

# Drainage During Endoscopic Thyroidectomy

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## ABSTRACT

**Background:** Conventional cervical drainage tubes are placed crossing the suprasternal fossa during endoscopic thyroidectomy. In our clinical experience, some patients show shallow or absent suprasternal fossa, which affects the cosmetic outcome in the patient. Therefore, this study aimed to assess the feasibility and significance of restoring the suprasternal fossa by changing the position of neck drainage tubes.

**Methods and Materials:** A total of 117 female patients were enrolled and divided into 2 groups, including 59 and 58 individuals in the Conventional (conventional anterior neck region negative pressure drainage) and Improvement (improved method with a negative pressure drainage) groups. Then, restoration of the suprasternal fossa in all subjects was observed at 1 day postsurgery, the day of extubation, and 3 months postoperatively. In addition, drainage volume, the time to extubation, and abnormal neck sensations were compared between the groups.

**Results:** Compared with the Conventional group, the Improvement group showed improved restoration of the suprasternal fossa, with the patients more satisfied with the cosmetic outcome. However, operation time, postoperative drainage volume, and extubation time were not significantly different between the 2 groups.

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

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**Conclusions:** In endoscopic thyroidectomy via the chest and breast approach, using the new drainage technique described here could yield improved restoration of the suprasternal fossa, ameliorating the cosmetic outcome and patient satisfaction.

**Key Words:** Endoscopy, Thyroid, Suprasternal fossa, Aesthetics, Drainage tube.

## INTRODUCTION

The incidence rates of benign and malignant thyroid tumors have shown an increasing trend over the past years.<sup>1,2</sup> Thyroid cancer is treated by radioactive iodine therapy and molecular-targeted therapies with tyrosine kinase inhibitors, and total thyroidectomy.<sup>1</sup> Traditionally, total thyroidectomy is carried out via an open transcervical incision, leaving a prominent scar on the anterior neck.<sup>3,4</sup> Therefore, some patients, especially young women, are reluctant to undergo such surgery for esthetic reasons.<sup>4</sup> Various methods for thyroid operation have been developed focusing on improved cosmetic outcomes, reduced postsurgical pain, and quality of life betterment.<sup>5-7</sup> After the introduction of endoscopic thyroidectomy 2 decades ago,<sup>8</sup> multiple techniques, eg, endoscopic breast-, endoscopic/robotic bilateral axillo-breast, endoscopic/robotic transaxillary, and endoscopic/robotic face-lift approaches have been developed by surgeons.<sup>6,9-11</sup> With such tremendous progress, endoscopic thyroidectomy has gained increasing recognition due to limited incision and improved cosmetic outcome, making up for the shortcomings of open thyroidectomy with the characteristics of minimally invasive surgery.<sup>12,13</sup>

Endoscopic thyroidectomy via the chest-breast approach requires separation of the anterior neck region and part of the anterior chest skin flap<sup>3,14</sup>; after the procedure, conventional cervical drainage tubes are placed across the suprasternal fossa to emerge on one side of the areola.<sup>15</sup> During postoperative followup, some patients show shallowness or absence of the suprasternal fossa, according to our clinical experience, a phenomenon that affects the esthetic outcome. Therefore, in an attempt to restore the

suprasternal fossa after surgery, we modified the positioning of the drainage tube. This study aimed to assess the feasibility and significance of the novel adaptation.

## MATERIALS AND METHODS

### Study Design

This was a prospective study performed at the Ningbo Medical Center LiHuili Eastern Hospital. Written informed consent was obtained from all patients and controls, and the study was approved by the Ethics Committee of the Ningbo Medical Center LiHuili Eastern Hospital (Ethic approval No. DYLL2014001).

### Participants

Women scheduled for unilateral thyroidectomy via the breast approach were enrolled.

