

Transcutaneous Laryngeal Ultrasonography for Postoperative Vocal Cord Evaluation After Thyroid and Parathyroid Surgery

Sezer Akbulut¹, Tuğba Matlım Özel¹, Aykut Çelik¹, Murat Altay¹, Begüm Bahar Yılmaz²,
Hamit Yücel Barut³, Serkan Sarı¹

¹University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of General Surgery, İstanbul, Türkiye

²University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of Otorhinolaryngology and Head and Neck Surgery, İstanbul, Türkiye

³University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of Radiology, İstanbul, Türkiye

ABSTRACT

Introduction: Recurrent laryngeal nerve injury is a major complication of thyroid and parathyroid surgery and may cause vocal cord movement impairment (VCMI), which can be symptomatic or silent. Early postoperative evaluation is essential. Flexible nasolaryngoscopy (FNL) is the reference standard, but may be limited by invasiveness and practical constraints. Transcutaneous laryngeal ultrasonography (TLUS) has emerged as a non-invasive alternative, although its diagnostic performance remains controversial.

Methods: This observational study included patients undergoing thyroid or parathyroid surgery between January 2026 and April 2026. Patients younger than 18 years or those with known vocal cord pathology were excluded. All patients underwent preoperative and postoperative FNL. Postoperative TLUS was performed in a blinded manner by an experienced radiologist (H.Y.B). VCMI was defined as reduced, asymmetric, or absent vocal cord mobility. TLUS performance was evaluated using FNL as the reference standard.

Results: A total of 102 patients were included. Postoperative FNL identified VCMI in 4 patients (3.9%). TLUS suggested VCMI in 1 patient (1.0%), whereas laryngeal landmarks were visualized in all patients (100%). Using FNL as the reference standard, TLUS demonstrated a specificity of 99.0%, a negative predictive value of 96.0%, and an overall diagnostic accuracy of 95.1%. No true-positive cases were observed, and sensitivity could not be meaningfully assessed.

Conclusion: TLUS is a feasible, non-invasive adjunct for postoperative vocal cord assessment after thyroid and parathyroid surgery. It may serve as a practical complementary tool when laryngeal landmarks are adequately visualized; FNL, however remains the reference standard for definitive evaluation.

Keywords: Flexible nasolaryngoscopy, parathyroidectomy, recurrent laryngeal nerve injury, thyroidectomy, transcutaneous laryngeal ultrasound, vocal cord palsy

Introduction

Thyroidectomy remains a widely utilized surgical intervention in endocrine surgery globally and is commonly indicated for malignant thyroid disease, benign goiter, and hyperthyroidism (1). Recurrent laryngeal nerve injury continues to represent a significant postoperative concern in thyroid surgery, with transient dysfunction reported in 1% to 30% of cases and permanent impairment in 0.5% to 5% (2). Recurrent laryngeal nerve injury may result in vocal cord movement impairment (VCMI), which can lead to voice changes, airway compromise, and, in severe cases, the need for tracheostomy. Importantly, VCMI may also occur without overt clinical symptoms and therefore remain undetected in the absence of systematic postoperative evaluation (3).

Prompt identification of iatrogenic vocal cord injury in the postoperative period is essential, particularly as documentation of perioperative vocal cord function may carry medicolegal implications after thyroid or neck surgery (4). Flexible nasolaryngoscopy (FNL) remains the reference standard for vocal cord visualization and allows reliable assessment of vocal cord mobility in most patients (5). However, routine implementation of FNL may be limited by the need for otolaryngology consultation, logistical constraints at some centers, increased healthcare costs, and patient discomfort due to its invasive nature (6).

Transcutaneous laryngeal ultrasonography (TLUS) has gained attention as a non-invasive and easily accessible alternative for evaluating vocal cord mobility. Using a linear ultrasound probe placed over the thyroid



Address for Correspondence: Sezer Akbulut, MD, University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, Clinic of General Surgery, İstanbul, Türkiye

E-mail: drsezerakbulut@gmail.com **ORCID ID:** orcid.org/0000-0003-4362-2240

Cite this article as: Akbulut S, Matlım Özel T, Çelik A, Altay M, Yılmaz BB, Barut HY, et al. Transcutaneous laryngeal ultrasonography for postoperative vocal cord evaluation after thyroid and parathyroid surgery. İstanbul Med J. 2026; 27(3): 207-11

Received: 27.04.2026

Accepted: 23.06.2026

Publication Date: 03.08.2026



©Copyright 2026 by the University of Health Sciences Türkiye, İstanbul Training and Research Hospital/İstanbul Medical Journal published by Galenos Publishing House.
Licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 (CC BY-NC-ND) International License

cartilage, dynamic assessment of vocal cord motion during respiration and phonation can be performed (7). Although TLUS offers advantages in terms of patient comfort and feasibility, published data demonstrate variable diagnostic performance, with considerable heterogeneity in reported sensitivity and specificity across studies (5,8).

