocauterization.

The mean postoperative VAS measurements were 5, 3, 2, and no pain or 0, on the first, second, third, and seventh postoperative days, respectively. Recurrent laryngeal nerve injury was noted in 1 patient, confirmed by video laryngoscopy through postoperative days 1, 2, 3, 7, and 1-month postoperatively. There was complete resolution of hoarseness and true vocal cord paresis after 3 months.

All of the patients were able to complete follow-ups up to 3 months, 7 patients were able to follow-up at 6 months, and 3 patients were seen after 1 year. *(Figure 7)* Only 5 of the patients came back with requested thyroid ultrasound results at three months, 4 of which showed adequate removal with 1 patient who had thyroid lobectomy noted to have a new thyroid nodule on the contralateral side that was managed accordingly via a completion TOETVA which is not included in this case series.

Figure 3. Abscess formation over the sternal area noted 8 days postoperatively

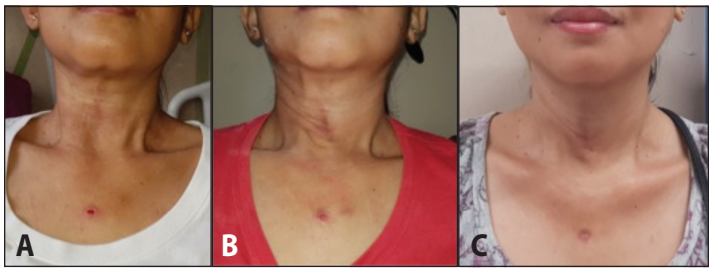

Figure 4. Incision and drainage done with noted progressive resolution of persistently draining abscess over the substernal incision site over 4 weeks post-TOETVA. (**A.** 8 days post-TOETVA, **B.** 2 weeks post-TOETVA, **C.** 4 weeks post-TOETVA)

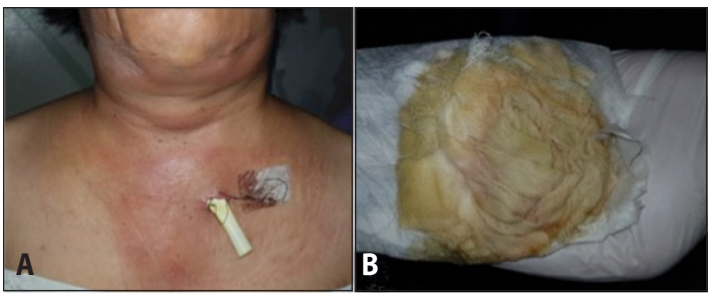

Figure 5. Patient who underwent total thyroidectomy via TOETVA presenting with a surgical site infection on postoperative day 4 (**A.** Marked hyperemia, erythema, and tenderness over the anterior neck. **B.** Purulent material soaking the 24-hour gauze dressing)

DISCUSSION

Our data suggest that TOETVA may be a viable alternative for patients with a solitary thyroid nodule who are motivated by its advantages and need to undergo a thyroid lobectomy. Complications seen in the series include transient RLN injury (managed via observation) and surgical site infection (managed through medical and surgical means).

According to Anuwong *et al.*, nodules included in the selection criteria were defined as those not exceeding 10 cm.[4] Thyroid gland size was initially thought to be directly proportional to the operative time for each case, but our experience shows that operative time still varied regardless of thyroid gland size. As previously mentioned in the literature, TOETVA comes with a steep learning curve, producing a longer operative time during the first few surgeries and noted to stabilize after 20 procedures.[1,4] Such a learning curve was noted in our experience. For the initial 6 cases, a thyroid lobectomy was indicated and pursued, afterwhich a total thyroidectomy via TOETVA was also done. However, 6 cases may not be enough to plateau the learning curve of TOETVA. Outcomes in terms of total thyroidectomy and lobectomy in this series were comparable in terms of blood loss and duration; however, the total thyroidectomy case had surgical site infection which necessitated prolonged hospital stay for resolution of the neck abscess. The incidence of infection may be multifactorial, and the experience of the surgeon in terms of the overall management of TOETVA cases is important. The operative time of 4 hours and 15 minutes for total thyroidectomy ranked fourth out of the 10 in the series in terms of speed of completing the operation. This may be attributed to the learning curve rather than the type of procedure as either lobectomy or total thyroidectomy. Factors such as size of the nodule and pathology may have a bearing on duration, although it is important to note that in this series, the total thyroidectomy case was the seventh surgery done by the surgeons and the succeeding cases are noted to have a decreasing trend.

Figure 6. Postoperative day 15. Wound dehiscence over the site of the Penrose drain.

