Management of Vocal Fold Lesions in Difficult Laryngeal Exposure Patients in Phonomicrosurgery

(Abbreviation: Management of Difficult Laryngeal Exposure)

Satoshi Ohno, MD
Shigeru Hirano, MD, PhD
Ichiro Tateya, MD, PhD
Tsuyoshi Kojima, MD
Juichi Ito, MD, PhD

Department of Otolaryngology, Head and Neck Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan

Corresponding author, Reprint request; Satoshi Ohno
Department of Otolaryngology, Head and Neck Surgery, Graduate School of Medicine, Kyoto University, Sakyo-ku, Kyoto 606-8507, JAPAN
Tel: +81-75-751-3346
Fax: +81-75-751-7225
E-mail: s_ohno@ent.kuhp.kyoto-u.ac.jp

The authors declare that they have no conflict of interest.

Acknowledgement

This study was supported in part by a grant from the Takeda Science Foundation.

Abstract

Objectives

Endolaryngeal microsurgery using a direct laryngoscope is a well-established procedure in phonosurgery. Adequate laryngeal exposure is essential, but in some cases sufficient view of the glottis cannot be obtained, leading to treatment failure. This study reports how to manage vocal fold lesions in difficult laryngeal exposure (DLE) cases.

Methods

From 2003 to 2009, 212 patients underwent endolaryngeal microsurgery at Kyoto Medical Center and Kyoto University Hospital. Phonomicrosurgery was performed under sniffing (Boyce-Jackson) position with triangular shaped laryngoscope for laryngeal exposure. However, in DLE cases, the posture and laryngoscope were modified as needed to adequately expose the lesion. Fiberoptic laryngeal surgery (FLS) with local anesthesia was also used for the most difficult cases.

Results

The number of the patients with DLE was 14 (6.6%). Endolaryngeal microsurgery

was possible in DLE cases by selecting the appropriate posture and laryngoscope. However, the procedure could not be completed in two patients with an anterior web and a vocal fold cyst, both of which required a subsequent revision procedure. Fiberoptic laryngeal surgery with topical anesthesia was a feasible alternative for these cases.

Conclusions

Phonosurgery was possible even in DLE cases. It is important to modify the setup of direct laryngoscopy as needed to obtain adequate exposure. Fiberoptic surgery may also be used in certain difficult cases.

Key Words

endolaryngeal microsurgery; direct laryngoscopy; difficult laryngeal exposure; triangular laryngoscope; fiberoptic laryngeal surgery

Introduction

Endolaryngeal microsurgery using a direct straight laryngoscope is a well-established procedure in phonosurgery. It enables the surgeon to perform a precise, exact procedure using the microflap technique for the treatment of small lesions in the vocal folds, such as cysts and polyps.

The first step of this procedure is to place a direct straight laryngoscope trans-orally and visualize the vocal folds. There are several articles explaining how to obtain sufficient laryngeal exposure. The general requirements for good visualization are patient posture, external laryngeal counterpressure, and internal laryngeal distension[1-4].

Patient posture is one of the most important components in achieving ideal laryngeal exposure. The best posture for laryngeal exposure is believed to be the sniffing (Boyce-Jackson) position[5], with neck flexion and head extension. Raising the head straightens the cervical spine, and as the head is raised, the glottis is easier to visualize[6]. Chin thrust in the sniffing position increases soft tissue stretching and elevates the larynx.

During direct laryngoscopy, chin thrust allows for relatively horizontal placement of the scope, allowing the surgeon to sit comfortably at the microscope while viewing the glottis[6].

External laryngeal counterpressure applies force directed posteriorly on the cricoid and lower thyroid cartilages, and helps the surgeon sufficiently view the anterior commissure of the vocal folds. Zeitels *et al.* reported the anterior commissure can be displaced posteriorly up to 6mm through external counterpressure, despite movement restriction caused by the endotracheal tube[1].

Internal laryngeal distention distracts the supraglottic structures peripherally in order to obtain the widest possible view of the vocal folds. It is performed by using the largest possible laryngoscope, and placing it from the lips to the vocal folds[1]. A triangularly shaped laryngoscope corresponds to the contour of the anterior commissure of the vocal folds and provides sufficient laryngeal exposure.

Laryngeal exposure is not problematic in most cases, but we occasionally encounter difficult laryngeal exposure (DLE) patients in whom it is not possible to obtain an adequate view of the anterior commissure. Poor visualization of the glottis prevents completion of an

adequate procedure. Obese patients with muscular necks have the highest probability of DLE[7]. There are some indicators to predict DLE patients, such as a neck circumference, BMI, Mallampati score and thyroid-mandible angle[8-10]. This necessitates a prepared strategy in the event of a patient with DLE, including posture modification and laryngoscope selection. This paper reports how we manage DLE cases in phonosurgery.

Materials and Methods

Subject Selection

From 2003 to 2009, 212 patients (138 men and 74 women) underwent endolaryngeal microsurgery at Kyoto Medical Center and Kyoto University Hospital. Patient ages ranged from 18 to 85 years (mean ± SD 55.57 ± 15.29 years). Indications for operation included vocal fold polyp, cyst, dysplasia, papilloma, sulcus vocalis, early stage glottic cancer (T1a), Reinke's edema and glottic web. Among these, DLE was encountered in 14 cases (6.6%): 9 men (6.5%) and 5 women (6.8%), summarized in Table 1. The diseases included polyps in two patients, Reinke’s edema in three, sulcus vocalis, dysplasia, glottic cancer in two patients each, and cyst, papilloma, and anterior web in one patient each.