Inclusion criteria were 1) female aged between 20 and 45 years; 2) body mass index of 18.5–23 kg/m<sup>2</sup>; 3) unilateral thyroid benign nodules, with preoperative fine-needle aspiration biopsy without evidence of malignancy; 4) preoperative assessment using B ultrasound or Computer tomography (CT) showing nodule diameter above 2.0 cm and below 3.5 cm. Exclusion criteria were 1) concomitant secondary hyperthyroidism, 2) concomitant severe cardiopulmonary disease (heart failure), 3) surgical contraindications such as coagulation dysfunction, 4) nodule located in the isthmus, 5) substernal struma, and 6) a history of cervical surgery. Exit criteria were postoperative pathology revealing malignancy and request for withdrawal from the experiment. Eligible patients were enrolled consecutively in this study according to their in-patient appointment sequence if they have fulfilled the inclusion criteria. For example, the first patient enrolled was randomly assigned to either improvement group or control group. Then the second patient was assigned to the group opposite to No. 1 patient (eg, if No. 1 patient was control group then No. 2 patient was allocated to improvement group). The rest of patients were assigned in the same way in pairs.

### Interventions

#### Improvement Group

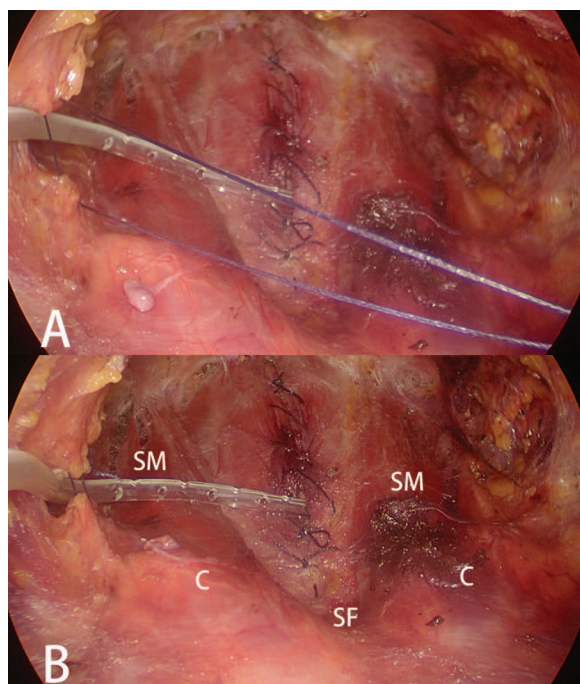
General anesthesia was performed with endotracheal intubation. The patient was placed in the head-elevated supine position with legs separated apart, with a shoulder pad allowing for certain extent of neck hyperextension.

The chief surgeon operated from between the patient's legs while assistant surgeons worked on both sides. Using the chest-breast approach, a 1–1.5-cm incision was made 1–2 cm slightly to the right or left of the center of the cleavage while 0.5-cm incisions were made around the right and left areolas for the trocars (**Figure 1**); then, CO<sub>2</sub> was infused with a pressure maintained at 5–6 mm Hg. After introducing the endoscope, an ultrasound scalpel was used to separate subcutaneous loose connective tissues, forming an operation space extending from top to the upper edge of the thyroid cartilage and on both sides to the inner margin of the sternocleidomastoid. Single-lobe thyroidectomy was then performed.

After surgery, at the level of the intersection of the inner 1/3 or 1/4 right clavicle, the superficial layers of the deep and superficial fasciae (cervical platysma and subcutaneous tissues) were sutured using absorbable 3-0 suture, dividing the subcutaneous space into middle and external lateral channels (**Figure 2**). The drainage tubes were placed in the external lateral channel, bypassing the suprasternal fossa, in the deep surface of the strap muscles of the operation area, and fixed via the areolar incisions.



**Figure 1.** Preoperative port sites placement. (A) A 1–1.5-cm incision was made 1–2 cm slightly to the right of the center of the cleavage while 0.5-cm incisions were made around the right and left areolas for the trocars.



