

## Review Article

Dr R Swaminathan takes responsibility for the integrity of the content of the paper

**Cite this article:** Swaminathan R, Rosa Opatha S, Mughal Z, Prasad S. A systematic review on efficacy, safety and cost-effectiveness of office-based laryngeal biopsy. *J Laryngol Otol* 2023;**137**:946–952. <https://doi.org/10.1017/S0022215122001566>



Accepted: 20 June 2022  
First published online: 29 June 2022

**Key words:**  
Laryngeal Biopsy; Outpatients; Office

### Author for correspondence:

Dr R Swaminathan, Department of Otorhinolaryngology and Head and Neck Surgery, Warwick Hospital, Lakin Road, Warwick, CV34 5BW, UK  
E-mail: [Ramanathan.Swaminathan@swft.nhs.uk](mailto:Ramanathan.Swaminathan@swft.nhs.uk)  
Fax: +44 1926 482 607

# A systematic review on efficacy, safety and cost-effectiveness of office-based laryngeal biopsy

R Swaminathan<sup>1</sup> , S Rosa Opatha<sup>1</sup>, Z Mughal<sup>2</sup>  and S Prasad<sup>3</sup>

<sup>1</sup>Department of Otorhinolaryngology and Head and Neck Surgery, Warwick Hospital, <sup>2</sup>Department of Otorhinolaryngology and Head and Neck Surgery, Queen Elizabeth Hospital, Birmingham and <sup>3</sup>Department of Otorhinolaryngology and Head and Neck Surgery, University Hospitals Coventry & Warwickshire NHS Trust, UK

## Abstract

**Objective.** Laryngeal cancer is the second most prevalent head and neck malignancy in the USA. With recent advances in technology, this procedure is increasingly performed under local anaesthesia. This study aimed to identify the efficacy, safety and cost-effectiveness of laryngeal biopsy in out-patients by conducting a systematic review.

**Method.** A literature search was conducted using PubMed, Medline, Google Scholar and Embase over a 20-year period. Inclusion criteria were: studies performed on out-patient diagnostic biopsy procedures of the larynx. Exclusion criteria included all therapeutic procedures. The outcome measures were sensitivity and specificity, complication rate and cost-savings.

**Results.** Thirty-five studies were included in the analysis. The sensitivity and specificity varied from 60 to 100 per cent with a low complication rate and cost savings.

**Conclusion.** Office-based laryngeal biopsies are increasingly used in the diagnosis of laryngeal cancers, resulting in earlier diagnosis and commencement of treatment. The barrier to undertaking this procedure is low sensitivity.

## Introduction

Laryngeal cancer is one of the commonest head and neck malignancies and is second in prevalence among the head and neck cancers in the USA.<sup>1</sup> Over 2000 cases of laryngeal cancer are diagnosed annually in the UK.<sup>2</sup> The diagnosis is based on clinical findings and confirmed by biopsy of the suspicious lesion. Traditionally, biopsy is carried out under general anaesthesia. With recent advances in technology, this procedure can now be undertaken in the out-patient setting. Office-based laryngeal procedures have come a long way over the years with the advances in technology, such as distal chip endoscopes, narrow-band imaging and better local anaesthetic techniques.<sup>3–5</sup>

A wide range of laryngeal procedures can be carried out under local anaesthesia in the out-patient setting. This includes laryngeal and hypopharyngeal biopsy, vocal fold injections, and laser surgery for vocal fold polyps and granulomas.<sup>6–8</sup> Laryngeal procedures carried out under local anaesthesia have advantages and disadvantages. The advantages include earlier diagnosis and access to treatment, that they can be performed on patients not suitable for general anaesthesia, and that they are suitable for patients with difficult anatomy and significant co-morbidities. There may also be a pecuniary benefit for the National Health Service because an office procedure is far less resource intensive than an elective in-patient operation. The disadvantages include intolerance of the procedure and a potential inconclusive diagnosis.

The aim of this systematic review was framed using the Population, Intervention, Control and Outcomes model to assess the efficacy, safety and cost-effectiveness (outcomes) of an office-based laryngeal biopsy under local anaesthesia (intervention), in patients with laryngeal lesions requiring histological diagnosis (population) in comparison with biopsy under general anaesthetic (control).

## Materials and methods

This systematic review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses ('PRISMA') statement standards.<sup>9</sup> The published literature in PubMed, Embase, Google Scholar and Medline were searched independently by two authors (RS and SRO). The search terms and Boolean operators used were: 'larynx' AND 'biopsy' AND 'outpatients' OR 'office'.

