Thyroidectomy: A novel endoscopic oral vestibular approach

Cunchuan Wang, MD, PhD,a Hening Zhai, MD,a Weijun Liu, MD,b Jinyi Li, MD,a Jingge Yang, MD,a Youzhu Hu, MD,a Jing Huang, MD,a Wah Yang, BD,a Yunlong Pan, MD, PhD,a and Hui Ding, MD,a

Guangdong, P.R. China

Background. To date, no report has discussed endoscopic thyroidectomy using the oral vestibular approach (ETOVA). The objective of this study was to evaluate the feasibility, safety, efficacy, and cosmetic results of endoscopic thyroidectomy involving this surgical approach.

Methods. Twenty-four patients with benign thyroid nodules were randomized into the ETOVA (n = 12) and the endoscopic thyroidectomy by areola approach (ETAA) groups (n = 12). Therapeutic effects were assessed at follow-up by physical examination. All patients were followed to evaluate thyroid function and scar formation from endoscopic treatment.

Results. Complete resection of all the lesions was performed endoscopically, and no conversion to open surgery was needed. There was no difference between the 2 groups with respect to surgical time (60.4 vs 59.6 min), blood loss (10.8 vs 13.8 mL), postoperative hospital stay (4.9 vs 4.6 d), or cost of surgery (17.6 vs 17.4 thousand yuan). Patients who underwent the areola approach had 3 scars, 10 × 2 mm, 5 × 1 mm, and 5 × 1 mm in size, all of which were visible at the 6-month follow-up. Patients in the ETOVA group did not have any scars. Follow-up showed a significant difference (P = .019) in the satisfaction score between the ETOVA (2.33 ± 0.65) and the ETAA group (1.58 ± 0.79). Imaging showed that all patients had complete resection and no residual disease. Severe complications such as subcutaneous accumulation of blood and fluid, superior or recurrent laryngeal nerve injury, and parathyroid dysfunction were not observed.

Conclusion. ETOVA was found to be safe and feasible and did not leave any scars; however, large-scale, randomized clinical trials are necessary for confirmation. (Surgery 2014;155:33-8.)

From the Departments of General Surgery,a and Stomatology,b the First Affiliated Hospital of Jinan University, Guangzhou, Guangdong, P.R. China

Conventional open thyroidectomy leaves scars over parts of the neck. This can place a great psychological burden on the patient. With economic development and improvements in lifestyle, patients’ demand for minimally invasive and esthetically pleasing surgery has increased greatly. Endoscopic treatment technology has obvious cosmetic advantages over conventional open operative treatments. Endoscopic surgery not only requires smaller surgical incisions, but also facilitates faster recovery and results in less postoperative scarring. Endoscopic surgical methods allow more hidden parts of the body to be entered to reach the focus of the thyroid through the subcutaneous tissue, which leads to better cosmetic results.

There are many approaches for performing endoscopic thyroidectomies. These include thyroidectomy through the neck,2,3 minimally invasive video-assisted thyroidectomy,4 subclavian approach,5,6 axillary approach,7,9 axillary areola approach,10-12 chest and breasts approach,12,14 complete areola approach,15,16 dorsal approach,17 and submandibular approach.18 These approaches allow the neck incision to be shorter or grossly invisible; however, endoscopic thyroid surgery still results in considerable surgical scarring on the skin surface. Comparing the current approaches of mature thyroidectomy, the complete areola approach has the best cosmetic result.19,21 As lifestyles have improved, so have cosmetic requirements for thyroidectomies, particularly among female patients who desire hidden or no scars. Endoscopic thyroid surgery through the oral cavity has been reported.22,26 However, the channel for observation is only 5 mm. Although the surgery is scarless, the removal of the specimen is difficult.

Support by the Science and Technology Development Fund of Macao (No. 027/2010/A). Accepted for publication June 20, 2013. Reprint requests: Cunchuan Wang, MD, PhD, Department of General Surgery, the First Affiliated Hospital of Jinan University, No. 613 Huangpu Road, West, Guangzhou, P.R. China. E-mail: twcc@jnu.edu.cn. 0039-6060/$ - see front matter © 2014 Mosby, Inc. All rights reserved. http://dx.doi.org/10.1016/j.surg.2013.06.010
Postoperative swelling on the floor of the mouth is severe, and there is a high conversion rate to open surgery. Benhidjeb et al. reported many difficulties with this surgical method.

