The Advantages of Applying a 5-mm Endoscope in the Transoral Endoscopic Thyroidectomy Vestibular Approach

Hang Chen, MD, Lijuan Deng, MD, Zhixian Gong, BN, and Xiaoping Zhu, MM

Objective: We sought to compare the effect of applying a 5-mm endoscope and a 10-mm endoscope in the transoral endoscopic thyroidectomy vestibular approach (TOETVA) and to clarify the advantages of using a 5-mm endoscope.

Materials and Methods: A retrospective analysis of the clinical data of 135 patients who were diagnosed with papillary thyroid carcinoma and who had undergone TOETVA in the thyroid disease center of The First Affiliated Hospital of Nanchang University between January 2019 and May 2020 was performed. Among the included patients, a 10-mm endoscope was used in 50 cases (the 10-mm endoscope group) and a 5-mm endoscope was used in 85 cases (the 5-mm endoscope group), respectively. Operative trauma, operative parameters, postoperative complications, and postoperative mandibular sensation scores were compared and analyzed.

Results: Compared with the 10-mm endoscope group, the 5-mm endoscope group had less surgical trauma, less injury to the mandibular muscles (orbicularis oris, depressor labii inferioris, and mentalis muscle), shorter operative times (107.7 ± 8.1 vs. 121.3 ± 11.6 min, P < 0.01), less intraoperative bleeding (14.3 ± 4.8 vs. 17.9 ± 5.3 mL, P < 0.01), no obvious postoperative complications, lower mandibular sensation score values (5.7 ± 0.6 vs. 6.0 ± 0.4 points, P < 0.01), and shorter mandibular recovery times (9.4 ± 2.5 vs. 12.3 ± 3.6 d, P < 0.01).

Conclusion: The application of a 5-mm endoscope not only improves the cosmetic effect of TOETVA but also reduces the degree of surgical trauma, saves the surgical space, improves the surgical efficiency, and reduces postoperative discomfort, with a promising application prospect.

Key Words: TOETVA, 5-mm endoscope, natural orifice transluminal endoscopic surgery, minimally invasive surgical procedure, papillary thyroid carcinoma

(MATERIALS AND METHODS)

Clinical Data

A retrospective analysis of the clinical data of 135 patients who had undergone TOETVA in the thyroid disease center of The First Affiliated Hospital of Nanchang University between January 2019 and May 2020 was performed. Among these patients, a 10-mm endoscope was used in 50 cases, and a 5-mm endoscope was used in 85 cases, and all of the surgeries were performed by the same thyroid surgeon.

The inclusion criteria were as follows: (1) The patient had a desire for the best possible cosmetic outcome. (2) The patient was preoperatively diagnosed with differentiated thyroid carcinoma, with a nodule diameter of <2 cm. There was no peripheral invasion, lymph node metastasis in the lateral cervical region, or distant organ metastasis throughout the body, no lymph node diameter exceeding 2 cm in the central region, and no fusion fixation. (3) There was no history of neck surgery or radiation.

Separately, the study exclusion criteria were as follows: (1) The patient had an oral malformation that affected the operation and serious oral infection. (2) The patient had severe cardiopulmonary dysfunction and could not be operated upon. (3) The tumor was located close to the recurrent laryngeal nerve (RLN) and near the laryngeal entry. (4) There was coexistence of diffuse thyroiditis.

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The authors declare no conflicts of interest.

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The removed thyroid gland was cut in half in a specimen bag and taken out. Finally, lymph nodes in the central area and the lower pole of the thyroid gland were then dissected. The running position of the endoscopic trocar was posterior to the hyoid bone, through the center of the depressor labii inferioris and part of the mentalis muscle. The diameter of the endoscopic tunnel was 10 to 12 mm. The length of the oral vestibular incision was about 8 to 10 mm. When the endoscopic tunnel was established with an electrotome, the depressor labii inferioris was preserved in situ or partially cut off. The diameter of the endoscopic tunnel was 5 to 7 mm. Separately, Figures 1D–F show the incision of the 10-mm endoscope group. The length of the oral vestibular incision was 20 to 25 mm. Part of the depressor labii inferioris and part of the mentalis muscle were cut off to establish the endoscopic tunnel with an electrotome. The diameter of the endoscopic tunnel was 10 to 12 mm.