The inclusion criteria were: studies on laryngeal biopsies in the out-patient setting, English language articles, human participants and papers that were published from 1 January 2001 to 31 October 2021. The exclusion criteria were laser therapy, laryngeal injections and other therapeutic laryngeal procedures. Article bibliographies and citations were also used to identify additional articles. The last search was run on 1 November 2021. Titles and abstracts were screened to determine whether they met the inclusion criteria. Full-text publications of all studies that were not primarily excluded were

obtained and read in full. Outcome measures were sensitivity and specificity of laryngeal biopsies, complications, and cost analysis. The quality of the included studies was independently assessed by authors RS and SRO. The studies were graded on level of evidence according to the Oxford Centre for Evidence-Based Medicine Levels of Evidence Working Group.<sup>10</sup>

**Results**

The database search identified 302 articles from Embase (*n* = 122), Medline (*n* = 82), PubMed (*n* = 186) and Google Scholar (*n* = 30). After removing duplicates and exclusion of studies, 35 studies met the inclusion criteria. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses ('PRISMA') flowchart is shown in Figure 1. A descriptive analysis was undertaken because of heterogeneity between studies. Table 1 summarises the effectiveness and complications of out-patient laryngeal biopsy.

**Diagnostic yield**

High rates of success in obtaining a diagnosis from laryngeal biopsy under local anaesthesia have been reported in the literature. In a retrospective study by Lippert *et al.*<sup>11</sup> on 116 patients, the diagnosis was made in 97 patients, and only 2 patients did

not tolerate the procedure. In a case-control study by Zalvan *et al.*<sup>12</sup> on 26 patients who had biopsy of the larynx carried out under both local and general anaesthesia, they found an overall concordance rate of 81 per cent, of which 83 per cent were benign and 79 per cent were non-benign. In a study by Cohen & Benyamini<sup>13</sup> with 117 patients, 110 patients had adequate biopsy with an office-based procedure. Similarly, in a study by Wellenstein *et al.*,<sup>14</sup> a definitive diagnosis was obtained for 97 per cent of cases. Reasons for failure included inability to insert the flexible endoscope, abandoning the procedure because of complications such as laryngeal bleeding and supraglottic oedema, and patient intolerance. In 1 out of 201 flexible endoscopic biopsy procedures, histological classification could not be determined by the pathologist because of the superficial nature of the biopsy specimens.

**Sensitivity and specificity**

Many studies have looked at the sensitivity of office-based laryngeal biopsies, with rates up to 97 per cent.<sup>15-24</sup> Excellent rates for specificity have been reported in multiple studies ranging from 83 per cent to 100 per cent.<sup>15-24</sup> A retrospective review on 581 patients by Cha *et al.*<sup>15</sup> showed a sensitivity and specificity of 78.2 per cent and 100 per cent, respectively. The negative predictive value of malignancy diagnosed on out-patient biopsy was 87.3 per cent, and the positive