The present study was performed on patients admitted to our hospital from November 2011 to June 2012 with a goiter. A prospective, randomized, comparative study was performed between patients undergoing the oral vestibular approach (ETOVA) for endoscopic thyroid resection and those undergoing the complete areola approach for endoscopic thyroidectomy to evaluate the feasibility, safety, efficacy, and cosmetic results of endoscopic thyroid resection.

MATERIALS AND METHODS

Patients. From November 2011 to June 2012, 24 consecutive patients were enrolled in a prospective, controlled clinical protocol approved by the ethical committee of the First Affiliated Hospital of Jinan University. All patients provided written informed consent before beginning the study and were randomly assigned to the treatment groups. Patients were informed of the potential risks and benefits of endoscopic thyroidectomy, and written consent was obtained. Twenty-four patients with a goiter underwent preoperative physical examinations, B-ultrasonography, and noncontrast computed tomography to determine the disease focus, diabetes status, and malignancy status. Biopsies were performed and the tissues were sent for cytopathology (Table I).

Study eligibility criteria were as follows: (a) B-ultrasonography and computed tomography suggesting a benign tumor, which was confirmed by cytopathology as nonmalignant. (b) Patient agreement to minimally invasive endoscopic thyroid resection. (c) Mass with a diameter not exceeding 6 cm with no skin damage over the neck or breast area. (d) Generally good patient health with normal heart and lung functions, normal tolerance to anesthesia, and normal coagulation. Study exclusion criteria were: (a) Maximum diameter of mass >6 cm with damage over the neck or breast area; (b) patient indifference regarding unscarred skin over the neck region; (c) advanced cardiac or pulmonary disease; and (d) patient not surgical candidate for minimally invasive endoscopic surgery.

Treatment modalities. Endoscopic thyroidectomy with a complete areolar approach. The patient was placed in a supine position with the neck tilted and the head lifted. Nasotracheal intubation was performed under general anesthesia. After conventional disinfection, the surgeon stood over the patient’s head. Oral disinfection was performed twice with chlorhexidine. Then, the lower lip was retracted, exposing the buccal cavity. An expansion solution of 1 mg adrenaline in 500 mL saline was injected down the middle of the buccal cavity towards the neck. Subsequently, a 10-mm mucosal incision was made in the oral vestibule parallel to the incisors. Using a 10-mm trocar (puncture cannula), the incision was punctured for observation, CO2 was injected and a constant pressure of 6 mmHg was maintained. Next, a 5-mm incision was made on both sides of the mucous membrane of the buccal cavity to allow placement of a 5-mm trocar into the main and auxiliary operation holes. A 10-mm endoscopic observation hole was placed (Fig. A–C). Under direct vision using ultrasonic scalpel separation of the jaw and neck, loose subcutaneous connective tissue of the suprasternal fossa was removed. Both sides reached the sternocleido-mastoid, and the subcutaneous gap was expanded. An ultrasonic scalpel was used for dissection of the anterior neck muscles. The infrahyoid muscle layer and thyroid gland were revealed using an in vitro suspension line retractor. The tumor was identified, and the thyroid isthmus was removed. Then, the superior blood supply to the thyroid was severed, and the thyroid suspensory ligament and finally the inferior blood supply were severed. Depending on the disease condition, resection of the entire side of the thyroid gland was performed, in some cases retaining only the recurrent laryngeal nerve and a small amount of gland. During the separation process, the head of the ultrasonic scalpel was maintained away from the trachea, other glands, and nerves. This protected the parathyroid, recurrent laryngeal nerve, and trachea. Under direct visualization, the resected tissue was removed from the observation hole and sent for pathologic examination. The surgical wound was flushed with normal saline. The oral vestibular wound was sutured close and a slight pressure bandage was applied to the surgical site for 2 days.

