

Review Article

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Cite this article: Johnstone L, Tassone P, Burrows S, Nassif R, Vijendren A. Extended role of transnasal oesophagoscopy: a review of the literature. *J Laryngol Otol* 2020;**134**:481–486. <https://doi.org/10.1017/S002221512000105X>

Accepted: 8 April 2020
First published online: 18 June 2020

Key words:

Endoscopy; Otolaryngology;
Head and Neck Neoplasms; Outpatients;
Patient Safety

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Extended role of transnasal oesophagoscopy: a review of the literature

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Abstract

Background. Advances in endoscopic technology have allowed transnasal oesophagoscopy to be used for a variety of diagnostic and therapeutic procedures.

Method. A review of the literature was carried out to look into the extended role of transnasal oesophagoscopy within otolaryngology, using the Embase, Cinahl and Medline databases.

Results. There were 16 studies showing that transnasal oesophagoscopy is safe and cost effective and can be used for removal of foreign bodies, tracheoesophageal puncture, laser laryngeal surgery and balloon dilatation.

Conclusion. This study presents a summary of the literature showing that transnasal oesophagoscopy can be used as a safe and cost-effective alternative or adjunct to traditional rigid endoscopes for therapeutic procedures.

Introduction

Over the last two decades, there has been significant advancement in digital endoscopes, with the use of office-based, unседated transnasal oesophagoscopy becoming more prevalent.^{1,2} The diagnostic value of transnasal oesophagoscopy has been shown to be comparable to traditional practice using rigid endoscopes but without requiring an operating theatre or needing general anaesthetic or sedation. Rigid endoscopes can pose an issue for patients who have an unexpected anatomical variant, resulting in difficult airway access, or in those unfit for anaesthesia.³

Evidence has shown that transnasal oesophagoscopy is well tolerated in head and neck patients, with a completion rate of more than 96 per cent compared with 79 per cent for endoscopic procedures performed via the transoral route. The instrument ports integrated into the scope have allowed a variety of procedures beyond diagnostic capabilities including tissue biopsy, tracheoesophageal puncture placements and oesophageal balloon dilatation. A couple of studies looking at such applications have demonstrated the enhanced role of transnasal oesophagoscopy for patient safety and have found it to be cost-effective while being well tolerated by patients.^{1,2}

This study aimed to review the existing literature to investigate the extended roles of transnasal oesophagoscopy within otolaryngology, from both a diagnostic and therapeutic perspective.

Materials and methods

This review was undertaken in line with Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols ('PRISMA-P') 2015 guidelines. A literature search was performed on Embase, Cinahl and Medline® databases using the medical subject headings ('MeSH') of 'transnasal oesophagoscopy' and 'TNO' as well as free text words. A generic set of keywords was agreed amongst the authors to try and broaden the search as much as possible.

The initial search, conducted in January 2018, returned 445 articles, which were narrowed down to 411 articles after duplicates were removed. Two authors (LJ and AV) screened the titles independently and selected 404 abstracts that focused on transnasal oesophagoscopy performed by ENT surgeons.

A further search was conducted in January 2019 because of the time lapse between the initial search and the writing of this review, and 20 further articles were found. A further 4 articles were added from a manual search of the references. The same two authors subsequently screened the 424 abstracts independently and then went on to review 40 full papers to assess eligibility. All disagreements were resolved by discussion amongst the authors, and 16 full text articles that were relevant to our aims were selected.

