Surgical and Voice Outcomes of Office-Based Laser Therapy for Benign Lesions of the Vocal Folds: A Systematic Review of the Literature☆

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SUMMARY: Objective. To investigate the surgical and voice quality outcomes of office-based laser therapy for benign vocal fold lesions (BVFL).

Methods. Two independent investigators searched PubMed, Google Scholar, and Cochrane databases for studies reporting surgical or voice quality outcomes of patients treated with office-based surgery for BVFL, including cysts, pseudocysts, polyps, nodules, granulomas, scars, sulci, and varices. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used. Primary outcomes included lesion regression, complications, number of interventions, patient tolerance, and voice quality assessments. The bias analysis was carried out with the Methodological Index for Non-Randomized Studies (MINORS).

Results. Forty-one studies met the inclusion criteria, accounting for 1936 patients with BVFL. Potassium-Titanyl-Phosphate (KTP), pulsed dye laser (PDL), and blue laser were the most frequently used lasers. Office-based laser therapy demonstrated a cumulative complication rate of 2.4%, with vocal fold hyperemia and edema being the most common complications. Complete lesion resolution rates ranged from 70% to 100% in most studies, while partial regression occurred in 27% to 75% of cases. Subjective [Voice Handicap Index (VHI-10), Grade of dysphonia, Roughness, Breathiness, Asthenia, Strain (GRBAS)] and objective voice parameters [percent jitter, percent shimmer, noise-to-harmonic ratio (NHR), and maximum phonation time (MPT)] commonly demonstrated pretreatment to post treatment significant improvements. Multidimensional voice quality assessment protocols were used in a small number of studies. Substantial heterogeneity existed across studies regarding inclusion criteria, surgical approaches, and voice quality outcome measurements. MINORS scores demonstrated low-to-moderate methodological quality of all studies.

Conclusion. Office-based laser surgery is a safe and effective treatment for BVFL leading to complete or partial lesion regression in most cases. Future studies need to consider multidimensional voice quality assessment protocols to evaluate longitudinal voice quality outcomes.

Key Words: Office–Blue laser–Voice–Laryngology–Benign lesion–Vocal fold.

INTRODUCTION

Voice disorders affect approximately 1 in 5 adults in the United States, with the highest incidence in professional voice users, reaching up to 80%.[1,2] Benign lesions of the vocal folds (BVFL) are among the most prevalent etiologies of dysphonia in both the general and professional voice user populations,[2] with polyps, Reinke's edema, and nodules being the primary BVFL in the United States and Europe.[3,4] Depending on the lesion, the management of BVFL may include voice therapy, laryngopharyngeal reflux disease medication, surgical excision, and adjunctive therapies such as steroid or botulinum toxin injections.[4,5] While office-based laryngology procedures have been well-established in the United States for two decades, this approach has gained popularity throughout the rest of the world over the past decade, with an increasing number of publications investigating the effectiveness, safety, and voice quality outcomes of office-based laryngeal procedures for BVFL.[5,6] One of the most commonly performed office-based treatment modalities for BVFL is laser therapy. Currently, office-based laser therapy is limited for polyps, Reinke's edema, nodules, varices/ectasias, granulomas, sulci, and scars, while most cases of cysts and pseudocysts remain commonly operated in the operating room.[5–7] The surgical outcomes of numerous studies suggest that office-based laser procedures are safe for BVFL, but, to date, there is no systematic review documenting associated potential adverse events and complications.[5] The literature is also limited to a few studies documenting presurgery to post comprehensive voice evaluation, including patient-reported outcome measures, perceptual and

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stroboscopic evaluations, and aerodynamic and acoustic measurements.[5–7]

This systematic review aimed to investigate the surgical and voice quality outcomes of office-based laser therapy for BVFL, offering a comprehensive overview of the current evidence.

MATERIALS AND METHODS

The criteria for study inclusion and exclusion were based on the population, intervention, comparison, outcome, timing, and setting (PICOTS) framework.[8] The data review and collection were carried out by two independent investigators (M.M. and J.R.L.) according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyse (PRISMA) checklist for systematic reviews.[9]

Population, inclusion, and exclusion criteria

Populations consisted of adults with a diagnosis of BVFL, including cysts, pseudocysts, polyps, nodules, granulomas, scars, sulci, and varices. The diagnosis was confirmed by stroboscopy examination and/or pathological analysis. Studies were selected for further examination if they reported inclusion/exclusion criteria, patient demographics, diagnostic criteria, potential laser parameters, surgical, or voice quality outcomes. Studies involving pediatric populations or malignant lesions were excluded. Single case reports were not included.

Outcomes

The primary outcomes consisted of surgical and voice quality outcomes of office-based laser therapy for BVFL. For studies using lasers, the following lasers were considered: photoangiolytic lasers (Potassium-Titanyl-Phosphate (KTP), Pulsed Dye Laser (PDL), and true blue laser) and cutting lasers (Carbon Dioxide Laser (CO2), Thulium Laser (Tm:YAG), and (Nd:YAG) laser). Surgical outcomes included safety, tolerance of the procedure, number of interventions, partial or total lesion regression seen on laryngeal examination with and without stroboscopy, operating room revisions, and complications. The voice quality outcomes included self-reported voice quality questionnaires (eg, Voice Handicap Index (VHI)[10]), perceptual evaluations (eg, Grade of dysphonia, Roughness, Breathiness, Asthenia, Strain (GRBAS)[11] and Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V)[12]), aerodynamics measurements (eg, Maximum Phonation Time (MPT), phonatory quotient), and acoustic measurements. According to the European consensus guidelines for voice quality assessment,[13] the following acoustic parameters were collected: fundamental frequency F0, percent jitter, percent shimmer, noise to noise-to-harmonic ratio (NHR), range of intensity, and minimal/maximal intensity. For acoustic and aerodynamic assessments, the method for determining the outcomes was investigated (eg, assigned patient tasks [sustained vowels, read text, and continuous speech], types of sustained vowels, number of sustained vowels, and part of the vowel where the acoustic parameters were measured).

The secondary outcomes included the study design, number of patients, and demographics (eg, mean/median age, gender, and body mass index).

Intervention and comparison

The investigators considered studies reporting findings of office-based surgery for BVFL (eg, cysts, pseudocysts, polyps, nodules, granulomas, scars, sulci, and varices), with or without comparison with a control group (operating room procedures).

Timing and setting

There were no criteria for specific stage or timing in the disease process of the study population.

Search strategy

The search was conducted through PubMed, Google Scholar, and Cochrane databases to identify studies evaluating surgical and voice quality outcomes of office-based procedures for BVFL. The literature search included retrospective case series, uncontrolled or controlled prospective studies, and case series published between January 2000 and January 2025. The studies were published in English or French in peer-reviewed journals.

The keywords included: “blue laser,” “KTP,” “PDL,” “Thulium Laser,” “in-office,” “office-based,” “laryngeal lesion,” “voice,” “procedure,” “surgery,” “polyps,” “cyst,” “pseudocyst,” “granuloma,” “nodule,” “scar,” “varice,” and “sulcus.” Results of the search strategy were reviewed for relevance and the reference lists of these articles were examined for additional pertinent studies. Each selected study was reviewed to exclude overlapping publications.