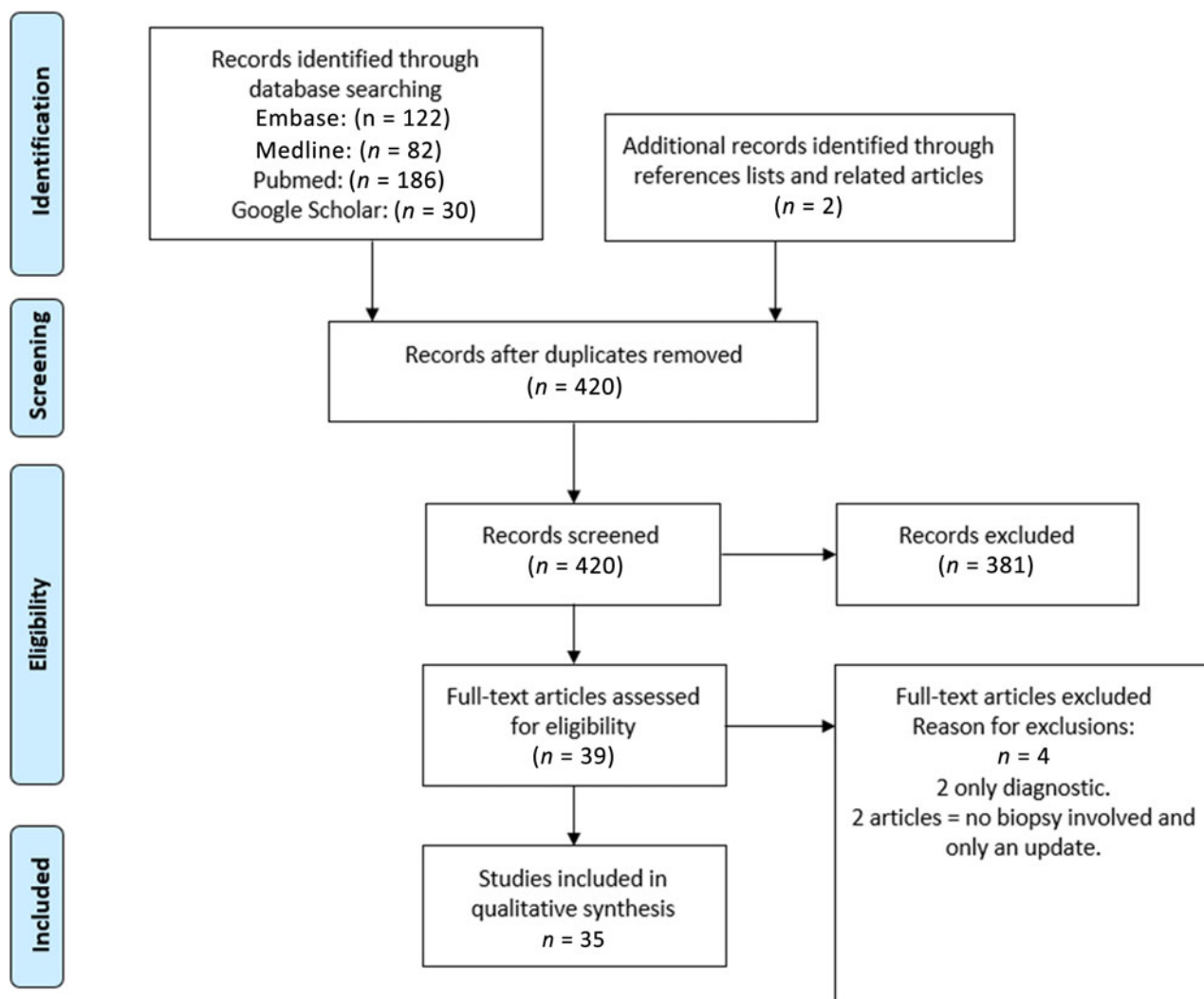


Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses ('PRISMA') study flow chart.

**Table 1.** Summary of effectiveness and complications of out-patient laryngeal biopsy

Study	Study design	Percentage success (%)	Complication rate (%)	Evidence level
Hassan <i>et al.</i> , <sup>16</sup> 2018, n = 47	Case cohort study	Sensitivity – 75.6; specificity – 100	2.35	2
Cha <i>et al.</i> , <sup>15</sup> 2016, n = 581	Retrospective study	Sensitivity – 78.2; specificity – 100; PPV – 100; NPV – 87.3	0	4
Chang <i>et al.</i> , <sup>24</sup> 2016, n = 90	Retrospective study	Sensitivity – 97.2; specificity – 100	1.10	4
Cohen <i>et al.</i> , <sup>17</sup> 2018, n = 355	Retrospective cohort study	Sensitivity – 77.8; specificity – 95.1	1	3
Castillo Farias <i>et al.</i> , <sup>18</sup> 2014, n = 88	Prospective study	Sensitivity – 81; specificity – 100; PPV – 100; NPV – 20	0	2
Cohen <i>et al.</i> , <sup>13</sup> 2014, n = 117	Prospective cohort study	Sensitivity – 70.6; specificity – 96.7; PPV – 98; NPV – 57	Not mentioned	2
Cohen <i>et al.</i> , <sup>19</sup> 2013, n = 102	Prospective cohort study	Sensitivity – 69.2; specificity – 96.1	1	2
Richards <i>et al.</i> , <sup>20</sup> 2015, n = 76	Retrospective study	Sensitivity – 60; specificity – 87; PPV – 78; NPV – 74	0	3
Refaat & Negm, <sup>23</sup> 2020, n = 60	Cohort selection cross sectional study	Sensitivity – 95.8; specificity – 83.3	6.60	4
Zalvan <i>et al.</i> , <sup>12</sup> 2013, n = 26	Retrospective study	81% concordance	0	3
Lippert <i>et al.</i> , <sup>11</sup> 2014, n = 116	Retrospective study	83.60	0	3
Wellenstein <i>et al.</i> , <sup>14</sup> 2017, n = 187	Prospective study	57.20	1.9%; 5 could not tolerate the procedure	2
Mozzanica <i>et al.</i> , <sup>26</sup> 2020, n = 55	Prospective study	61.80	0	2
Naidu <i>et al.</i> , <sup>28</sup> 2012, n = 12	Retrospective study	Diagnostic in 64%	Not mentioned	3
Schutte <i>et al.</i> , <sup>27</sup> 2018, n = 188	Prospective study	92.5	0	2
Uys <i>et al.</i> , 2019, n = 54	Prospective study	Sensitivity – 77.1; specificity – 100	Not mentioned	2
Schimberg <i>et al.</i> , n = 184	Prospective study	Sensitivity – 80; specificity – 100	Not mentioned	2
Saga <i>et al.</i> , <sup>22</sup> 2018, n = 30	Retrospective study	Sensitivity – 73; specificity – 100; PPV – 100; NPV – 64	0	3
Mozzanica <i>et al.</i> , <sup>26</sup> 2020, n = 55	Prospective study	Rate of adequate sampling – 100	0	2
Qi <i>et al.</i> , <sup>41</sup> 2014, n = 3675	Prospective study	Sensitivity – 98.81; specificity – 99.89	Not mentioned	2

PPV = positive predictive value; NPV = negative predictive value

predictive value was 100 per cent. They reported a high false negative rate in glottic lesions and lesions less than 1 cm of 27 per cent and 27.5 per cent, respectively.

