Implementation of Office-Based Procedures: Experience and Learning Curve of a Single Center☆

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SUMMARY: Objective. To report surgical outcomes and learning curve findings of a single laryngeal surgeon throughout the implementation of an office-based laryngology setting.

Methods. From January 2022 to January 2025, 114 consecutive patients were treated with office-based laryngological procedures in the EpiCURA hospital (Belgium). The following outcomes were prospectively collected: gender, age, indications, laser settings, setting, anesthesia and procedure duration, pain (visual analog scale), laryngeal sensory testing, exposure, immediate adverse events, patient compliance, local anesthesia efficacy, and patient satisfaction. Pitfalls were prospectively collected, and the impact of related adjustments was investigated.

Results. A total of 142 office-based laryngology procedures were performed (114 patients), with a 96.5% success rate. Primary indications included vocal fold augmentation (30.3%) and laser surgery for Reinke edema (16.9%). Mean procedure duration decreased significantly from 13.8 to 8.0 minutes over time. The learning curve statistics reported an overall stability of outcomes (time of procedure) after 101 cases for all office-based procedures, with minimum case numbers of 41 for polyp/Reinke edema and 38 for vocal fold augmentation, respectively. Key improvements included changing anesthesia concentration, adding preoperative speech therapy consultation, modifying laser settings, and introducing preoperative anxiolytics. These adjustments significantly reduced procedure duration, patient anxiety, dysphagia, and dyspnea while maintaining high satisfaction rates.

Conclusion. Office-based laryngology shows a significant learning curve with procedure duration decreasing by 42% over three years with consistent patient satisfaction. Key adjustments may significantly reduce procedure duration, patient anxiety, dysphagia, and dyspnea while maintaining high satisfaction rates.

Key Words: Otolaryngology–Otorhinolaryngology–Voice–Office-based–In-office–Learning.

INTRODUCTION

The shift of many in-operating room procedures into ambulatory settings occurred in many fields of the otolaryngology head and neck surgery specialty over the past two decades.[1] The reason for implementing office-based procedures included economic pressure from the hospital and healthcare system, advancement of technologies, and patient demand to reduce the costs and the risks related to general anesthesia and hospital stay.[1,2] Laryngology was one of the first otolaryngological subspecialties to make this shift with the development of office-based laryngeal procedures for many benign lesions of the vocal folds.[3] The development of fiber-guided laser systems (eg, potassium titanyl phosphate, pulsed dye, and blue laser) represented a key advancement in office-based laryngological practice, as their precise wavelength selectivity for hemoglobin, minimal thermal spread to adjacent tissues, and fiber-delivery capabilities ensure a safe and effective office-based procedure.[4,5] Although a paradigm shift, in Europe, the office-based procedure offerings remain limited to some Academic and University Medical Centers, with limited training opportunities. Moreover, to date, a few publications report surgical outcomes and learning curve findings of the implementation of office-based laryngology settings.

The aim of this study was to report surgical outcomes and learning curve findings of a single laryngeal surgeon throughout the implementation of an office-based laryngology setting.

MATERIALS AND METHODS

Patients and settings

The laryngology and broncho-esophagology division of the Department of Otolaryngology—Head and Neck Surgery at EpiCURA Hospital (Baudour, Belgium) opened in December 2021 following the appointment of the author of this paper as laryngeal surgeon. The author completed a fellowship in laryngology in Paris (Foch Hospital) and received training for office-based laryngology at the Hamburg International courses (Germany; M. Hess and colleagues in 2021). From January 2022 to January 2025, 142 consecutive patients underwent office-based laryngological procedures in the laryngology division. The baseline protocol consisted of an initial consultation for

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procedure indication, patient education, and obtaining informed consent. Voice quality assessment was conducted during the first consultation by the laryngologist. On the day of the office-based procedure, the patient's vital parameters were recorded. Patients received an anxiolytic 30 minutes before the procedure. For laser indications, the blue-laser (Soluvos, Netherlands) settings were adjusted according to manufacturer recommendations and the Hamburg laryngology protocol, and protective goggles were distributed to all subjects in the office. The procedure began with laryngopharyngeal local anesthesia (lidocaine 10%) in addition to skin anesthesia (lidocaine 2%) for patients undergoing vocal fold augmentation.