**Figure 2.** Endoscopic thyroidectomy with improved drainage. (A) At the level of the intersection of the inner 1/3 or 1/4 right clavicle, the superficial layers of the deep and superficial fasciae (cervical platysma and subcutaneous tissues) were sutured, dividing the subcutaneous space into middle and two lateral channels. (B) The drainage tubes were placed in the external lateral channel, bypassing the suprasternal fossa, in the deep surface of the strap muscles of the operation area. SM, sternocleidomastoid muscle; C, clavicle; SF, suprasternal fossa.

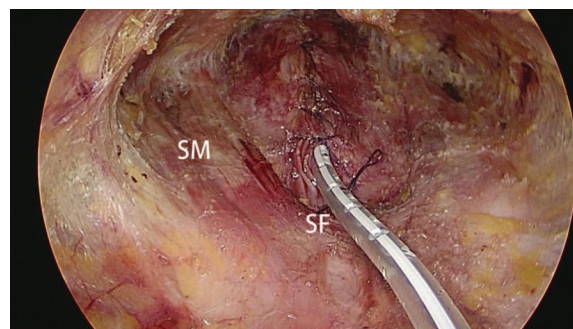
### Conventional Group

Anesthesia, patient posture, procedure steps, and surgeon positions were the same as described for the improved drainage group. After surgery, the conventional method was used to place the drainage tubes in the deep surface of the strap muscles in the operation area, across the suprasternal fossa and fixed via the incision on the right areola (Figures 3 and 4).

### Outcomes

#### Primary Outcomes

The restoration status of the suprasternal fossa was assessed one day postoperation, at the day of extubation, and 3 months postoperatively, by physicians others than those of the surgical team, using the suprasternal fossa assessment scoring system: 3, close to the preoperative level; 2, shallow, but still below the level of the manubrium; 1, suprasternal fossa disappearance or at the level or higher than the manubrium.



**Figure 3.** Endoscopic thyroidectomy with the conventional drainage. The drainage tubes were placed across the suprasternal fossa and fixed via the incision on the right areola. SM, sternocleidomastoid muscle; SF, suprasternal fossa.

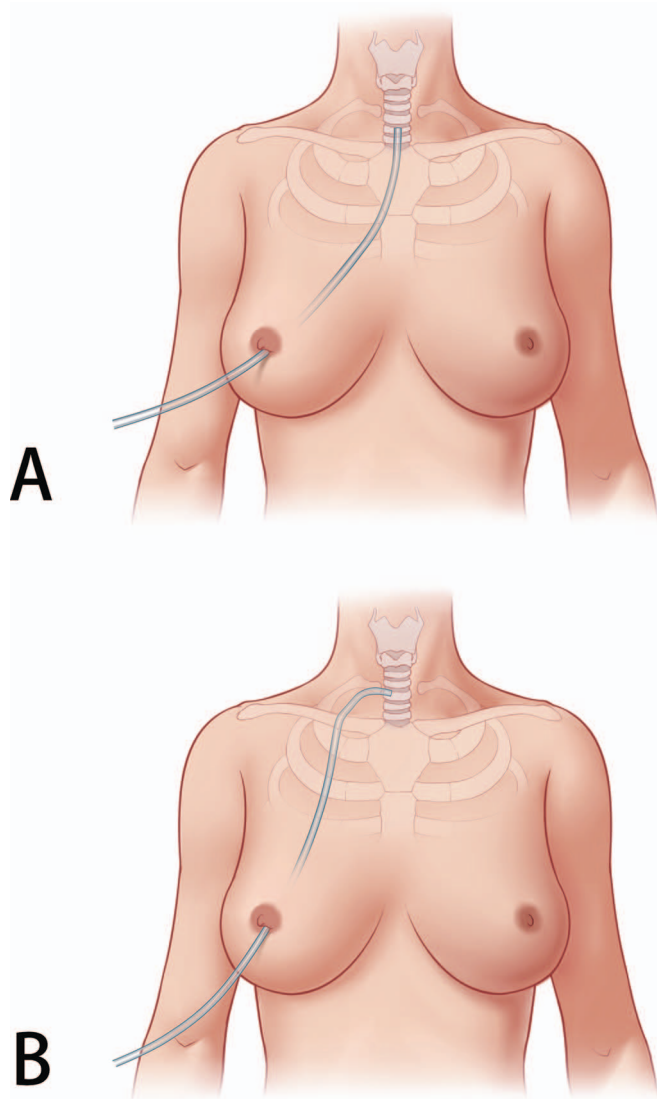
Three months after the operation, preoperative photographs of the neck were handed over to the patients, and the degree of aesthetic satisfaction was assessed. During the interview, patients were asked about their satisfaction with overall cosmetic results, rating from 1 (very unsatisfied), 2 (unsatisfied), 3 (satisfied), to 4 (very satisfied). Then; patient-satisfaction score, which is widely used for assessing overall cosmetic satisfaction,<sup>16</sup> was derived for each individual (Figure 5).