A case cohort study performed by Hassan *et al.*<sup>16</sup> on 47 patients gave a specificity of 75.6 per cent and sensitivity of 100 per cent. A similar study by Chang *et al.*<sup>24</sup> on 390 patients reported a sensitivity and specificity of 77.8 per cent and 95.1 per cent, respectively. In the study by Cohen & Benyamini<sup>13</sup> on 117 patients, the sensitivity and specificity were 70.6 per cent and 96.7 per cent, respectively. Castillo Farias *et al.*<sup>18</sup> compared the efficacy of office-based biopsy performed under local anaesthesia and operating room biopsy performed under general anaesthesia in 88 patients. This was a

prospective study performed during two periods of time, with one blinded and the other one unblinded. They had a sensitivity of 81 per cent and specificity of 100 per cent. The negative predictive value was 20 per cent.

Cohen *et al.*<sup>19</sup> carried out a prospective study on 102 patients with laryngeal lesions who underwent office-based biopsy. An adequate sample was obtained in 96 patients. The biopsy showed carcinoma in 34 patients, carcinoma in situ in 17 patients and was benign in 45 patients. All patients with a benign and carcinoma in situ diagnosis had a direct laryngoscopy and biopsy. The sensitivity of office-based biopsy compared with direct laryngoscopy was 69.2 per cent and specificity was 96.1 per cent. Richards *et al.*<sup>20</sup> carried out a

retrospective case series on office-based biopsy on 261 patients. The sensitivity was 60 per cent and specificity was 87 per cent. A prospective study by Uys *et al.*<sup>21</sup> reported a sensitivity, specificity and accuracy of 77.1 per cent, 100 per cent and 97.9 per cent, respectively. A retrospective study by Saga *et al.*<sup>22</sup> showed sensitivity and specificity of endoscopic in-office biopsy to be at 73 per cent and 100 per cent, respectively, and they reported positive and negative predictive values of 100 per cent and 30 per cent, respectively.

The approach for in-office flexible endoscopic laryngeal biopsy can be transnasal or transoral. A cross-sectional cohort study by Refaat *et al.*<sup>23</sup> looked into the difference in sensitivity and specificity of the two approaches. Sixty patients underwent out-patient biopsy: 30 underwent the transnasal approach and 30 underwent the transoral approach. The sensitivity and specificity of the transnasal approach was 26.3 per cent and 90.9 per cent, respectively. The sensitivity and specificity of the transoral approach was 95.8 per cent and 83.3 per cent, respectively.

Few studies have looked into improving sensitivity and specificity by employing narrow-band imaging. A retrospective study by Chang *et al.*<sup>24</sup> using the narrow-band imaging technique showed sensitivity and specificity rates of 97.2 per cent and 100 per cent, respectively. The diagnostic accuracy was 98.9 per cent.

Chung-Tsung *et al.*<sup>25</sup> performed laryngeal biopsy with narrow-band imaging on patients not suitable for general anaesthesia. Nineteen patients were included in the study: 12 patients had a positive result from the initial biopsy, and 1 had a positive result after a repeat biopsy. Six patients had a benign result and were just followed up.

### Complications

The literature has shown in-office flexible endoscopic laryngeal biopsy to be a safe procedure with only a few complications reported. Chang *et al.*<sup>24</sup> mentioned that all their patients tolerated the procedure except one patient who required temporary fluid resuscitation. Cohen *et al.*<sup>17</sup> reported on four patients who developed complications, giving a complication rate of 1 per cent. These complications included epistaxis ( $n = 2$ ), vocal fold haematoma ( $n = 1$ ) and aspiration ( $n = 1$ ). In the study by Wellenstein *et al.*,<sup>14</sup> 4 patients out of 201 developed complications, which were graded according to Clavien–Dindo classification. The noted complications included laryngospasm (Clavien–Dindo grade I), anterior epistaxis (Clavien–Dindo grade I), laryngeal bleeding (Clavien–Dindo grade II) and supraglottic oedema (Clavien–Dindo grade IIb).

A recognised advantage of in-office flexible endoscopic laryngeal biopsy is its feasibility in patients who are not fit for general anaesthesia. Mozzanica *et al.*<sup>26</sup> studied 55 patients who were unfit for general anaesthetic and went on to have out-patient biopsies. Thirty-four patients were diagnosed with malignancy with a diagnostic rate of 61.8 per cent. There were no reported complications in this high-risk group.

### Cost saving

The shift from an operating room to an in-office endoscopic procedure has been shown to be more cost efficient in the literature. In a study by Schutte *et al.*,<sup>27</sup> the average cost of out-patient biopsy was €105.11 as opposed to €864.83 for operating-room biopsy. Cha *et al.*<sup>15</sup> showed that the cost of out-patient biopsy was \$50 USD compared to \$1200 USD

