Int Surg 2017;**102:**351–355
DOI: 10.9738/INTSURG-D-16-00037.1

Application of Straight Line Tunnel With Less Subcutaneous Separation in Transthoracic Endoscopic Thyroidectomy

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The objective of this paper was to evaluate the value of straight-line tunnel application in transthoracic endoscopic thyroidectomy. Forty patients were given 3-port transthoracic endoscopic thyroidectomy from March 2011 to June 2014. Preoperative diagnoses found 20 cases of nodular goiter, 16 cases of adenoma, and 4 cases of thyroid calcification. We used a metal rod to free skin flap in a straight way toward the neck, and a straight-line tunnel was created to obtain a good view. All 40 cases involving endoscopic thyroidectomy were performed successfully, 28 were performed with unilateral subtotal thyroidectomy, 5 were performed with unilateral thyroidectomy, 5 were performed with bilateral partial thyroidectomy, and 2 were performed with radical thyroidectomy for carcinoma. One is anaplastic thyroid carcinoma (ATC) and the other is follicular thyroid carcinoma. Operation time was 78.5 ± 18.6 minutes, intraoperative blood loss was 40.2 ± 15.6 mL, intraoperative flap-freeing time was 14.3 ± 3.8 minutes, and the diameter of the thyroid tumor was 3.8 ± 2.5 cm. Postoperative hospital stay was 3.5 ± 2.0 days. One patient got voice hoarseness and recovered in 3 months. Two patients suffered from transient hypocalcemia and recovered without treatment. No subcutaneous effusion or seroma was observed. No recurrence was found during the 12- to 36-month (mean: 28 months) follow-up. One patient felt chest numbness 3 months after the surgery. Thirty-two patients were very satisfied with the cosmetic appearance and 8 patients were satisfied. The application of straight-line tunnel in transthoracic endoscopic thyroidectomy is a simple, safe, feasible procedure with less trauma, seroma, and skin contraction.

Key words: Thyroidectomy – Endoscopic – Transthoracic

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With the development of endoscopic equipment and technology, thyroid surgery has evolved toward minimal incisions and endoscopic approach. Since endoscopic parathyroidectomy and thyroidectomy were first introduced by Gagner in 1996,[1] various endoscopic techniques have been described including cervical, axillary, breast, and chest wall.[2] In order to minimize the extent of dissection, we used a self-made metal rod to create a straight-line tunnel in transthoracic endoscopic thyroidectomy. The application of a straight-line tunnel resulted in a satisfactory outcome with no postoperative seroma and skin contracture.

Materials and Methods

Patients

Between March 2011 and June 2014, a total of 40 patients underwent transthoracic thyroid surgery in Shanghai Shuguang Hospital. The age of patients ranged from 25 to 54 years (mean age: 36 years; 29 women and 11 men). Preoperative ultrasound and computed tomography scans revealed thyroid mass in left lobe (12 cases), in right lobe (23 cases), and in both (5 cases). The diameter of the thyroid mass ranged from 1.2 to 6.5cm (mean 3.8 ± 2.5 cm). As fine-needle aspiration cytology was not routinely performed, preoperative diagnoses were nodular goiter (n = 20), thyroid adenoma (n = 16), and thyroid calcification (n = 4). (There were also 3 punctate calcifications and 1 small focus calcification.) Eligibility criteria were benign thyroid nodules (diameter < 5cm) and papillary microcarcinoma diagnosed by fine-needle aspiration cytology. Exclusion criteria were a history of neck surgery and radiotherapy; thyroiditis diagnosed by preoperative biochemistry or ultrasound; and autoimmune or endocrine diseases.[3]

Surgical technique

All patients were prepared for endoscopic thyroidectomy under general anesthesia. After the patient was placed in a supine position, a pillow was placed beneath the shoulder to extend the head and neck. The operator and scope assistant stood on the right side of the patient, the first assistant stood on the left side of the patient, and the monitors were placed on the head side of the patient. A 10-mm incision was made in the intersection point of median thoracic line and bilateral nipples. A self-made metal rod with blunt round end was used to create a straight-line tunnel toward the sternal notch. Two 5-mm incisions were made in the intersection point of the bilateral midclavicular line and the second rib. Also two 5-mm metal rods were used to create straight-line tunnels. Three straight-line tunnels met at suprasternal fossa and no other thoracic wall dissection was necessary (Fig. 1 and Fig. 2).