Secondary outcomes were operative time, postoperative pain, mean duration to removal of the surgical drain, mean duration of hospital stay, complications (vocal cord palsy, wound infection, seroma, hemorrhage, and tracheal injury). The operative time was defined as the time from skin incision to closure. On postoperative days 1 and 3, all patients were assessed for pain severity, using a visual analog scale for pain ranging from 1 to 5 (no pain, very slight pain, slight pain, moderate pain, and severe pain, respectively) according to subjective pain experienced by the patient. The amount of surgical site drainage was measured on a daily basis until drain removal. Surgical drains were removed with daily drainage < 20 mL.

### Statistical Analysis

All statistical analyses were performed with the SPSS (version 22.0, SPSS, Inc. Chicago, Illinois, USA) software package. The  $\chi^2$  test and Fisher's exact test were used to compare dichotomous variables. Student *t* test and the Mann-Whitney *U* test were used to compare continuous variables between groups where appropriate. The Pearson's correlation method was used to assess the relationship between two continuous variables. *P* < .05 was considered statistically significant.



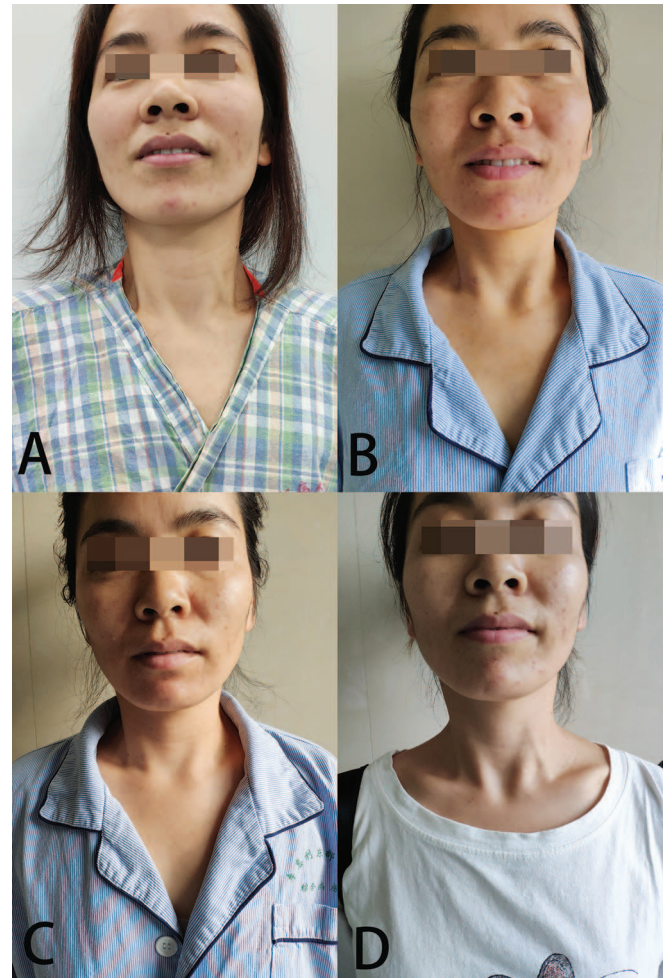


**Figure 4.** (A) Conventional drainage tube placement. (B) Improved placement of drainage tube.

## RESULTS

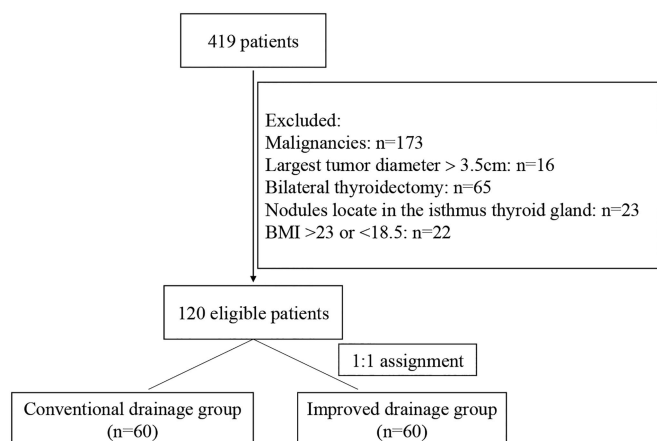
### Baseline Characteristics

From May 2014 to March 2017, a total of 419 patients were enrolled. Among them, 173 subjects with preoperative puncture for malignancy, 23 with the thyroid gland remaining, 16 with nodules of maximal diameter > 3.5 cm, 22 with body mass index > 23 or < 18.5 kg/m<sup>2</sup>, and 65 with bilateral thyroid nodules scheduled for bilateral thyroidectomy were excluded, leaving 120 eligible patients included for analysis. Meanwhile, 2 and 1 cases in the