In this study, most vocal fold augmentation procedures consisted of suprathyroid membrane injection of hyaluronic acid (Volift, Allergan®, Abbvie, Dublin, Ireland) through a 21-G incurved needle. Concerning blue-laser lesion resection, the procedure was performed through the operative channel of the fiberscope (Xion®, Berlin, Germany). For polyps, the procedure started with a blue-laser cauterization of the polyp, followed by the resection of the lesion through forceps introduced in the operative channel.

The laryngologist performed the procedure with a speech-language pathologist (SLP) assistant. Following the procedure, patients were monitored for 15 minutes to detect potential adverse events before discharge. Postoperative care included voice rest for 2 days (vocal fold augmentation) or 5 days (laser procedures), with voice therapy initiated one week post surgery. Medication included dextromethorphan-codeine sirup to reduce postoperative cough and antireflux therapy (postmeal alginate or antacids three times daily for one month). Patients consented to participate to the study. The local ethics committee approved the study (EpiCURA-Register voice—2023).

Surgical and clinical outcomes

The following outcomes were prospectively collected: gender, age, indications, laser settings, procedural environment, anesthesia and procedure duration, pain (1-10 visual analog scale (VAS)), laryngeal sensitivity throughout the procedure (1-10 VAS), exposure difficulties (1-10 VAS), immediate adverse events, patient compliance, local anesthesia efficacy, and patient satisfaction. For adverse events, dysphagia and dyspnea were evaluated by patients with a 1-10 VAS. All VAS evaluations ranged from 1 (no problem) to 10 (severe problem). After each case, the laryngeal surgeon documented surgeon-related difficulties and pitfalls. Patients were asked to rate their tolerance of the procedure on a scale from 1 (very difficult tolerance) to 10 (perfect tolerance). Success of office-based laryngeal surgery was reported as the achievement of procedure. Hospital anxiety and depression scale (HAD)[6] was used to evaluate the anxiety and depression of patients. Reflux symptom score (RSS),[7] Voice Handicap Index (VHI),[8] and Perceived Stress Scale (PSS)[9] were used for the assessment of laryngopharyngeal reflux disease symptoms, patient-reported voice quality, and stress.

Statistical analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows (SPSS, v29.0; IBM Corp, Armonk, NY, USA). Surgical outcomes were compared across three cohorts: the first 47 procedures, the second 47 procedures, and the last 48 procedures. The impact of specific adjustments was investigated using Mann-Whitney *U* test or Chi-square test according to data characteristics. Association studies between outcomes and validated patient-reported outcome questionnaires were conducted using Spearman correlation coefficient, with correlations classified as low ($k < 0.40$), moderate ($k = 0.40$-0.60), and strong ($k > 0.60$). A significance level of $P < 0.05$ was considered.

Concerning the learning curve analysis, three independent datasets of task-completion times T_n (in minutes) were analyzed to assess learning dynamics in all office-based laryngology (first dataset), Reinke edema (second dataset), and vocal cord paralysis (third dataset). For each series of N observations $T_1, T_2, \ldots, T_n$, we first computed the running (cumulative) mean

$$\bar{T}_n = (1/n)\ \textstyle\sum_{i=1}^{n} T_i,\ n = 1, \ldots, N,$$

to smooth trial-to-trial variability and visualize the overall improvement trend. We then postulated a power-law relation $T_n = a \cdot n^b$, in which the scale parameter estimates the duration on the first trial and the exponent b (expected negative) quantifies the rate of learning. Nonlinear least-squares estimation of (a, b) employed the Gauss-Newton algorithm as implemented in R's nls function (with initial guesses a^(0) = max T_n and b^(0) = −0.2). Model fit was evaluated both by visual inspection of cumulative-mean curves and through log-log plots of T_n against n, where a perfect power law yields a straight line. Coefficients of determination (R^2) on the log-log regressions and the asymptotic values $\bar{T}_n$ of the cumulative mean were recorded to compare learning across datasets.