Figure 7. Follow-up photos of patients taken 6 months post-TOETVA

In this series, there were no noted complications from technique, and intraoperative bleeding was addressed with monopolar cauterization and ultrasonic device. Hence, conversion to open surgery was not necessary in all of the cases. Our results are comparable to those of Anuwong *et al.* who recorded zero conversion rates among 200 patients who underwent TOETVA in 2017.[4]

The mean operative blood loss in this case series was considered low and below the computed allowable blood loss based from the preoperative complete blood count of each patient. However, this was not validated postoperatively. Although this result was considered minimal by computation of allowable volume loss per patient, the result was still slightly high compared to the literature, where an excellent profile for intraoperative blood loss was recorded at 11.1 to 97 ml for both lobectomy and total thyroidectomy cases.[1]

The 2-day median length of hospital stay postoperatively is comparable to literature with average length of hospital days ranging from 2 to 7 days.[1-6] Factors affecting length of stay in this series include delay in the submission of requirements for the purpose of government reimbursement such as official personal documents and community clearances. One patient was discharged 12 days postoperatively due to surgical site infection, which was considered a factor that extended hospital stay in this series. However, another patient with both wound dehiscence and surgical site infection showed no signs of these complications on postoperative days 1, 2, and 3 and these were not considered factors delaying discharge in this case. Pain was not considered a cause of delay in discharge because a significant decrease in pain was noted for all patients by postoperative day 3. Perhaps the decrease in postoperative pain may also be because TOETVA creates less flap dissection compared with open thyroidectomy.[6]

Recurrent laryngeal nerve injury was recorded in one case (10%) with spontaneous resolution of hoarseness and vocal cord paralysis noted on the third month postoperatively. Thus, this was considered as a transient RLN injury. Nevertheless, this complication rate is still high compared to the literature wherein a complication rate for RLN injury of 2.67% was reported.[1,4] The main difference in locating the RLN in TOETVA is that the nerve is initially located in its insertion to the cricothyroid muscle, and dissection proceeds caudally. This is in contrast to open thyroidectomy where various landmarks are used to locate the RLN in its inferior portion and then the dissection proceeds cephalad. Injury to the RLN in TOETVA may be attributed to mechanical injury via trauma or stretch injury during dissection using laparoscopic instruments and/or thermal injury from use of an energy device and electrocauterization. There were no cases of hypocalcemia reported in this case series, which is comparable to the literature (0-11%).[1,4] Because the magnified endoscopic view afforded by TOETVA allows excellent identification of the parathyroid glands, it is considered beneficial in preventing hypoparathyroidism[3,4] although it is important to note that this also limits depth perception due to the 2-dimensional view through a video monitor. Previous approaches for transoral thyroidectomy documented a higher complication rate for mental nerve injury (1.5 to 4.3%)[1] which has decreased since 2017 due to some modifications to the technique.[4] None of the cases in the series had mental nerve injury which is lower compared to recent literature with rates ranging from 1.5 to 4.3%.[1,4]

Surgical site infection was recorded in 2 cases (20%), with both cases having a wound dehiscence on the oral vestibule as well (20%). One of the possible reasons for this occurrence is the concern for infection due to the clean-contaminated nature of the procedure. This data is in contrast to the literature with reports of very low incidences of postoperative infection and wound dehiscence for TOETVA.[1,3-6] Most studies have mentioned zero rates of postoperative infection[3-6], with a systematic review reporting surgical site infection in 2 out of 211 cases which was also attributed to the clean-contaminated nature of the procedure, hence prophylactic antibiotics were given to all the succeeding cases as what was done initially in this series.[1] Wound dehiscence for both cases occurred in the gingivobuccal sulcus of the lower lip, which appears to happen because of the collision of laparoscopic instruments in the oral vestibule during surgery, inadvertently extending the initial incisions and forming unwanted lacerations directed posteriorly to the gingivobuccal sulcus, an area which is more difficult to appose due to the lack of deep soft tissue available for closure. Factors to lessen collision may include surgeon experience, camera handling, as well as having smaller ports. Changes and possible standardization in suturing techniques may be reviewed in the future.

Seroma formation was treated with aspiration using a 10-cc syringe with a gauge-23 needle. Varying rates of seroma formation were reported (4.7 – 5%) which were noted to be lower compared to the percentage seen in this series (10%). It is recognized that seroma formation is a minor complication of TOETVA and a higher incidence was expected due to the larger flap elevation necessary to create a working space.[4] For other complications of TOETVA, skin burn was noted in 1 case which has a reported rate of 2.4% in a literature review.[4] For this series, this complication was attributed to the usage of monopolar cauterization during the creation of the workspace. The plan for this case was to do excision and primary closure; however, the patient did not consent for further corrective surgery and was satisfied with the current cosmetic results.

Limitations of this study include the cost in performing TOETVA in the local setting, as this may affect replicability of the study in some institutions. This was not considered a limitation in this series because our institution shouldered the hospital expenses of patients who underwent the surgical procedure, provided these patients were able to submit all the needed requirements. Establishing efficacy and safety of the procedure compared with existing effective, standard operative procedures with controlled and standardized processes, in a setting of a randomized controlled trial would be ideal and should be the next step after this study.

In summary, TOETVA was replicated in the local setting and a presentation of the perioperative data of all the patients who underwent this novel technique, the indications, as well as surgical and patient outcomes, have been described.

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