In addition, through the anatomic study of the mandibular muscles, it could be seen that the mandibular muscles involved in the operation were mainly the orbicularis oris, depressor labii inferioris, depressor anguli oris, and mentalis muscle (Fig. 2). The running position of the endoscopic trocar was posterior to the mentalis oris, through the center of the depressor labii inferioris on both sides, and between the mentalis muscles on both sides.9 Before conventional 10-mm endoscopic trocar implantation, the surgeon tore part of the depressor labii inferioris. After trocar implantation, the orbicularis oris, depressor labii inferioris, and mentalis muscle were stretched, and part of the mentalis muscle was torn. The application of the 5-mm endoscopic trocar could reduce stretching of the mandibular muscle and require less area to be cut off of the depressor labii inferioris, even without any injury, and tearing and stretching of the mentalis muscle were also reduced in this context. The 5-mm endoscope was used to make the trocar cavity narrower and cause less muscle trauma, which could accelerate postoperative recovery and effectively reduce postoperative oral discomfort.

Comparison of Surgical Parameters

All of the operations were completed successfully, and none of the surgeries were converted to open thyroidectomy. Postoperatively, the surgical parameters of the 2 groups were compared, as shown in Table 2. The operative time in the 5-mm endoscope group was significantly shortened, and the intraoperative bleeding volume was relatively low, with a statistically significant difference between the 2 groups. However, there was no significant difference in the postoperative drainage volume. Regarding complications, in the 5-mm endoscope group, there were 2 cases of hoarseness due to RLN injury, but both patients improved 2 months after the operation. There was 1 patient who developed hand and foot cramps due to parathyroid injury, and their symptoms disappeared 10 days after calcium supplementation. In the 10-mm endoscope group, there were 2 patients with hoarseness due to RLN injury, and they improved 2 months

**TABLE 1.** General Clinical Data of Patients in the 2 Groups

| Clinical Characteristics | 5-mm Endoscope Group (N = 85) | 10-mm Endoscope Group (N = 50) | P |
|--------------------------|-------------------------------|-------------------------------|---|
| Age (mean ± SD) (y)      | 32.6 ± 6.7                    | 31.0 ± 4.7                    | 0.108 |
| Sex [n (%)]              |                               |                               | 1.000 |
| Male                     | 6 (7.1)                       | 3 (6)                         |      |
| Female                   | 79 (92.9)                     | 47 (94)                       |      |
| Body mass index (mean ± SD) | 21.9 ± 2.9                 | 21.8 ± 2.3                    | 0.797 |
| Nodule diameter (mean ± SD) (mm) | 8.4 ± 3.7                  | 8.1 ± 3.5                     | 0.650 |
| Specimen quality (mean ± SD) (g) | 11.5 ± 2.3                  | 12.2 ± 2.3                    | 0.092 |

All of the included patients were diagnosed with papillary thyroid carcinoma before surgery. After informing each patient of the relevant treatment plan, retained participants chose to undergo TOETVA and signed a surgical consent form after obtaining the relevant information and gaining knowledge about the complications. Participating patients were divided into 2 groups according to the diameter of the endoscope used during the operation, that is, a 5-mm endoscope group and a 10-mm endoscope group. The ethics committee of The First Affiliated Hospital of Nan-chang University approved this study.

All surgical resection areas were unilateral lobe with isthmus+central lymph node. General clinical data of patients in the 2 groups are shown in Table 1. As seen in Table 1, there were no significant differences in age, sex, body mass index, specimen quality, and nodule diameter between the 2 groups.