The excluded papers included case reports, conference proceedings, papers that focused solely on the diagnostic application of transnasal oesophagoscopy and articles focusing on transnasal oesophagoduodenoscopy, which is performed by gastroenterologists and general surgeons. Studies containing duplicated data from previously published

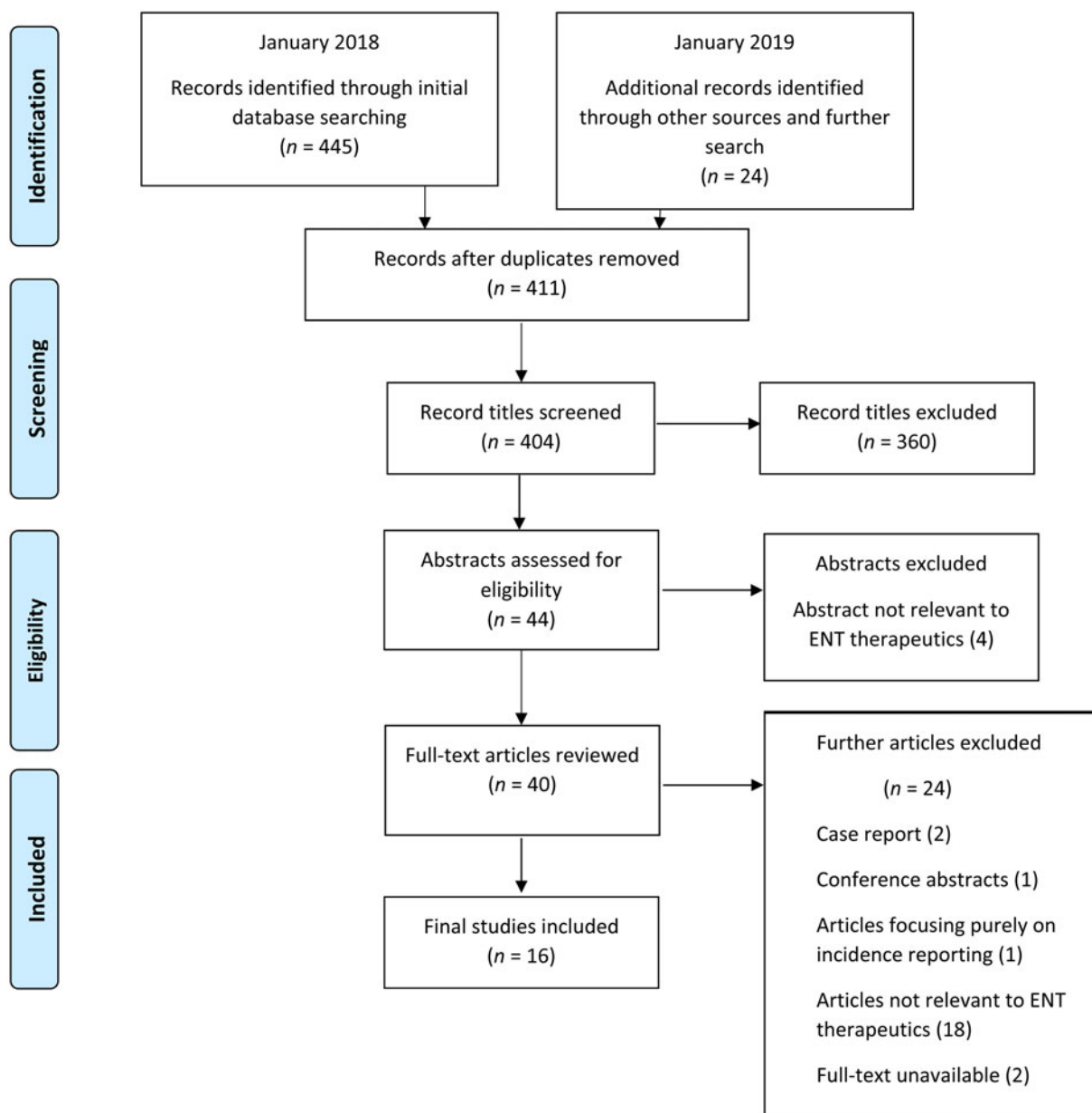


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols ('PRISMA-P') diagram showing the search strategy for this study.

work were also excluded, as were review articles, editorials and letters. No restrictions were placed on study design or study population (Figure 1).