This study aimed to evaluate the feasibility and diagnostic performance of TLUS when performed by an experienced radiologist (H.Y.B) for assessing postoperative vocal cord mobility in patients who had undergone thyroid and parathyroid procedures. FNL was employed as the reference standard.

Methods

Study Design and Patient Selection

This observational study was carried out between January 2026 and April 2026. Patients undergoing surgical treatment for thyroid or parathyroid disorders during the study period were eligible for inclusion. Thyroid operations included lobectomy, total thyroidectomy, and procedures combined with central and/or lateral neck dissection. Parathyroid surgery consisted of parathyroid adenoma removal and four-gland exploration. Patients under 18 years of age were not included. Further exclusion criteria included isolated lateral neck dissection without accompanying thyroid surgery, prior vocal cord pathology, or previous vocal cord procedures. All thyroid and parathyroid operations were carried out with routine intraoperative nerve monitoring in accordance with institutional practice.

Laryngeal Assessment

All patients underwent preoperative FNL as part of the routine clinical evaluation to document baseline vocal cord function. In the postoperative period, FNL was repeated either on postoperative day 1 or within the first postoperative week, according to institutional practice. Following postoperative FNL, TLUS was performed in a blinded manner.

FNL was performed by experienced clinicians. Vocal cord dysfunction was defined as any departure from normal mobility, including diminished movement suggestive of weakness, asymmetry between the vocal cords, or complete absence of motion.

Transcutaneous Laryngeal Ultrasonography

TLUS was carried out using a high-frequency linear ultrasound probe. During the examination, patients were positioned supine with gentle extension of the neck to facilitate laryngeal visualization. The probe was initially placed on the anterior neck at the level of the thyroid cartilage and slowly repositioned to obtain optimal views of both vocal cords.

Identification of laryngeal anatomy was achieved by visualizing surrounding structures, including the false vocal cords and arytenoid cartilages, which served as reference landmarks when visible (Figure 1). Image settings were individually adjusted to enhance tissue contrast, allowing clear differentiation between the hyperechoic false vocal cords and the hypoechoic true vocal cords. Assessment of vocal cord mobility was performed in real time during quiet breathing and active phonation with sustained production of the vowel "ii." Normal vocal cord function was defined as the symmetric and coordinated movement of both true

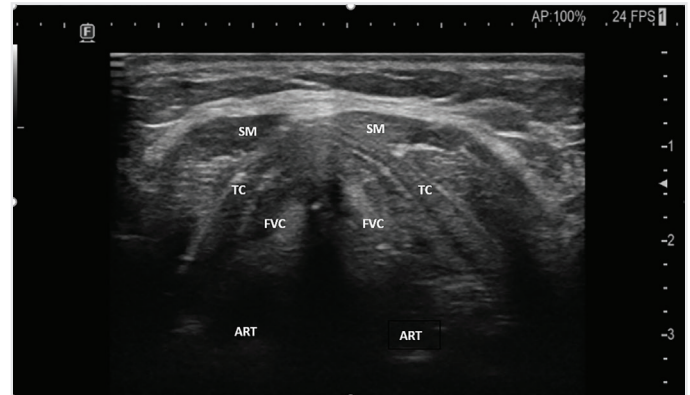


Figure 1. Anterior view of vocal cords abduction. ART: Arytenoids, FVC: False vocal cord, SM: Strap muscles, TC: Thyroid cartilage

vocal cords during opening and closing.

All ultrasonographic examinations were performed by a single radiologist with extensive experience in neck ultrasonography to ensure consistency and minimize observer-related variability.