RESULTS

One hundred and forty-two procedures were performed on 114 patients. There were 67 female patients (58.8%). The mean age was 61.8 ± 15.9 years. The mean age and gender ratio were comparable across groups. The most common indications for office-based laryngology included vocal fold augmentation for unilateral vocal fold paralysis (18.3%) and aging voice (12.0%), laser surgery for Reinke edema (16.9%), vocal fold polyp (13.4%), and leukoplakia (7.0%) (Table 1). Patient groups were comparable for baseline RSS, VHI, PSS, and HAD scores (Table 2). Three vocal fold augmentations were carried out transnasally, while the

TABLE 1.
Demographics and Procedure Indications

Outcomes	First period group (n = 47)	Second period group (n = 47)	Third period group (n = 48)	Total procedures (n = 142)
Age (mean, SD)	62.0 ± 14.6	63.5 ± 16.4	59.4 ± 16.8	61.8 ± 15.9
Gender				
Female	24 (51.1)	28 (59.6)	28 (58.3)	80 (56.3)
Male	23 (48.9)	19 (40.4)	20 (41.7)	42 (29.6)
Indications and procedures				
Vocal fold augmentations				
Aging voice/atrophy	2 (4.3)	9 (19.1)	6 (12.5)	17 (12.0)
Unilateral paralysis	7 (14.9)	10 (21.3)	9 (18.8)	26 (18.3)
Sulcus	0 (0)	2 (4.3)	2 (4.2)	4 (2.8)
Post cordectomy	0 (0)	1 (2.1)	1 (2.1)	2 (1.4)
Vocal fold scar	3 (6.4)	0 (0)	1 (2.1)	4 (2.8)
Mean hyaluronic acid volume (mL)	62.0 ± 14.6	63.5 ± 16.4	59.4 ± 16.8	61.8 ± 15.9
Laser surgery				
Reinke edema	10 (21.3)	10 (21.3)	4 (8.3)	24 (16.9)
Vocal fold polyp	7 (14.9)	2 (4.3)	10 (20.8)	19 (13.4)
Vocal fold nodules	0 (0)	1 (2.1)	2 (4.2)	3 (2.1)
Vocal fold granuloma	1 (2.1)	2 (4.3)	0 (0)	3 (2.1)
Tracheal stenosis/web	1 (2.1)	1 (2.1)	0 (0)	2 (1.4)
Leukoplakia/dysplasia	4 (8.5)	3 (6.4)	3 (6.3)	10 (7.0)
Vocal fold hemorrhage	2 (4.3)	0 (0)	4 (8.3)	6 (4.2)
Vocal fold papillomatosis	3 (6.4)	4 (8.5)	0 (0)	7 (4.9)
Vocal fold angioma	1 (2.1)	0 (0)	0 (0)	1 (0.7)
Vocal fold cyst	2 (4.3)	1 (2.1)	1 (2.1)	4 (2.8)
Microbiopsies and lesion resection				
Carcinoma	4 (8.5)	0 (0)	1 (2.1)	5 (3.5)
Laryngocele	0 (0)	1 (2.1)	1 (2.1)	2 (1.4)
Posterior transverse cordotomy	0 (0)	0 (0)	2 (4.2)	2 (1.4)
Botulinum toxin (R-CPD)	0 (0)	0 (0)	1 (2.1)	1 (0.7)

Abbreviations: SD, standard deviation; *n*, number; R-CPD, retrograde cricopharyngeal dysfunction.

others were performed transcervically (suprathyroid membrane).

Surgical and clinical outcomes

Office-based surgery failed in five patients due to laryngeal hypersensitivity (n = 3) or excessive swallowing (n = 2). These issues led to an inability to complete the procedure (two polyps, two vocal fold augmentations, and one leukoplakia). In the remaining 137 procedures, both patients and laryngologists reported appropriate postoperative results. None of the 137 patients required operating room revision. Twenty-six patients underwent a second office-based procedure for the following reasons: grade IV Reinke edema requiring two blue-laser sessions (n = 8), recurrence of leukoplakia (n = 4), repetitive hyaluronic acid injection for vocal fold paralysis (n = 9), and vocal fold augmentation for aging voice (n = 5). Two patients had three sessions for repetitive hyaluronic acid injection for vocal fold paralysis; both individuals were rejected by anesthesiologists for operating room fat medialization.

