Modified transoral endoscopic thyroidectomy technique using trapdoor suspension sutures

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Running title: Transoral thyroidectomy using trapdoor sutures
CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

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<Short Communication>

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Running title: Transoral thyroidectomy using trapdoor sutures
Transcervical thyroidectomy has been the standard operative method, but it leaves a visible lifetime scar in the anterior cervical region. Various remote access thyroidectomy techniques [1] to hide this scar have some risks and limitations including extensive dissection, increased likelihood of nerve and vascular damage, narrow and deep working space, and so on [2, 3]. Recently, transoral endoscopic thyroidectomy vestibular approach (TOETVA) technique has been developed and refined by Anuwong, et al. to minimize dissection distance and likelihood of nerve damage [4, 5]. However, this approach might have several complications such as CO$_2$ embolism and subcutaneous emphysema if CO$_2$ is continuously insufflated to expand the operation field [6, 7].

In an effort to address these problems, we developed new approach technique of TOETVA technique called modified transoral endoscopic thyroidectomy using trapdoor suspension sutures. We employed transoral endoscopic thyroidectomy without CO$_2$ insufflation to get rid of fatal complication such as CO$_2$ embolism. Also, we did not use a retractor because of possibility of facial sensory numbness and instrument interference. Here, we present a case series of our early experiences with this technique to evaluate its feasibility, usefulness, and safety in properly selected patients.

A retrospective analysis was conducted for patients who underwent modified transoral endoscopic thyroidectomy using trapdoor suspension sutures by one single surgeon. Patients’ selection for modified transoral endoscopic thyroidectomy was referred from Tae. et al [8]. Demographics, clinical, and pathological status, surgical details, complication, and cosmetic satisfaction were analyzed. Facial sensory numbness was checked at 2 and 4 weeks after operation for five sites: middle mentum, right mentum, left mentum, submentum, and lower lip.
Sensory numbness was evaluated with a scale of 0 (no sensory) to 10 (normal) using a Questionnaire.

Surgical procedures were conducted similarly to previous studies [5, 8]. Only, we used multiple trapdoor sutures and the L-shaped suspension bar instead of using CO₂ gas and retractor. Briefly, a 10 mm 0° laparoscope was placed in a 10mm trocar inserted into vestibular midline transverse incision. An external trapdoor suture using reverse cutting needle type silk 2-0 was placed in the anterior midline of the neck to elevate the subplatysmal flap and retracted using an L-shaped suspension bar. The needle was inserted from the outside of the skin where the endoscopic light shone, grasped by needle forceps, and then passed through contralateral skin again to perform trapdoor sutures. The subplatysmal working space was made by dissection with ultrasonic device, L-hook cautery and laparoscopic instruments. After changing the 0° laparoscope to the 30° laparoscope, skin flap was elevated to the level of the sternal notch inferiorly and to the edge of the sternocleidomastoid muscle laterally. Dissected subplatysmal flap was retracted by multiple external trapdoor sutures and an L-shaped suspension bar (Fig. 1A). The midline raphe between strap muscles was identified and divided. Divided strap muscles were dissected from the ipsilateral thyroid lobe, and the whole anatomy of the anterior neck area was well exposed to a degree similar to that of standard TOETVA via CO₂ insufflation (Fig. 1B) [5]. Thyroidectomy was conducted as described in previous studies [5, 8].

Eight patients (1 male and 7 females) underwent modified transoral endoscopic thyroidectomy using trapdoor suspension sutures (mean age: 41.75 ± 13.68 years). Clinicopathological features of these eight patients are summarized in the order of surgery as shown in supplemental Table 1. Six patients were diagnosed as papillary thyroid carcinoma (PTC) and two patients were
diagnosed as nodular hyperplasia using sonography guided fine needle aspiration. Extent of operation was lobectomy plus isthmusectomy in PTC patients and isthmusectomy in patients with nodular hyperplasia confined to the isthmus.

Mean operation time was 196.67 ± 58.74 min for lobectomy plus isthmusectomy (Table 1). However, there was a steep learning curve to 132.00 min for our 6th lobectomy plus isthmusectomy case. This might be because of acclimated setting process and more selective indications. As cases continued, thyroidectomy time was decreased significantly. Mean operation time for only isthmusectomy was 94.00 ± 5.66 min. This suggests that isthmusectomy is a good indication for transoral endoscopic thyroidectomy without CO₂ gas or retractor.