Patient-related parameters were systematically recorded, including anthropometric measurements such as neck circumference, neck length, and body mass index (BMI), and demographic variables such as age and sex. Postoperative TLUS findings were assessed for the visibility of laryngeal structures and vocal cord mobility and were categorized as either normal function or VCMI. Findings obtained from postoperative FNL were also documented for each patient.

FNL served as the reference method for identifying VCMI. The diagnostic performance of TLUS was evaluated by determining sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, compared with FNL findings.

The study was conducted in accordance with the Declaration of Helsinki and received approval from the Institutional Ethics Committee of University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital (decision number: 2026-39, date: 21 January 2026). Given its observational design and reliance on routinely collected clinical data, the requirement for written informed consent was waived in line with institutional policy.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 28.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as numbers and percentages, and continuous variables as mean $\pm$ standard deviation. Diagnostic performance measures, including sensitivity, specificity, PPV, NPV, and overall accuracy, were calculated by comparing postoperative TLUS findings with FNL findings.

Results

The study included 102 patients who underwent thyroid or parathyroid procedures. Most patients were female (75.5%), with a mean age of 48.5 ± 12.6 years. The average BMI was 29.0 ± 5.3 kg/m². Mean neck circumference, neck length, and subcutaneous fat thickness measured 39.8 ± 4.1 cm, 16.0 ± 1.7 cm, and 3.6 ± 1.4 mm, respectively. Postoperative

TLUS allowed visualization of laryngeal landmarks in all patients (100%). Comprehensive demographic and clinical data are summarized in Table 1.

Thyroid lobectomy was carried out in 43 patients, while 33 patients underwent total thyroidectomy alone. Total thyroidectomy combined with central neck dissection was performed in 6 patients, and total thyroidectomy with both central and lateral neck dissection was performed in 8 patients. Parathyroid procedures included adenoma excision in 10 patients and four-gland exploration in 2 patients.

Postoperative FNL identified VCMI in 4 patients (3.9%), while the remaining patients demonstrated normal vocal cord mobility.

TLUS suggested VCMI in 1 patient (1.0%), whereas 101 patients (99.0%) were classified as having normal vocal cord mobility. The comparison between TLUS and FNL findings is shown in Table 2.

When FNL was used as the reference standard, TLUS demonstrated a high specificity (99.0%), a high NPV (96.0%), and an overall diagnostic accuracy of 95.1%. No true-positive cases were observed; as none of the patients diagnosed with VCMI by FNL were identified by TLUS. Accordingly, sensitivity and PPV could not be demonstrated in this cohort.

Discussion

International guidelines highlight the importance of perioperative laryngeal assessment in patients undergoing thyroid and parathyroid procedures. The American Academy of Otolaryngology-Head and Neck Surgery recommends evaluation in both the preoperative and postoperative periods, whereas the American Thyroid Association suggests postoperative assessment particularly in patients presenting with voice-related symptoms (9,10). FNL remains the gold standard due to its direct visualization and high diagnostic accuracy (11). However,

its routine use in all patients may be limited by its invasiveness, patient discomfort, and the need for otolaryngology consultation in many centers (12).

In light of these practical constraints, TLUS has been increasingly recognized as a non-invasive and cost-effective approach for the perioperative evaluation of vocal cord function. TLUS enables dynamic assessment without radiation exposure and can be performed at the bedside. Nevertheless, its diagnostic performance is known to be operator-dependent (13). Earlier prospective investigations and pooled analyses have shown that TLUS enables visualization of the vocal cords in approximately 86-96% of patients, with pooled estimates approaching 94-95.7%. Limited visualization has been associated with several patient- and anatomy-related factors, including male sex, increasing age, calcification of the thyroid cartilage, greater neck circumference, and higher BMI (14). In addition, sex-related differences have been described, with better visualization rates reported in women, likely due to thinner thyroid cartilage compared with men (15,16). The uniform visualization rate in our study may be explained by the use of a standardized examination approach and all TLUS assessments being performed by a single experienced radiologist, thereby limiting operator-related variability.

Studies comparing TLUS with flexible laryngoscopy suggest strong diagnostic performance, with sensitivities reported between 75% and 100% and specificities generally exceeding 95%. PPVs have been noted in the range of 55% to 70%, whereas NPVs are usually greater than 98% (17). In a large retrospective study of 668 patients who underwent thyroidectomy across two tertiary endocrine surgery centers, Knyazeva et al. (18) demonstrated strong postoperative diagnostic performance of TLUS, with sensitivity reaching 86% and specificity 99.1%, while PPV and NPV were 89.4% and 98.7%, respectively, highlighting its potential role in routine clinical practice.