Thyroid-mandible angle(TMA) was measured as in all patients while the patients' heads were in "natural" posture in an upright-seated position at the end of expiration phase and without swallowing. Natural head posture was defined as that achieved while the patient looked into his or her own eyes as reflected in a mirror located at eye level. TMA was obtained

by measuring the angle between the line of mandible angle to prominence, and the skin line from thyroid notch to mandible in the natural head posture (Fig.1). A large TMA was defined as TMA was above 120 degrees in men, 130 degrees in women[10].

Surgical Procedures

Patients were intubated with an endotracheal tube (5.5-6.5 mm in diameter) under general anesthesia and muscle relaxation. The sniffing (Boyce-Jackson)[5] position was attempted first using pillows placed under the head to facilitate the best glottic exposure (Fig.2A). A triangular shaped laryngoscope, The Rudert-type laryngoscope (K8589C, Karl Storz GmbH & Co., Tuttlingen, Germany) or Zeitels universal modular glottiscope (Endocraft LLC, Boston, MA, USA), was passed into the mouth along the tongue and tongue base to elevate the epiglottis and visualize the glottis. The laryngoscope holder and chest device (K8575 GK, Karl Storz GmbH & Co., Tuttlingen, Germany) were fixed into position, the holder device was fastened, and maximal laryngeal view was verified. If the laryngeal exposure was limited, external counterpressure to the lower half of the larynx was applied to improve visualization.

If laryngeal exposure was insufficient by these procedures, a round shape Kleinsasser laryngoscope (Large size; K8590B, Medium size; K8590C, Small size; K8590DN, Karl Storz, GmbH&Co, Tuttlingen, Germany) was used to enhance laryngeal exposure. Figure3 shows laryngoscopes used in this study (Fig.3A,B,C). DLE cases were defined as those in whom laryngeal exposure was limited to the posterior third or less with the large size Kleinsasser laryngoscope and the sniffing position. For DLE cases, we alternatively modified the posture from the sniffing position to the extension-extension position, in which both the neck and head are extended (Fig.2B). Extension-extension position is usually utilized for esophagoscopy, so that the esophagoscope can be passed straight through the pharynx. This position is considered to be inappropriate for laryngeal exposure, but in DLE cases, this position helps to visualize the glottis as widely as possible. A round shaped laryngoscope is inferior to a triangular laryngoscope in terms of exposure of the anterior commissure, but in DLE cases, it allows for easier insertion into the glottis. We used the smaller sized scope in the extension-extension position for the most difficult cases. Although the surgical view and working space are considerably limited with this setup, surgical procedures on the glottis are

still possible. However, the ability to perform some surgical procedures in this view may occasionally be restricted, resulting in inadequate completion and lesion recurrence.

If laryngeal exposure was limited, and sufficient manipulation was not possible even with the modification, fiberoptic laryngeal surgery (FLS) with local anesthesia was considered [11, 12] for remnant or recurrent lesions. FLS was developed as a less invasive procedure for patients in whom general anesthesia is contraindicated due to comorbidities. In this surgical procedure, the nose, pharynx, and larynx are thoroughly anesthetized with 4% xylocaine spray, followed by insertion of a flexible laryngoscope (ENF T3, Olympus Co, Tokyo, Japan) through the nose, and connected to a charge-coupled camera system device (OTV-S4, Olympus Co) to visualize the larynx. Vocal fold lesions can be treated trans-orally. We have also reported the usefulness of FLS for lesions at the posterior glottis where visualization and manipulation are often difficult under phonomicrosurgery with general anesthesia, because the endotracheal tube hampers visualization of the posterior glottis. FLS provides a complete view of the glottis, although the ability to perform surgical procedures is limited.

Results

Table I shows demographic data of the 14 DLE cases, which shows that the BMI of DLE cases ranged from 18.4 to 33.4 (mean ± SD 24.8 ± 3.63), 13 (92.9%) cases had a short neck, and 11 (78.6%) cases had a large TMA.

Endolaryngeal microsurgery was completed for all DLE patients with the extension-extension position in 13 cases. Ten (71.4%) DLE cases were visualized with small size Kleinsasser laryngoscope with the extension-extension position.

A microflap technique was usually used for cases with polyp, Reinke's edema, cyst, dyaplasia, sulcus vocalis, and glottis cancer (type I cordectomy). However, 2 polyps were resected by an amputation procedure due to a poor surgical field and limited working space.

Two patients (Cases 13 and 14) had disease recurrence due to an inadequate procedure by endolaryngeal microsurgery and needed a revision procedure by FLS under topical anesthesia. In the end, all patients were successfully treated.

Cases that needed revision FLS are described below.

Case 13: The patient presented with a vocal fold cyst on the right side. She had stiff neck following neck irradiation for oropharyngeal cancer. The glottic visualization was limited with the small size Kleinsasser laryngoscope under the extension-extension position (Fig.4A). The cyst ruptured during microflap elevation due to a very narrow working space (Fig.4B,C,D) and additional procedures were difficult, resulting in postoperative recurrence (Fig.5A). Revision FLS under topical anesthesia was performed, during which the microflap technique was impossible, and so the cyst was completely amputated with forceps (Fig.5B,C,D).

Case 14: The patient presented with an anterior glottic web. Even using the small Kleinsasser laryngoscope in the extension-extension position, visualization of the anterior commissure was insufficient (Fig.6A). The web was separated using upward scissors, but cutting was performed blindly at the anterior portion. Additional procedures, such as suturing of the cut end or rotational flap, could not be performed due to poor visualization and narrow working space (Fig.6B,C,D). The web recurred postoperatively (Fig.7A), and revision FLS was performed (Fig.7B,C). The web was sufficiently separated to the anterior end using KTP laser, and the wound healed well without web reformation (Fig.7D).

Discussion

Direct straight laryngoscopy provides good visualization of vocal folds and allows fine manipulation in phonomicrosurgery. Recently, the microflap technique has been developed[13,14] to minimize surgical damage to the vocal fold mucosa, and maintain function as much as possible. It is essential to obtain sufficient laryngeal exposure in order to perform such a precise surgical procedure.