for operating-room biopsy. Castillo Fariás *et al.*<sup>18</sup> showed an annual savings of \$50 140.80. Naidu *et al.*<sup>28</sup> compared the cost of out-patient biopsy and in-patient biopsy on 12 patients in a retrospective study. The cost of out-patient biopsy was \$2053.91, and the cost of in-patient biopsy was \$9024.47, giving a cost saving of \$7000 for out-patient procedures. Fang *et al.*<sup>29</sup> performed a retrospective study on the cost effectiveness of out-patient and in-patient biopsy and its impact on the Taiwanese health insurance programme. The cost of out-patient biopsy was 1264 Taiwanese dollars compared with in-patient biopsy which was 10 913 Taiwanese dollars. Marcus *et al.*<sup>30</sup> performed a retrospective cost analysis study on patients who underwent office-based biopsy and operating-room biopsy and showed the cost for these were \$7000 and \$11 000, respectively. They also concluded that even if the patient has to undergo operating-room biopsy after office-based biopsy, it was still found to be cost effective. A prospective study carried out by Uys *et al.*<sup>21</sup> showed a saving of 5343 South African Rand with out-patient endoscopic laryngeal biopsy as opposed to rigid laryngoscopy. A retrospective study by Saga *et al.*<sup>22</sup> showed an 80 per cent cost reduction with out-patient endoscopic laryngeal biopsy. The cost saving results are summarised in Table 2.

### Time for diagnosis

Diagnosis using in-office endoscopic biopsy has been shown to be more time efficient, possibly leading to a better patient outcome. Lee *et al.*<sup>31</sup> performed a retrospective study on 114 patients, of which 44 underwent out-patient biopsy. They looked at time to diagnosis and treatment between the two groups. They found the time to diagnosis for office biopsy to be 1.3 days and 17.4 days for operating-room biopsy. The time from initial consultation to treatment was 51.7 days and 44.6 days for operating-room biopsy and out-patient biopsy, respectively. Schutte *et al.*<sup>27</sup> found the time to treatment from first patient contact in out-patient biopsy was 27 days as opposed to 41.5 days for operating-room biopsy. The time to diagnosis and treatment is summarised in Table 3.

## Discussion

### Summary of results

We analysed results on the sensitivity and specificity of the biopsy results of the studies included. The population group ranged from 19 patients to 581 patients. The sensitivity ranged from 60 to 97.2 per cent and specificity ranged from 83.3 to 100 per cent. Use of narrow-band imaging has improved the sensitivity and specificity rates up to 97.2 and 100 per cent, respectively. The complication rate ranged from 0 to 2.35 per cent in the reported studies, with the largest study on 581 patients demonstrating a 0 per cent complication rate. Most studies showed that out-patient laryngeal biopsy provides a significant cost saving, with one study showing an annual cost saving of \$50 140.80. Overall, a percentage cost saving ranging from 36 to 95.8 per cent has been demonstrated. Out-patient endoscopic laryngeal biopsies have also been shown to considerably reduce time to both diagnosis and treatment.

### Quality of evidence

Most of the studies were observational studies with a level of evidence from 2 to 4. There were no randomised, controlled

**Table 2.** Costs of out-patient laryngeal biopsy compared with in-patient biopsy

Study	Cost effectiveness	Percentage savings (%)
Cha <i>et al.</i> , <sup>15</sup> 2016	OP – US\$50; IP – US\$1200	95.8
Castillo Farias <i>et al.</i> , <sup>18</sup> 2014	OP – US\$65.44; IP – US\$1253.52	94.8; reported annual cost savings – US\$50 140.80
Naidu <i>et al.</i> , <sup>28</sup> 2012	OP – US\$2053.91; IP – US\$49 024.47	95.8
Fang <i>et al.</i> , <sup>29</sup> 2012	OP Taiwan \$1264; IP – Taiwan \$10 913	88.4
Marcus <i>et al.</i> , <sup>30</sup> 2019	OP – US\$7000; IP – US\$11 000	36.4
Schimberg <i>et al.</i> , <sup>42</sup> 2012	OP – €110; IP – €1101	90.0
Schutte <i>et al.</i> , <sup>27</sup> 2012	OP – €87.95; IP – €821.58	89.3
Saga <i>et al.</i> , <sup>29</sup> 2012	Not reported	80

OP = out-patient; IP = in-patient

**Table 3.** Time to diagnosis or treatment

Study	Time to diagnosis or treatment
Cohen <i>et al.</i> , <sup>17</sup> 2018, <i>n</i> = 355	10.7 days to diagnosis for OP biopsy
Lippert <i>et al.</i> , <sup>11</sup> 2014, <i>n</i> = 116	OP time to treatment – 24.2 days; IP time to treatment – 48.8 days
Lee <i>et al.</i> , <sup>31</sup> 2018, <i>n</i> = 114	Consultation to OP diagnosis – 7.5 days; consultation to in-patient diagnosis – 23 days
Schutte <i>et al.</i> , <sup>27</sup> 2018, <i>n</i> = 188	Diagnostic investigation to multidisciplinary meeting: OP – 2 days; IP – 16 days

OP = out-patient; IP = in-patient

studies identified. Several studies had a small sample size with numbers less than 100, including those performed by Lippert *et al.*,<sup>11</sup> Zalvan *et al.*<sup>12</sup> and Hassan *et al.*<sup>16</sup> The retrospective review on 581 patients by Cha *et al.*<sup>15</sup> had the limitations of the possibility of under-diagnosis of pre-malignant lesions and that not all the benign lesions were re-biopsied.