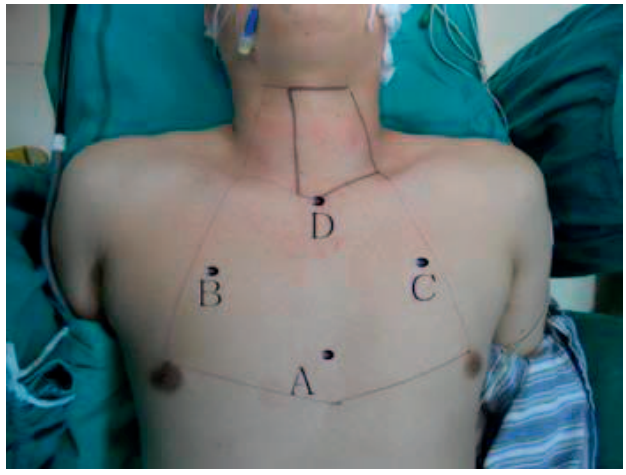

Fig. 1 A, B, and C are puncture points, and D is meeting point; cervical area surrounded by solid lines is dissection area.

The 3 tunnels should be between the superficial layer of thoracic fascia and the deep layer of superficial fascia to prevent mammary or pectoralis major injuries. After the blunt dissection, 3e trocars were inserted through each tunnel. Carbon dioxide gas was injected with a pressure of 8 mmHg. A 30° 10-mm endoscope was inserted through the middle 10-mm trocar; an ultrasonic scalpel and a grasping forceps were inserted through two 5-mm trocars. Subplatysmal space was dissected to create a working space from suprasternal fossa to the thyroid cartilage level and laterally to the medial edge of sternocleidomastoid muscles (Fig. 3 and Fig. 4).

Fig. 2 Creating straight-line tunnels.

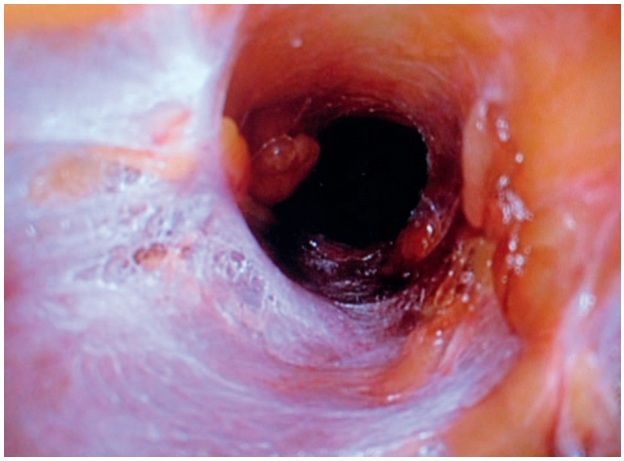

Fig. 3 Subcutaneous straight-line tunnel.

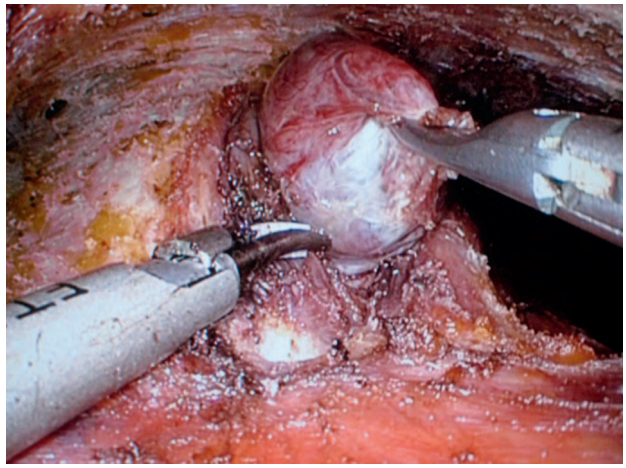

Fig. 4 Resection for thyroid adenoma.