**Figure 5.** Representative cosmetic outcome after endoscopic thyroidectomy via the chest and breast approach with improved drainage. (A) The supraclavicular fossa in the experimental group before the operation. (B) Restoration situation of the supraclavicular fossa 1 day postsurgery (score, 3 points). (C) Restoration situation of the supraclavicular fossa after extubation (score, 2 points). (D) Restoration situation of the supraclavicular fossa 3 months after surgery (score, 3 points).

improved and conventional drainage groups, respectively, diagnosed with papillary carcinoma, were excluded. Eventually, 58 and 59 patients in the Improvement and Conventional groups, respectively, underwent the operation (Figure 6). The clinical and pathological characteristics of all patients are summarized in Table 1. There was no significant difference in baseline characteristics, such as age, body mass index, smoking history, tumor location, the extent of resection, and pathological types, between the two groups.



**Figure 6.** Flow of participants divided into the conventional or improved drainage groups.

**Primary and Secondary Outcomes**

**Table 2** shows primary and secondary outcomes in both groups. Operative times in the improvement and conventional groups were  $108.9 \pm 20.2$  and  $111.6 \pm 19.8$  minutes, respectively; drainage volumes were  $126.1 \pm 40.2$  mL and  $137.3 \pm 43.2$  mL, respectively. There were no significant differences between the two groups in operative time, postoperative drainage, duration of drainage, and hospital stay. Visual analog scale scores for postoperative pain were  $3.5 \pm 0.7$  and  $3.3 \pm 0.7$  in the improved

and conventional drainage groups, respectively, at postoperative day 1;  $2.6 \pm 0.6$  and  $2.4 \pm 0.7$  were obtained at postoperative day 3, respectively (**Table 2**). There were no statistically significant differences in visual analog scale scores for pain between the two groups at postoperative days 1 and 3. A total of 2 transient vocal cord palsy and 2 flap ecchymosis events were identified in the improved drainage group (ie, 4/58 patients; 7.0%), meanwhile, 1 transient vocal cord palsy and 2 flap ecchymosis events were identified in the conventional group (i.e., 3/59 patients; 5%). There was no statistically significant difference between the two groups in surgical complications.