Modified transoral endoscopic thyroidectomy has similar advantages to the standard TOETVA via CO₂ insufflation. Additionally, there are no severe complications such as CO₂ embolism in modified technique. However, modified technique takes longer to perform subplatysmal dissection from the mouth to the sternal notch than the standard TOETVA via CO₂ insufflation.

There were no postoperative complications associated with conventional thyroidectomy including recurrent laryngeal nerve palsy, hematoma, seroma, infection, or tracheoesophageal injury. Hypoparathyroidism was not evaluated because we did not perform total thyroidectomy. Unlike transcervical thyroidectomy, the following complications such as skin flap perforation, mental nerve palsy, and facial sensory numbness may arise in transoral endoscopic thyroidectomy. There is no platysma muscle in midline neck areas. Thus, special attention is required not to puncture or burn the anterior neck skin. Mental nerve injury was prevented by taking panoramic view and confirming mental foramen. Facial sensory numbness was our
special area of interest. The first two patients complained of transient middle mentum numbness, although sensory had been recovered to some extent after 4 weeks (Table 1). It might be due to a sustained retraction and a long operation time during our learning curve. Thus, we intermittently released external trapdoor sutures to relieve sustained and excessive retraction. After that, patients did not complain about severe facial sensory numbness on the first day after operation. We also checked postoperative cosmetic satisfaction. Only external trapdoor suture points were visible after 1 day and 2 weeks later. Four weeks later, most suture points disappeared. All patients were very satisfied or satisfied with cosmetic status at 4 weeks after operation.

However, indications for transoral endoscopic thyroidectomy are limited compared to transcervical thyroidectomy, especially in the initial phase of implementation. Tae et al. [8] have described that the ideal indication for TOETVA might be a benign and differentiated thyroid tumor < 2 cm in diameter not located in the uppermost part. We selected patients relative strictly by referring to the above indications because these were our initial experiences in modified transoral endoscopic thyroidectomy using trapdoor suspension sutures. Thus, this study has a small sample size of a restricted group of patients. Indications can be expanded as we proceed with the operation continuously.

In conclusion, our institution has successfully implemented modified transoral endoscopic thyroidectomy using trapdoor suspension sutures for thyroid surgery on selected patients. Based on our initial experiences, a transoral endoscopic thyroidectomy without CO2 gas or retractor is a safe and feasible method showing excellent cosmetic status when it is applied to patients with appropriate indication. Further experiences are needed to evaluate its indications, feasibility, and safety in more detail.
REFERENCES


TABLE AND FIGURE LEGENDS

Table 1. Operation time and sensory change of eight patients treated by modified transoral endoscopic thyroidectomy using trapdoor suspension sutures

Figure 1. External and endoscopic findings in modified transoral endoscopic thyroidectomy using trapdoor suspension sutures. Multiple external trapdoor sutures were hung on the L-shaped suspension bar using mosquito (A). Exposure of the anterior neck area using 30° laparoscope (B).
SUPPLEMENTAL TABLE LEGEND

Supplemental Table 1. Clinicopathological summary of eight patients treated by modified transoral endoscopic thyroidectomy using trapdoor suspension sutures
### TABLE LEGEND

Table 1. Operation time and sensory change of eight patients treated by modified transoral endoscopic thyroidectomy using trapdoor suspension sutures

<table>
<thead>
<tr>
<th>Case</th>
<th>Operation extent</th>
<th>Operation time (min)</th>
<th>Sensory change (0, no sense; 10, normal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Skin flap elevation</td>
<td>Thyroidectomy</td>
</tr>
<tr>
<td>1</td>
<td>L, I</td>
<td>65</td>
<td>110</td>
</tr>
<tr>
<td>2</td>
<td>L, I</td>
<td>65</td>
<td>150</td>
</tr>
<tr>
<td>3</td>
<td>L, I</td>
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<td>55</td>
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</tr>
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</table>

Abbreviations: POD, postoperative day; L, lobectomy; I, isthmusectomy