Bias analysis

The bias analysis was carried out with the Methodological Index for Non-Randomized Studies (MINORS) tool. MINORS is a validated tool designed for grading the quality of nonrandomized surgical studies, whether comparative or noncomparative.[14] The MINORS consists of 12 items related to the analysis of methodological points of comparative and noncomparative studies. The items were scored 0 if absent; 1 when reported but inadequate; and 2 when reported and adequate. The aim of the study was rated as clearly stated (2), unclear (1), or absent (0). The inclusion of patients was evaluated in terms of consecutive inclusion (0 or 2), while the prospective data collection was rated as perfectly prospective (2), retrospective analysis of prospectively recruited patients (1), or absent (0). The quality of endpoints was judged as high (2) when authors reported surgical outcomes and both subjective and objective voice quality outcomes. The evaluation of surgical outcome only, or partial evaluation of voice quality was judged as incomplete (1). According to the time of tissue healing and the timing of occurrence of early and delayed complications related to procedures and the risk of

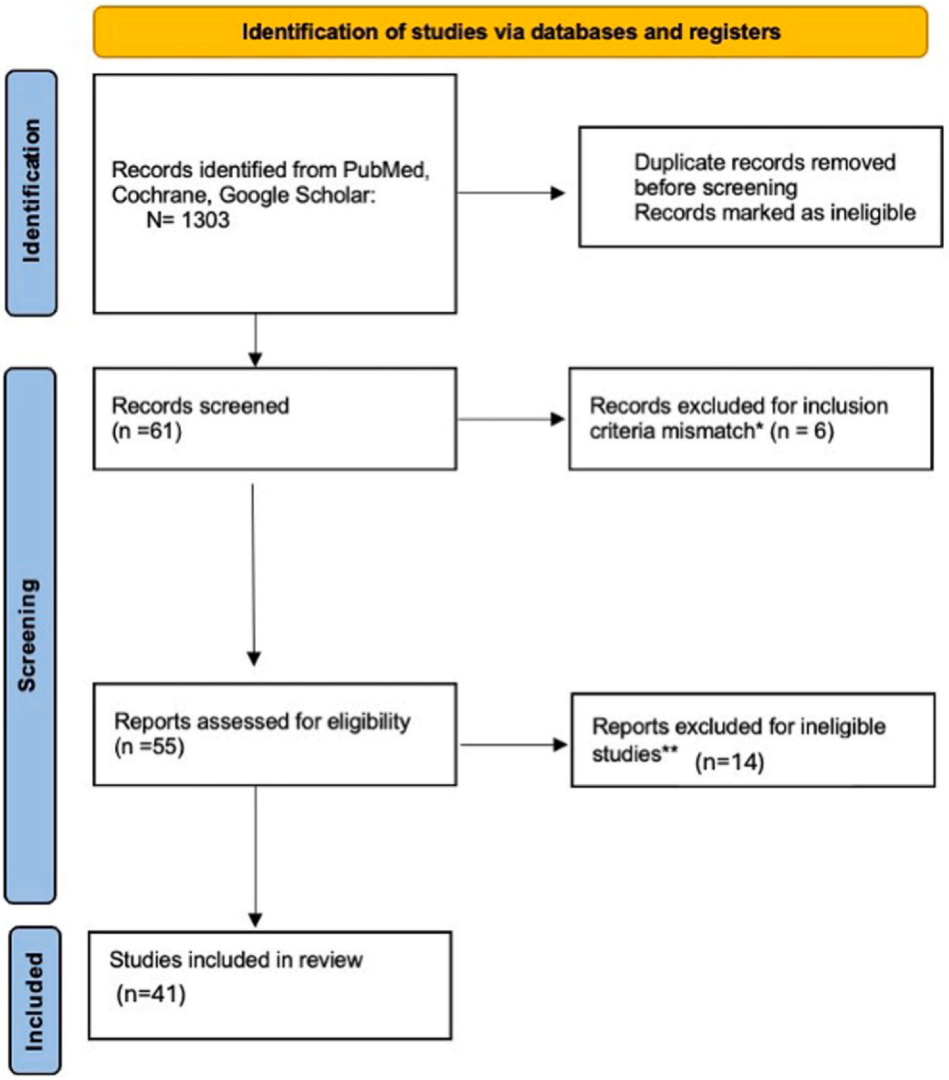

FIGURE 1. *Flowchart.* *Microlaryngeal surgery under general anesthesia, systematic reviews, and meta-analysis studies. **Use of adjunctive treatments and treatment of benign vocal fold lesions not considered in this review.

recurrence, a follow-up period of at least 3 months was considered as adequate. Finally, a lost-to-follow-up rate of less than 5% was considered acceptable according to the MINORS. The ideal MINORS score was 16 for non-comparative studies and 24 for comparative studies.[14]

RESULTS

Of the 1303 records identified, 41 studies met the inclusion criteria (Figure 1, Tables 1 and 2). Among them, 32 were retrospective studies,[15–46] six were uncontrolled prospective studies,[47-52] and one was a controlled prospective study.[24] Demographics, patient characteristics, and laser types are summarized in Table 1. Surgical or voice outcomes were reported for 1,936 patients with BVFL. The most frequently reported BVFL was vocal fold polyps (n = 972), Reinke's edema (n = 241), and granulomas (n = 117). Gender information was not reported for 658 patients. In studies specifying gender ratio, most participants were male (Table 1). When reported, the mean ages ranged from 41 to 61 years. The most-used laser types were the KTP (n = 16 studies), the PDL (n = 11), and the blue laser (n = 10). The types of BVFL in studies are described in Table 3.

Surgical outcomes

Lesion regression

The most common surgical outcome was the BVFL regression seen on stroboscopic examinations (Table 4). Complete lesion resolution rates ranged from 70% to 100% in most studies.[15-17,32,33,36-39,44,49,53-55] Three studies[23,35,45] reported complete resolution in 50% of cases. According to studies, partial regression occurred in 27% to 75% of cases (Table 2).[17,23,32,34,35,39,42,43,45,54] The lowest resolution rate was found for vocal fold polyps (16%).[39] In most studies, BVFL regression was assessed subjectively, ie, the laryngeal examination was rated by a physician without the use of any requiring objective analysis system. The number of interventions and criteria used for defining partial or

TABLE 1.
Demographics and Types of Lesions

Outcomes	Number
Total number of patients	1936
Total number of BVFL	1577
Polyps (N)	972
Reinke's edema (N)	241
Nodules (N)	4
Cysts (N)	35
Pseudocysts (N)	2
Granuloma (N)	117
Scar (N)	45
Varices (N)	83
Sulcus (N)	6
Gender	
Females (N, %)	598 (30.8%)
Males (N, %)	680 (35.1%)
Unspecified (N, %)	658 (33.9%)
Mean age (years)	41-70.75
Types of Lasers	
KTP (532 nm)	16
PDL (585 nm)	11
Blue laser	10
ND:YAG (1064 nm)	1
CO2	2
Green laser (532 nm)	1
Thulium laser (2013 nm)	4

Abbreviations: BVFL, benign lesions of the vocal folds; n, number.

complete resolution varied across studies. Thus, Mizuta et al observed complete polyp resolution in 15% of patients after two procedures,[34] while Ivey et al reported > 70% reduction in polyp size in 38% of patients after an average of 1.1 sessions.[32] Chadwick et al used the Voice-Vibratory Assessment of Laryngeal Imaging[56] demonstrating a significant reduction in polyp size at 1 month post procedure.

Lesion recurrences

Recurrence was investigated in three studies[24,27,41] with only one reporting one recurrence of an excised granuloma.[41] Regarding the need for surgery in an operating room after office-based treatment, 26% of granuloma ultimately required operating room excision in the study of Koufman.[25] Ivey et al showed that 40% of large polyps versus 13% of small polyps required revision in the operating room.[32]

Tolerability and complications

Tolerance was investigated in five studies, reporting high rates of tolerance according to several evaluation tools.[16,18,26,28,49] Zheng et al found that reduced tolerance was reported in smokers, patients with posteriorly located lesions, and in lesions involving more than 50% of the vocal fold.[28] Complications are detailed in Table 5. The cumulative complication rate for office-based procedures treating BVFL—including cysts, pseudocysts, polyps, nodules, granulomas, scar tissue, sulcus, and varices—was 2.4%. A total of 23 complications were reported across all included studies, with the most frequent being vocal fold hyperemia ($n = 7$) and edema ($n = 5$).

