The Accuracy of Preoperative Rigid Stroboscopy in the Evaluation of Voice Disorders in Children

***Jobran Mansour, †‡§Ofer Amir, *Doron Sagiv, *§Eran E. Alon, *§Michael Wolf, and *§Adi Primov-Fever,** *†*Ramat-Gan and* ‡§*Tel Aviv, Israel*

Summary: Objectives. Stroboscopy is considered the most appropriate tool for evaluating the function of the vocal folds but may harbor significant limitations in children. Still, direct laryngoscopy (DL), under general anesthesia, is regarded the "gold standard" for establishing a diagnosis of vocal fold pathology. The aim of the study is to examine the accuracy of preoperative rigid stroboscopy in children with voice disorders.

Study Design. This is a retrospective study.

Methods. A retrospective study was conducted on a cohort of 39 children with dysphonia, aged 4 to 18 years, who underwent DL. Twenty-six children underwent rigid stroboscopy (RS) prior to surgery and 13 children underwent fiber-optic laryngoscopy. The preoperative diagnoses were matched with intraoperative (DL) findings.

Results. DL was found to contradict preoperative evaluations in 20 out of 39 children (51%) and in 26 out of 53 of the findings (49%). Overdiagnosis of cysts and underdiagnosis of sulci were noted in RS compared to DL. The overall rate of accuracy for RS was 64%.

Conclusions. The accuracy of rigid stroboscopy in the evaluation of children with voice disorders was found to be similar with previous reports in adults.

Key Words: Stroboscopy–Dysphonia–Children–Vocal folds–Nodules.

INTRODUCTION

The incidence of voice disorders in children varies between 6% and 9%.[1,2] The current view suggests that vocal fold nodules, considered the most common pathology, involutes spontaneously or may regress following voice therapy.[1,3] However, other pathologies, such as cysts or polyps, may need a nonconservative approach.[4]

Flexible fiber-optic laryngoscopy (FOL) is applicable in most children even of young age and serves as a basic clinical diagnostic tool.[5–7] However, stroboscopy is regarded as the most appropriate technique for the evaluation of vocal fold mucosal pathology attributed to enhanced inspection of the vocal fold's vibratory pattern and mucosal wave.[8,9] Yet direct laryngoscopy (DL) is considered the "gold standard" in the diagnosis of vocal folds' pathologies.

Previous study described that the majority of children over the age of 10 years tolerated rigid stroboscopy (RS) quite well,[7] and that complete visualization of the larynx could be obtained in 83% of 747 children, 7–16 years of age, using rigid laryngoscopes.[3] RS with magnifying endoscopes render better illumination and resolution but its implementation among children is quite limited due to the same parameters related to fiber-optic examination, that is, limited cooperation, intolerable gag reflex, and a relatively short phonation time.[5,6]

A comparison between preoperative RS evaluations and DL findings yielded inconsistency in 36% of adult patients with a false positive incidence of 2%[10]; no such study was performed regarding the pediatric population. The aim of this study is to assess by RS the accuracy of preoperative evaluation of children with voice disorders.

METHODS

All children who underwent DL for voice disorders in the ENT department of the Sheba Medical Center, during a 7-year period, were retrospectively reviewed. All children, accompanied by parents or legal guardians, underwent perceptual voice assessment and an analysis of voice recording. RS was performed with a rigid 70° (6 mm and 10 mm) magnifying laryngoscopes (XION GmbH, Berlin, Germany, and Richard Wolf Medical Instruments Co., Vernon Hills, Illinois, USA, respectively). Flexible fiber-optic laryngoscope (3.0 mm, PENTAX FNL-10RPS Paragon drive montavle, New Jersey, USA) was used for children who failed RS.

An engaging atmosphere was established by oral explanation and visual demonstration of the procedure. Inhalation of lidocaine solution (1%, 2 cc) was used in young children under 12 years of age to enable better tolerability, and topical spray of a 10% lidocaine solution was applied, when necessary. All examinations were recorded and reviewed in front of the children and their parents. All stroboscopic evaluations were analyzed by the members of the voice team, including a laryngologist and a speech language pathologist, following each examination. The results were compared with the intraoperative findings established by DL. In the present study, we applied the acceptable description of benign lesion, as provided by many authors.[11,12] Specifically, nodules were defined as fairly symmetrical, usually bilateral lesion, confined to the superficial layer of the lamina propria and composed primarily by edematous tissue or collagenous fibers. A polyp was defined as a lesion that usually occurs on one vocal fold, may be sessile or pedunculated, and typically

Accepted for publication December 19, 2016.