All titles, abstracts, full text articles and referencing were handled using Mendeley Desktop v1.17 (Elsevier, Amsterdam, the Netherlands) 2008–2017 reference manager. Our selection process is outlined in our Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols ('PRISMA-P') diagram in Figure 1.

Results

Indications for transnasal oesophagoscopy

Best *et al.*⁴ evaluated the current indications for transnasal oesophagoscopy. An online survey was sent to all 251 members of the American Broncho-Esophagological Association, and 60 members replied. Results showed that transnasal oesophagoscopy is currently used mainly for diagnostic purposes, with 28 respondents using it in the investigation of dysphagia,

17 using it for biopsy, 16 using it for laryngopharyngeal reflux (usually for persistent disease after a trial of medication), and 15 using it for the investigation of gastroesophageal reflux disease, cough and cancer screening. Respondents also noted that transnasal oesophagoscopy was used for the therapeutic procedures of foreign body removal (11 respondents) and balloon dilatation (10 respondents) in an ENT setting.

Postma *et al.* carried out a large study detailing the indications for transnasal oesophagoscopy in 711 patients. They noted that the most frequent indication was for patients with a diagnosis of reflux, globus or dysphagia ($n = 490$), for biopsy ($n = 42$), and for cancer surveillance ($n = 45$). The only therapeutic procedure that transnasal oesophagoscopy was used for in this study was removal of foreign body ($n = 12$).⁵

Foreign bodies

Our literature search identified two papers, a non-randomised comparative study by Shih *et al.* and a small case series by Bennett *et al.*, which discussed the experience of using

transnasal oesophagoscopy in the management of pharyngeal and oesophageal foreign bodies.^{6,7} Both studies showed relatively good outcomes for foreign body identification and removal.

Foreign body identification

In the study carried out by Shih *et al.*, foreign bodies were found in 72.1 per cent of those undergoing rigid oesophagoscopy (43 individuals). Of the 320 patients who underwent transnasal oesophagoscopy, foreign bodies were identified in 17.2 per cent (52) of individuals.⁶ Foreign bodies were identified in 5 out of 6 individuals in the Bennett *et al.* study. This study did not have a control group.⁷

Foreign body removal

Out of the 52 foreign bodies found in the study by Shih *et al.*, 36 were successfully removed via transnasal oesophagoscopy. The remaining 16 patients underwent rigid oesophagoscopy because of suspected oesophageal perforation or because the large size and sharp nature of the foreign bodies rendered them irremovable via transnasal oesophagoscopy.⁶ All foreign bodies were successfully removed in the group undergoing rigid oesophagoscopy as a primary procedure. Bennett *et al.* stated that one patient underwent direct pharyngoscopy under general anaesthetic for reasons not addressed by authors.⁷

Complication rates

Neither study reported any major complication with transnasal oesophagoscopy removal of foreign bodies, or with rigid methods (rigid oesophagoscopy or direct pharyngoscopy).^{6,7}

Transoesophageal puncture

Bach *et al.* described one of the earliest transnasal oesophagoscopy-guided tracheoesophageal puncture procedures with the advances of fibre-optic endoscopes, whereby no complications were reported, and the procedure was completed in under 10 minutes.⁸

Successful placement

Morrison *et al.* studied 13 patients who underwent transnasal oesophagoscopy-guided tracheoesophageal puncture after failed attempts using rigid oesophagoscopy and in those unfit for a general anaesthetic. Successful placement was achieved in all 13 patients.⁹ These results were echoed by a study by LeBert *et al.* which detailed 39 patients who underwent transnasal oesophagoscopy-guided secondary tracheoesophageal puncture over two years. Of the 39 patients, 25 underwent a total laryngectomy, 8 underwent a total laryngectomy with partial pharyngectomy and 14 underwent a microvascular flap reconstruction.¹⁰ Transnasal oesophagoscopy-guided tracheoesophageal puncture was successful in 38 cases, with the remaining patient undergoing a successful flexible oesophagoscopy-guided tracheoesophageal puncture. The authors state that the sole failure was most likely a result of surgeon inexperience.¹⁰ Difficulties with placement were a result of scar formation in four patients, nasopharyngeal stenosis in one patient and aberrant course of the oesophagus in one patient. In a retrospective study, Britt *et al.* reviewed 83 patients who underwent in-office transnasal oesophagoscopy-guided secondary tracheoesophageal puncture over 7 years. A successful puncture was achieved in all cases.¹¹