**Surgical Technique**

After general anesthesia through nasal endotracheal intubation, the patient was placed in the supine position with high shoulder pads, and their head slightly tilted backward. Disinfection and towel laying, further disinfection of the mouth 3

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**Surgical Technique**

After general anesthesia through nasal endotracheal intubation, the patient was placed in the supine position with high shoulder pads, and their head slightly tilted backward. Disinfection and towel laying, further disinfection of the mouth 3 times, and placement of 3 gauze balls to prevent tongue damage were completed. The oral vestibule was cut open, and the mandibular tissues were gradually separated to the mandibular angle, followed by further blunt separation to the subcutaneous layer of the anterior neck. After the endoscopic tunnel was initially established, the endoscopic trocar was placed. The other 2 lateral trocars were inserted into the oral vestibule, avoiding the mental nerve. The operating space was supported by low-pressure CO2 pneumoperitoneum combined with external neck suspension. The space level was the deep surface of the platysma muscle, and the space scope was as follows: the lower boundary reached the superior sternum fossa, and both sides reached the sternocleidomastoid muscle. First, the white line of the neck was incised, then the banded muscles of the thyroid surface were separated. The peripheral lymph nodes were developed by injecting a nanocarbon developer into the affected thyroid gland. After the isthmus was severed, the upper pole of the thyroid gland was dissociated. A nerve monitor (Medtronic; NIM-3.0) was used to identify the position and running of the RLN, and the bony ligament and the lower pole of the thyroid gland were then dissociated successively. Care was taken to protect the blood supply to the parathyroid gland and the integrity of the RLN.

The removed thyroid gland was cut in half in a specimen bag and taken out. Finally, lymph nodes in the central region were dissected. The area of lymph node dissection ranged between the inner boundaries of the trachea, down to
after the operation. A third patient had neck swelling and pain after surgery, which improved after puncture and anti-infection treatment for 1 week. A fourth patient developed a dimple. There were no permanent RLN or parathyroid gland injuries, subcutaneous hematoma, air embolism, superior laryngeal nerve injury, mental nerve injury, tracheal injury, or other complications recorded, and there was no statistically significant difference in the incidence of complications between the 2 groups.

In addition, the postoperative sensation in the mandibular region of the patients was investigated, and relevant scoring criteria were established. In this section, 1 case of postoperative infection and 1 case of postoperative dimples at the bottom of the jaw were screened out in consideration of the interference factors of the mandibular sensation score (MSS). MSS values were awarded as follows: 9 to 10 points for obvious foreign body sensation accompanied by severe pain, 7 to 8 points for significant foreign body sensation with mild pain; 5 to 6 points for mild paresthesias with mild pain, 2 to 3 points for mild paresthesias with no pain, and 0 to 1 point(s) for the absence of abnormal sensation without pain. Scoring was performed according to patients’ feelings and facial expressions. MSS values at postoperative 24 hours in patients of the 5-mm endoscope group were lower than those in patients of the 10-mm endoscope group, with a statistically significant difference. There was no significant difference in MSS values at 48 hours, 1 week, and 1 month after the operation. Follow-up was continued after discharge, and the patients’ submaxillary region returned to basically normal when the MSS was 2 points or less. The average recovery time for the maxillofacial region was 9.4 ± 2.5 days in the 5-mm endoscope group, while the average recovery time for the maxillofacial region was 12.3 ± 3.6 days in the 10-mm endoscope group, indicating that recovery occurred faster in the 5-mm endoscope group, with a statistically significant difference (Table 2).

**DISCUSSION**

The incidence of thyroid disease is increasing every year, and most patients are female, which may be one reason for the rapid development of scarless endoscopic thyroidectomy of the neck. Early endoscopic thyroidectomy procedures mainly adopted endoscopic-assisted thyroidectomy before operators gradually progressed to performing total endoscopic thyroidectomy. Compared with traditional open thyroidectomy, endoscopic thyroidectomy can not only avoid
Can be improved, and the operation time can be shortened. At the same time, because the trocar tunnel is narrower, it can effectively reduce surgical bleeding and postoperative edema.

Effectively reduce the surgical trauma, thus limiting the amount of surgical bleeding and postoperative edema. Additionally, it saves the operation space and allows more room for operating instruments. Furthermore, a finer endoscope requires a narrower trocar tunnel, making the surgical incision more minimally invasive and reducing the degree of trauma to the mandibular muscle, which can effectively limit the postoperative discomfort of patients. However, there are also a series of problems in the process of using a 5-mm endoscope, such as lower CO₂ inflation speed, poor visual field definition, and increased complexity in collecting samples.

The 5-mm trocar has a smaller diameter and slower ventilation speed than the 10-mm one. The pressure of our pneumoperitoneal machine was set at 4 to 6 mm Hg, and the flow was set at 15 to 20 L/min. With the suspension of the anterior cervical skin, a sufficient operating space can be obtained.