Stroboscopy and voice quality outcomes

Table 4 reports surgical and voice quality outcomes. The stroboscopic evaluations, VHI-10, MPT, percent jitter, and shimmer were the most commonly used voice quality outcomes.

Stroboscopy evaluations

Among studies using stroboscopy as a primary outcome, Chadwick et al used the Voice-Vibratory Assessment of Laryngeal Imaging to describe vocal fold regularity, phase symmetry, and mediolateral supraglottic activity, all demonstrating presurgery to postsurgery significant improvements at 1 month post treatment.[24] Wang et al reported 87% of patients had normal or mildly reduced mucosal wave at 2 weeks postsurgery, reaching 100% at 6 weeks. Moreover, mucosal wave improvement was observed in 25% of patients at 2 weeks postsurgery and 38% at 6 weeks.[21] Three studies reported significant gains in mucosal wave amplitude and vibratory movement of the vocal fold after office-based laryngology procedures.[27,39,52] Improvements in mucosal wave function were also reported by other teams, ranging from 81.82% to 100% (Table 4).[21,29,39,50]

Subjective voice quality

Subjective voice assessment was primarily evaluated using the VHI-10, which was the most frequently utilized patient-reported outcome questionnaire across studies.[15–17,20,21,23,24,26,30,37,38,40,42–46,48,51–54] Perceptual voice quality was evaluated in most studies with the GRBAS scale.[17,21,26,27,33,38,39,43,45,48,51] VHI-10, GRBAS, and VAS scores showed significant postoperative improvements. Ma et al reported a significant association between lesion size and GRBAS outcomes. Halum et al used a subjective voice self-assessment 10-point scale (1 = much better voice; 10 = much worse), which showed presurgery to postsurgery significant improvements at 24 hours and 1 week after surgery, except for the patient with granuloma (Table 4). Similarly, Gurău et al used a nonvalidated voice self-assessment and demonstrated a significant improvement of perceptual voice quality after the procedures in a follow-up period ranging from 1 to 72 months (polyps, cysts, or granuloma).

Objective measurements

The most common acoustic and aerodynamic parameters were percent/absolute jitter, percent/absolute shimmer, NHR, and MPT (Table 4). Several studies did not specify the exact type of jitter[21,38,39,43,50] or shimmer[21,38,39,43,51,53] measured. Percent jitter,[17,26,27,33,34,39,46,48] percent

TABLE 2.
Demographic, Surgical, and Voice Quality Outcomes of Studies

Reference	Design	Disease	N	M/F	Age	Laser	Setting	Interventions (N)	Outcomes	Results	FU
		P N C PC G Sc V S RE									
Chadwick et al, 2024[24]	Controlled prospective	+	27	16/11	42.63	KTP (532-nm)	20 W 20 ms ON 2 Hz	5/27: *N* = 2	VHI-10, SVHI-10 CAPE-V VALI Acoustic and aerodynamic measures*	pre > post CPP, CPP SD: pre > post at 1mo MADV: post > pre at 1mo	3 months
Hamdan et al, 2024[15]	Retropective	+ +	35	17/18	48.43	TBL	NP	*N* = 1	VHI-10 VLS NHR, VTI, MPT, % jitter, % shimmer	pre > post P: 76.5% complete regressionRE: 33.3%type I 100%, type II 36%, type III 25%P: MPT pre < postRE & P: % shimmer pre > postRE: NHR pre > post	3 weeks-6 months
Hamdan et al, 2023[53]	Case report	+ +	3	2/1	47	TBL	10W,40 ms ON/ 150 ms OFF	*N* = 1	VHI-10VLSF0, HP, jitter (RAP), shimmer, NHR, VTI, MPT	Pre > post100% regressioncase 1 & 3: amelioration for VTIcase 2: amelioration F0 & HP	3-4 months
Filauro et al, 2023[16]	Retrospective	+ +	52	26/26	54.58	TBL	10W,30 ms ON/ 150 ms OFF	*N* = 1.08	VHI-10VLSPain and discomfort	Pre > postP: 80.9%, 100% remissionRE: 70.1%, 100% remissionP = RE	2 months
Hamdan et al, 2023[17]	Retrospective	+	18	12/6	52.5	TBL	10W,10 ms ON/ 300 ms OFF	NP	VHI-10, GRBASVLS% jitter, % shimmer, NHR, VTI, MPT	Pre > post: VHI-10, GRB73% (100%) regression27% partial regression% jitter, % shimmer: pre > postMPT pre < post	3-10 weeks
Hamdan et al, 2025[47]	Uncontrolled prospective	+ + + + +	45	25/20	48.87	TBL	NP	NP	GAD-7 PHQ-9 SBP, DBP, HR, Sp02	no corr. btw anxiety/ depression and changes in vital signs. SBP, DBP, HR: pre < postSp02: pre > post	5 minutes
Hamdan et al, 2023[18]	Retrospective	+ + +	48	26/22	54	TBL	NP	NP	Tolerance (IOWA)	SMO < non-SMOSize (< 1/2 VF) < (> 1/2 VF)↓ with swallows	10.38 ± 4.8 minutes
Del Signore et al, 2016[19]	Retrospective	+ + + +	255	145/110	49	PDL(585 nm)KTP (532 nm)	PDL: 0.75 J/ pulseKTP: NP	NP	Complications	4.3% complications	10 months
Sridharan et al, 2014[20]	Retrospective	+	31	20/11	42.29	KTP (532 nm)	NP	NP	VHI-10 NHR & F0	VHI-10: pre > post at 1st FUNo signif amelioration	1st FU: 56.7 d2nd FU: 69.9d from 1st FU
Wang et al, 2015[21]	Retrospective-matched cohort	+	50 (OB +OR)	16/34	44	KTP (532 nm)	6-8 W/ pulse,20-30 ms ON, 2 Hz	*N* = 1	VAS (dysphonia) VHI-10GBR scaleVLS Jitter, shimmer, NHR, MPT	pre < postpre > postpre > post87% of the patients had= or mildly ↓ mucosal wave MPT pre < post, shimmer pre > post	2-6 weeks

TABLE 2 (*Continued*)