The practitioner evaluated laryngeal sensitivity differently throughout the office-based procedures, with higher sensitivity values in the first period of procedures compared with the last ones (Table 2). The practitioner progressively modified the laser settings. The laser-delivered energy and pulse length significantly increased, while the pauses significantly decreased from the first to the last procedure (Table 2). The mean duration of procedures significantly decreased from 13.8 to 8.0 minutes over time. Subgroup analysis showed that the mean duration time of polyp and Reinke edema procedures was 11.8 ± 7.2 minutes, with 11.9 ± 8.1 minutes for polyp procedures and 11.4 ± 5.5 minutes for Reinke edema procedures. The mean duration time of augmentation procedures was 12.3 ± 6.0 minutes. The patient-reported duration of procedures did not differ from the actual duration and significantly decreased over time. The difficulties in exposing the larynx, the practitioner-reported compliance, the patient pain, and satisfaction remained steady throughout the study period.

Subgroup analyses were carried out for the three most common procedures: polyp resection (n = 19), Reinke edema intervention (n = 24), and vocal fold augmentation (n = 53). The mean procedure duration, patient satisfaction, and pain levels were comparable across all groups. The endpoint of polyp resection was the achievement of the

TABLE 2.
Surgical Outcomes

Outcomes	First period group ($n = 47$)	Second period group ($n = 47$)	Third period group ($n = 48$)	P value	Total ($n = 142$)
Baseline Symptom Scores					
Reflux Symptom Score	109.3 ± 70.5	114.3 ± 88.9	124.7 ± 63.6	NS	114.6 ± 78.8
Voice Handicap Index	59.1 ± 31.2	57.9 ± 32.7	40.1 ± 28.2	NS	54.8 ± 31.8
Perceived Stress Scale	26.9 ± 7.9	29.4 ± 6.7	30.1 ± 6.4	NS	28.8 ± 7.0
HAD—Depression	6.3 ± 3.8	6.3 ± 4.0	6.5 ± 5.4	NS	6.3 ± 4.0
HAD—Anxiety	8.6 ± 5.1	9.5 ± 4.3	7.8 ± 4.0	NS	9.0 ± 4.6
Laryngeal VAS sensitivity (1-10)	6.0 ± 3.3	4.2 ± 3.9	3.8 ± 3.0	0.002	4.7 ± 3.5
Laser setup (watts)	8.5 ± 0.8	9.0 ± 0.8	9.4 ± 0.5	0.019	9.4 ± 0.5
Pulse length (mean, SD; ms)	26.3 ± 5.5	30.0 ± 0.01	30.0 ± 0.01	0.018	27.9 ± 4.5
Pauses (mean, SD; ms)	244.6 ± 71.1	150.0 ± 0.01	150.0 ± 0.01	0.001	187.9 ± 64.5
Laser setting time (minutes)	1.4 ± 0.7	1.2 ± 0.4	1.9 ± 1.0	NS	1.4 ± 0.7
Duration of procedure (minutes)	13.8 ± 7.7	11.2 ± 6.0	8.0 ± 5.2	0.016	11.1 ± 6.8
Patient-evaluated duration (minutes)	13.4 ± 7.1	12.5 ± 7.3	8.8 ± 5.4	0.002	11.7 ± 6.9
Exposure difficulty (1-10)	1.4 ± 0.7	1.2 ± 0.4	1.6 ± 0.9	NS	1.8 ± 1.5
1-2 no problem/mild problem	37 (78.7)	43 (91.5)	43 (89.6)	NS	123 (86.6)
3-5 moderate problem	9 (19.1)	2 (4.3)	5 (10.4)	NS	16 (11.3)
6-8 severe problem	1 (2.1)	2 (4.3)	0 (0)	NS	3 (2.1)
9-10 very severe problem	0 (0)	0 (0)	0 (0)	NS	0 (0)
Practitioner-reported compliance	8.4 ± 1.9	8.4 ± 2.5	8.2 ± 2.5	NS	8.3 ± 2.3
Patient-reported overall pain (1-10)	1.0 ± 2.0	1.1 ± 1.8	1.2 ± 2.1	NS	1.1 ± 2.0
Patient-reported nasal pain (1-10)	1.0 ± 2.1	1.3 ± 1.9	0.9 ± 1.4	NS	1.1 ± 1.9
Patient-reported laryngeal pain (1-10)	0.7 ± 1.7	0.5 ± 1.3	0.2 ± 0.6	NS	0.5 ± 1.4
Patient-reported satisfaction (1-10)	8.5 ± 1.6	8.9 ± 1.6	8.5 ± 2.3	NS	8.6 ± 1.8

Abbreviations: HAD, Hospital Anxiety Depression; NS, nonsignificant; VAS, visual analog scale.

procedure defined as the total resection of the lesion. In Reinke edema, the procedure was achieved when the blue laser was applied to the entire edematous part of the vocal fold.

