Original Article

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Use of a mini-instrument in endoscopic thyroidectomy *via* a breast approach to improve cosmetic outcomes

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Summary **The objective of this research was to evaluate the clinical benefits of using a mini-instrument during endoscopic thyroidectomy *via* a breast approach (ETBA). Surgery-related indices and cosmetic results were compared for 20 patients underwent ETBA with a mini-instrument (ETBA-m) and 20 patients who underwent standard ETBA (sETBA). Patients were closely matched in terms of age, gender, tumor size, and pathology. Patients who underwent sETBA had a significantly larger area of dissection and total length of incisions compared to patients who underwent ETBA-m (136.25 ± 19.22 cm^2 *vs.* 105.25 ± 9.54 cm^2, $p < 0.001$ and 2.66 ± 0.09 cm *vs.* 2.08 ± 0.24 cm, $p < 0.001$). All patients who underwent ETBA-m commented that they preferred their current cosmetic appearance after they were shown a picture of the scars of a patient who underwent sETBA. Results of this study revealed that use of a mini-instrument in ETBA is technically safe and feasible and it offers improved cosmetic outcomes compared to sETBA.**

Keywords: Endoscopic, thyroidectomy, mini-instrument

1. Introduction

Thyroid disease has a particularly high incidence in women. Although conventional thyroidectomy is safe, effective, and well-tolerated, it results in an obvious cervical scar that compromises a patient's cosmetic appearance. Endoscopic thyroid surgery was developed to provide an aesthetically pleasing scar after open thyroidectomy (*1,2*).

Endoscopic thyroid surgery can be classified into video-assisted endoscopic and pure endoscopic surgery (*3*). The former requires only a small skin incision in the neck and limited tissue dissection, while the latter is performed remotely and involves extracervical incisions. Pure endoscopic surgery is popular in Asia since it yields superior cosmetic results. More than 20 "scarless" approaches for endoscopic thyroidectomy have been developed (*4*).

To further improve the cosmetic results of "scarless" endoscopic thyroidectomy (SET), some surgeons have attempted to reduce the number of incisions. Single-incision endoscopic thyroidectomy *via* an axillary approach was reported by Lee *et al*. (*5*) and similar surgery *via* a trans-areolar approach was reported by Fan *et al*. (*6*). Both groups of researchers found that single-incision endoscopic thyroidectomy was safe and technically feasible and offered an advantage in terms of the excellent cosmetic appearance of the thoracic wall. However, such procedures are technically difficult, they offer a singular view and more confined working space, and they carry the risk of instrument interference (*5,6*). Single-incision endoscopic thyroidectomy also takes a great deal of time and it involves a very steep learning curve.

Another way to improve cosmetic appearance is to reduce the size of an incision, as in mini-laparoscopic surgery. Mini-laparoscopic instruments are widely used in general surgery and gynecology (*7-9*) and can provide excellent cosmetic results without significantly altering the laparoscopic approach. However, such instruments have seldom been used in SET.

Reported here is experience using a mini-instrument in endoscopic thyroidectomy *via* a breast approach (ETBA), the most popular technique for SET in China.

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The potential advantages of using mini-instruments are that first, the longest parasternal incision for the camera port can be moved to the areola, thus reducing the likelihood of hypertrophic scar formation at the parasternal incision. Second, a mini-incision will heal without leaving a mark, so the trocar for the mini-instrument can be inserted in the chest wall while maintaining the convenient triangular positioning of instruments. This rearrangement of trocar sites should not increase the procedure's technical difficulty and may improve cosmetic appearance afterwards.

2. Methods

2.1. *Patient demographics*

This study was approved by the Institutional Review Board of Changzheng Hospital. From September to December 2012, 20 consecutive patients (18 women, mean age: 34.7 ± 9.17 years) underwent ETBA with a mini-instrument (ETBA-m). Eligibility criteria were the same as for conventional ETBA: benign thyroid nodules (diameter < 5 cm) and papillary microcarcinoma diagnosed by preoperative ultrasound and fine needle aspiration cytology. Exclusion criteria were: a history of neck surgery or radiotherapy; thyroiditis diagnosed by preoperative biochemistry or ultrasound; liver dysfunction; and autoimmune disease (*10,11*). Twenty consecutive patients who underwent standard ETBA (sETBA) from June to September 2012 (17 women; mean age: 38.85 ± 9.95 years) served as the control group. All patients provided written informed consent prior to study participation.