Reference	Design	Disease	N	M/F	Age	Laser	Setting	Interventions (N)	Outcomes	Results	FU
Centric et al, 2014[22]	Retrospective	+ +	33	21/12	49	PDL (585 nm)	NP	6/33, *N* = 2 5/33, N ≥ 3	ComplicationsResolution of Σ	1G anxiety, 0% complicP: 100% resolution	6 months
Hamdan and Ghanem, 2021[23]	Retrospective	+ +	11	8/3	55.18	TBL	10 W,10 ms ON/ 300ms OFF	NP	VHI-10VAS (dysphonia)VLS	Pre > postPre > post 50% (100%) resolution50% partial	53.13 days
Koufman et al, 2007[25]	Retrospective	+ +	151	75% ♂	PDL:55	PDL (585 nm)	1 J/pulse	G: 1.6RE: 1.5	Need of OR surgery after OBComplications	G: 26% OR after PDLRE: 0%0.9%	G:12moRE:7.3 mo
Wang et al, 2013 [48]	Uncontrolled prospective	+	36	10/26	45	KTP (532 nm)	6-8 W/pulse, 15-25 ms ON, 2 Hz	NP	VHI-10, GRBVLS% jitter, % shimmer, NHR, F0, v F0, MPTAdverse effects	Pre > postKTP +polypectomy: 70% KTP only: 38% MPT pre < post at 6wShimmer pre > postJitter pre > post in KTP onlymild→ resolved within 1 week.	2-6 week
Halum and Moberly, 2010[49]	Uncontrolled prospective	+ +	10	6/4	57.2	CO2PDL (585 nm)	CO2: 4WPDL: 1 J/pulse.	NP	Pain/burn (/10) VLS: resolutionVoice self-assessment tool (/10)	CO2 = PDL (2-3/10)100%G: no improvementV: pre > post	1 month
Hu et al, 2017[26]	Retrospective	+ + + +	40	28/12	56	CO2	5 W 0.05second O-N/ 0.01second O-FF	RE: 1-2/patient	Tolerance & feasibilityMPT, % jitter, % shimmer, NHRVHI-10, GRBAS	1 N: VF mobility→stiffnessMPT pre < post% jitter, NHR pre > postVHI-10 pre > post	3.5 monthsRE: 7.5 months
Hsiung et al, 2003[27]	Retrospective	+	14	6/8	39	KTP (532 nm)	1-2 W, 3-7 seconds	NP	% jitter, % shimmer, NHR, MPTGRBASVLS	% jitter, % shimmer: pre > post GBRAS pre > postVLS: post > pre, no recurrence	7 months
Zheng et al, 2021[28]	Retrospective	+ +	56	42/12	61	KTP (532 nm)	NP	NP	Tolerance (VAS)	PL > NPL, SMO > no-SMOPolyp/ cyst > RRP > RE > DY	NP
Sheu et al, 2012[29]	Retrospective	+ + + + +	102	NP	NP	KTP (532 nm)	NP	NP	VLS	↓ size except ScMucosal wave/ glottic closure ↑ or = in > 90%	1st FU: 60d2nd FU: 148 d
Mouadeb and Belafsky, 2007[30]	Retrospective	+ + + +	47	30/17	NP	PDL (585 nm)	0.75-1.5 J/ pulse	NP	ComplicationsVHI-10Need of OR intervention	8/117 procedures incomfort3/ 117 inadequate visualization/ edema1 RE -> stridor -> hospital admissionPre > postRE:20%, P:28.6%, G:33.3%, C:100%, V:0%	13.5 months

TABLE 2 (*Continued*)

Reference	Design	Disease	N	M/F	Age	Laser	Setting	Interventions (N)	Outcomes	Results	FU
Mallur et al, 2011[31]	Retrospective	+ + + + +	32	NP	NP	KTP (532 nm)	27.5 ms ON2 Hz	7/32: *N* = 2	Variability in laser parameters Regression	No ≠ in laser parameters↓ in size, except nonhemorrhagic P	1 yrC/PC: 1-2 months
Zeitels et al, 2006[50]	Uncontrolled prospective	+	39	18/21	NP	PDL(585 nm)KTP (532 nm)	PDL: 0.45 ms ON, 5 J/ pulse 2HzKTP: l5 ms ON, 5.25 J/ pulse, 2Hz	NP	VLSF0, jitter,NHR, ratio of SPL to subglottal pressureComplic-ations	↑ in mucosal wave function ImprovedEcchymosis of the SLP: PDL > KTP	NP
Ivey et al, 2008[32]	Retrospective	+	29	NP	NP	PDL (585 nm)	450 μs ON, 1 s OFF0.75 J/ pulse	*N* = 1.1	Polyp size% of patients who opted for OR surgery after OB	11/29 > 70% improvement after *N* = 1.1 procedures 48% > 50% improvement40% of larger P13% of those with small P	NP
Kim et al, 2008[33]	Retrospective	+	62	34/28	44	PDL (585 nm)	450 ms ON0.75-1J/ pulse2 Hz	1/62 had 2 procedures	Disease regressionGRBA-SNHR,% jitter, % shimmer, sPPQ, sAPQ, SPI	100% in 60/6295% in 2/62 Pre > postSignificant improvement	5.2 months
Mizuta et al, 2015[34]	Retrospective	+	20	11/9	59.3	Green laser (532 nm)	1.5 W, 300 ms ON/ 500ms OFF	3/20, *N* = 2	Disease resolution% Jitter, % shimmer,MFR,M-PT	85%, 100% resolution after 1 procedure, 15% with 2 proceduresImporvement & OB = GA	6 weeks
Clyne et al, 2005[35]	Retrospective	+	10	NP	58	PDL (585 nm)	450 μs ON, 1 J/pulse1 Hz	2/10, *N* > 1	Lesion resolutionCompli-cations	50%, 100% resolution 30% partial 20% no change0%	6 months
Gurău et al, 2023[36]	Retrospective	+ + + +	315	NP	NP	ND: YAG(1064 nm)	40 W	*N* = 1.04	Lesion resolutionVoice subjective evaluation	100% complete ablationSatisfactoryRE: 25.7% satisfactory	1-72 months
Dominguez et al, 2017[37]	Retrospective	+	26	18/8	59.04	KTP (532 nm)	20-45 W, 20-40 ms ON, 2-3 Hz	*N* = 1.65 ± 1.16	VLSVHI-10Σ improvement	96.2% ↓ in size73.1%, 100% resolution, 53.8%, 100% after 1 KTPnot signif70% resolved, 20%=, 10% ↓	9.5 months
Lin et al, 2018[38]	Retrospective	+	97	48/49	45.6	KTP (532 nm)	NP	7/97 multiples procedures	VLS MPT,jitter,shimm-er, NHRVAS (dysphonia)GRB-VHI-10	*laser+ polypectomy 94% complete resolutionLaser only 72% = btw the 2 groups except for MPT; *laser+polypectomy > laser only*Pre < postPre > postPre > post	1-2mo

TABLE 2 (*Continued*)

Reference	Design	Disease	N	M/F	Age	Laser	Setting	Interventions (N)	Outcomes	Results	FU
Ma et al, 2021[39]	Retrospective	+	25	3/22	45.26	KTP (532 nm)	6W	NP	VLSVHIGRBASM-PT, F0, jitter, shimmer	mucosal wave post > pre4/25 100% reduction, 13/25 50-100%, 7/25 < 50% Pre > postPre > postMPT pre < postJitter, shimmer pre > post	6.04mo
McGarey et al, 2021[40]	Retrospective	+	6	6/0	41	KTP (532 nm)	NP	*N* = 1	VHI-10/ SVHI-10VLS	VHI/ SVHI-10 pre > postresolved after 1 TT	2-6w
Hamdan et al, 2024[54]	Retrospective	+ +	35	17/18	48.43	TBL	NP	*N* = 1	VHI-10Disease regression% jitter, % shimmer, NHR, VTI, MPT, F0, HP	Pre > postcomplete regression:P:76.5%RE: 33.3% Shimmer pre > post, P: MPT pre < postRE: NHR pre > post	3w-6mo
González-Herranz et al, 2023[41]	Retrospective	+ +	47	63.4% ♀17/30	51.2	Blue laser400 & 600nm	P & G: 5-10 W, 20-50 ms ON, 100 ms OFFSc/S: 2-3W, 10ms ON/ 50-200ms OFF	*N* = 2.1 all lesions includedSc, G > P	VLSComplication-s	95.75% resolutionRecurrence in one bulky G→ dyspnea1 Sc did not tolerate	4-24mo
Hamdan et al, 2024[42]	Retrospective	+	22	Tm:YA-G3/ 9TBL: 2/8	Tm: YA-G55.7-5TBL: 57.1	Tm:YA-G(2013 nm)TBL	YAG: 3.5-4.5 W, repetition 2-4 HzTBL: 10 W, 40 ms ON/ 300 ms OFF	NP	VHI-10VLS: disease regression	pre > postYAG = TBLYAG: 40.9%, 100% regressionTBL: 52.9%YAG = TBL	NP
Hamdan et al, 2022[43]	Retrospective	+	11	3/8	51.27	Tm: YA-G(2013n-m)	Noncontact mode contact mode (grade II/III) 3.5-4.5 W,70-300 ms ON, 2-4 Hz	*N* = 1 except for 2	VHI-10GRBASHPjitter, shimmerMPTVLS	Pre > postPre > postpre < pos-tpre > post but NSpre = post25% 100% resolution75% partial	VLS: 6–12 w
Hamdan et al, 2020[44]	Retrospective	+	20	15/5	50.95	Tm: YA-G(2013n-m)	contact/ noncontact mode,3.5-4 W, 300 ms ON, repetition2 Hz	*N* = 1 except for 1	Disease regressionincom-plete glottal closure (N) impaired mucosal waves (N)VHI-10	80%, 100% resolutionpre > postpre > postpre > post	14-124 d