Adverse events

The adverse event findings are reported in Table 3. Dysphagia, anxiety, and nausea were the most prevalent adverse events during procedures. The number of patients reporting anxiety and dysphagia, the severity and duration of dysphagia, and the sensation of dyspnea significantly decreased over time (Table 3). In two vocal fold augmentation cases, hyaluronic acid was expelled from the injected vocal fold when patients spoke during the procedure. In one case, the leakage of hyaluronic acid occurred between the syringe and the needle, leading to a subcutaneous deposit of the material, while in the second case, the hyaluronic acid was ejected into the larynx and subsequently expelled after a cough episode. All patients were discharged home after 30 to 60 minutes of observation.

Key adjustments throughout time

After treating the first 58 patients, the practitioner changed the anesthesia spray concentration (from lidocaine 10% to lidocaine 2%), which was associated with improved dysphagia and dyspnea outcomes (Figure 1). A specialized SLP began preparing patients for the office-based procedure during preoperative consultations starting with the 55th patient, which was associated with a significant decrease in operative time (Figure 1). Similarly, the laser pause setting was reduced after the first 35 patients, which led to decreased operative time. Anxiety scores significantly decreased following the introduction of preoperative alprazolam (0.5 mg) administered 30 minutes before the intervention (Figure 1).

The Spearman correlation analysis suggested that procedure duration was significantly influenced by laser energy and pause settings, patient sensitivity, pain, exposure difficulties, and dysphagia. Similarly, practitioner-reported compliance was influenced by patient laryngeal sensitivity, pain, laryngeal exposure difficulties, and dysphagia. There were significant negative associations between procedure duration and both overall patient satisfaction and practitioner-reported compliance (Table 4).

Learning curve analysis

In the entire dataset (all procedures), durations decreased from $T_1 = 16.0$ minutes to a cumulative-mean plateau $\bar{T}_{113} = 11.83$ minutes. Power-law fitting yielded $a = 31.67$ and $b = -0.304$ ($R^2 = 0.236$), corresponding to a time-reduction factor of $2^b \approx 0.81$ for each doubling of practice. This moderate fit reflects substantial early gains that taper off toward the observed plateau.

The second dataset (polyp and Reinke edema procedures) began at $T_1 = 28.0$ minutes and approached $\bar{T}_{44} = 11.84$ minutes as a cumulative mean. The estimated

TABLE 3.
Complications

Adverse events	First period group ($n = 47$)	Second period group ($n = 47$)	Third period group ($n = 48$)	P value	Total ($n = 142$)
Events (n, %)					
Dysphagia	40 (85.1)	13 (27.7)	11 (22.9)	0.001	64 (45.1)
Nausea	8 (17.0)	2 (4.3)	0 (0)	0.003	10 (7.0)
Vasovagal malaise	2 (4.3)	0 (0)	0 (0)	NS	2 (1.4)
Cough	2 (4.3)	0 (0)	0 (0)	NS	2 (1.4)
Expulsion of injected hyaluronic acid	1 (2.1)	1 (2.1)	0 (0)	NS	2 (1.4)
Anxiety	11 (23.4)	2 (4.3)	3 (6.3)	0.005	16 (11.3)
Severe laryngeal hypersensitivity affecting the procedure*	4 (8.5)	4 (8.5)	3 (6.3)	NS	11 (7.7)
Dysphagia and dyspnea score					
Dysphagia score (1-10 VAS)	3.0 ± 2.3	1.0 ± 2.1	0.9 ± 1.7	0.001	1.8 ± 2.3
Dysphagia duration (min)	16.0 ± 11.6	4.1 ± 7.4	0.1 ± 0.1	0.001	9.9 ± 11.4
Dyspnea score (1-10 VAS)	2.2 ± 2.2	0.8 ± 2.1	0.8 ± 2.0	0.001	1.4 ± 2.2
Office-based procedure failure	1 (2.1)	3 (6.3)	1 (2.1)	NS	5 (3.5)

Abbreviations: N, number; NS, nonsignificant; VAS, visual analog scale.
* From these 11 patients, the procedure was aborted in only three patients because of the hypersensitivity.

parameters $a = 32.20$ and $b = -0.410$ produced a higher log-log $R^2 = 0.375$ and an inter-doubling reduction factor of $2^b \approx 0.75$, indicating more pronounced early learning relative to the first series.