2.2. *Thyroidectomy*

sETBA has been described previously (*10,11*). Briefly, three incisions were made: a 12-15-mm curved longitudinal parasternal incision for the camera port and two 5-mm working port incisions in the circumareolar region. Several tunnels were created with a plastic rod, and then a thyroidectomy was performed with a harmonic scalpel (HS, Ethicon Endo Surgery, Cincinnati, OH, USA). When exposure was difficult, a puncture was made in the skin of the neck and a suture retractor was inserted to pull the strap muscles laterally (*12*). Either a unilateral or a bilateral near-total or total lobectomy was performed depending on the size of benign tumors, and a hemi- or total thyroidectomy with central compartment node dissection (CCND) was performed for papillary microcarcinoma.

The location of trocars in ETBA-m differed from that in sETBA: a 10-mm optical trocar was inserted on the right areolar border and a 5-mm manipulation trocar for the HS was inserted along the left areolar border. A subcutaneous tunnel in the direction of the neck was first created *via* a 10-mm incision, and a 5-mm trocar was inserted on the left to connect to the tunnel. A working space was created with the HS under endoscopic guidance. A 2-mm mini-instrument was inserted *via* the chest wall, maintaining a wide angle for extensive manipulation and facilitating exposure with the surgeon's left hand (Figures 1A and 1B). The rest of the procedure was the same as that for sETBA (Figures 1C and 1D). Even though the view is lateral, resection of either lobe is no more difficult than in sETBA. If, however, central compartment dissection is necessary, then the sternal portion of the clavicle and the lower right strap muscle may hinder visualization. Thus, the strap muscles were usually transected in part for better exposure.

2.3. *Collection of surgery-related data*

The diameter of thyroid lesions as determined by ultrasound, pathologic diagnosis, operating time, extent of the subcutaneous area marked with endoscopic illumination, blood loss, and total incision length were recorded and compared.

2.4. *Subjective assessment of postoperative pain*

Postoperative pain was assessed 12, 24, and 48 h after surgery using a visual analog scale (VAS) from 0-10 ("0" = "no pain," "10" = "worst pain imaginable") (*10,13*).

2.5. *Monitoring of complications*

Blood samples were collected to measure calcium levels on day 1 postoperatively. Hypocalcemia was diagnosed depending on symptoms and laboratory findings. Patients who presented with postoperative hoarseness underwent laryngoscopy. Transient hypocalcemia and transient recurrent laryngeal nerve (RLN) injury were defined based on recovery from symptoms and normalization of laboratory data within 6 months (*10,14*).

2.6. *Evaluation of cosmetic results*

Three months postoperatively, patients evaluated their cosmetic outcomes using a numerical scoring system (NSS) similar to VAS ("0" = "extreme dissatisfaction", "10" = "extreme satisfaction") (*10*). Patients who underwent ETBA-m were also shown a picture of scars following sETBA and their comments were recorded.

2.7. *Statistical analysis*

The student's *t*-test and the Pearson χ^2 test were used to compare means and categorical variables, respectively. A p value of less than 0.05 was considered to be statistically significant.