Compared with the conventional group, the improved drainage group showed significantly improved suprasternal fossa assessment score at postoperative day 1, extubation day, and postoperative 3 months ( $2.6 \pm 0.6$  vs.  $1.8 \pm 0.6$ ,  $P < .01$ ;  $1.8 \pm 0.6$  vs.  $1.3 \pm 0.5$ ,  $P < .01$ ; and  $2.4 \pm 0.6$  vs.  $2.2 \pm 0.5$ ,  $P < .05$ , respectively), and higher patient satisfaction scores ( $3.5 \pm 0.6$  vs.  $3.2 \pm 0.6$ ,  $P < .01$ ) (**Tables 2 and 3**).

**DISCUSSION**

In this study we assessed a novel drainage technique, which restores the suprasternal fossa in endoscopic thyroidectomy. With advances in endoscopy and improved adaptability of endoscopic surgical instruments and tech-

**Table 1.**  
Baseline Characteristics of Participants

	Improvement Group	Conventional Group	P Value
n	58	59	
Age, mean (SD)	34.7 (6.0)	35.4 (5.5)	.512
BMI, mean (SD)	20.5 (1.3)	20.8 (1.1)	.180
Smoking history (%)	1 (1.7%)	2 (3.3%)	1
Histopathology			.546
Nodular hyperplasia	50	53	
Follicular adenoma	8	6	
Tumor size (cm), mean (SD)	2.5 (0.7)	2.7 (0.6)	.100
Location of the neoplasm			.546
Upper pole	20	19	
Lower pole	38	40	
Extent of resection			.455
Total lobectomy	36	31	
Nearly total lobectomy	17	19	
Subtotal lobectomy	5	9	

**Table 2.**  
Primary and Secondary Outcomes

Variable	Improvement Group	Conventional Group	P Value
n	58	59	
Primary Outcome			
Suprasternal fossa assessment score, mean (SD)			
Postoperative day 1	2.6 (0.6)	1.8 (0.6)	.000
Extubation day	1.8 (0.6)	1.3 (0.5)	.000
Postoperative 3 months	2.4 (0.6)	2.2 (0.5)	.036
Patient satisfaction score, mean (SD)	3.5 (0.6)	3.2 (0.6)	.008
Secondary Outcomes			
Operation time (minutes), mean (SD)	108.9 (20.2)	111.6 (19.8)	.467
Duration of drainage (days), mean (SD)	4.4 (0.9)	4.3 (0.9)	.549
Drainage volume (mL), mean (SD)	126.1 (40.2)	137.3 (43.2)	.149
Hospital stay (days), mean (SD)	6.7 (0.8)	6.4 (0.8)	.090
Postoperative pain (VAS), mean (SD)			
Postoperative 1 day	3.5 (0.7)	3.3 (0.7)	.125
Postoperative 3 day	2.6 (0.6)	2.4 (0.7)	.100
Surgical complications (%)	4 (7%)	3 (5%)	.717

VAS, visual analog scale.

**Table 3.**  
Suprasternal Fossa Assessment Scores in the 2 Groups

Suprasternal Fossa Assessment Score	Improvement Group	Conventional Group
n	58	59
Postoperative day 1		
3, n (%)	36 (62.1%)	4 (6.8%)
2, n (%)	20 (34.5%)	38 (64.4%)
1, n (%)	2 (3.4%)	17 (28.8%)
Extubation day		
3, n (%)	6 (10.3%)	0 (0%)
2, n (%)	36 (62.1%)	18 (30.5%)
1, n (%)	16 (27.6%)	41 (69.5%)
Postoperative 3 months		
3, n (%)	29 (50%)	16 (27.1%)
2, n (%)	24 (41.4%)	39 (66.1%)
1, n (%)	5 (8.6%)	4 (6.8%)

niques, diverse surgical approaches have been developed for endoscopic thyroidectomy; these include Endoscopy-assisted small neck incision surgery,<sup>17</sup> complete endoscopic thyroid surgical approaches such as the scarless neck chest-breast approach,<sup>18</sup> the axillary approach,<sup>19</sup> and other scarless approaches such as entry from the oral cavity.<sup>20</sup>