In this study, the incidence of DLE was 6.6%, which is within reported ranges (4.9 to 23.7%) [7, 8, 15]. The BMI of DLE cases varied from 18.4 to 33.4. Roh *et al.* state that BMI >25.0 suggests the patient may have DLE[8]. In our series, 6 of 14 DLE cases had a BMI greater than 25.0, who also had higher frequency of short necks and large TMA.

It is suggested that excellent glottic exposure from the anterior commissure to the arytenoids is best provided by a laryngoscope with a triangular distal configuration[10]. The Rudert-type laryngoscope and Zeitels universal modular glottiscope are triangular in shape at the distal end, which facilitates complete exposure of the anterior commissure. Our series

showed that 196 (92.5%) out of 212 patients were successfully treated with sufficient glottic exposure using the triangular laryngoscope.

It has been suggested that a round laryngoscope, such as the Kleinsasser laryngoscope, may not be appropriate to reveal the anterior one-fourth of the membranous folds even with application of extreme external pressure[6]. In DLE cases, however, our experience indicates that in patients with a narrow airway where glottic visualization is difficult using a triangular scope, a round laryngoscope is useful to visualize the glottis.

There are three postures that are applicable in direct laryngoscopy; the flexion-flexion position, the sniffing position and the extension-extension position. The flexion-flexion position, in which both the head and neck are flexed, is considered to be the best posture for laryngeal exposure. However, it is difficult to perform surgery with the patient in this posture because the laryngoscope points toward the ceiling[5]. The sniffing position is considered the best posture in endolaryngeal microsurgery using a direct straight laryngoscope. However, in cases where sufficient view of the glottis cannot be obtained in the sniffing position with triangular laryngoscope, the extension-extension position using a round

laryngoscope was useful for laryngeal exposure. The head extension at the atlanto-occipital joint causes posterior displacement of the tongue base into the airway, which opposes the anterior distraction forces of the pharyngeal tissues required for glottic exposure[5]. Therefore, the extension-extension position is generally considered unfavorable for laryngeal exposure. However, it requires the least amount of force to expose the glottis when using smaller laryngoscopes[5]. Therefore, we selected the extension-extension position and the Kleinsasser laryngoscope for DLE cases. Through these methods, all microsurgery cases were performed using the direct straight laryngoscope.

Finally, two DLE cases were not sufficiently treated at initial phonomicrosurgery resulting in disease recurrence. In these cases, limited visualization and narrow working space due to a small laryngoscope caused inadequate treatments under direct laryngoscopy. Using a curved rigid laryngoscope is reported to provide good visualization for DLE cases, but does not allow straight access for use of surgical instruments or the laser system[16,17].

Fiberoptic laryngeal surgery (FLS) under topical anesthesia has the advantage of providing good visualization of the whole glottis, while techniques requiring fine manipulation,

such as the microflap technique, are difficult to perform[18]. However, the present study showed that FLS is a useful alternative in DLE cases.

Conclusions

Endolaryngeal microsurgery using a direct straight laryngoscope is a useful procedure in phonosurgery. The present study shows that this procedure is useful even for difficult laryngeal exposure patients through modification of patient posture and laryngoscopes. Fiberoptic laryngeal surgery using flexible laryngoscopes and topical anesthesia is another useful strategy to treat DLE cases with recurrent diseases.

References

1. Zeitels SM, Vaughan CW. "External counterpressure" and "internal distention" for optimal laryngoscopic exposure of the anterior glottal commissure. Ann Otol Rhinol Laryngol. 1994;103:669-75.

2. Zeitels SM. Universal modular glottiscope system: the evolution of a century of design and technique for direct laryngoscopy. Ann Otol Rhinol Laryngol Suppl. 1999;179:2-24.

3. Zeitels SM, Burns JA, Dailey SH. Suspension laryngoscopy revisited. Ann Otol Rhinol Laryngol. 2004 ;113:16-22.

4. Jackson C. Position of the patient for peroral endoscopy. In: Peroral Endoscopy and Laryngeal Surgery. St. Louis, Mo: The Laryngoscope Co; 1915:77-88.

5. Hochman II, Zeitels SM, Heaton JT. Analysis of the forces and position required for direct laryngoscopic exposure of the anterior vocal folds. Ann Otol Rhinol Laryngol. 1999 ;108:715-24.

6. Vaughan CW. Vocal fold exposure in phonosurgery. J Voice. 1993 ;7:189-94.

7. Pinar E, Calli C, Oncel S, Selek B, Tatar B. Preoperative clinical prediction of difficult laryngeal exposure in suspension laryngoscopy. Eur Arch Otorhinolaryngol. 2009 ;266:699-703.

8. Roh JL, Lee YW. Prediction of difficult laryngeal exposure in patients undergoing microlaryngosurgery. Ann Otol Rhinol Laryngol. 2005 ;114:614-20.

9. Hekiert AM, Mick R, Mirza N. Prediction of difficult laryngoscopy: does obesity play a role? Ann Otol Rhinol Laryngol. 2007 ;116:799-804.

10. Hsiung MW, Pai L, Kang BH, Wang BL, Wong CS, Wang HW. Clinical predictors of difficult laryngeal exposure. Laryngoscope. 2004 ;114:358-63.

11. Omori K, Shinohara K, Tsuji T, Kojima H. Videoendoscopic laryngeal surgery. Ann Otol Rhinol Laryngol. 2000;109:149-55.

12. Hirano S, Kojima H, Tateya I, Ito J. Fiberoptic laryngeal surgery for vocal process granuloma. Ann Otol Rhinol Laryngol. 2002;111:789-93.