Voice quality after placement

LeBert *et al.* found that most patients (64 per cent) undergoing transnasal oesophagoscopy-guided tracheoesophageal puncture achieved very good voice quality, measured using the Performance Status Scale for Head and Neck Cancer. The authors found no correlation between individuals who had undergone radiotherapy or cricopharyngeal myotomy and the success of transnasal oesophagoscopy-guided tracheoesophageal puncture ($p > 0.05$).¹⁰ A similar outcome was described by Britt *et al.* In their study, conversational speech was achieved in 69.9 per cent of individuals with failure of this in only 3.6 per cent as a result of anatomical defects from previous surgery.¹¹

A small study by Noel *et al.* followed four patients who underwent a secondary tracheoesophageal puncture using transnasal oesophagoscopy in gastric pull-up reconstruction after total laryngo-pharyngo-oesophagectomy. Although three patients had received previous radiotherapy, all four patients gained a functional voice with intelligible speech.¹²

Complication rates

All papers report low complication rates, with Morrison *et al.* reporting two minor incidents (one patient with suspected false passage and one patient who developed post-operative cellulitis, which required a course of antibiotics).⁹ Britt *et al.* reported no complications in 97.6 per cent of cases with the remaining cases experiencing bleeding from the puncture site and closure of puncture site after dislodgement of the prosthesis.¹¹ No adverse outcomes were reported in the study by LeBert *et al.*¹⁰

Laser

Successful treatment of lesions

Price *et al.* detailed transnasal oesophagoscopy-guided vocal cord surgery using a neodymium-doped yttrium-aluminium-garnet (YAG) laser. The procedure was performed on one patient, who had two benign papillomatous lesions on his vocal cords, under local anaesthetic. The patient had undergone a previous microlaryngoscopy under general anaesthetic, which had failed due to large dentition and tongue base.³ Local anaesthetic was introduced via the transnasal flexible laryngo-oesophagoscopy, and the laser was delivered via the instrument port. There were no signs of papilloma at six weeks post-procedure.³

Halum and Moberly looked at pulsed dye and carbon dioxide (CO₂) laser surgery in 10 individuals. Of these, five patients had recurrent respiratory papillomatosis and five had other benign lesions including amyloidosis ($n = 1$), granuloma ($n = 1$), varies ($n = 1$) and leukoplakia ($n = 2$). Disease reoccurred in three of the recurrent respiratory papillomatosis patients, and residual disease remained in the patients with amyloid and leukoplakia.¹³

Koufman *et al.* reviewed 443 cases of laser laryngeal surgery (170 patients) for benign laryngeal lesions, including recurrent respiratory papillomas, granulomas, leukoplakia and polypoid degeneration. Three different lasers were used in the surgical procedures: 406 procedures for 151 patients were performed with the pulsed-dye laser, 10 procedures for 2 patients were performed with the CO₂ laser and 27 procedures for 17 patients were performed with the thulium YAG laser.¹⁴ Transnasal oesophagoscopy using the pulsed dye laser was effective for small lesions; however, 15 per cent of patients treated for recurrent respiratory papillomatosis (9 of 59) had