In the third dataset (vocal cord augmentation procedures), initial performance was faster ($T_1 = 8.0$ minutes) but the cumulative mean asymptoted at $\bar{T}_{45} = 12.33$ minutes. The fitted law $a = 19.30$, $b = -0.200$ achieved a lower log-log $R^2 = 0.108$ and a reduction factor of $2^b \approx 0.87$, signifying smaller proportional gains per practice doubling and greater variability around the model. Collectively, these results confirm the ubiquity of power-law learning across diverse initial conditions, with exponent b governing the steepness of improvement and asymptotic mean durations reflecting limits of task proficiency.

To quantify the point at which performance gains effectively plateau, we defined stabilization as the first trial n_s beyond which the cumulative mean duration $\bar{T}$_n remains within 5% of its final asymptotic value $\bar{T}$_N. Applying this criterion, we found that learning stabilizes at n_s = 101 for all office-based laryngology procedures ($N = 113$), at n_s = 41 for office-based polyp/Reinke edema procedures ($N = 44$), and at n_s = 38 for vocal fold augmentation ($N = 45$).

DISCUSSION

Office-based laryngology is gaining attention for epithelial lesions of the vocal folds, but this approach is still not widespread. In Europe, the introduction of office-based laryngology experienced slow and gradual acceptance as an alternative surgical management for selected benign lesions of the vocal folds due to equipment costs and lack of training. To date, the teaching features and learning curve of office-based laryngology remain poorly investigated in the literature, despite high patient satisfaction rates and excellent postoperative outcomes.[10]

The present study describes a single surgeon's 3-year learning curve with a progressive reduction in procedure time, which was considered the primary outcome, while maintaining consistent office-based surgical success and patient satisfaction. The learning curve statistics reported an overall stability of outcomes (time of procedure) after 101 cases, with minimum case numbers of 41 for polyp/Reinke edema and 38 for vocal fold augmentation, respectively.

To the best of our knowledge, there is no similar office-based laryngology learning curve study in the literature, which limits comparisons with other office-based laryngology learning studies. The mean duration of office-based procedures significantly decreased from 13.8 ± 7.7 to 8.0 ± 5.2 minutes over time, with the final procedure time corroborating those reported in the literature. In a cohort of 48 patients with heterogeneous indications for office-based laryngology, Hamdan et al reported a mean procedure duration of 10.38 minutes.[11] Interestingly, the mean tolerance score of patients was high according to the IOWA scale[12] (1.51 ± 1.1), which indirectly supports our observation (8.3 ± 2.3; 10-point VAS).[11] The same team reported a mean procedure time for office-based polyp resection of 9.58 ± 4.92 min, which is close to our observation (polyp resection time: 11.8 ± 7.2 minutes).[13] Hamdan et al investigated the influencing factors of office-based laryngology success.[11] Patient satisfaction scores were highest for patients with vocal fold cysts and polyps, and lowest for those with Reinke edema. In the present study, patient satisfaction scores did not vary across patient subgroups (polyps, Reinke edema, and vocal fold augmentation). However, similarly to the study of Hamdan et al,[11] there was a significant mild correlation between compliance and procedure duration ($r_s = -0.275$).