Endoscopic thyroidectomy with a complete areolar approach. After successful intubation after induction of general anesthesia, the patient’s neck and shoulders were slightly raised. The patient was prepped and draped in the usual sterile fashion and the primary surgeon was positioned between the patient’s legs and his assistants were on either side of the patient. A curved, 10-mm incision was made at the 2 o’clock position of the areola on the right breast. An expansion solution of 1 mg adrenaline in 500 mL saline was injected subcutaneously into the neck and chest regions. The neck and chest regions were repeatedly subcutaneously punctured with a blunt rod. Then, a 10-mm trocar
was placed in the observation hole and CO₂ was injected and maintained at a constant pressure of 6 mmHg. A 10-mm, 30° endoscope was introduced. Under direct visualization, two 5-mm trocars were placed in the left and right areolas on the inner and outer upper edges. These served as the main and auxiliary operating holes. With an ultrasonic scalpel, neck and chest subcutaneous tissues were separated above the thyroid cartilage until both sides reached the lateral side of the sternocleidomastoid muscle. An ultrasonic scalpel was used to open the linea alba cervicalis, and we used silk sutures to pull the anterior superficial neck muscles bilaterally to reveal the thyroid. Incision or resection of the thyroid isthmus was performed, and the inferior blood supply to the thyroid, the thyroid suspensory ligament, and finally the superior blood supply were severed. According to the disease conditions, resection of the entire side of the thyroid gland was performed, in some cases retaining only the recurrent laryngeal nerve and a small amount of the gland. During the separation process, the head of the ultrasonic scalpel was kept away from the trachea, other glands, and nerves, to protect the parathyroid and recurrent laryngeal nerves and the trachea.

**Evaluation of efficacy.**

Clinical manifestations.

The patient's physical condition and local symptoms were recorded before and after endoscopic thyroidectomy. The patients underwent routine

<table>
<thead>
<tr>
<th>Patient no./age (y)/gender</th>
<th>Tumor location</th>
<th>No. of tumors</th>
<th>Diameter of the largest tumor (mm)</th>
<th>Pathologic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/24/F</td>
<td>Double lobe</td>
<td>2</td>
<td>27 × 18 × 12</td>
<td>Hyperplastic nodule</td>
</tr>
<tr>
<td>2/18/F</td>
<td>Right lobe</td>
<td>1</td>
<td>42 × 28 × 19</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>3/28/F</td>
<td>Right lobe</td>
<td>1</td>
<td>37 × 31 × 25</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>4/42/F</td>
<td>Left lobe</td>
<td>1</td>
<td>25 × 19 × 15</td>
<td>Follicular adenoma</td>
</tr>
<tr>
<td>5/21/F</td>
<td>Left lobe</td>
<td>1</td>
<td>41 × 27 × 26</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>6/29/F</td>
<td>Left lobe*</td>
<td>2</td>
<td>46 × 27 × 26</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>7/21/F</td>
<td>Right lobe</td>
<td>1</td>
<td>23 × 18 × 16</td>
<td>hyperplastic nodule</td>
</tr>
<tr>
<td>8/21/M</td>
<td>Right lobe</td>
<td>1</td>
<td>25 × 20 × 20</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>9/21/F</td>
<td>Double lobe*</td>
<td>4</td>
<td>25 × 15 × 10</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>10/21/F</td>
<td>Double lobe</td>
<td>2</td>
<td>40 × 30 × 23</td>
<td>Hyperplastic nodule</td>
</tr>
<tr>
<td>11/21/M</td>
<td>Left lobe</td>
<td>1</td>
<td>45 × 26 × 14</td>
<td>Follicular adenoma</td>
</tr>
<tr>
<td>12/21/F</td>
<td>Double lobe</td>
<td>2</td>
<td>15 × 11 × 9</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>13/21/F</td>
<td>Double lobe*</td>
<td>4</td>
<td>50 × 30 × 25</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>14/22/F</td>
<td>Double lobe</td>
<td>3</td>
<td>37 × 26 × 15</td>
<td>Hyperplastic nodule</td>
</tr>
<tr>
<td>15/19/F</td>
<td>Double lobe*</td>
<td>4</td>
<td>30 × 20 × 17</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>16/21/F</td>
<td>Double lobe</td>
<td>2</td>
<td>50 × 15 × 10</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>17/23/F</td>
<td>Right lobe*</td>
<td>4</td>
<td>7 × 7 × 5</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>18/31/M</td>
<td>Left lobe</td>
<td>1</td>
<td>23 × 19 × 15</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>19/23/F</td>
<td>Right lobe</td>
<td>1</td>
<td>21 × 14 × 11</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>20/29/F</td>
<td>Double lobe*</td>
<td>4</td>
<td>35 × 30 × 20</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>21/41/F</td>
<td>Left lobe</td>
<td>1</td>
<td>27 × 24 × 19</td>
<td>Colloid nodule</td>
</tr>
<tr>
<td>22/21/M</td>
<td>Right lobe</td>
<td>1</td>
<td>18 × 12 × 10</td>
<td>Hyperplastic nodule</td>
</tr>
<tr>
<td>23/29/F</td>
<td>Right lobe</td>
<td>1</td>
<td>28 × 27 × 20</td>
<td>Benign follicular nodule</td>
</tr>
<tr>
<td>24/28/F</td>
<td>Left lobe</td>
<td>1</td>
<td>15 × 11 × 10</td>
<td>Colloid nodule</td>
</tr>
</tbody>
</table>