TABLE 2 (*Continued*)

Reference	Design	Disease	N	M/F	Age	Laser	Setting	Interventions (N)	Outcomes	Results	FU
Hamdan et al, 2021[55]	Case report	+	3	2/1	52.33	Tm: YA-G(2013n-m)	4.5 W, 70-300 ms, repetition 5 Hz	*N* = 1	Disease regressionSelf-reported voice qualityGlottal closure	100%normal post treatmentpre < post	case 1: 2 yrscase 2: 3mo & 1 yrcase 3: 5 mo
Ghanem et al, 2025[45]	Retrospective	+	8	0/7	59.63	TBL	10W, 40ms ON/ 300ms OFF	*N* = 1	VHI-10GRBASVLSTM-PF0, HP, % jitter, % shimmer, NHR, VTI	Pre > postG,R,B pre > post50% complete, 50% partial regressionNS	3-6w
Koszewski et al, 2015[46]	Retrospective	+	19	18/1	53.9	KTP(532 nm) &PDL (585 nm)	NP	NP	Safety & tolerabilityVHI-10DSI% jitter, frequency range, MPT, phonation threshold pressure, mean airflow rate	20% procedures truncated due to patient intolerancePre > postPre < p-ost%jitter, phonation threshold pressure: pre > postPhonatory frequency range: pre < post	NP
Pitman et al, 2012[51]	Uncontrolled prospective	+	7	0/7	51.8	KTP (532 nm)	35 W, 15 ms ON	*N* = 1	VHI-10GRBASVLS examinationMPT, median F0, RAP%, NHR, shimmer, open quotientHistologi-cal effects	5/7 pre > postpre > postintact mucosal wave PTMPT, median F0 post > preintact epithelium with changes in vocal fold vascularity	5-78w
Mortensen et al, 2008[52]	Uncontrolled prospective	+	11	8/3	NP	PDL (585 nm)	0.75 J/pulse	NP	VHI-10VLS%Jitter, % shimmer, NHR, MPFSelf-evaluation	Pre > post at 6mo PTbetter vibration and amplitude with decreased hyperemiamean phonatory flow:pre < post10/11 improved	6mo

*CPP, F0, low/high F0, mean pitch, MPT, MADV, MSPLDV, MPAP, SPR, S:Z ratio

Abbrevations: Σ, symptoms; btw, between; corr, correlation; CPP, cepstral peak prominence; DBP, diastolic blood pressure; F0, fundamental frequency; GAD-7, Generalized Anxiety Disorder scale-7; HR, heart rate; IOWA, Iowa Satisfaction with Anesthesia Scale; MADV, maximum airflow during voicing; MFR, mean flow rate; MPAP, mean peak air pressure; MPT, maximum phonation time; MSPLDV, mean sound pressure level during voicing; no-SMO, non smokers; NP, not provided; NPL, non posterior lesions; OB, office-based procedure; OBLS, office-based laryngeal surgery; OR, operating room; RAP, Relative Average Perturbation; sAPQ, smoothed amplitude perturbation quotient; SBP, systolic blood pressure; SD, standard deviation; SLP, superficial lamina propria; SMO, smokers; PHQ-9, Patient Health Questionnaire-9; PL, posterior lesions; PT, post treatment; SPI, soft phonation index; Sp02, oxygen saturation; sPPQ, smoothed pitch perturbation quotient; SPR, semitone pitch range; TBL, true blue laser (445nm); VALI, Voice-Vibratory Assessment of Laryngeal Imaging; VAS, visual analog scale; vF0, variation of fundamental frequency in female patients; VLS, videolaryngoscopic examination.

TABLE 3.
Types of Lesions Across Studies

References	Design	Patients (*n*)	N (BVFL Under OB)	Procedures (*n*)	P	N	C	PC	G	Sc	V	S	RE
Hamdan et al, 2024[15]	Retropective	28	38	28	17	0	0	0	0	0	0	0	21
Hamdan et al, 2023[53]	Case report	3	3	3	0	0	2	1	0	0	0	0	0
Filauro et al, 2023[16]	Retrospective	52	52	NP	37	0	0	0	0	0	0	0	15
Hamdan et al, 2023[17]	Retrospective	18	18	NP	18	0	0	0	0	0	0	0	0
Hamdan et al, 2025[47]	Uncontrolled prospective	45	40	NP	14	2	3	0	0	2	0	0	11
Hamdan et al, 2023[18]	Retrospective	48	37	NP	15	0	3	0	0	0	0	0	19
Del Signore et al, 2016[19]	Retrospective	255	180	NP	116	0	0	0	5	31	28	0	0
Sridharan et al, 2014[20]	Retrospective	31	31	NP	31	0	0	0	0	0	0	0	0
Wang et al, 2015[21]	Retrospective matched cohort	25	25	25	25	0	0	0	0	0	0	0	0
Centric et al, 2014[22]	Retrospective	33	15	NP	10	0	0	0	5	0	0	0	0
Hamdan and Ghanem, 2021[23]	Retrospective	11	6	NP	4	0	0	0	0	0	0	0	2
Chadwick et al, 2024[24]	Controlled prospective	27	27	32	27	0	0	0	0	0	0	0	0
Koufman et al, 2007[25]	Retrospective	151	35	58	0	0	0	0	23	0	0	0	12
Wang et al, 2013[48]	Uncontrolled prospective	36	36	36	36	0	0	0	0	0	0	0	0
Halum and Moberly, 2010[49]	Uncontrolled prospective	10	2	NP	0	0	0	0	1	0	1	0	0
Hu et al, 2017[26]	Retrospective	40	14	NP	5	2	3	0	0	0	0	0	4
Hsiung et al, 2003[27]	Retrospective	14	14	NP	0	0	0	0	0	0	14	0	0
Zheng et al, 2021[28]	Retrospective	56	21	NP	16	0	0	0	0	0	0	0	5
Sheu et al, 2012[29]	Retrospective	102	48	NP	24	0	2	0	13	1	0	0	8
Mouadeb et al, 2007[30]	Retrospective	47	21	34	7	0	0	0	3	0	1	0	10
Mallur et al, 2011[31]	Retrospective	32	44	44	30	0	1	1	7	0	0	0	5
Zeitels et al, 2006[50]	Uncontrolled prospective	39	65	40	0	0	0	0	0	0	39	0	0
Ivey et al, 2008[32]	Retrospective	29	29	NP	29	0	0	0	0	0	0	0	0
Kim et al, 2008[33]	Retrospective	62	72	NP	62	0	0	0	0	0	0	0	0
Mizuta et al, 2015[34]	Retrospective	20	20	23	20	0	0	0	0	0	0	0	0
Clyne et al, 2005[35]	Retrospective	10	10	NP	0	0	0	0	10	0	0	0	0
Gurău et al, 2023[36]	Retrospective	315	308	328	256	0	18	0	24	0	0	0	14
Dominguez et al, 2017[37]	Retrospective	26	26	43	0	0	0	0	26	0	0	0	0
Lin et al, 2018[38]	Retrospective	97	97	NP	97	0	0	0	0	0	0	0	0
Ma, 2021[39]	Retrospective	25	25	NP	25	0	0	0	0	0	0	0	0
McGarey et al, 2021[40]	Retrospective	6	6	6	6	0	0	0	0	0	0	0	0
Hamdan et al, 2024[54]	Retrospective	35	38	35	17	0	0	0	0	0	0	0	21
González-Herranz et al, 2023[41]	Retrospective	47	16	NP	7	0	0	0	0	0	0	6	3
Hamdan et al, 2024[42]	Retrospective	22	39	NP	0	0	0	0	0	0	0	0	39
Hamdan et al, 2022[43]	Retrospective	11	19	13	0	0	0	0	0	0	0	0	19
Hamdan et al, 2020[44]	Retrospective	20	21	21	21	0	0	0	0	0	0	0	0
Hamdan et al, 2021[55]	Retrospective	3	3	3	0	0	3	0	0	0	0	0	0
Ghanem et al, 2025[45]	Retrospective	7	7	7	0	0	0	0	0	0	0	0	7
Koszewski et al, 2015[46]	Retrospective	19	37	25	0	0	0	0	0	0	0	0	19
Pitman et al, 2012[51]	Uncontrolled prospective	7	14	7	0	0	0	0	0	0	0	0	7
Mortensen et al, 2008[52]	Uncontrolled prospective	11	14	NP	0	0	0	0	0	11	0	0	0