to have further treatment in the operating theatre because of bulky disease.¹⁴ Of the other conditions that were studied, the number of patients requiring further operative treatment varied: 20 per cent of leukoplakia patients (20 of 25) and 31 per cent of granuloma patients (6 of 19) required further treatment; however, all individuals with Reinke's oedema (12) were treated successfully. Two patients with recurrent respiratory papillomatosis underwent a CO₂ laser procedure in conjunction with the pulsed dye laser and thulium YAG laser, although the aim in these cases was to control the disease rather than cure it. Disease burden was improved in both cases.¹⁴ Seventeen patients underwent a thulium YAG laser procedure to treat recurrent respiratory papillomatosis, granuloma, amyloid, vocal cord lesion, glottic web and dystonia; however, the outcomes were not stated.¹⁴

Patient satisfaction and pain scores

Of the 13 individuals studied by Mohammed *et al.*, patient satisfaction and tolerability was high, with only 5 individuals reporting little to moderate distress during anaesthetic and 8 reporting a small degree of pain during the procedure.¹⁵ Halum and Moberly reported high tolerance and satisfaction of both pulsed dye and CO₂ lasers in 10 individuals. Pain scores were low for both lasers, with mean pain and burning scores of 2.0 and 2.3, measured using a visual analogue scale.¹³

Complications

No complications from the procedures were reported across all four studies.^{3,13–15}

Oesophageal dilatation

Oesophageal stricture is a common complication in those who have received radiotherapy as part of their head and neck cancer treatment.

Successful dilatation

The study by Howell *et al.* analysed 47 dilatations in 22 patients who had all undergone radiotherapy and had successful outcomes.¹⁶ In a study by Rees *et al.*, describing their experience using transnasal oesophagoscopy balloon dilatation, 54 balloon dilatations were recorded in 38 patients with two procedures abandoned due to laryngospasm and gagging.¹⁷

Complications

Although the Howell *et al.* study reported no major complications, minor complications including superficial lacerations to the oesophagus in three patients and self-limiting epistaxis in two patients were noted.¹⁶ The study by Rees *et al.* reported no major complications. Patient follow-up was not reported in this study.¹⁷

Vocal cord medialisation

There was only one case study, by Montgomery *et al.*,¹⁸ reporting the use of transnasal oesophagoscopy in vocal cord medialisation using collagen. The nose and throat were anaesthetised, and the endoscope was passed transnasally until the vocal cords were viewed. Zyplast® collagen was passed down the instrument channel, where it was delivered directly into the vocal cord. The patient was then asked to phonate to determine how much collagen was needed. No complications were reported.

Discussion

Our literature review identified 16 papers describing extended roles for transnasal oesophagoscopy. The majority of the studies were small local case outcome studies. No randomised controlled trials or meta-analyses were found. All studies support the excellent safety profile of transnasal oesophagoscopy with no studies reporting major complications across all procedures.

The quality of evidence presented by each paper has been analysed in accordance with the levels of evidence system as detailed by the Oxford Centre for Evidence-based Medicine (Table 1). In addition to its safety profile, transnasal oesophagoscopy has been proven to be efficient and economical.² Wellenstein *et al.* recorded cost savings of between €94.43 and €831.31 depending on the diagnostic procedure.¹⁹ Howell *et al.* found that the cost savings of oesophageal dilatation via transnasal oesophagoscopy was \$15 000 less compared to the same procedure in the operating theatre.¹⁶ With such significant benefits to the patient, surgeon and healthcare system, our aim was to determine what therapeutic procedures transnasal oesophagoscopy is currently being used for within otolaryngology and what the evidence is behind these roles.