*Left or right total lobectomy (the other side of the double tumor location and all others had subtotal resection of the thyroid lobe).

The oral vestibular approach group, the number of patients is 1–12.

The areola approach group, the number of patients is 13–24.

**Fig.** Each puncture location of the endoscopic thyroidectomy by oral vestibular approach, a1, b1, c1, Observation hole; a2, b2, c2, main operating hole; a3, b3, c3, auxiliary operation hole.
laryngoscopy to evaluate their vocal cords. Physical condition was assessed using vital signs and physical examination. Thyroid function tests were performed as well. Local symptoms included tumor size and texture.

Satisfaction evaluation. The satisfaction evaluation was performed by 1 doctor who was blinded to the surgical approach of the patients. The evaluation consisted of questions regarding the cosmetic results 8 weeks after the patient’s surgery based on the postoperative pictures of the patients after different thyroidectomy approaches. The patients were asked to view the pictures and give the doctor an evaluation grade of their cosmetic results. Patients rated their satisfaction as follows: 0, no satisfaction; 1, mild satisfaction; 2, moderate satisfaction; and 3, pronounced satisfaction.

Radiographic imaging examination. Imaging was performed to evaluate the therapeutic efficacy of endoscopic thyroidectomy. Prior to endoscopic thyroidectomy and 6–8 weeks after thyroidectomy, all patients underwent B-ultrasonography and x-ray analysis. Radiographic examinations were performed to determine the location, size, and shape of the tumors and the relationship of the tumors to nearby nerves and blood vessels. Personal therapeutic schedules were set based on the results of these examinations and on the patient’s history.

Statistical analysis. All values are presented as the means ± standard deviation. Statistical analysis was performed using the Wilcoxon test. The Wilcoxon nonparametric test was used to compare tumors. The satisfaction scale had continuous variables and the t-test was used to compare the differences and evaluate the significance.

RESULTS

Patients and complications. All lesions were completely resected endoscopically and conversion to open surgery was not needed. Surgical time, blood loss, cost of surgery, and length of postoperative hospital stay were not different between the 2 groups (P > .05). With ETOVA, there were only 2 cases in which the submandibular skin developed small areas of ecchymosis. These disappeared after 10 days. The other patients did not develop subcutaneous accumulation of blood and fluid, or suffer vocal cord, superior or recurrent laryngeal nerve injury; parathyroid dysfunction was not noted (Table II). Patients who underwent the areolar approach had 3 scars, 10 × 3 mm, 5 × 1 mm, and 5 × 1 mm in size, which were all visible after 6 months. The patients in the ETOVA group had no visible scars.

Satisfaction evaluation. After 6 months of follow-up, patient satisfaction was 1.58 ± 0.79 and 2.33 ± 0.65 in the ETAA and ETOVA groups, respectively (P = .019). Based on this, the cosmetic quality of the ETOVA procedure was better than that of the ETAA procedure (Table III).

Follow-up imaging. Six months after the procedure, all patients underwent B-ultrasonography and radiographic imaging. The remaining glands were echo uniform. No obvious space-occupying lesions or calcifications were seen. No abnormalities were visible around the original site of the thyroid gland, confirming complete excision with no residual disease.