Abbreviations: C, cyst; G, granuloma; N, nodule; OB, office-based surgery; P, polyp; PC, pseudocyst; S, sulcus; Sc, scar; V, varix.

TABLE 4.
Surgical and Voice Quality Outcomes

Outcomes	Number of Studies	References (ref)	Amelioration Number (ref)	No Change Number (ref)	Worsening Number (ref)
Surgical outcomes					
Lesion regression	29	15-17,21,23,24,27,29,31-45,48,49,50,53,54,55	-	-	-
Recurrence	3	24,27,41	-	-	-
Need of OR after OB	2	25,32	-	-	-
Tolerance	6	16,18,26,28,46,49	-	-	-
Pain/discomfort	2	16,49	-	-	-
GAD-7/PHQ-9	1	47	-	-	-
Vital signs	1	47	-	-	-
Complications	9	19,22,25,30,35,41,46,55	-	-	-
Voice quality (VQ) outcomes					
Subjective VQ					
VHI	1	39	1/1	-	-
VHI-10	22	15-17,20,21,23,24,26,30,37,38,40,42-46,48,51-54	21/22 (37) ↓ but NS	-	-
SVHI-10	2	24,40	2/2	-	-
CAPE-V	1	24	1/1	-	-
Perceptual VQ evaluation					-
Self-reported voice quality (VAS)	7	21,23,36,38,49,52,55	5/7 (36) 25.7% for RE	(49) only for granuloma	
GRBAS	11	17,21,26,27,33,38,39,43,45,48,51	10/11 (26) ↓ in G,R,A but not significant	(26) = in B,S	-
Stroboscopy findings				-	-
VALI	1	24	Mucosal wave, ML and AP supraglottic activity		
Mucosal wave	12	21,23,27,29,32,38,39,44,49-51,53	3/12 (27), (39), and (51) 7/12* (21) 100% at 6w (29) 90% PT (50) 100% PT (39) 81, 8% PT	(50) in singing induced phonotraumatic zones (38) 12% of patients	-
Glottic closure	5	29,39,44,53,55	5/5	-	-
Wave amplitude	3	27,39,52	3/3	-	-
Vibrational asymmetry	1	40	-	52% asymmetry	-
Objective VQ					
Acoustic measurements					
Jitter	16	15,17,21,26,27,33,34,38,39,43,45,46,48,50,52,54	10/16 (15), (21), (54), (43), (45), and (52) NS	-	-
Jitter (RAP)	2	51,53	2/3 cases*	(51)	1/3 cases*
Shimmer	16	15,17,21,26,27,33,34,38,39,43,45,48,51-54	10/16 (53)* and (26)*(43), (45), and (52) NS	(51)	-

TABLE 4 (*Continued*)

Outcomes	Number of Studies	References (ref)	Amelioration Number (ref)	No Change Number (ref)	Worsening Number (ref)
NHR	15	15,17,20,21,26,27,33,38,45,48,50-54	3/12 (15), (54) only for RE (21), (45), (52) NS (27)*	(50)* 1/39 patients (51)	(53)*(48) (17), (20) NS
VTI	5	15,17,45,53,54	(53)*: 1/3 cases (45) NS	(53)*: 1/3 cases	(15), (17), (54): NS (53)* 1/3 cases
F0	9	20,24,39,45,48,50,51,53,54	(50), (20) ↑ for females, (51), (48), (39), (45): NS (53)* 1/3 cases	(54), (20) for males (24)	-
HP	4	43,45,53,54	(43) ↑(45) NS	(54) (53)* ↑ 2/3 cases, ↓ 1/3 cases	-
Aerodynamic measurements					
MPT	16	15,17,21,24,26,27,33,38,39,43,45,46,48,51,53,54	9/16 (15) only for P(24), (27), (45), (46): NS (53)*	(43)	-
MFR	2	34,46	1/2 (46) NS	-	-
S/Z ratio	1	24	-	(24)	-
Other	3	24,33,50	-	-	-

Abbreviations: CAPE-V, Consensus Auditory-Perceptual Evaluation of Voice; GAD-7, Generalized Anxiety Disorder scale-7; HP, habitual pitch; MFR, mean flow rate; NHR, noise-to-harmonic ratio; PHQ-9, Patient Health Questionnaire-9; VALI, Voice-Vibratory Assessment of Laryngeal; VTI, Voice Turbulence Index.

shimmer,[15,17,21,27,33,34,39,48,54] and NHR[26,33,38] showed significant postoperative improvements. MPT increased from pretreatment to post treatment in nine studies.[17,21,26,33,38,39,48,51,54]

Some teams assessed other objective measures such as cepstral peak prominence, fundamental frequency range (low/high F0), mean pitch (F0), smoothed pitch perturbation quotient, smoothed amplitude perturbation quotient, and soft phonation index.[24,33,46] Among aerodynamics, the ratio of oral sound pressure level to subglottal pressure, maximum airflow during voicing, mean sound pressure level during voicing, mean peak air pressure, phonation threshold pressure, semitone pitch range, and S/Z ratio were used in one study.[24,46]