Cervical linea alba was dissected and the thyroid anterior muscles were separated by ultrasonic scalpel, and then the anterior cervical muscle group was retracted with suture to expose the thyroid tissue. The rest of the procedure was the same as that for endoscopic thyroidectomy. The specimen was pulled out in an endo-bag through the endoscope port site and a drainage tube was routinely placed.

Results

All 40 cases were performed with endoscopy successfully. Twenty-eight were unilateral subtotal thyroidectomy, 5 were unilateral total thyroidectomy, 5 were bilateral partial thyroidectomy, and 2 were radical thyroidectomy with central compartment lymph node dissection (intraoperative frozen section revealed 1 anaplastic thyroid carcinoma and 1 follicular thyroid carcinoma). Operation time (minutes), intraoperative bleeding (mL), and free flap time (minutes) were summarized in Table 1.

Postoperative pathology diagnosis found 20 cases of nodular goiter, 16 cases of thyroid adenoma, 5 cases of thyroid papillary microcarcinoma (performed total thyroidectomy after identification of frozen section), 1 case of anaplastic thyroid carcinoma, and 1 case of follicular thyroid carcinoma. One of the 3 punctuate calcifications was confirmed as thyroid papillary microcarcinoma and the other 2 were nodular goiter. The only one small focus calcification was confirmed as thyroid adenoma. Drainage tubes were removed 24 to 48 hours after surgery. The hospitalization time was 2 to 5 (3.5 ± 2.0) days. Postoperative complications included: 1 case of hoarseness who recovered in 3 months and 2 cases of temporary hypocalcaemia who recovered spontaneously. No subcutaneous effusion and seroma was observed postoperatively. Follow-up time ranged from 12 to 36 months with a mean period of 28 months. There was no recurrence of tumor or metastasis during the follow-up period. Cosmetic results were evaluated by numerical score system, NSS (0-10). The cosmetic satisfactory score ranged from 7.5 to 10, with a mean score of 8.12 ± 1.05. Thirty-two patients were very satisfied and 8 patients were satisfied with the cosmetic results.

Discussion

As the rapidly increasing incidence of thyroid diseases in young women, cosmetic result plays an

Table 1 Operation time, intraoperative bleeding, and free flap time of different operation type

Operation type	Operation time (min)	Intraoperative bleeding (mL)	Free flap time (min)
Unilateral subtotal thyroidectomy (n = 28)	75.32 ± 8.71	43.42 ± 12.21	13.75 ± 2.99
Unilateral total thyroidectomy (n = 5)	81.00 ± 17.14	36.80 ± 10.92	14.65 ± 2.42
Bilateral partial thyroidectomy (n = 5)	83.60 ± 13.97	34.60 ± 9.56	15.29 ± 3.03
Radical thyroidectomy (n = 2)	98, 122	54, 45	14, 16
Total (n = 40)	78.50 ± 18.60	40.20 ± 15.60	14.30 ± 3.80

important role in thyroid operations. Thus, various endoscopic thyroid surgical approaches have been performed to create better cosmetic results, including cervical,[4] anterior chest wall,[5] axilla,[6] breast,[7] and oral cavity.[8] Although the operation time, the amount of fluid drainage, and the time of removing drainage tube of endoscopic surgery were much better than those of open surgery, whether endoscopic thyroidectomy belongs to minimally invasive operation remains controversial.[9] Endoscopic thyroidectomy needs a larger working space made by separating skin flap from the anterior chest wall to neck than conventional operation, which resulted in more exudates after surgery. That is the reason why many surgeons regard endoscopic thyroidectomy as cosmetic surgery rather than minimally invasive surgery.