The visual field definition of the 5-mm endoscope was inferior to that of the 10-mm endoscope. However, the resolution and clarity of nerves, blood vessels, and parathyroid glands did not significantly differ under endoscopy with a high-resolution video camera and high-resolution screen.

The operating space of TOETVA encompasses only the anterior cervical region, descending to the superior sternum fossa, and from both sides to the sternoclavicular joint, with a narrow operating space. There is a higher risk of gas embolism and hypercapnia if high pressure is used to expand the space. The application of a 5-mm endoscope can effectively save the surgical space and allow more room for operating instruments. Furthermore, fine dissection in a narrow area can avoid the obstacle of the “chopstick effect” caused by interference between the apparatus and stem when the lens moves forward. This can ensure the safety of surgery, effectively improve the efficiency of surgery, and save on operation time.

With the application of a 5-mm endoscope in TOETVA, the specimens were collected through the endoscope tunnel. The incision length was about 8 to 10 mm. As shown in Table 1, the average mass of specimens was 11.5 ± 2.3 g. Under normal circumstances, the specimen is first loaded into the specimen bag and cut in half. After that, the 2 specimens are placed facing each other in the specimen bag, drawn to the oral vestibular incision, and finally taken out by turns using curved forceps. If the specimen volume is large, the subcutaneous tunnel should be bluntly separated first and then removed according to the above steps.

### TABLE 2. Comparison of Surgical Parameters

|                      | 5-mm Endoscope Group (N = 85) | 10-mm Endoscope Group (N = 50) | P     |
|----------------------|-------------------------------|--------------------------------|-------|
| Operative time (min) | 107.7 ± 8.1                   | 121.3 ± 11.6                   | <0.01 |
| Intraoperative bleeding (mL) | 14.3 ± 4.8                 | 17.9 ± 5.3                     | <0.01 |
| Postoperative drainage (mL) | 31.1 ± 7.0                 | 31.4 ± 6.7                     | 0.781 |
| Complications [%]    |                               |                                |       |
| Temporary RLN injury | 2 (2.4)                       | 2 (4)                          | 0.984 |
| Temporary hyoparathyroidism | 1 (1.2)                   | 0                              | 1.000 |
| Infection            | 0                             | 1 (2)                          | 0.370 |
| Postoperative dimple | 0                             | 1 (2)                          | 0.370 |
| Length of hospital stay (days) | 2.6 ± 0.5                 | 2.6 ± 0.5                      | 0.864 |
| MSS (points)         | 24 ± 3.5                      | 24 ± 3.5                       |       |
| 24 h                 | 5.7 ± 0.6                     | 6.0 ± 0.4                      | <0.01 |
| 48 h                 | 4.5 ± 0.6                     | 4.5 ± 0.5                      | 0.309 |
| 1 wk                 | 2.5 ± 0.5                     | 2.4 ± 0.5                      | 0.827 |
| 1 mo                 | 0.2 ± 0.4                     | 0.1 ± 0.4                      | 0.705 |
| Recovery time for the maxillofacial region (days) | 9.4 ± 2.5                 | 12.3 ± 3.6                     | <0.01 |

MSS: 9 to 10 points for obvious foreign body sensation accompanied by severe pain, 7 to 8 points for significant foreign body sensation with mild pain; 5 to 6 points for mild paresthesias with mild pain, 2 to 3 points for mild paresthesias with no pain, and 0 to 1 point(s) for the absence of abnormal sensation without pain.

Bold values indicate that the difference is statistically significant. MSS indicates mandibular sensation score; RLN, recurrent laryngeal nerve.
To improve the safety of TOETVA surgery and reduce the number of complications, many thyroid surgeons have conducted relevant research. Celik et al.19 investigated the anatomic level of the oral vestibular approach using cadavers to establish a theoretical basis for surgical safety. Park et al.20 described an innovative postoperative drainage device used to effectively improve surgical safety and cosmetic effect. To reduce the rate of RLN injury, intraoperative neuromonitoring has been applied in TOETVA.21,22 Furthermore, according to our research, operative neuromonitoring has been applied in TOETVA.20

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