13. Sataloff RT, Spiegel JR, Heuer RJ, Baroody MM, Emerich KA, Hawkshaw MJ, *et al.* Laryngeal mini-microflap: a new technique and reassessment of the microflap saga. J

Voice. 1995;9:198-204.

14. Courey MS, Garrett CG, Ossoff RH. Medial microflap for excision of benign vocal fold lesions. Laryngoscope. 1997 ;107:340-4.

15. Kikkawa YS, Tsunoda K, Niimi S. Prediction and surgical management of difficult laryngoscopy. Laryngoscope. 2004 ;114:776-8.

16. Kim JK, Jeong HS, Kwon HN. A new curved rigid layngoscope to overcome the difficult laryngeal exposure (DLE) in endolaryngeal surgery. Eur Arch Otorhinolaryngol. 2007 ;264:901-5.

17. Friedrich G, Kiesler K, Gugatschka M. Curved rigid laryngoscope: missing link between direct suspension laryngoscopy and indirect techniques? Eur Arch Otorhinolaryngol. 2009;266:1583-8.

18. Tsunoda K, Kikkawa YS, Yoshihashi R, Sakai Y. Detachable forceps for flexible fibre-optic surgery: a new technique for phonosurgery in cases where rigid laryngoscopy is contraindicated. J Laryngol Otol. 2002;116:559-61.

Figure legends

Table I: DLE cases. FLS: Fiberoptic Laryngeal Surgery. TMA: Thyroid-Mandibular Angle. Scope Size: Size of Kleinsasser laryngoscope. Case 13: After radiation therapy for oropharyngeal cancer.

Fig.1: Measurement of Thyroid-mandible angle(TMA)

Fig.2: Patient postures. (A) The sniffing (Boyce-Jackson) position. (B) The extension-extension position

Fig.3: Laryngoscopes. (A) From left, Rudert type, large size Kleinsasser, medium size Kleinsasser, small size Kleinsasser (lateral view). (B) Zeitels universal modular glottiscope (lateral view). (C) Direct view of the triangular shaped Rudert type laryngoscope(left) and the round shaped Kleinsasser laryngoscope(right).

Fig.4: Images from endolaryngeal microsurgery for a cyst in the right vocal fold (Case 13). (A) A cyst in the right vocal fold was visualized, but the surgical field and working space was limited. (B) Elevation of microflap. (C) Rupture of cyst occurred during the procedure. (D) Residual cyst wall was removed as far as possible.

Fig.5: Fiberoptic laryngeal surgery for recurrent lesion in Case 13 (A) Cyst (asterisk) recurs in the right vocal fold. (B-D) Cyst was amputated using forceps.

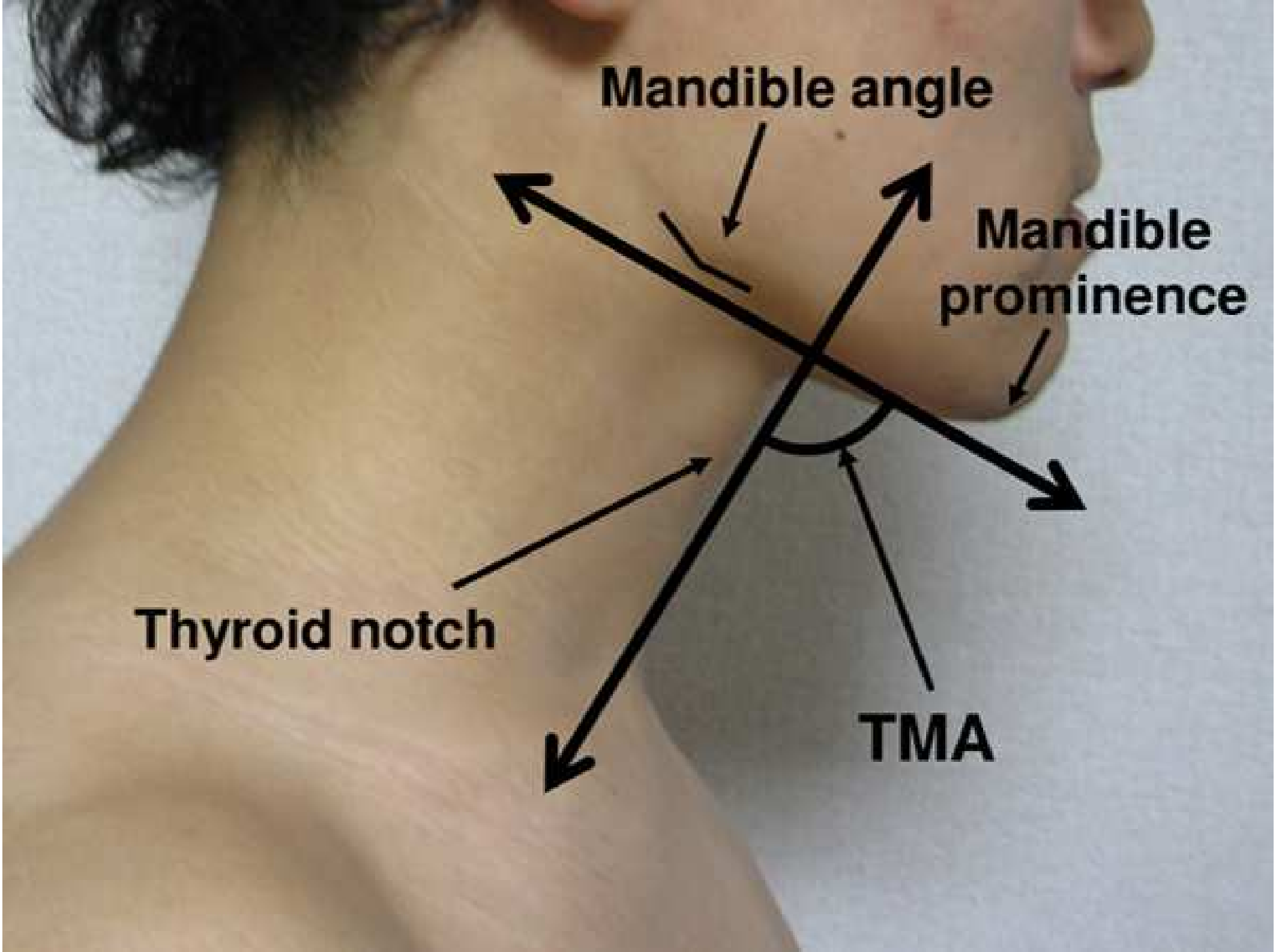
Fig.6: Images of endolaryngeal microsurgery for anterior web (Case 14). (A) Anterior web (arrow) was partially visualized, but the anterior commissure was not fully visualized. (B,C) Web separation using microscissors in blind fashion. (D) Following separation of web, the cut end of web was not visualized.

