UNIDADE LOCAL DE SAÚDE LISBOA OCIDENTAL

NOVA MEDICAL SCHOOL

Comparison of Three-Dimensional and Conventional Laryngostroboscopy in Diagnosing Functional Dysphonia

ABSTRACT

Introduction: Diagnosing functional dysphonia (FD) can be challenging, especially with the limitations of traditional laryngostroboscopy, which may not always capture vocal issues.

Methods: It is a randomized prospective study which primary objective is to evaluate the diagnostic accuracy of three-dimensional laryngostroboscopy compared to conventional laryngostroboscopy in detecting functional dysphonia. The inclusion criteria are: Adults aged 18-65; Presenting with symptoms of hoarseness or vocal strain for at least 4 weeks; Clinically diagnosed with functional dysphonia by an ENT Doctor. The exclusion criteria: Presence of organic voice disorders; Prior vocal surgery; Any contraindications to laryngostroboscopic evaluation. All participants will be assessed by an 2 ent doctor- Laringology. Then, each participant will undergo both the conventional and 3D laryngostroboscopic examination with at least 1 days between each examination.Two independent ENT doctors will review the images and assign a diagnosis based on the visual information. For each participant, VHI or SVHI will be applied. Data will be analyzed using concordance tests will be used to assess the closeness between the diagnostic methods. A p-value of < 0.05 will be considered statistically significant. Population study will also be presented

Results: We similar results between both methods, with a slightly better awareness found for three-dimensional laryngoscopy

Conclusions: While conveying a clearer and overall better image, both methods demonstrated comparable levels diagnostic accuracy for functional dysphonia. Further studies should investigate this relationship for other specific vocal pathologies, and for different levels of doctor training.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

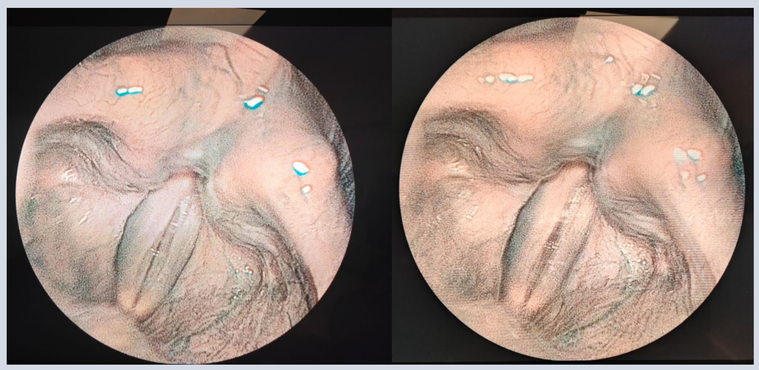

Figure 1 – Comparison between 2D and 3D Laryngostroboscopy in a Type 1 functional dysphonia, with a median chink. The figure on the left is in 2D and the figure on the right is in 3D. 3D glasses are recommended for viewing the image. Laryngoscopy performed on a XION EndoSTROBE Spectar P

INTRODUCTION

Functional dysphonia (FD) is defined as a voice disorder resulting from **excessive tension in the muscles of the neck and larynx**[1].

It can be visually classified through the Koufman Classification[2]. The most common types are:

- **Type 1** – Median chink
- **Type 2** – Supraglottal contraction, with the positioning of the ventricular folds over the vocal folds
- **Type 3** – Anteroposterior contraction of the Larynx
- **Type 4** – Sphincteric larynx

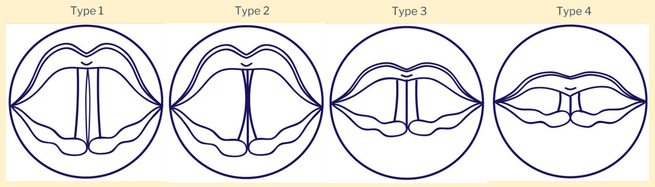

Figure 2 – Laryngoscopical features of functional dysphonia according to Koufman et al.

Diagnosis traditionally relies on **2D videolaryngostroboscopy**, which has been the gold standard, although it **has some limitations**. While effective for evaluating glottal closure and vibratory patterns, it **falls short in depth perception** and may **underestimate supraglottic space alterations**.

Three-dimensional laryngostroboscopy was introduced in clinical practice in the late 2010s. It provides **enhanced depth and spatial resolution**, with better visualization of laryngeal structures.