Table 1. Demographic and clinical characteristics of the patients

Variable	Total (n=102)
Sex, n (%)	
Female	77 (75.5)
Male	25 (24.5)
Age, years (mean ± SD)	48.5±12.6
Body mass index, kg/m² (mean ± SD)	29.0±5.3
Neck circumference, cm (mean ± SD)	39.8±4.1
Neck length, cm (mean ± SD)	16.0±1.7
Subcutaneous fat thickness, mm (mean ± SD)	3.6±1.4
Visualization of laryngeal landmarks on postoperative TLUS, n (%)	102 (100)

SD: Standard deviation, TLUS: Transcutaneous laryngeal ultrasonography

Table 2. Comparison of postoperative TLUS and FNL findings in patients with evaluable vocal cords (n=102)

TLUS	FNL normal, n	FNL VCMI, n	Total, n (%)
Normal, n	97	4	101 (99.0)
VCMI, n	1	0	1 (1.0)
Total, n (%)	98 (96.1)	4 (3.9)	102 (100)

TLUS: Transcutaneous laryngeal ultrasonography; FNL: Flexible nasolaryngoscopy; VCMI: Vocal cord movement impairment

In contrast, other investigators have raised concerns regarding the limited sensitivity of TLUS, emphasizing that it cannot reliably replace laryngoscopy for detecting vocal cord dysfunction (19,20). These discrepancies across studies likely reflect variations in study design, patient characteristics, operator expertise, timing of assessment, and the underlying incidence of postoperative VCMI.

In our cohort, only four patients were diagnosed with postoperative VCMI by FNL. Consequently, no true-positive cases were identified by TLUS, precluding a meaningful assessment of sensitivity. Importantly, this finding should be interpreted in the context of the very low incidence of recurrent laryngeal nerve injury observed in a cohort with favorable surgical outcomes rather than as definitive evidence of inadequate diagnostic performance of TLUS. These findings highlight the challenges of evaluating diagnostic sensitivity when the prevalence of the target condition is very low and underscore the need for larger studies including a greater number of pathological cases.

Some studies have indicated that TLUS may demonstrate lower sensitivity and greater variability when performed by operators without dedicated training in laryngeal ultrasonography (5,21). As an example, Borel et al. (5) documented limited diagnostic performance, with TLUS showing a sensitivity of 33% and a NPV of 95% in identifying vocal cord palsy following thyroidectomy. In that study, TLUS examinations were performed by radiologists who lacked prior dedicated experience with this technique, which may have contributed to the diagnostic limitations observed.

Conversely, when TLUS is performed by surgeons with expertise in thyroid and neck ultrasonography, higher visualization success and better agreement with laryngoscopic findings have been observed (3,8,22). Surgeons may benefit from an intraoperative perspective, particularly when the recurrent laryngeal nerve is deemed to be at risk. In such situations, postoperative ultrasonographic assessment may be performed with heightened awareness of subtle vocal cord motion abnormalities. For this reason, some authors have suggested that surgeon involvement in the TLUS evaluation may enhance diagnostic performance (23).

In the present study, TLUS examinations were performed by a single radiologist with more than 30 years' experience in neck ultrasonography and dedicated practice in thyroid imaging. The complete visualization of laryngeal landmarks in all patients may be attributable, at least in part, to examiner experience and familiarity with laryngeal anatomy, meticulous probe positioning, dynamic assessment during phonation, and optimization of image settings. These factors may have helped overcome potential anatomical challenges, including increased soft tissue thickness and thyroid cartilage calcification, which have been reported to limit TLUS visualization in previous studies. These findings highlight the importance of examiner expertise in maximizing the diagnostic utility of TLUS.

The findings of this study suggest that TLUS may play a complementary role in the postoperative evaluation of vocal cord function after thyroid and parathyroid procedures. In patients with clearly visualized laryngeal landmarks and normal ultrasonographic findings, TLUS may provide reassurance regarding preserved vocal cord mobility.

As a rapid and non-invasive examination that can be integrated into routine cervical ultrasonography, TLUS may serve as a practical first-line assessment tool in selected patients. In this context, TLUS could be considered an initial postoperative screening method, potentially reducing the need for routine invasive assessment. Nevertheless, FNL remains the reference standard for the definitive evaluation of vocal cord dysfunction.