DISSCUSSION

In 1987, Dr Philippe Mouret of Lyon, France, performed the first successful laparoscopic
cholecystectomy. This technique was effective, minimally invasive, and had desirable cosmetic results. In 1996, Gagner performed the first endoscopic parathyroid resection. Currently, a variety of approaches for endoscopic thyroid surgery are available. All approaches except those through the floor of the mouth leave visible surgical scars, which can place great psychological stress on patients. Wilhelm et al. reported 8 cases using the approach through the floor of the mouth. Of these, 3 had to be converted to open surgery because of the narrow passage. We have designed endoscopic thyroid surgery through an oral vestibular approach to suit Chinese patients, who generally have a flat mandibular symphysis and great capacity for oral mucosa repair. Endoscopic thyroid surgery via the oral vestibular approach avoids the drawbacks that the approach through the floor of the mouth has, avoids structural damage to the floor of the mouth, postoperative damage to the floor of the mouth, and laryngeal edema, thereby increasing the safety of the surgery. This technique can be used for bilateral lesions, and surgical specimen bags, because the loose tissue of the subcutaneous layer allows expansion of the channel. It also allows the removal of larger specimens, which otherwise requires large surgical incisions. Currently, this surgical strategy has been used for the removal of benign thyroid lesions, such as thyroid adenomas, for partial removal of the thyroid gland, and for complete resection of the side lobe of the thyroid. We believe that, as surgeons gain experience, surgical indications will gradually increase. In addition, owing to the close proximity of the buccal cavity and the thyroid gland, the subcutaneous surgical separation tunnel is relatively short. This can reduce surgical trauma and postoperative tightness of the skin at the incision site. Oral mucosal wounds heal without scarring, and are therefore easily accepted by patients.

The usual indications for thyroidectomy in the United States and Europe are (1) cancer or suspicion for cancer or cannot rule out cancer (usually after fine-needle aspiration biopsy), (2) symptomatic large goiter (compressive symptoms), or hyperthyroidism (instead of radioimmunoassay or medication). In China, surgical indications also include progression of nodules according to the thyroid disease treatment guidelines (Chinese Society of Endocrinology, 2008). Most patients with fine-needle aspiration biopsy results that have ruled out a malignancy are followed up with regular reexaminations. However, patients with shallow nodule(s) or increase in size, who are concerned about the appearance and psychological consequences request to have the nodules removed to rule out malignancy and/or prevent malignant transformation. Based on these indications, we evaluate these patients and determine the feasibility, safety, effectiveness, and cosmetic results. The extent of the surgery depends on the disease condition, that is, if the target side has a large tumor with a greater risk of recurrence, we perform a total lobectomy. The side opposite the tumor and all others required a subtotal lobectomy, thereby preventing the patient from needing long-term, postoperative thyroxine supplementation.

The following conditions require attention: (1) The surgeon must be skilled in endoscopic techniques. (2) During the procedure, the surgeon should be careful to avoid injury to the superior laryngeal nerve, recurrent laryngeal nerve, trachea, and parathyroid, and the ultrasonic scalpel should be maneuvered carefully to avoid heat damage. Identification of endoscopic images of these important tissues requires a skilled surgeon. (3) The surgeon must be able to adapt to visual changes because the endoscopic display shows the tissue images upside down compared with traditional methods of endoscopic surgery. The surgeon should have pronounced technical skills and be able to improvise. High-definition endoscopic instruments are needed during the surgery to allow surgeons to identify the tissues easily and avoid errors that may cause complications. (4) Large specimens may cause lacerations or may break apart. (5) This surgery expands a type I to a type II incision. Drainage apparatuses cannot be placed, and this may lead to effusion or postoperative hemorrhage; therefore, hemostasis must be achieved and the operative field must be rinsed. (6) The surgical space under the endoscopic thyroidectomy has to be small. Smoke from the surgical field should immediately be removed to avoid obscuring the operative field.

This study shows that the ETOVA procedure has several advantages, including a short surgical pathway, less trauma, better healing of the oral

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of cases</th>
<th>VAS</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETOVA</td>
<td>12</td>
<td>2.33 ± 0.65</td>
<td>0.019</td>
</tr>
<tr>
<td>ETAA</td>
<td>12</td>
<td>1.58 ± 0.79</td>
<td></td>
</tr>
</tbody>
</table>

Values are presented as means ± standard deviation.
mucosa, quick postoperative wound healing, and a lack of visible residual surgical scars. However, no differences were observed between the 2 surgical approaches with respect to operative time, blood loss, duration of the postoperative hospital stay, or severity of postoperative complications. We believe that, after surgeons gain experience and acquire more medical equipment, this surgical approach may see widespread use in the clinical treatment of benign thyroid conditions.

REFERENCES