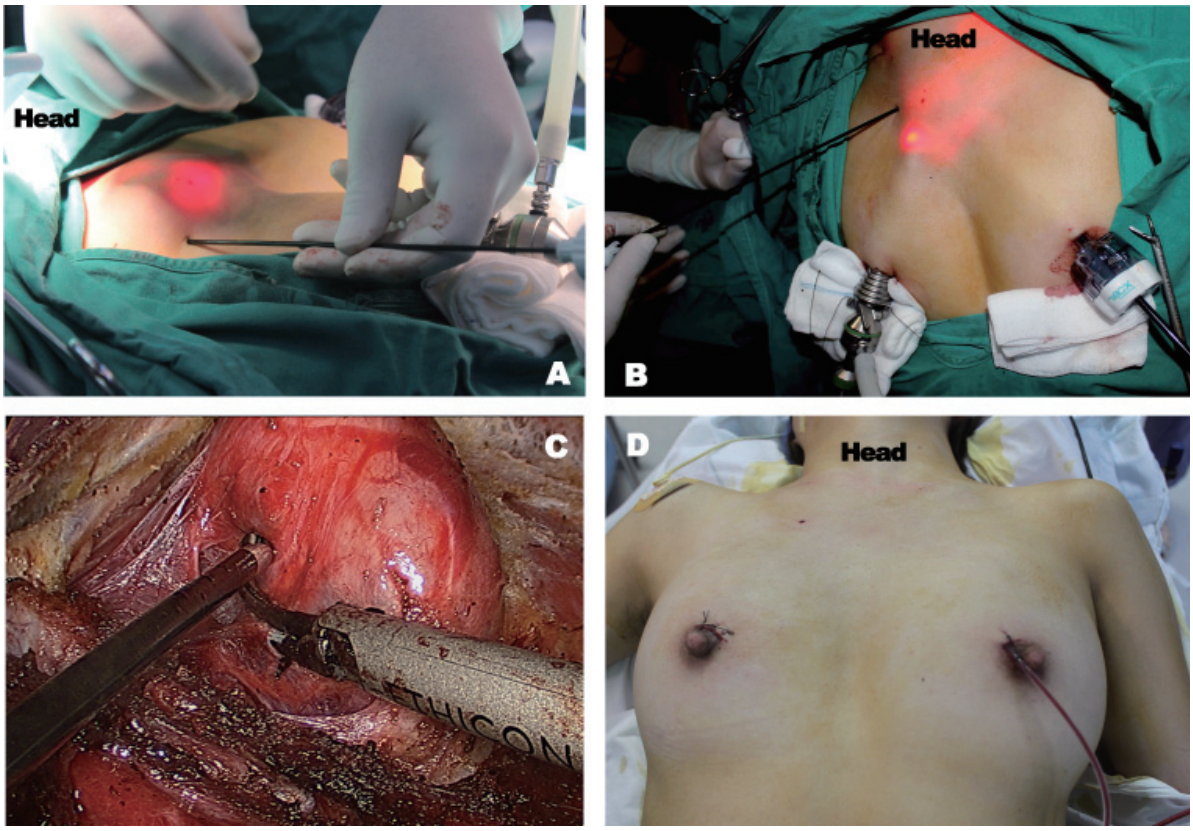

Figure 1. Surgical procedure for ETBA-m. A: A 2-mm mini-instrument was inserted in the chest wall; **B**: A wide angle was maintained for extensive manipulation; **C**: A thyroidectomy was performed with the mini-instrument facilitating exposure, and **D**: Surgical sites once the surgery was completed.

Table 1. Baseline data of patients underwent BAET

Items	sBAET group	mBAET group	*p* value
Gender (male/female)	3/17	2/18	1.000
Age(y)	38.85 ± 9.95	34.70 ± 9.00	0.175
Tumor size (mm)			
benign	29.50 ± 10.27	31.39 ± 8.65	0.623
Cancer	6.88 ± 2.17	7.29 ± 1.50	0.681
Lateral (uni/bilateral)	13/7	11/9	0.519
Pathology (adenoma/goiter/cancer)	11/3/6	13/2/5	0.795

3. Results

3.1. *Baseline data*

The two groups were closely matched in terms of age, gender, tumor size, and pathology, as shown in Table 1

3.2. *Surgical outcomes*

The surgical procedures for patients who underwent ETBA-m were a lobectomy for 7 patients, hemithyroidectomy with CCND for 4, sub-total thyroidectomy for 5, total thyroidectomy (TT) for 3, and TT with CCND for 1.

There were no deaths or conversion to another procedure for either group. There were no significant differences in blood loss and operating time for the two groups. The location of trocars was altered since the shape of the area of subcutaneous dissection was changed from a rhomboid shape to an upside-down Y shape. Thus, the area of dissection decreased significantly from 136.25 ± 19.22 cm^2 in patients who underwent sETBA to 105.25 ± 9.54 cm^2 in patients who underwent ETBA-m ($p < 0.001$). Use of the mini-instrument also significantly shortened the total length of incisions (2.66 ± 0.09 cm *vs*. 2.08 ± 0.24 cm, $p < 0.001$, Table 2).

There was one case of RLN palsy in each group, and both resolved within 3 months. Transient hypocalcemia occurred in 3 patients who underwent ETBA-m and in 2 patients who underwent sETBA. Hypercapnia, subcutaneous emphysema, and seroma were not observed in either group.