Three primary adjustments were implemented after the first 40 to 50 patients, which could have potentially

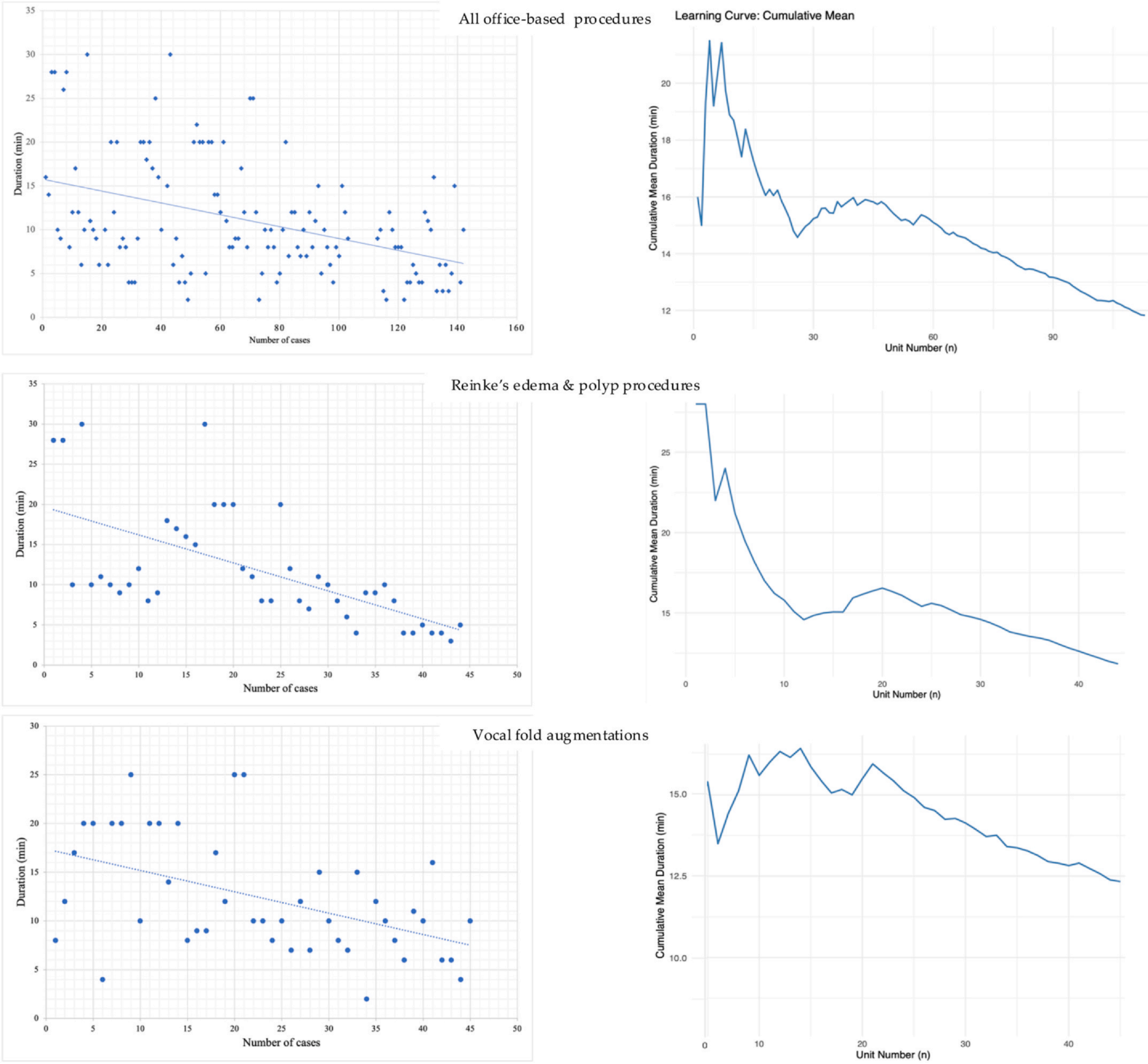

FIGURE 1. Evolution of procedure duration in several indications.

influenced surgical outcomes. The first consisted of scheduling a preconsultation with an SLP a few days before the procedure to simulate breathing and swallowing management throughout the surgical procedure steps. In the study by Bar et al, the application of preprocedure SLP consultations improved patient adherence during office-based procedures,[14] which could reduce failure rates. The aborted rate in the study by Bar et al was 3.9% ($n = 13/337$), which was close to the rate reported in the present study (3.5%; $n = 5/142$). The second adjustment concerned local anesthesia. In a recent review, Wellenstein et al demonstrated that there is an important heterogeneity across office-based laryngology studies for the topical anesthesia drugs and doses.[15] In this study, lidocaine 10% was initially used to ensure maximum local anesthesia. However, in practice, this concentration was associated with a substantial increase in saliva secretion, dysphagia severity, and duration. While it remains difficult to demonstrate a causal relationship, the change in lidocaine concentration occurred during a period showing substantial reduction in procedure duration.