Two studies examining the use of transnasal oesophagoscopy for the removal of pharyngeal or oesophageal foreign bodies, although both small sample studies, concluded that transnasal oesophagoscopy removal of foreign bodies was well tolerated, safe and effective, with the majority of foreign bodies removed or clearly excluded.^{6,7} Traditionally patients presenting with suspected pharyngeal or oesophageal foreign bodies would receive a lateral neck and chest X-ray, and if a foreign body is identified or highly suspected, individuals would most commonly undergo a direct pharyngo-oesopharyngoscopy under a general anaesthetic.⁶ Where there is significant possibility that individuals would undergo an operation with the inherent complication risks and costs but with potential normal findings, removal under endoscopic guidance could prove advantageous.⁷ Of the 52 individuals in the study by Shih *et al.*, 16 had to proceed to rigid oesophagoscopy because of the risk of perforation, which is important to note when selecting individuals who would benefit from transnasal oesophagoscopy.⁶ No large cohort trial has been carried out looking at outcomes for transnasal oesophagoscopy versus rigid oesophagoscopy.

One of the earliest therapeutic procedures carried out via transnasal oesophagoscopy was transoesophageal puncture. Transoesophageal puncture is used for voice restoration after laryngectomy and is traditionally sited using rigid oesophagoscopy. Transnasal oesophagoscopy-guided tracheoesophageal puncture placement was first described in 2003.⁹ Morrison *et al.*⁹ reported that that tracheoesophageal puncture was achieved in all individuals studied who had all previously failed under rigid oesophagoscopy. This was again mirrored by the study by LeBert *et al.*, where 38 out of 39 transnasal oesophagoscopy-guided tracheoesophageal puncture procedures were successful.¹⁰ Although rigid oesophagoscopy is an effective method for tracheoesophageal puncture placement, exposure can be difficult in some individuals due to radiation damage or dentition. Due to the flexibility that transnasal oesophagoscopy affords, the oesophagus can be visualised during the entire procedure. In addition, transnasal oesophagoscopy has the added benefit of only requiring local anaesthesia and is therefore safe in individuals unable to undergo general anaesthesia.^{8–10}

Table 1. Summary of papers reviewed alongside the corresponding level of evidence

Category	Author	Year	Journal	Sample size	Summary of results	Level of evidence*
Indications for TNO	Best <i>et al.</i> ⁴	2018	<i>Annals of Otolaryngology, Rhinology & Laryngology</i>	60	Questionnaire looking at the current indications for TNO	2c
Indications for TNO	Postma <i>et al.</i> ⁵	2005	<i>Laryngoscope</i>	711	Consecutive reviews of indications for TNO in 711 patients	2b
Foreign body removal	Shih <i>et al.</i> ⁶	2015	<i>Otolaryngology–Head & Neck Surgery</i>	345	Comparison of success & experience of management of oesophageal foreign bodies with rigid oesophagoscopy & TNO. Foreign body was removed via TNO in 36 patients	2a
Foreign body removal	Bennett <i>et al.</i> ⁷	2008	<i>Annals of Royal College of Surgeons of England</i>	5	Paper looking at safety & comfort of 5 patients undergoing TNO to remove pharyngeal & oesophageal foreign bodies	4
Transoesophageal puncture	Morrison <i>et al.</i> ⁹	2012	<i>American Journal of Otolaryngology</i>	13	13 patients all successfully underwent TNO-guided transoesophageal puncture	4
Transoesophageal puncture	LeBert <i>et al.</i> ¹⁰	2009	<i>Archives of Otolaryngology–Head & Neck Surgery</i>	39	39 patient TNO-guided transoesophageal puncture, which was successful in 38 individuals	2c
Transoesophageal puncture	Britt <i>et al.</i> ¹¹	2014	<i>Otolaryngology–Head & Neck Surgery</i>	83	Successful TNO-guided secondary transoesophageal puncture in 83 patients, with conversational speech was achieved in 69.9% of individuals	2c
Transoesophageal puncture	Noel <i>et al.</i> ¹²	2015	<i>Head & Neck</i>	4	4 patients successfully underwent TNO-guided transoesophageal puncture but failed to achieve good speech	4
Transoesophageal puncture	Bach <i>et al.</i> ⁸	2003	<i>The Laryngoscope</i>	1	TNO-guided transoesophageal puncture, procedure time 10 minutes	4
Laser	Price <i>et al.</i> ³	2007	<i>Lasers Medical Science</i>	1	TNO used for laser vocal cord surgery, no evidence of recurrence of disease at 6 weeks	4
Laser	Mohammed <i>et al.</i> ¹⁵	2007	<i>Journal of Laryngology & Otology</i>	13	All patients tolerated TNO with only reported minimal to moderated pain	3b
Laser	Halum & Moberly ¹³	2010	<i>Journal of Voice</i>	10	All patients tolerated TNO well using both lasers, with no complication. Disease reoccurred in 3 of the respiratory papillomatosis patients & residual disease remained in the patients with amyloid & leukoplakia	3b
Laser	Koufman <i>et al.</i> ¹⁵	2007	<i>Otolaryngology–Head & Neck Surgery</i>	443	All patients underwent laser laryngeal surgery via TNO, with no reported complications & high patient satisfaction	2c
Vocal cord medialisation	Montgomery <i>et al.</i> ¹⁸	2005	<i>Journal of Laryngology & Otology</i>	1	TNO used for vocal cord medialisation	4
Oesophageal dilatation	Howell <i>et al.</i> ¹⁶	2018	<i>The Laryngoscope</i>	22	TNO oesophageal dilatation is safe & well tolerated in patients who have had previous head & neck cancer	2c
Oesophageal dilatation	Rees <i>et al.</i> ¹⁷	2009	<i>Archives of Otolaryngology–Head & Neck Surgery</i>	38	Experience of two units performing TNO balloon dilatations	3b