Fig.7: Fiberoptic laryngeal surgery for recurrent web in Case 14 (A) Recurrent anterior web (arrow). (B) Web separation by KTP laser under FLS (asterisk: the applicator of KTP laser). (C) Web was separated successfully. (D) Web reformation was not observed.

Case	Gender	Age	BMI	Short Neck	Large TMA	Disease	Procedure		Posture	Scope Size	Revision surgery
1	M	74	26.0	Yes	Yes	Glottic Ca. (T1a)	Microflap	Type I cordectomy	Sniffing	Medium	
2	F	58	22.2	Yes	Yes	Reinke's edema	Microflap		Extension-Extension	Medium	
3	F	44	23.1	Yes	Yes	Sulcus vocalis	Microflap		Extension-Extension	Medium	
4	M	72	27.1	Yes	Yes	Sulcus vocalis	Microflap		Extension-Extension	Medium	
5	F	77	18.4	No	No	Polyp	Amputation		Extension-Extension	Small	
6	F	57	22.0	Yes	Yes	Polyp	Amputation		Extension-Extension	Small	
7	M	59	22.7	Yes	Yes	Papilloma	KTP Laser		Extension-Extension	Small	
8	M	64	21.6	Yes	No	Glottic Ca. (T1a)	Microflap	Type I cordectomy	Extension-Extension	Small	
9	M	62	24.7	Yes	No	Dysplasia	Microflap	Photocoagulation	Extension-Extension	Small	
10	M	50	26.9	Yes	Yes	Dysplasia	Microflap		Extension-Extension	Small	
11	M	62	28.4	Yes	Yes	Reinke's edema	Microflap		Extension-Extension	Small	
12	M	58	33.4	Yes	Yes	Reinke's edema	Microflap		Extension-Extension	Small	
13*	F	61	24.7	Yes	Yes	Cyst	Microflap		Extension-Extension	Small	Amputation (FLS)
14	M	62	25.5	Yes	Yes	Web	Web separation		Extension-Extension	Small	KTP Laser (FLS)

Table 1: DLE cases. FLS: Fiberoptic Laryngeal Surgery. TMA: Thyroid-Mandibular Angle. Scope Size: Size of Kleinsasser laryngoscope. Case 13:

After radiation therapy for oropharyngeal cancer.