A bi-centric prospective study performed by Chabrilac *et al.*<sup>32</sup> compared the results of laryngeal biopsy using white light and narrow-band imaging with direct laryngoscopy and biopsy. The narrow-band imaging result contributed to an upgrade of clinical T-staging in 4.8 per cent of patients, which had an impact on the type of treatment administered to one patient who was switched from exclusive radiotherapy to an organ preservation protocol. However, all the biopsies were only performed in the operating theatre under general anaesthetic.

Bensoussan and Anderson<sup>33</sup> carried out a survey in Canada for those performing out-patient laryngeal procedures, focusing on the safety aspects of practice. An electronic survey questionnaire was sent to 22 practising otolaryngologists and 16 responded. The results of the survey showed that 20 to 30 per cent of otolaryngologists did not have access to medical resources in the event of any complication, such as laryngospasm or allergic reaction. Also, it is worth mentioning that only the study by Wellenstein *et al.*<sup>14</sup> graded complications according to the Clavien–Dindo classification.

There are currently no guidelines in laryngology for office-based laryngeal procedures in terms of patient selection, cardiac screening, local anaesthetic dosage, stopping anti-coagulants and post-procedure monitoring. The limitation of our study

was that none of the studies included were of level 1 evidence. However, given the nature of the procedure, it may be difficult to do a randomised, controlled study. The faster access to diagnosis and treatment, resulting in better prognosis and survival, through office-based biopsy remains uncertain.<sup>11</sup> The longitudinal study of long-term outcomes may clarify this.

### Practical issues

The success of the procedure depends on proper planning, good communication with the patient, adequate local anaesthesia, patient selection and skill of the surgeon performing the procedure.<sup>34</sup> Patients with a suspicious lesion on the larynx naturally become anxious about having a procedure under local anaesthetic. If they tolerate the initial examination well, then with appropriate anaesthetic and skill, the procedure can be completed successfully. The absolute contraindication for an office-based procedure is a compromised airway.<sup>12</sup> The relative contraindication was anti-coagulant use and patients who cannot tolerate the procedure because of the gag reflex. However, the study carried out by Fritz *et al.*<sup>35</sup> did not show any complications for those who had office-based laryngeal procedures and were on anti-coagulants.

A variety of local anaesthetic techniques have been described. Endoscopic office-based procedures are usually well tolerated in up to 90 per cent of patients, but this drops to 70 per cent in patients with uncontrolled gag reflex and anxiety.<sup>36</sup> Effective local anaesthetic of the larynx and the pharynx is therefore important in completing the laryngeal procedure successfully. The choice of local anaesthetic is 4 per cent



lignocaine or 2 per cent Cetacaine®. Adequate decongestion of the nasal cavity is also needed, and this can be achieved with 25 per cent Neo-Synephrine® spray.<sup>37</sup> However, different centres use different local anaesthetic. Cohen *et al.* used 2 per cent lignocaine mixed with 0.05 per cent oxymetazoline hydrochloride for the nose, 10 per cent lignocaine spray for the soft palate and 2 per cent lignocaine for the larynx that was administered through the working channel.<sup>19</sup>

Superficial biopsies may result in false negative results.<sup>28</sup> If clinical suspicion is high, it is recommended to take multiple and deeper biopsies. With the advancement of narrow-band imaging, a targeted biopsy can be taken, which will yield a higher positive result. Narrow-band imaging can identify early changes in the mucosal and submucosal vascular pattern and help in early diagnosis of superficial lesions.<sup>38</sup> There are five mucosal aspects on narrow-band imaging, with I to IV being non-malignant and Va to Vc being malignant according to Ni *et al.*<sup>39</sup> Zhou *et al.*<sup>40</sup> carried out a meta-analysis on the diagnostic accuracy of narrow-band imaging in laryngopharyngeal cancers and found a sensitivity of 91 per cent and specificity of 91.5 per cent. Qi *et al.*<sup>41</sup> performed an analysis of 3675 patients who attended the ENT department with different laryngeal symptoms. They used both white light and narrow-band imaging to examine and biopsy the suspected lesions. Malignant lesions show a demarcated brownish area with scattered brown spots on narrow-band imaging. Biopsy of 168 patients with features of malignancy on narrow-band imaging showed only two false negatives. This was because of overlying thick keratin and necrosis.

Schimberg *et al.* carried out a literature review on the cost of office-based laryngeal procedures and found the cost varied between €57 to €110 for out-patient biopsy and €822 to €1101 for operating-room biopsy.<sup>42</sup> The present review has also demonstrated a percentage cost saving ranging from 36 to 95.8 per cent in office-based laryngeal procedures over operating-room biopsy.

## Conclusion

Office-based laryngeal procedures have been increasingly performed with the advent of newer technology. The analysis of the published data clearly shows the benefit on cost, safety and efficacy of out-patient laryngeal biopsy under local anaesthetic. Even though the sensitivity is low in some of the studies, the use of narrow-band imaging improved sensitivity and specificity for laryngeal biopsy.