Bias analysis

The MINORS scores of the included studies ranged from 3 to 10 (Table 6), indicating low-to-moderate methodological quality. The main limitations were the retrospective design of most studies and the absence of sample size calculation. All studies clearly stated their research objectives. However, only 17 studies[17,22,24,25,27,29,31,32,37,38,41,44–46,48,49,51] detailed their inclusion and/or exclusion criteria. Comorbidities potentially impacting surgical or vocal outcomes were inconsistently reported. A history of smoking was documented in only 17 studies,[15-18,23,28,42-47,49,51,53-55] while vocal abuse or phonotraumatic behavior was assessed in 9 studies.[15,17,22,33,39,40,53,54,55] Laryngopharyngeal reflux disease was documented in four studies[15,35,37,47] with a prevalence ranging from 22.2% to 100%. Three additional studies referred to reflux disease without distinguishing laryngopharyngeal reflux and gastroesophageal reflux diseases.[17,18,41,51,55] Additionally, diagnostic clarity was scarce in some studies. Thus, most studies did not specify whether a postoperative histopathological examination was done to confirm the diagnosis. Some studies also included benign lesions located outside the true vocal folds, such as in the supraglottic, infraglottic, false vocal fold, or paraglottic regions;[26,30,41] these data were therefore excluded from the present review. It should be noted that the number of polyps, granulomas, Reinke's edema, and cysts reported in this review as being treated with office-based laser therapy is likely overestimated. For instance, Lin et al included 68 patients who underwent laser procedures combined with polypectomy.[38] Moreover, in the study by Gurău et al, 216 out of 315 patients were treated using flexible endoscopic techniques such as cold surgery (forceps), diathermy excision (snare), or a combination of both—without the use of laser.[36] Therefore, these figures should be interpreted with caution.

Due to the retrospective design, most studies lacked prospective inclusion of consecutive patients, which impacted their MINORS scores. The low mean MINORS scores may also be attributed to insufficient reporting of loss to follow-up and methodological bias in outcome assessments. Only thirteen studies provided appropriate endpoint assessment with both subjective and objective voice measures.[15,17,21,24,27,33,38,39,41,43,45,48,51] From a

TABLE 5.
Complications

References	Complication Rate	Sample Size	Laser Type	Types of Complications
Chadwick et al, 2024[24]	0%	27	KTP	-
Hamdan et al, 2024[15]	NP	35	TBL	NP
Hamdan et al, 2023[53]	NP	3	TBL	NP
Filauro et al, 2023[16]	NP	52	TBL	NP
Hamdan et al, 2023[17]	NP	18	TBL	NP
Hamdan et al, 2025[47]	NP	45	OBLS	NP
Hamdan et al, 2023[18]	NP	48	TBL	NP
Del Signore et al, 2016[19]	4.3%	255	PDL KTP	P: hyperemia (*N* = 3) Sc: hyperemia (*N* = 2), atrophy (*N* = 1) V: hyperemia (*N* = 2), swallowed piece of glass (*N* = 1)
Sridharan et al, 2014[20]	0%	31	KTP	-
Wang et al, 2015[21]	NP	50	KTP	NP
Centric et al, 2014[22]	3%	33	PDL	Anxiety attack (*N* = 1)
Hamdan and Ghanem, 2021[23]	0%	11	TBL	-
Koufman et al, 2007[25]	0.9%	151	PDL	Vasovagal episode (*N* = 1), VF hemorrhages (*N* = 2), and PDL fiber tip broke off in the trachea (*N* = 1)
Wang et al, 2013[48]	NP	36	KTP	NP
Halum and Moberly, 2010[49]	NP	10	CO2 PDL	NP
Hu et al, 2017[26]	2%	40	CO2	Mild vocal fold wound stiffness (*N* = 1)
Hsiung et al, 2003[27]	0%	14	KTP	-
Zheng et al, 2021[28]	NP	56	KTP	NP
Sheu et al, 2012[29]	NP	102	KTP	NP
Mouadeb et al, 2007[30]	0%	47	PDL	-
Mallur et al, 2011[31]	NP	32	KTP	NP
Zeitels et al, 2006[50]	0%	39	PDL KTP	-
Ivey et al, 2008[32]	NP	29	PDL	NP
Kim et al, 2008[33]	0%	62	PDL	-
Mizuta et al, 2015[34]	NP	20	Green laser (532 nm)	NP
Clyne et al, 2005[35]	0%	10	PDL	-
Gurău et al, 2023[36]	NP	315	ND:YAG	NP
Dominguez et al, 2017[37]	NP	26	KTP	NP
Lin et al, 2018[38]	8%	97	KTP	VF edema (*N* = 5), vocal hematoma (*N* = 2), and vocal ulceration (*N* = 1)
Ma, 2021[39]	NP	25	KTP	NP
McGarey et al, 2021[40]	NP	6	KTP	NP
Hamdan et al, 2024[54]	NP	35	TBL	NP
González-Herranz et al, 2023[41]	0%	47	Blue laser 400 and 600 nm	-
Hamdan et al, 2024[42]	NP	22	Tm: YAG and TBL	NP
Hamdan et al, 2022[43]	NP	11	Tm:YAG	NP
Hamdan et al, 2020[44]	NP	20	Tm:YAG	NP
Hamdan and Rizk, 2021[55]	0%	3	Tm:YAG	-
Ghanem and Hamdan, 2025[45]	0%	8	TBL	-
Koszewski et al, 2015[46]	0%	19	KTP and PDL	-
Pitman et al, 2012[51]	0%	7	KTP	-
Mortensen et al, 2008[52]	NP	11	PDL	NP

Abbreviations: CO_2, carbon dioxide; KTP, potassium titanyl phosphate (532 nm); NP, not provided; P, polyp; PDL, pulsed dye laser (585 nm); Sc, scar; TBL, true blue laser (455 nm); V, varix; VF, vocal fold; YAG, yttrium aluminum garnet.

TABLE 6.
Bias Analysis

References	Clearly stated aim	Inclusion of consecutive patients	Prospective data collection	Endpoints appropriate to study	Unbiased endpoint assessment	Follow-up adequate period	<5% of lost to follow-up	Sample size calculation	Total MINORS score
Chadwick et al, 2024[24]	2	1	2	2	1	2	0	0	10
Hamdan et al, 2024[15]	2	0	0	2	0	2	1	0	7
Filauro et al, 2023[16]	2	0	0	1	0	1	0	0	4
Hamdan et al, 2023[17]	2	0	0	2	1	1	1	0	7
Hamdan et al, 2025[47]	2	0	2	1	0	1	0	0	6
Hamdan et al, 2023[18]	2	1	0	1	0	1	0	0	5
Del Signore et al, 2016[19]	2	0	0	1	1	1	0	0	5
Sridharan et al, 2014[20]	2	2	1	1	0	2	0	0	8
Wang et al, 2015[21]	2	2	0	2	1	1	0	0	8
Centric et al, 2014[22]	2	1	0	1	0	2	0	0	6
Hamdan and, Ghanem, 2021[23]	2	0	0	1	0	1	0	0	4
Koufman, 2007[25]	2	0	0	1	0	2	1	0	6
Wang et al, 2013[48]	2	1	0	2	1	1	0	0	7
Halum and Moberly, 2010[49]	2	1	2	1	2	1	0	0	9
Hu et al, 2017[26]	2	2	1	1	0	2	0	0	8
Hsiung et al, 2003[27]	2	0	0	2	1	2	0	0	7
Zheng et al, 2021[28]	2	1	0	1	2	0	0	0	6
Sheu et al, 2012[29]	2	1	0	1	2	2	0	0	8
Mouadeb et al, 2007[30]	2	0	0	1	1	2	0	0	6
Mallur et al, 2011[31]	2	1	0	1	1	1	0	0	6
Zeitels et al, 2006[50]	2	0	2	1	0	0	0	0	5
Ivey et al, 2008[32]	2	2	1	1	1	0	2	0	9
Kim et al, 2008[33]	2	0	0	2	2	2	0	0	8
Mizuta et al, 2015[34]	2	0	0	1	0	1	0	0	4
Clyne et al, 2005[35]	2	0	0	1	0	1	0	0	4
Gurău et al, 2023[36]	2	0	0	1	0	2	0	0	5
Dominguez et al, 2017[37]	2	1	0	1	0	2	0	0	6
Lin et al, 2018[38]	2	2	1	2	0	1	0	0	8
Ma, 2021[39]	2	0	0	2	0	2	0	0	6
McGarey et al, 2021[40]	2	2	1	1	2	1	0	0	9
Hamdan et al, 2024[54]	2	0	0	2	0	2	1	0	7
González-Herranz et al, 2023[41]	2	1	0	1	0	2	0	0	6
Hamdan et al, 2024[42]	2	0	0	1	2	0	0	0	5
Hamdan et al, 2022[43]	2	0	0	2	0	1	2	0	7