Mandible angle
Mandible prominence
Thyroid notch
TMA

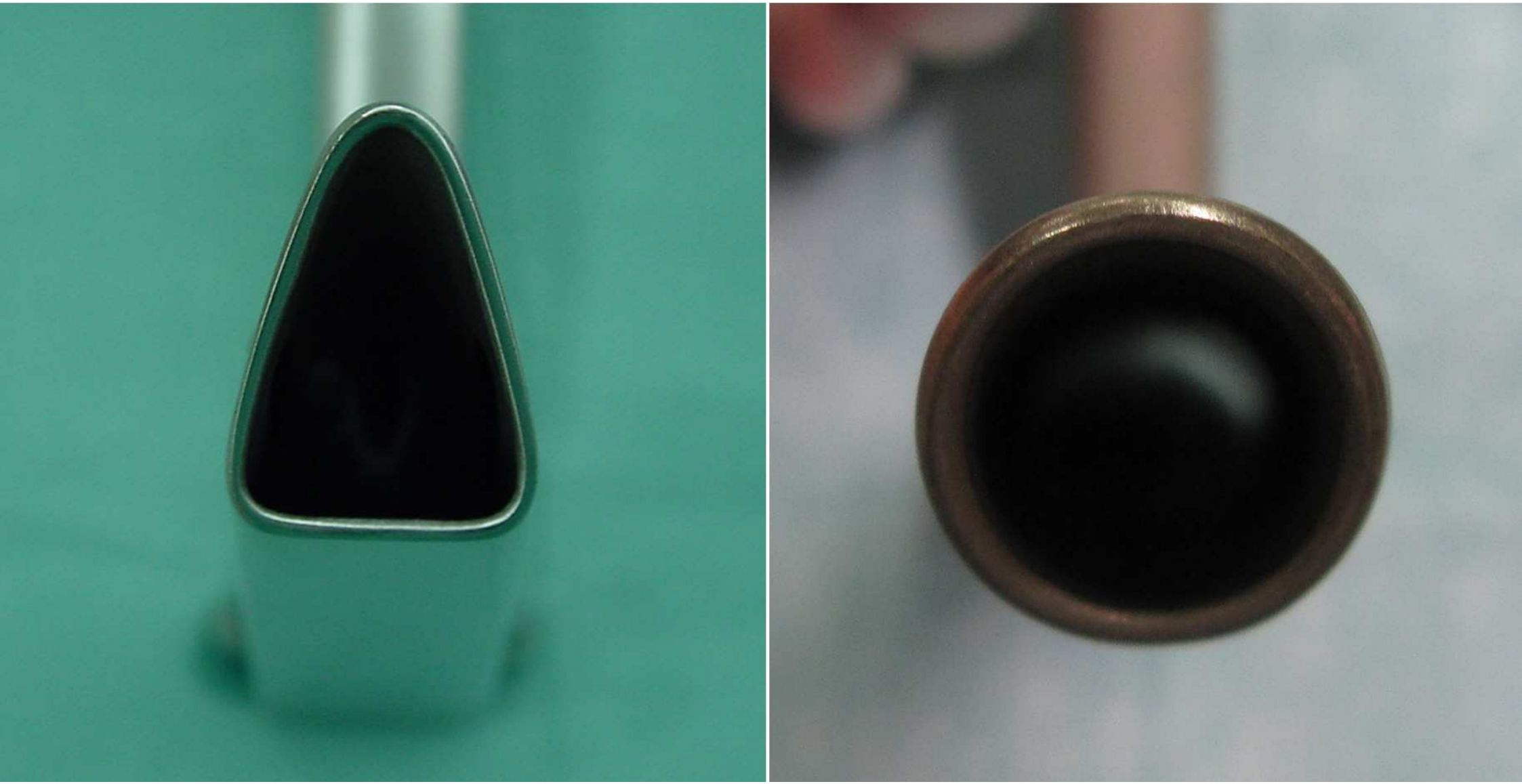

A