*The Oxford Centre for Evidence-based Medicine system was used to categorise the level of evidence.²⁰ TNO = transnasal oesophagoscopy

There have been a number of studies looking at outcomes in patients who have undergone laser surgery using transnasal oesophagoscopy, which has the advantage of increased mobility over traditional microlaryngoscopy. Transnasal oesophagoscopy-guided laser surgery was well tolerated with a favourable pain profile.^{13,14} Although in the majority of

individuals, disease can be successfully treated or controlled using transnasal oesophagoscopy-guided laser surgery, up to 30 per cent may require further treatment in the operating theatre.¹⁵

Oesophageal stricture can arise as a complication of head and neck surgery or can be idiopathic. The studies we reviewed where

transnasal oesophagoscopy-guided dilatation was used reported a good degree of success with no major complications. However, one study reported that laryngospasm and gagging complicated the procedure resulting in the procedure being abandoned.^{16,17} There was very little evidence on the use of transnasal oesophagoscopy during vocal cord medialisation, although, based on the authors' experience, this is possibly because of the nature of vocal cord palsy and patient compliance.

Conclusion

Endoscopes have advanced significantly in the last two decades, enabling procedures that would traditionally be carried out in the operating theatre under general anaesthesia to be done in an out-patient setting under local anaesthesia or sedation. Our review has found a lack of strong evidence for the extended role of transnasal oesophagoscopy beyond its diagnostic capabilities, particularly in guiding therapeutic procedures. However, the reported case series and the authors' own experiences suggest that many of these interventional procedures are possible, safe and effective with minimal side effects. Hence, transnasal oesophagoscopy offers a reasonable alternative to patients who are unable to tolerate a general anaesthetic.