**Competing interests.** None declared

## References

- American Cancer Society. Cancer facts and figures, 2007. In: <https://www.cancer.org> › research › cancer-facts-figures
- Jones TM, De M, Foran B, Harrington K, Mortimore S. Laryngeal cancer: United Kingdom National Multidisciplinary guidelines. *J Laryngol Otol*. 2016;**130**:S75–8
- Wellenstein DJ, Schutte HW, Takes RP, Honings J, Marres HAM, Burns JA *et al.* Office-based procedures for the diagnosis and treatment of laryngeal pathology. *J Voice* 2018;**32**:502–13
- Schimberg AS, Wellenstein DJ, Schutte HW, Honings J, van den Hoogen FJA, Marres HAM *et al.* Flexible endoscopic biopsy: identifying factors to increase accuracy in diagnosing benign and malignant laryngopharyngeal pathology. *J Voice* 2022;**36**:128–33
- Shoffel-Havakuk H, Halperin D, Yosef L, Lahav Y. Transnasal office-based laryngeal surgery using a distal-chip endoscope with a working channel. *Otolaryngol Head Neck Surg* 2014;**151**:P77–7
- Rosen CA, Amin MR, Sulica L, Simpson CB, Merati AL, Courey MS *et al.* Advances in office-based diagnosis and treatment in laryngology. *Laryngoscope* 2009;**119**:S185–212
- Kraimer KL, Husain I. Updated medical and surgical treatment for common benign laryngeal lesions. *Otolaryngol Clin North* 2019;**52**:745–57
- Caffier PP, Nawka T, Ibrahim-Nasr A, Thomas B, Müller H, Ko S-R *et al.* Development of three-dimensional laryngostroboscopy for office-based laryngeal diagnostics and phonosurgical therapy. *Laryngoscope* 2018;**128**:2823–31
- Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA Statement. *PLoS Med* 2009;**6**:e1000097
- Oxford Centre for Evidence-Based Medicine. OCEBM Levels of Evidence. In: <https://www.cebm.ox.ac.uk/resources/levels-of-evidence/ocebml-levels-of-evidence>
- Lippert D, Hoffman MR, Dang P, McCulloch TM, Hartig GK, Dailey SH. In-office biopsy of upper airway lesions: safety, tolerance, and effect on time to treatment. *Laryngoscope* 2014;**125**:919–23
- Zalvan CH, Brown DJ, Oiseth SJ, Roark RM. Comparison of trans-nasal laryngoscopic office based biopsy of laryngopharyngeal lesions with traditional operative biopsy. *Eur Arch Otorhinolaryngol* 2013;**270**:2509–13
- Cohen J, Benyamini L. Transnasal flexible fiberoptic in-office laryngeal biopsies-our experience with 117 patients with suspicious lesions. *Rambam Maimonides Med J* 2014;**5**:e0011
- Wellenstein DJ, de Witt JK, Schutte HW, Honings J, van den Hoogen FJA, Marres HAM *et al.* Safety of flexible endoscopic biopsy of the pharynx and larynx under topical anesthesia. *Eur Arch Otorhinolaryngol* 2017;**274**:3471–6
- Cha W, Yoon B-W, Jang JY, Lee JC, Lee BJ, Wang S-G *et al.* Office-based biopsies for laryngeal lesions: analysis of consecutive 581 cases. *Laryngoscope* 2016;**126**:2513–9
- Hassan NH, Usman R, Yousuf M, Ahmad AN, Hirani I. Transoral flexible laryngoscope biopsy: safety and accuracy. *World J Otorhinolaryngol Head Neck Surg* 2019;**5**:30–3
- Cohen JT, Bishara T, Trushin V, Benyamini L. Adverse events and time to diagnosis of in-office laryngeal biopsy procedures. *Otolaryngol Head Neck Surg* 2018;**159**:97–101
- Castillo Farias F, Cobeta I, Souviron R, Barberá R, Mora E, Benito A *et al.* In-office cup biopsy and laryngeal cytology versus operating room biopsy for the diagnosis of pharyngolaryngeal tumors: efficacy and cost-effectiveness. *Head Neck* 2014;**37**:1483–7
- Cohen JT, Safadi A, Fliss DM, Gil Z, Horowitz G. Reliability of a transnasal flexible fiberoptic in-office laryngeal biopsy. *JAMA Otolaryngol Head Neck Surg* 2013;**139**:341–5
- Richards AL, Sugumaran M, Aviv JE, Woo P, Altman KW. The utility of office-based biopsy for laryngopharyngeal lesions: comparison with surgical evaluation. *Laryngoscope* 2014;**125**:909–12
- Uys HK, Pelser A, Attwood R, Adam S, Afrogheh A, Hille J *et al.* Diagnosis and staging of laryngopharyngeal tumours with flexible endoscopy: a prospective study. *South Afr J Oncol* 2019;**3**:8
- Saga C, Olalde M, Larruskain E, Álvarez L, Altuna X. Application of flexible endoscopy-based biopsy in the diagnosis of tumour pathologies in otorhinolaryngology. *Acta Otorrinolaringol Esp (Engl Ed)* 2018;**69**:18–24
- Refaat AM, Negm A. Transoral versus transnasal approaches in office-based laryngeal biopsy: a cohort-selection cross-sectional diagnostic accuracy study. *J Voice* 2020;S0892-1997:30343-X
- Chang C, Lin W-N, Hsin L-J, Lee L-A, Lin C-Y, Li H-Y *et al.* Reliability of office-based narrow-band imaging-guided flexible laryngoscopic tissue samplings. *Laryngoscope* 2016;**126**:2764–9
- Pan C-T, Lee L-A, Fang T-J, Li H-Y, Liao C-T, Chen I-How. NBI flexible laryngoscopy targeted tissue sampling in head and neck cancer patients with difficult airways. *Eur Arch Otorhinolaryngol* 2012;**270**:263–9
- Mozzanica F, Ottaviani F, Ginocchio D, Schindler A. Office-based laryngeal biopsy in patients ineligible for general anesthesia. *Iran J Otorhinolaryngol* 2020;**32**:373–8
- Schutte HW, Takes RP, Slootweg PJ, Arts MJPA, Honings J, van den Hoogen FJA *et al.* Digital video laryngoscopy and flexible endoscopic biopsies as an alternative diagnostic workup in laryngopharyngeal cancer: a prospective clinical study. *Ann Otol Rhinol Laryngol* 2018;**127**:770–6
- Naidu H, Noordzij JP, Samim A, Jalisi S, Grillone GA. Comparison of efficacy, safety, and cost-effectiveness of in-office cup forcep biopsies versus operating room biopsies for laryngopharyngeal tumors. *J Voice* 2012;**26**:604–6
- Fang T-J, Li H-Y, Liao C-T, Chiang H-C, Chen I-How. Office-based narrow band imaging-guided flexible laryngoscopy tissue sampling: a