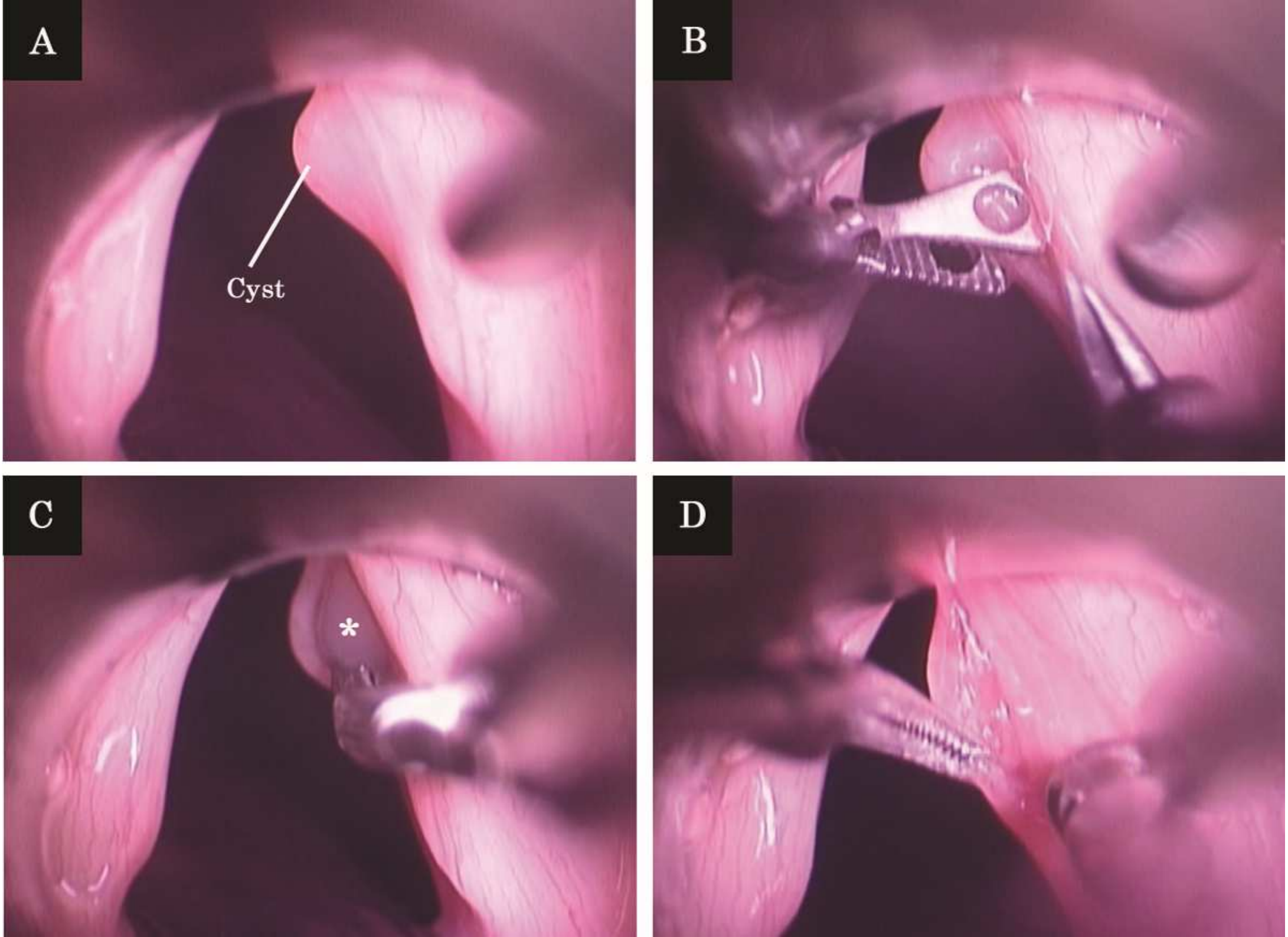

B

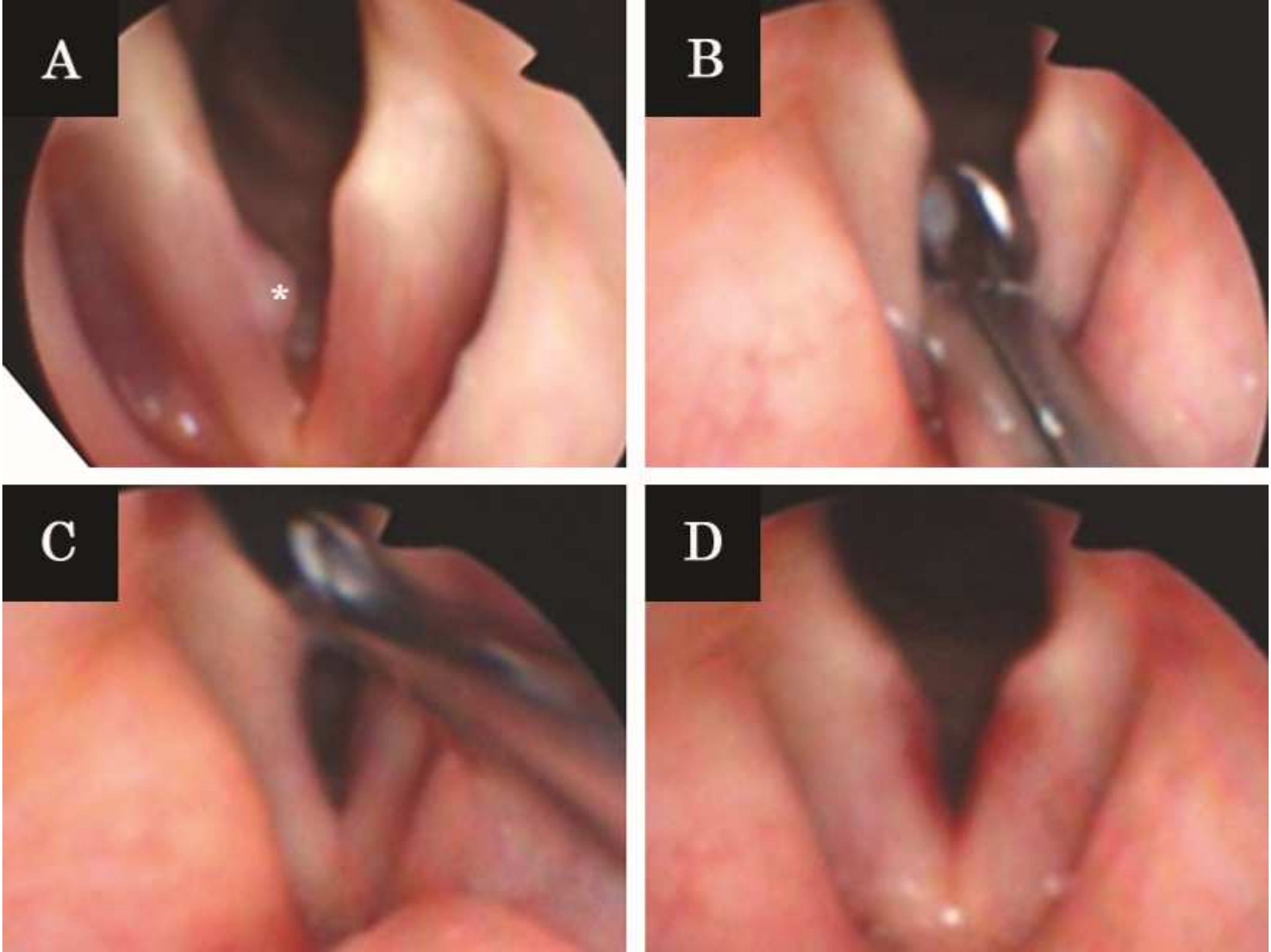

A

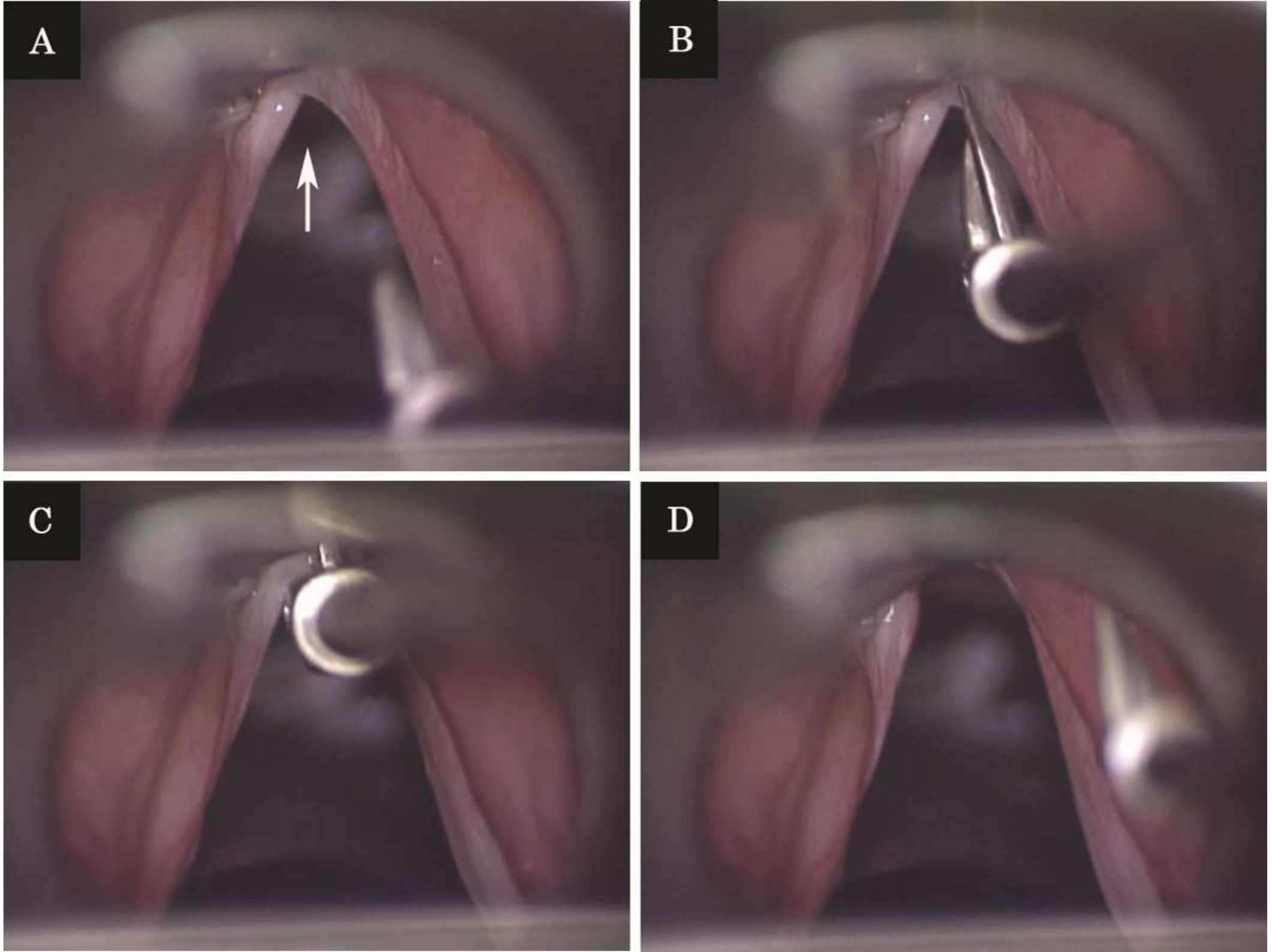