Analysis of straight-line tunnel

Transthoracic endoscopic thyroidectomy is a modified operation type of transareolar approach. The aim of modification is to shorten the length between incision and surgical field and reduce the range of thoracic skin flap. However, some patients who underwent transthoracic endoscopic thyroidectomy still suffered from subcutaneous seroma and skin contracture. Subcutaneous seroma mostly appeared in breast and axillary approach with an incidence of 1.1% to 1.2%.[10] It always occurred 3 to 5 days after operation, which was caused by accumulated lymph and serum under the thoracic skin flap. Mainly clinical manifestation included local swelling, pain, and undulating sensation. The diagnosis could be identified if ultrasonic or CT scan revealed subcutaneous liquid dark area. We were always trying to minimize the range of skip flap when performing transthoracic endoscopic thyroidectomy. A mature endoscopic operation type needs not only suitable working space but also minimal tissue injury. After a large amount of operation practice, we made a consensus as follows: (1) 3 self-made metal rods were used to create straight-line tunnels and thoracic wall dissection was no longer necessary before they met at the suprasternal fossa; (2) the upper border of cervical skip flap (unilateral lesion) was the level of thyroid cartilage, the lateral border was the sternocleidomastoid and the medial border was 2 cm across the linea alba cervicalis. We believed the range of dissection was enough to perform almost all of the transthoracic endoscopic thyroidectomy. The total area of skip flap, which was about 6*8 cm^2, including the range of cervical dissection and 3 tunnels, was almost the same size of conventional thyroidectomy. Since this kind of operation type had avoided a cervical incision, it achieved a good balance of cosmetic results and minimal invasion. Patients who underwent such procedures were satisfied with the outcomes without any complications of subcutaneous ecchymosis, seroma, or skin contracture. As for the surgical details, we considered that (1) a metal rod should be rotating, pushed toward one direction with a relatively low speed to create a straight-line tunnel, because high speed pushing would cause direction biasing; (2) push gently, otherwise the end of metal rod would enter into another level; (3) rub the ends of 3 metal rods at the meeting point (point D in Fig. 1) repeatedly to make fully contact. We might not have been able to find the ultrasonic scalpel if the 3 tunnels have been at different levels; (4) when the visual field is hindered by subcutaneous fibers, use an ultrasonic scalpel to dissect the tunnel toward the endoscopy rather than creating a new tunnel.

Prevention of complications

Recurrent laryngeal nerve (RLN) injury is one of the most common complications of endoscopic thyroidectomy. However, with improved visualization and amplification of the endoscope, the recurrent laryngeal nerve was convenient to expose its position and course by skilled surgeons. With the accumulations of surgeons' experiences, the incidence of direct RLN injuries is decreasing. More and more RLN injuries are indirect thermal injuries caused by ultrasonic scalpel. According to our experience, ultrasonic scalpel should keep some distance from RLN while maintaining sufficient surgical extension; the functional knife head should be kept away from RLN for at least 2 mm[11] and coagulating time should be reduced as soon as possible while operating near RLN. When performing lobectomy, routine identification of RLN can help to decrease the rate of RLN injury.[12] In Korea, 55% of the surgeons thought that there were not significant differences between conventional and endoscopic approaches for the complications such as RLN injury and hypocalcemia.[13] Parathyroid injury may occur in some total thyroidectomies. Parathyroid glands show pale orange red on the screen while adipose tissues show yellow. With the help of a good endoscopic vision, we can easily recognize them by different colors. Although the parathyroid glands can be preserved, the blood supply may be affected by the thermal damage of ultrasonic scalpel. Once it

occurs, patients may suffer from temporary postoperative hypocalcemia. Most patients got a spontaneous recovery and those with severe symptoms could be treated by intravenous infusion of calcium gluconate. As for the complication of bleeding, surgeons always pay more attention to the remaining gland. Hemorrhage of tunnels may be neglected due to the compression of trocars. We always check the subcutaneous tunnels carefully after removing the trocars. Flushing with epinephrine saline may be an alternative hemostasis method with a satisfactory effect.

Conclusions

In conclusion, the application of straight-line tunnel in transthoracic endoscopic thyroidectomy is a simple, safe, feasible procedure with less trauma, seroma, and skin contraction. It provides satisfactory cosmetic outcomes while also reducing subcutaneous dissection.

Acknowledgments

XiWei Zhang and Gang Liu equally contributed to this study.

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