TABLE 6 (*Continued*)

References	Clearly stated aim	Inclusion of consecutive patients	Prospective data collection	Endpoints appropriate to study	Unbiased endpoint assessment	Follow-up adequate period	< 5% of lost to follow-up	Sample size calculation	Total MINORS score
Hamdan et al, 2020[44]	2	0	0	1	0	1	0	0	4
Hamdan and Rizk, 2021[55]	2	0	0	1	0	2	0	0	5
Ghanem and Hamdan, 2025[45]	2	0	0	2	0	1	1	0	6
Koszewski et al, 2015[46]	2	0	0	1	0	0	0	0	3
Pitman et al, 2012[51]	2	0	2	2	2	2	0	0	10
Mortensen et al, 2008[52]	2	1	2	1	2	2	0	0	10

Abbreviations: MINORS, Methodological Index for non-randomized studies.

methodological standpoint, most studies did not perform blinded stroboscopic evaluations or blinded perceptual voice assessments.[15-20,22,23,25-43,47,49,50,53,54] No study reported a sample size calculation, although some acknowledged that small sample sizes limited the generalizability of their findings. Based on the MINORS methodological threshold of 16 for noncomparative studies, no included study reached the standard for high-quality evidence in the office-based management of BVFL.

DISCUSSION

The indications for office-based laser therapy have been limited for a long time to mucosal and some selected submucosal lesions, including polyps, Reinke's edema, nodules, and varices, while still being controversial for cysts and pseudocysts.

The primary findings of this review suggested adequate surgical outcomes, with a cumulative complication rate of 2.4%, high patient tolerance, and adequate lesion resolution for small and controllable mucosal and submucosal lesions. Regarding the investigation of mucosal versus submucosal BVFL outcomes, the number of studies considering office-based laryngology procedures for submucosal BVFL remains low.[19,26,36] Gurău et al treated 18 cysts through office-based YAG laser procedures, reporting both adequate postoperative lesion resolution (100%) and patient-reported voice quality.[36] Interestingly, no recurrence of excised cysts has been reported by the authors. The surgical and patient-reported voice quality outcomes were comparable across mucosal and submucosal BVFL, supporting the safety and interest of office-based laser procedures for both types of lesions. Hu et al investigated the usefulness of office-based CO2 laser procedures in patients with BVFL, including cysts, polyps, and vocal fold nodules.[26] Similarly to Gurău et al, they suggested the feasibility of operating on cysts and nodules through office-based laryngology laser procedures without reporting significant postoperative lesion-related complications, tolerance issues, or voice quality disorders at 3.5 months post treatment.[26] Del Signore et al reported postoperative findings of 255 patients who underwent office-based laryngology PDL/KTP laser procedures for BVFL, including scars and varices. While the authors did not provide pretreatment to post treatment data of voice quality, they observed a substantially higher complication rate (4.3%) compared with studies focusing on mucosal BVFL only, with higher complication proportions in varices and scars compared with polyps.[19] The results of this systematic review support a similar tolerance rate for mucosal and submucosal BVFL to those observed in other recent systematic reviews dedicated to office-based procedures for recurrent respiratory papillomatosis[57] and leukoplakia.[58] Importantly, consistent with previous studies conducted in non-BVFL,[18] patient tolerance may be associated with tobacco consumption,[28] which is related to an overall mucosal sensory disorder.[59]

Although the review supports consistent surgical outcomes for office-based laser therapy for BVFL, the heterogeneity across studies for the proportions of included submucosal BVFLs, and the lack of large-cohort studies considering subgroup analyses (mucosal versus submucosal BVFL), limits the drawing of a valid conclusion.

The present review explored the voice quality outcomes following office-based laser therapy for BVFL. The trends found in this review suggest potential substantial improvements of subjective and objective voice quality pretreatment to post treatment, but the heterogeneity across studies in terms of voice quality methodology and postoperative follow-up limits our understanding of the recovery process and our ability to draw valid conclusions. Indeed, only a few studies used partial or full multidimensional voice quality outcomes, combining validated patient-reported outcome questionnaires, perceptual, stroboscopic, aerodynamic, and acoustic evaluations.[15,17,21,24,27,33,38,39,41,45,48,51,52] The method used to evaluate voice quality has a critical impact on the outcomes.[13,60,61] For example, it has been demonstrated that depending on the selection of the time interval over which the acoustic parameters are measured (mid 1, 2, and 3 seconds versus most stable part of the sustained vowel /a/), the potential effect of the treatment may or may not be statistically demonstrated.[60] In the same vein, most studies failed to implement blinded stroboscopic evaluations or blinded perceptual assessments of voice quality, which may influence the judgment of postoperative voice.[13,62,63] While most studies considered the patient perception, using VHI, VHI-10, or CAPE-V, this single approach is limited and cannot capture some subtle changes highlighting the biomechanical properties of the vocal folds and their related functioning.[13] For this reason, current consensus statements and expert papers recommend using a multidimensional approach to reliably evaluate presurgical to postsurgical voice quality outcomes, including subjective and objective evaluation modalities.[13,61] The implementation of short-term to long-term multidimensional voice quality evaluation protocols could lead to valuable insights regarding the efficacy of office-based laser therapy for BVFL. Concerning stroboscopy, the rapid development of AI-powered software analyzing the vocal fold macro- and microscopic aspects, as well as the vibratory process,[64] could be considered as adjunctive clinical tools to better evaluate the impact of the type of BVFL on the postoperative outcomes.

The primary limitations of this review were the low number of large-cohort and high-quality prospective studies, the lack of studies assessing voice quality through a multidimensional approach, and the limited evaluation of confounding factors, including laryngopharyngeal reflux disease, tobacco use, and vocal behavior. Although the findings of this review suggest adequate postoperative surgical and voice quality outcomes, future studies are needed to investigate the safety, usefulness, and voice quality outcomes in patients who underwent office-based laser therapy for BVFL. Such studies are important to refine the indications and boundaries of office-based laryngology procedures.

CONCLUSION

Office-based laser therapy appears to be a safe and well-tolerated approach for BVFL, with high rates of complete or partial lesion resolution and low complication rates. Surgical and voice quality outcomes commonly improved from pretreatment to post treatment. However, the lack of a large cohort comparing mucosa versus submucosal BVFL outcomes through multidimensional voice quality evaluation limits the drawing of a valid conclusion.

CRediT Authorship Contribution Statement

Jerome Lechien: design, acquisition of data, final approval, and accountability for the work; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Meryem Miri**: design, final approval, and accountability for the work; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. **Kathy Huet, Véronique Delvaux, and Abdul-Latif Hamdan**: final approval, and accountability for the work; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Declaration of Competing Interest

About the paper entitled: "Surgical and Voice Outcomes of Office-Based Surgery for Benign Lesions of the Vocal Fold: A Systematic Review." (The authors have no financial interest in the subject under discussion. All authors have read and approved the paper. Would you be so kind to consider the present paper and send us the Reviewer's comments).

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