Study Limitations

Our study has certain limitations that should be considered when interpreting the findings. The relatively low rate of postoperative impairment of vocal cord movement limited the ability to perform a more robust evaluation of TLUS sensitivity. In addition, the single-center design, conducted at University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital, a high-volume tertiary referral center, may limit the generalizability of the results to other clinical settings. As all TLUS evaluations were performed by one experienced radiologist, interobserver variability could not be assessed. Moreover, the analysis was confined to the early postoperative period; long-term functional outcomes of vocal cord mobility were not evaluated.

Conclusion

TLUS is a feasible and non-invasive method for the postoperative evaluation of vocal cord function following thyroid and parathyroid surgery. In patients with adequately visualized laryngeal landmarks, TLUS may have a complementary role in postoperative vocal cord assessment and serve as a practical first-line evaluation tool. However, the limited number of cases of postoperative VCMI in our cohort restricted the assessment of sensitivity, and TLUS should not be considered a standalone diagnostic modality. FNL remains the reference standard for the definitive evaluation of vocal cord dysfunction. Further studies involving larger patient populations are needed to better define the role of TLUS in clinical practice.

Ethics

Ethics Committee Approval: The study was conducted in accordance with the Declaration of Helsinki and received approval from the Institutional Ethics Committee of University of Health Sciences Türkiye, Başakşehir Çam and Sakura City Hospital (decision number: 2026-39, date: 21 January 2026).

Informed Consent: Given its observational design and reliance on routinely collected clinical data, the requirement for written informed consent was waived in line with institutional policy.

Footnotes

Authorship Contributions: Surgical and Medical Practices - S.A., T.M.Ö., A.Ç., M.A., B.B.Y., H.Y.B., S.S.; Concept - S.A., T.M.Ö., A.Ç., B.B.Y., H.Y.B., S.S.; Design - S.A., T.M.Ö., B.B.Y., S.S.; Data Collection or Processing - S.A., A.Ç., M.A.; Analysis or Interpretation - S.A., M.A.; Literature Search - S.A., S.S.; Writing: S.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