Competing interests. None declared

References

- Wellenstein DJ, Schutte HW, Marres HAM, Honings J, Belafsky PC, Postma GN *et al.* Office-based procedures for diagnosis and treatment of esophageal pathology. *Head Neck* 2017;**39**:1910–19
- Roof SA, Amin MR. Transnasal esophagoscopy in modern head and neck surgery. *Curr Opin Otolaryngol Head Neck Surg* 2015;**23**:171–5
- Price T, Sharma A, Snelling J, Bennett AM, Qayyum A, Bradnam T *et al.* How we do it: the role of trans-nasal flexible laryngo-oesophagoscopy (TNFLO) in ENT: one year's experience in a head and neck orientated practice in the UK. *Clin Otolaryngol* 2005;**30**:551–6
- Best AR, Halum SL, Parker NP. Current indications for transnasal esophagoscopy: an American Broncho-Esophagological Association survey. *Ann Otol Rhinol Laryngol* 2018;**127**:926–30
- Postma GN, Cohen JT, Belafsky PC, Halum SL, Gupta SK, Bach KK *et al.* Transnasal esophagoscopy: revisited (over 700 consecutive cases). *Laryngoscope* 2005;**115**:321–3
- Shih CW, Hao CY, Wang YJ, Hao SP. A new trend in the management of esophageal foreign body: transnasal esophagoscopy. *Otolaryngol Head Neck Surg* 2015;**153**:189–92
- Bennett AM, Sharma A, Price T, Montgomery PQ. The management of foreign bodies in the pharynx and oesophagus using transnasal flexible laryngo-oesophagoscopy (TNFLO). *Ann R Coll Surg Engl* 2008;**90**:13–16
- Bach KK, Postma GN, Koufman JA. In-office tracheoesophageal puncture using transnasal esophagoscopy. *Laryngoscope* 2003;**113**:173–6
- Morrison MP, Chheda NN, Postma GN. The tough tracheoesophageal puncture. *Am J Otolaryngol* 2012;**33**:113–5
- LeBert B, McWhorter AJ, Kunduk M, Walvekar RR, Lewin JS, Hutcheson KA *et al.* Secondary tracheoesophageal puncture with in-office transnasal esophagoscopy. *Arch Otolaryngol Head Neck Surg* 2009;**135**:1190–4
- Britt CJ, Lippert D, Kammer R, Ford CN, Dailey SH, McCulloch T *et al.* Secondary tracheoesophageal puncture in-office using Seldinger technique. *Otolaryngol Head Neck Surg* 2014;**150**:808–12
- Noel D, Fink DS, Kunduk M, Schexnaildre MA, DiLeo M, McWhorter AJ. Secondary tracheoesophageal puncture using transnasal esophagoscopy in gastric pull-up reconstruction after total laryngopharyngoesophagectomy. *Head Neck* 2016;**38**:E61–3
- Halum SL, Moberly AC. Patient tolerance of the flexible CO2 laser for office-based laryngeal surgery. *J Voice* 2010;**24**:750–4
- Koufman JA, Rees CJ, Frazier WD, Kilpatrick LA, Wright SC, Halum SL *et al.* Office-based laryngeal laser surgery: a review of 443 cases using three wavelengths. *Otolaryngol Head Neck Surg* 2007;**137**:146–51
- Mohammed H, Masterson L, Nassif R. Out-patient flexible carbon dioxide laser surgery for benign laryngopharyngeal pathologies via transnasal flexible laryngo-oesophagoscopy. *J Laryngol Otol* 2017;**131**:650–4
- Howell RJ, Schopper MA, Giliberto JP, Collar RM, Khosla SM. Office-based esophageal dilation in head and neck cancer: safety, feasibility, and cost analysis. *Laryngoscope* 2018;**128**:2261–7
- Rees CJ, Fordham T, Belafsky PC. Transnasal balloon dilation of the esophagus. *Arch Otolaryngol Head Neck Surg* 2009;**135**:781–3
- Montgomery P, Sharma A, Qayyum A, Mierzwa K. Direct phonoplasty under local anaesthetic. *J Laryngol Otol* 2005;**119**:134–7
- Wellenstein DJ, Honings J, Schutte HW, Herruer JM, van den Hoogan FJA, Marres HAM *et al.* Cost analysis of office-based transnasal esophagoscopy. *Eur Arch Otorhinolaryngol* 2019;**276**:1457–63
- Levels of evidence. In: <https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/> [5 May 2019]