Table 2. Surgery-related data of patients underwent BAET

Items	sBAET group	mBAET group	*p* value
Dissection area (cm^2)	136.25 ± 19.22	105.25 ± 9.54	<0.001
Incision length (cm)	2.66 ± 0.09	2.08 ± 0.24	<0.001
Blood loss (mL)	6.85 ± 2.08	6.65 ± 3.63	0.832
Surgery duration (min)	105.75 ± 20.02	113.75 ± 41.51	0.442
VAS-12h	3.45 ± 1.57	2.55 ± 1.19	0.048
VAS-24h	1.75 ± 1.41	0.95 ± 0.76	0.031
VAS-48h	0.75 ± 1.41	0.30 ± 0.47	0.184
Drainage volume (mL)	120.75 ± 38.12	113.75 ± 41.51	0.442
NSS	8.75 ± 1.21	9.30 ± 1.21	0.090

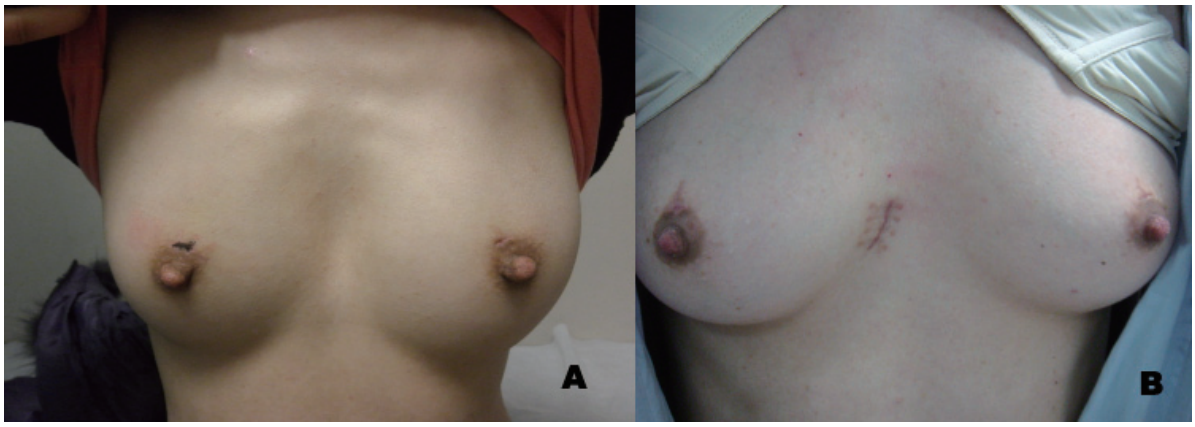

Figure 2. Cosmetic outcomes of ETBA. A: Surgical scars following ETBA-m and **B**: Surgical scars following sETBA.

3.3. *Postoperative pain*

The severity of pain according to the VAS differed significantly 12 and 24 h postoperatively but did not differ significantly 48 hours postoperatively for either group.

3.4. *Cosmetic outcomes*

The areolar incisions blended well with the areola, and the mini-incision on the chest wall left no obvious trace (Figure 2A). Although the patients who underwent ETBA-m had a higher NSS score than patients who underwent sETBA, the difference was not statistically significant. However, all patients who underwent ETBA-m commented that they preferred their incisions after they were shown a picture of scars of a patient who underwent sETBA (Figure 2 B).

4. Discussion

Use of a mini-instrument in endoscopic thyroidectomy has the advantages as mini-laparoscopic surgery, yielding the same surgical results after minor technical adjustments (*15*). Some technical pitfalls have been encountered when mini-instruments were used for complex procedures, such as antireflux surgery (*15*). This is not a problem in ETBA-m since the surgeon only used the mini-instrument in his left hand to facilitate exposure. A new learning curve is not required, as the triangular positioning of instruments is maintained. This was evident in the absence of a significant difference in the operating time for either group. This is despite the fact that ETBA-m was performed for the first time during this study and sETBA has been performed more than 700 times by the current authors. That said, ETBA-m involved unilateral lobectomy for adenoma as well as TT with CCND for bilateral papillary microcarcinoma. There was also no difference in the incidence of RLN palsy and hypocalcaemia in the groups, and this incidence was within the range reported in literature (*2,16-18*). Thus, clinical use of mini-instruments is feasible and yields consistent results (*7,8*).