B

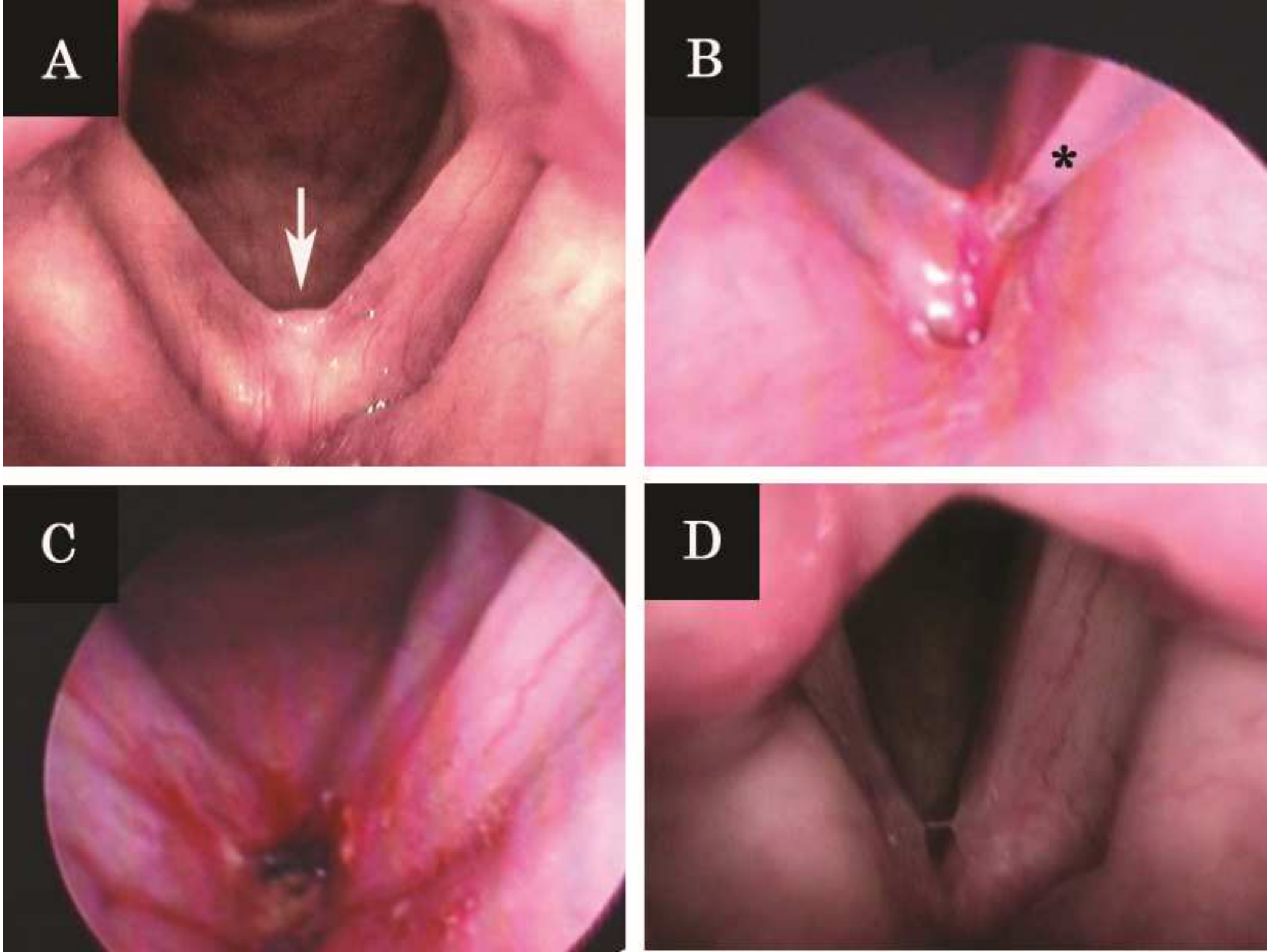
C




A
Cyst
B
C
*
D


A
B
C
D


A
B
C
D


A
B
*
C
D