Thanks to superior cosmetic results and its minimally invasive nature, with good treatment outcome, endoscopic thyroidectomy has gradually attracted attention from the medical field, and is sometimes referred to as oncoplastic thyroidectomy.<sup>21</sup> After endoscopic thyroidectomy, cervical drainage tubes are conventionally placed across the suprasternal fossa to emerge on one side of the areola.<sup>15</sup> However, our clinical experience reveals that the suprasternal fossa becomes shallow or even disappeared postsurgery. Meanwhile, restoration of the suprasternal fossa following endoscopic thyroid surgery has not been reported. Therefore, we attempted to restore the suprasternal fossa by changing the position of the drainage tube in the anterior region of the neck.

Interestingly, at all time points assessed (1 day postsurgery, on the extubation day, or at 3 months postoperatively), significantly improved restoration of the suprasternal fossa in the improved drainage group was obtained compared with the conventional group (**Table 2**). These findings suggested that improved cosmetic effects were obtained by the novel method, as also determined by patient satisfaction.

As shown above, suprasternal fossa assessment scores in the improved drainage group on postoperative day 1 and 3 months were high, but reduced at the time of extubation, indicating an initial decline followed by a rising trend during the recovery process. Such trend was also noticed in the conventional group. This might be due to postoperative cervical anterior flap edema, which would normally peak at 3–7 days; with the gradual fading of the edema, the suprasternal fossa would gradually be restored. Therefore, in the time period directly following endoscopic thyroid surgery, changes or disappearance of the suprasternal fossa are common, but recovery occurs to a certain extent with time.

As shown in **Table 3**, scores in the conventional group at postoperative day 1 and on the day of extubation were low, indicating that the suprasternal fossa became shallow or disappeared. This might be due to the position and placement of the drainage tube (across the suprasternal fossa), with the skin flap not able to stick to the deep fascia; 3 months after surgery, the skin flap could stick to

the fascia again, restoring the suprasternal fossa, resulting in an overall score increase. Meanwhile, the improved drainage group showed relatively high scores at one day after the operation (mostly scores of 3 and 2) and similar values 3 months after the procedure. These findings suggested that early restoration and settling of the skin flap may result in permanent restoration of the suprasternal fossa.

Nevertheless, some patients in the improved drainage group had suprasternal fossa disappearance at one day postsurgery, showing low scores. Interestingly, deep fascia and subcutaneous tissue suturing in these patients was not dense enough, allowing a larger motion range of the drainage tube. After the skin flap starts to settle postoperatively, the drainage tube moves to the midline, making it more difficult to attain the expected effect, hence failing to restore the suprasternal fossa. Meanwhile, there were some patients with high scores (3 points) the day after surgery, but eventually showed poor scores 3 mo later. This could be due to effusion after extubation, which further impacted the settling of the skin flap. Therefore, the extubation time in such patients should be extended as appropriate in order to achieve recovery of the suprasternal fossa. Interestingly, operation time, volume of postoperative drainage, and time to extubation were similar between the two groups. Therefore, by suturing and separating the deep fascia suture, the course of the drainage tube could be changed in order to keep the suprasternal fossa intact. This is a simple and effective approach that deserves promotion and more recognition.

This study is not without limitations. First, despite its prospective nature, this study was performed in a single center with a relatively small sample size. Therefore, multicenter prospective trials with large sample sizes are warranted to confirm our findings. In addition, the technique should be further improved, for example, monitoring drainage conditions more closely and extending the time to extubation when needed.

## CONCLUSION

With the novel technique described in this study, improved restoration of the suprasternal fossa was obtained, and the patients were more satisfied with the cosmetic outcome. Meanwhile, operation time, postoperative drainage volume, and extubation time were similar to those of the conventional method. Therefore, using this new drainage technique in endoscopic thyroidectomy via the chest and breast approach should be promoted for clinical use.



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