Third, patients reporting preoperative anxiety received alprazolam 30 minutes before the procedure. As with local anesthesia, there are no international guidelines for preparing patients for office-based laryngology, and the prescription of alprazolam was not recommended in the

TABLE 4.
Correlation Analysis

Outcomes	Laser settings			Patient features					Clinical score			
	Energy	Length	Pause	Sensitivity	Pain	Exposure	Satisfaction	Dysphagia	HAD Anxiety	HAD Depression	VHI	RSS
Duration	−0.268***	−0.163	0.298***	0.598*	0.293**	0.246**	−0.315*	0.263**	−0.163	−0.114	0.156	−0.057
Compliance	0.197	−0.014	−0.142	−0.676*	−0.201***	−0.449*	0.746*	−0.310*	−0.110	−0.129	0.140	0.074

Abbreviations: HAD, Hospital Anxiety Depression; RSS, Reflux Symptom Score; VHI, Voice Handicap Index. *$P < 0.001$; **$P < 0.01$; ***$P < 0.05$. Duration and compliance reported significantly negative association ($rs = -0.275$; $P = 0.002$).

courses followed by the primary investigator. These three adjustments may have contributed to significant reductions in patient anxiety and procedure duration, while the SLP consultation and local anesthesia modifications may have reduced nausea and dysphagia rates and severity.

Regarding complications, considering vasovagal reactions ($n = 2$), expulsion of hyaluronic acid from the surgical field ($n = 2$), and severe dysphagia and hypersensitivity associated with aborted procedures ($n = 5$) as the primary complications, the overall complication rate was 6.3%. Woisard et al reviewed complications of 308 office-based laryngology procedures and reported a complication rate of 10.3%, including laryngeal bleeding, vasovagal syncope, laryngospasm, severe dysphagia, severe nausea, voice disorders, laryngitis, hypertensive crisis, asthma attack, and pneumonia.[16]

Given the heterogeneity of procedures included in the present study, it was difficult to determine a precise inflection point in the duration curve (Figure 1) and the related minimum number of cases required to achieve proficiency in office-based laryngology skills. However, the overall, polyp/Reinke edema, and vocal fold augmentation curves suggest a long learning curve, which is closer to laryngeal microsurgery curves[17] rather than transoral robotic surgery (TORS) curves.[18,19] Learning curve studies dedicated to TORS reported a required number of cases ranging from 20 to 42, with consensus suggesting that 20 cases tend to mark the end of a learning period.[19,20]

The heterogeneity of included cases and the design (single-surgeon practice) are the primary limitations of the study. Determining the minimum number of cases required to complete the learning curve of office-based laryngology would require studying several surgeons, considering their variability in terms of residency/fellowship experiences and their intrinsic skills. Before implementing the voice clinic and conducting the present study, the author completed fellowships in laryngology (transoral microsurgery) and in robotic head and neck surgery, both being factors that could influence the learning curve and related surgical outcomes of office-based laryngology procedures. The lack of tobacco use, alcohol consumption, and comorbidity data is an additional limitation, as these factors could be associated with heterogeneity across groups.

The originality of the study is its primary strength because, to the best of our knowledge, there is no similar learning curve investigation conducted in office-based laryngology in the literature. Future studies are needed to evaluate the cost-benefit impact of adding a SLP consultation a few days before the procedure to save time during the operation, potentially achieving higher success rates.

CONCLUSION

This 3-year learning experience demonstrates significant improvement in office-based laryngology efficiency, with procedure times decreasing from 13.8 to 8.0 minutes. Key factors influencing the learning curve included preoperative speech therapy consultation, optimized anesthesia concentration, and anxiety management. Despite heterogeneous procedures, most procedures were successfully achieved (96.5%) with low complication rate (6.3%).

Data Availability Statement

Not applicable.

Declaration of Competing Interest

The author has no financial interest in the subject under discussion. All authors have read and approved the paper.

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Author Contributions

Jerome R. Lechien: design, acquisition of data, data analysis and interpretation, drafting, 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.

Institutional Review Board Statement

EpiCURA-IRB approved the protocol (reference: 034/008).

Informed Consent Statement

Not applicable.

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