- cost-effectiveness analysis evaluating its impact on Taiwanese health insurance program. *J Formos Med Assoc* 2015;**114**:633–8
- 30 Marcus S, Timen M, Dion GR, Fritz MA, Branski RC, Amin MR. Cost analysis of channeled, distal chip laryngoscope for in-office laryngopharyngeal biopsies. *J Voice* 2019;**33**:575–9
- 31 Lee F, Smith KA, Chandarana S, Matthews TW, Bosch JD, Nakoneshny SC *et al.* An evaluation of in-office flexible fiber-optic biopsies for laryngopharyngeal lesions. *J Otolaryngol Head Neck Surg* 2018;**47**:31
- 32 Chabrillac E, Espinasse G, Lepage B, Uro-Coste E, Dupret-Bories A, De Bonnecaze G *et al.* Contribution of narrow band imaging in delineation of laryngopharyngeal superficial cancer spread: a prospective study. *Eur Arch Otorhinolaryngol* 2021;**278**:1491–7
- 33 Bensoussan Y, Anderson J. In-office laryngeal procedures (IOLP) in Canada: current safety practices and procedural care. *J Otolaryngol Head Neck Surg* 2018;**47**:23
- 34 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**:1910–9
- 35 Fritz MA, Peng R, Born H, Cerrati EW, Verma A, Wang B *et al.* The safety of antithrombotic therapy during in-office laryngeal procedures—a preliminary study. *J Voice* 2015;**29**:768–71
- 36 Young VN, Smith LJ, Sulica L, Krishna P, Rosen CA. Patient tolerance of awake, in-office laryngeal procedures: a Multi-Institutional Perspective. *Laryngoscope* 2011;**122**:315–21
- 37 Woo P. Office-based laryngeal procedures. *Otolaryngol Clin North America* 2006;**39**:111–33
- 38 Filauro M, Paderno A, Perotti P, Marchi F, Garofolo S, Peretti G *et al.* Role of narrow-band imaging in detection of head and neck unknown primary squamous cell carcinoma. *Laryngoscope* 2018;**128**:2060–6
- 39 Ni X-G, He S, Xu Z-G, Gao L, Lu N, Yuan Z *et al.* Endoscopic diagnosis of laryngeal cancer and precancerous lesions by narrow band imaging. *J Laryngol Otol* 2010;**125**:288–96
- 40 Zhou H, Zhang J, Guo L, Nie J, Zhu C, Ma X. The value of narrow band imaging in diagnosis of head and neck cancer: a meta-analysis. *Sci Rep* 2018;**8**:515
- 41 Qi X, Yu D, Zhao X, Jin C, Sun C, Liu X, Cheng J, Zhang D. Clinical experiences of NBI laryngoscope in diagnosis of laryngeal lesions. *Int J Clin Exp Med* 2014;**7**:3305–12
- 42 Schimberg AS, Wellenstein DJ, van den Broek EM, Honings J, van den Hoogen FJA, Marres HAM *et al.* Office-based vs. operating room-performed laryngopharyngeal surgery: a review of cost differences. *Eur Arch Otorhinolaryngol* 2019;**276**:2963–73