- Singh H, Nelson T, Kataria K, Agarwal A, Thakur UK, Kairo A, et al. A prospective observational study on the accuracy of transcutaneous laryngeal ultrasonography in assessing vocal cord mobility before and after thyroid surgery. *Iran J Otorhinolaryngol*. 2025; 37: 253-9.
- Joliat GR, Guarnero V, Demartines N, Schweizer V, Matter M. Recurrent laryngeal nerve injury after thyroid and parathyroid surgery: incidence and postoperative evolution assessment. *Medicine (Baltimore)*. 2017; 96: e6674.
- Rossi L, Papini P, De Palma A, Fregoli L, Becucci C, Ambrosini CE, et al. Surgeon-performed transcutaneous laryngeal ultrasound for vocal cord assessment after total thyroidectomy: a prospective study: original article. *Langenbecks Arch Surg*. 2024; 409: 183.
- Wong KP, Lang BH, Chang YK, Wong KC, Chow FC. Assessing the validity of transcutaneous laryngeal ultrasonography (TLUSG) after thyroidectomy: what factors matter? *Ann Surg Oncol*. 2015; 22: 1774-80.
- Borel F, Delemazure AS, Espitalier F, Spiers A, Mirallie E, Blanchard C. Transcutaneous ultrasonography in early postoperative diagnosis of vocal cord palsy after total thyroidectomy. *World J Surg*. 2016; 40: 665-71.
- Patel A, Spychalski P, Polomska K, Albrahim M, Markiet K, Kurylowicz J, et al. Technical aspects of transcutaneous laryngeal ultrasonography: a review. *J Voice*. 2025; S0892-1997(25)00041-4.
- Wolff S, Gałazka A, Dedejusz M. Transcutaneous laryngeal ultrasonography in vocal fold assessment before and after thyroid surgery in light of recent studies. *Pol J Radiol*. 2022; 87: e195-201.
- Gambardella C, Offi C, Romano RM, De Palma M, Ruggiero R, Candela G, et al. Transcutaneous laryngeal ultrasonography: a reliable, non-invasive and inexpensive preoperative method in the evaluation of vocal cords motility-a prospective multicentric analysis on a large series and a literature review. *Updates Surg*. 2020; 72: 885-92.
- Chandrasekhar SS, Randolph GW, Seidman MD, Rosenfeld RM, Angelos P, Barkmeier-Kraemer J, et al. Clinical practice guideline: improving voice outcomes after thyroid surgery. *Otolaryngol Head Neck Surg*. 2013; 148: S1-37.
- Ringel MD, Sosa JA, Baloch Z, Bischoff L, Bloom G, Brent GA, et al. 2025 American Thyroid Association Management Guidelines for adult patients with differentiated thyroid cancer. *Thyroid*. 2025; 35: 841-985. Erratum in: *Thyroid*. 2025; 35: 1350.
- Patel A, Spychalski P, Aszkiełowicz A, Mikaszewski B, Kobiela J. Transcutaneous laryngeal ultrasound for vocal cord paralysis assessment in patients undergoing thyroid and parathyroid surgery-a systematic review and meta-analysis. *J Clin Med*. 2021; 10: 5393.
- Figuerola-Bohorquez D, Marulanda M, Betancourt C, García C, Sanchez JG, Trujillo Y, et al. Surgeon-performed transcutaneous laryngeal ultrasonography after thyroidectomy: diagnostic accuracy and learning curve. *Surgery*. 2025; 188: 109779.
- Moore CL, Copel JA. Point-of-care ultrasonography. *N Engl J Med*. 2011; 364: 749-57.
- Woo JW, Suh H, Song RY, Lee JH, Yu HW, Kim SJ, et al. A novel lateral-approach laryngeal ultrasonography for vocal cord evaluation. *Surgery*. 2016; 159: 52-6.
- Fung MMH, Lang BH. A prospective study evaluating the feasibility and accuracy of very early postoperative translaryngeal ultrasonography in the assessment of vocal cord function after neck surgery. *Surgery*. 2021; 169: 191-6.
- Kılıç MÖ, Terzioğlu SG, Gülçek SY, Sarı E. The role of ultrasonography in the assessment of vocal cord functions after thyroidectomy. *J Invest Surg*. 2018; 31: 24-8.
- Lazard DS, Bergeret-Cassagne H, Lefort M, Leenhardt L, Russ G, Frouin F, et al. Transcutaneous laryngeal ultrasonography for laryngeal immobility diagnosis in patients with voice disorders after thyroid/parathyroid surgery. *World J Surg*. 2018; 42: 2102-8.
- Knyazeva P, Makarin V, Seeliger B, Chernikov R, Sleptsov I, Semenov A, et al. Transcutaneous laryngeal ultrasonography (TLUS) as an alternative to direct flexible laryngoscopy (DFL) in the perioperative evaluation of the vocal cord mobility in thyroid surgery. *Langenbecks Arch Surg*. 2018; 403: 1015-20.
- Kandil E, Deniwar A, Noureldine SI, Hammad AY, Mohamed H, Al-Qurayshi Z, et al. Assessment of vocal fold function using transcutaneous laryngeal ultrasonography and flexible laryngoscopy. *JAMA Otolaryngol Head Neck Surg*. 2016; 142: 74-8.
- Sidhu S, Stanton R, Shahidi S, Chu J, Chew S, Campbell P. Initial experience of vocal cord evaluation using grey-scale, real-time, B-mode ultrasound. *ANZ J Surg*. 2001; 71: 737-9.
- Shah MK, Ghai B, Bhatia N, Verma RK, Panda NK. Comparison of transcutaneous laryngeal ultrasound with video laryngoscope for assessing the vocal cord mobility in patients undergoing thyroid surgery. *Auris Nasus Larynx*. 2019; 46: 593-8.
- Pérez-Sánchez LE, Caballero-Rodríguez E, Orti-Rodríguez R, Soto-Sánchez A, García-Bello MÁ, Jordán-Balanza JC, et al. Cervical ultrasound for the evaluation of the vocal cords: a pilot study in an endocrine surgery unit. *Cir Esp (Engl Ed)*. 2022; 100: 755-61.
- Kim DH, Lee J, Seo Y, Kim SW, Hwang SH. Perioperative transcutaneous laryngeal ultrasonography to assess vocal cord function in thyroid surgery. *Am J Surg*. 2022; 223: 893-9.