Breast and axillary approaches to endoscopic thyroidectomy (ETAA) were both developed by Asian surgeons (*19,20*). ETBA has an advantage over ETAA in terms of a wide triangular positioning of instruments so they do not interfere with one another (*21*), and ETBA offers excellent visualization when approaching bilateral lesions. Thus, ETBA is the most popular approach for endoscopic thyroidectomy in China (*22*). However, ETBA is inferior in terms of cosmetics as it may leave a hypertrophic parasternal scar (*21,23*). To resolve this issue, the breast and axillary approaches were combined, including the bilateral axillo-breast approach (BABA) (*24*), axillo-bilateral breast approach (ABBA) (*25*) and bilateral breast areola and ipsilateral

axillary approach (BBIA) (*3*). These techniques do not provide an optimal solution since the axillary scar can be rather prominent and it compromises a patient's cosmetic appearance, especially for young women who wear sleeveless clothing (*23*).

Hur *et al*. (*23*) developed a bilateral areolar approach (BAA) to endoscopic thyroidectomy, offering an advantage of an excellent cosmetic appearance compared to other approaches, including BABA. ETBA with the mini-instrument results in a scar with an almost identical appearance since the 2-mm mini-incision was no longer evident during the follow-up 3 months postoperatively. The NSS score did not differ significantly for patients who underwent the ETBA-m and those who underwent the sETBA, but all of the patients who underwent ETBA-m felt that endoscopic thyroidectomy with a mini-instrument yielded a better cosmetic appearance after viewing a picture of the scars of a patient who underwent sETBA. The current approach has several advantages over BAA. First, only 3 incisions are required. Second, total incision length can be reduced (22 mm *vs*. 26 mm). Third, instruments were positioned in a triangular shape with larger angles, so instruments did not interfere with one another.

Proponents of BAA argue that the approach is minimally invasive (*23*). Although patients who underwent ETBA-m had significantly less postoperative pain than those who underwent sETBA 12 and 24 h postoperatively, one cannot rationally conclude that ETBA-m is superior, as personal bias may be involved (*26*). However, ETBA-m has the potential to reduce invasiveness in terms of total incision length (2.66 ± 0.09 cm *vs*. 2.08 ± 0.24 cm, $p < 0.001$) and the lack of a parasternal incision (the triangle-shaped area between the nipples does not need to be dissected, reducing the area of subcutaneous dissection; 136.25 ± 19.22 cm^2 *vs*.105.25 ± 9.54 cm^2, $p < 0.001$). Additional research is necessary to provide a more comprehensive evaluation.

In conclusion, use of a mini-instrument in ETBA is technically safe and feasible and it offers improved cosmetic outcomes compared to sETBA while also reducing invasiveness in terms of incision length and subcutaneous dissection.