METHODS

This was a prospective study with **paired populations**, taking into account age, sex, singer vs Non-singer status. Other clinical information such as comorbidities, smoking status and score on the Voice Handicap Index (VHI) and Singing Voice Handicap Index (SVHI) was collected.

Both patients were **observed by two ENT doctors** with experience in laryngology, both with 3D laryngoscope (XION EndoSTROBE Spectar P), which has the capability of recording 2D and 3D laryngoscopies. The recordings were at least 1 day apart. The diagnoses were then recorded.

	Control Group N = 40 (%)	Functional Dysphonia N = 40 (%)	p-value
Sex			>0.999
Male	20 (50.0%)	20 (50.0%)	
Female	20(50.0%)	20 (50.0%)	
Mean age ± SD	41.13 ± 11.39	40.93 ± 11.88	0.939
Minimum	22	20	
Maximum	61	61	
Smoking Status			0.469
Smoker	14 (35.0%)	11 (27.5%)	
Non-Smoker	26 (65.0%)	29 (72.5%)	
Comorbidities	14 (35.0%)	17 (42.5%)	0.491
Gastric Reflux	9	10	
Allergic Rhinitis	5	7	
Professional Status			>0.999
Singer	20	20	
Non-Singer	20	20	
Vocal Questionnaires (mean ± SD)			
VHI (N = 20 vs 20)	6.65 ± 2.115	28.50 ± 10.59	<0.001
SVHI (N = 20 vs 20	7.00 ± 2.317	27.00 ± 11.00	<0.001

Table 1 - Population characteristics. Chi-square tests were used for the analysis of Sex, Smoking-status, and Professional-status analysis. In the case of the vocal questionnaires, the analysis was done within the strata of Professional-status. The cutt-off for the VHI and SVHI

RESULTS

Agreement analysis between 2D vs 3D				Agreement percentage	kappa Agreement (95% CI)
		3D		95.0%	0.900 (0.681 - 1.000)
		Healthy	FD		
2D	Healthy	39 (92.9%)	3 (7.1%)		
	FD	1 (2.6%)	37 (97.4%)		
		3D		98.75%	0.975 (0.926 – 1.000)
		Healthy	FD		
2D	Healthy	39 (100.0%)	0 (0.00%)		
	FD	1 (2.44%)	40 (97.56%)		

Table 2 - Agreement analysis of 2D vs 3D laryngoscopy, with two crossed raters, between laryngoscopic diagnosis of Healthy individuals and FD

DISCUSSION

The results show an **excellent level of concordance** between 2D and 3D laryngoscopy (kappa = 0.900 and 0.975 for the crossed raters evaluation). We don't consider it significant, for the population is too small to extrapolate a relationship of superiority for 3D.

In the clinical sense, we found a slightly better awareness with the 3D laryngoscope, taking into account the better **depth perception** and **movement**, leading to a better understanding of the **phonation biomechanic**.

This greater awareness may help the diagnosis of FD, with a special mention of Type 2 FD, since it enhances the identification of the ventricular fold. Early diagnosis of FD leads to **more effective treatment**.

Regarding other **limitations** of this study, it didn't consider different **types of functional dysphonia** in the diagnosis (since we didn't include type 3 and 4 FD); the **experience of the laryngologist** observing the patient, since laryngostroboscopy is **operator-dependent**.

3D Laryngoscopy is still a **recent technology,** with a more limited use, specially in the diagnostic and surgical field in Portugal, where the study was conducted.

Some studies found an inferior learning curve[3,4] and superior anatomical visualization of the laryngeal structures among lower experience surgeons[5]. Since there are few comparative studies with the use of 3D laryngoscopes in the field of diagnostics, this presents itself as a key strength of our study.

Therefore, greater use amongs laryngologist may facilitate

The **number of singers** included in this population is high and isn't representative of the general population. This is due to the high number of singers that are followed in the center. **Some voice professionals weren't accounted** for in the present study.

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Maria Clara Pinheiro Capucho
ENT Voice Department - ULSLO
mariaclaracapucho@gmail.com

Clara Capucho, MD PhD[1,2]; David Gil, MD[2]; André Pereira, MD[1]; Pedro Aguiar, PhD[2,3]

[1]Hospital Egas Moniz (ULSLO), [2]NOVA Medical School, [3]NOVA National School of Public Health