References

1. Hüscher CS, Chiodini S, Napolitano C, Recher A. Endoscopic right thyroid lobectomy. Surg Endosc.1997; 11:877.
2. Tan CT, Cheah WK, Delbridge L. "Scarless" (in the neck) endoscopic thyroidectomy (SET): An evidence-based review of published techniques. World J Surg. 2008; 32:1349-1357.
3. Jeryong K, Jinsun L, Hyegyong K, Eilsung C, Jiyoung S, Insang S, Moonsang A, Jiyeon K, Jaeeun H. Total endoscopic thyroidectomy with bilateral breast areola and ipsilateral axillary (BBIA) approach. World J Surg. 2008; 32:2488-2493.
4. Schardey HM, Schopf S, Kammal M, Barone M, Rudert W, Hernandez-Richter T, Pörtl S. Invisible scar endoscopic thyroidectomy by the dorsal approach: Experimental development of a new technique with human cadavers and preliminary clinical results. Surg Endosc. 2008; 22:813-820.
5. Lee D, Nam Y, Sung K. Single-incision endoscopic thyroidectomy by the axillary approach. Laparoendosc Adv Surg Tech A. 2010; 20:839-842.
6. Fan YB, Wu B, Zhong CL, Kang J, Guo BM, Yang F, Deng XZ, Zheng Q. Trans-areola single-site endoscopic thyroidectomy: Pilot study of 35 cases. Surg Endosc. 2012; 26:939-947.
7. Bona S, Molteni M, Montorsi M. Minilaparoscopic colorectal resections: Technical note. Minim Invasive Surg. 2012; 2012:482079.
8. Di Lorenzo N, Manzelli A, Coscarella G, Pietrantuono M, Jarzembowski TM, Fisichella PM, Gaspari AL. Minilaparoscopic appendectomy for acute appendicitis. JSLS. 2006; 10:52-55.
9. Wattiez A, Goldchmit R, Durruty G, Mage G, Canis M, Cucinella G, Pouly JL, Bruhat MA. Minilaparoscopic hysterectomy. J Am Assoc Gynecol Laparosc. 1999; 6:97-100.
10. Jiang ZG, Zhang W, Jiang DZ, Zheng XM, Shen HL, Shan CX, Liu S, Qiu M. Clinical benefits of scarless endoscopic thyroidectomy: An expert's experience. World J Surg. 2011; 35:553-557.
11. Liu S, Qiu M, Jiang DZ, Zheng XM, Zhang W, Shen HL, Shan CX. The learning curve for endoscopic thyroidectomy: A single surgeon's experience. Surg Endosc. 2009; 23:1802180-1802186.
12. Liu S, Zheng XM, Jiang DZ, Zhang W, Shan CX, Qiu M. New technique for retraction of the strap muscles in endoscopic thyroidectomy. Surg Innov. 2011; 18:141-144.
13. Perigli G, Cortesini C, Qirici E, Boni D, Cianchi F. Clinical benefits of minimally invasive techniques in thyroid surgery. World J Surg. 2008; 32:45-50.
14. Jeong JJ, Kang SW, Yun JS, Sung TY, Lee SC, Lee YS, Nam KH, Chang HS, Chung WY, Park CS. Comparative study of endoscopic thyroidectomy versus conventional open thyroidectomy in papillary thyroid microcarcinoma (PTMC) patients. J Surg Oncol. 2009; 100:477-480.
15. 15. Dimbarre D, de Loureiro PM, Claus C, Carvalho G, Trauczynski P, Elias F. Minilaparoscopic fundoplication: Technical adaptations and initial experience. Arq Gastroenterol. 2012; 49:223-226.
16. Cao F, Jin K, Cui B, Xie B. Learning curve for endoscopic thyroidectomy: A single teaching hospital study. Onco Targets Ther. 2013; 6:47-52.
17. Zhou J, Wu Z, Wang Y, Peng B. Endoscopic thyroidectomy for bilateral thyroid diseases: Safety and effectiveness. J Craniofac Surg. 2012; 23:565-570.
18. Chen B, Wang Y, Xuan S, Zhang G, Hu S, Wachtel MS, Frezza EE. Endoscopic thyroidectomy: The development in a Chinese center. J Laparoendosc Adv Surg Tech A. 2012; 22:76-80.
19. Ikeda Y, Takami H, Sasaki Y, Kan S, Niimi M. Endoscopic neck surgery by the axillary approach. J Am Coll Surg. 2000; 191:336-340.
20. Ohgami M, Ishii S, Arisawa Y, Ohmori T, Noga K, Furukawa T, Kitajima M. Scarless endoscopic thyroidectomy: Breast approach for better cosmesis. Surg Laparosc Endosc Percutan Tech. 2000; 10:1-4.

21. Choe JH, Kim SW, Chung KW, Park KS, Han W, Noh DY, Oh SK, Youn YK. Endoscopic thyroidectomy using a new bilateral axillo-breast approach. World J Surg. 2007; 31:601-606.
22. Zhang W, Jiang DZ, Liu S, Li LJ, Zheng XM, Shen HL, Shan CX, Qiu M. Current status of endoscopic thyroid surgery in China. Surg Laparosc Endosc Percutan Tech. 2011; 21:67-71.
23. Hur SM, Kim SH, Lee SK, Kim WW, Choe JH, Lee JE, Kim JH, Nam SJ, Yang JH, Kim JS. New endoscopic thyroidectomy with the bilateral areolar approach: A comparison with the bilateral axillo-breast approach. Surg Laparosc Endosc Percutan Tech. 2011; 21:e219-224.
24. Choi JY, Lee KE, Chung KW, Kim SW, Choe JH, Koo do H, Kim SJ, Lee J, Chung YS, Oh SK, Youn YK. Endoscopic thyroidectomy *via* bilateral axillo-breast approach (BABA): Review of 512 cases in a single institute. Surg Endosc. 2012; 26:948-955.
25. Bärlehner E, Benhidjeb T. Cervical scarless endoscopic thyroidectomy: Axillo-bilateral-breast approach (ABBA). Surg Endosc. 2008; 22:154-157.
26. Sasaki A, Nakajima J, Ikeda K, Otsuka K, Koeda K, Wakabayashi G. Endoscopic thyroidectomy by the breast approach: A single institution's 9-year experience. World J Surg. 2008; 32:381-385.

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