From the *Department of Otolaryngology and Head and Neck Surgery, Chaim Sheba Medical Center, Ramat-Gan, Israel; †The Speech and Hearing Institute, Chaim Sheba Medical Center, Ramat-Gan, Israel; ‡Department of Communication Disorders, School of Health Professions, Tel Aviv University, Tel Aviv, Israel; and the §Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel.

Address correspondence and reprint requests to Jobran Mansour, Department of Otolaryngology and Head and Neck Surgery, The Chaim Sheba Medical Center, Tel Hashomer 52621, Israel. E-mail: jobran.h@gmail.com

Journal of Voice, Vol. 31, No. 4, pp. 516.e1–516.e4
0892-1997

http://dx.doi.org/10.1016/j.jvoice.2016.12.013

located in the superficial layer of the lamina propria without involvement of the vocal ligament. A cyst was defined as a lesion lined with thin squamous epithelium, generally located in the superficial layer of the lamina propria but may be attached to the vocal ligament. Cysts may occasionally be bilateral and may contain mucous or caseous material.

A one-tailed z test study was calculated to determine the statistical significance of the accuracy of preoperative RS. The study was approved by the Institutional Review Board of the Chaim Sheba Medical Center (3141-16-SMC).

RESULTS

Thirty-nine children, aged 4 to 18 (mean = 10, median = 11), including 23 boys (59%) and 16 girls (41%), underwent DL (Table A1). RS was performed on 26 (67%) children with a mean age of 12 years and FOL was performed on 13 (33%) children with a mean age of 7 years, who did not tolerate RS.

Fifty-three lesions were identified by DL in 39 children. The distribution of vocal fold findings detected during DL is described in Table A2. A noticeable predominance of vocal fold nodules (38%) was followed by cysts and sulci. Fifteen children were found to have multiple lesions involving both vocal folds, the majority being vocal fold nodules.

Clinical diagnoses, based on RS, were inaccurate in 9 out of 26 children (12 out of 33 findings, 36%), whereas diagnoses based on FOL were found to be inaccurate in 11 out of 13 children (14 of 20 findings, 70%).

Twenty-one nodules were diagnosed by DL compared to 14 nodules identified preoperatively. Those 21 nodules were diagnosed in 13 patients, eight were females, and five were males. The preoperative diagnosis of three (false positive) nodules was changed, by DL, to cyst, sulcus, and normal vocal fold (one each) (Table A3). In most cases, nodules were defined as bilateral lesions. However, reactive lesions opposite other lesions (such as a cyst) were also regarded as a "nodule" in this report.

Twenty-five cysts were diagnosed by RS compared to only 15 cysts diagnosed by DL. The diagnosis of 12 (false positive) cysts defined by RS was changed into nodules (6), sulci (3), polyp (1), papilloma (1), and normal vocal fold (1) (Table A3). Only 1 sulcus out of 9 was diagnosed by RS, the other 8 (false negative) sulci were described as cysts (3), papilloma (2), edematous folds (2), and nodule (1) (Table A3). One child was found to have normal vocal folds by DL, although a cyst was described by RS.

The overall accuracy of preoperative RS and FOL in comparison with DL findings were 64% and 30%, respectively ($z = 0.01$).

Figure 1A shows a stroboscopic image of a cyst, taken during preoperative examination, using RS. This diagnosis was later confirmed during DL. Figure 1B shows an image taken during DL, of a lesion originally diagnosed as polyp, and then during DL diagnosis was changed to a cyst.

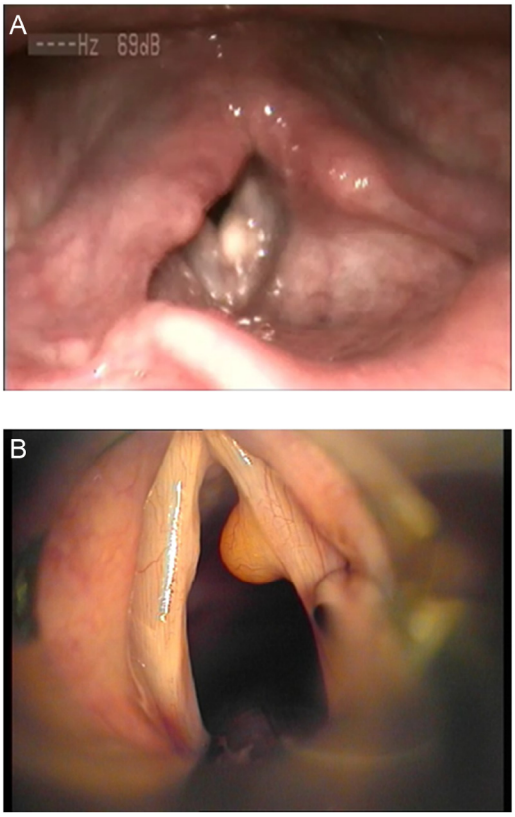

FIGURE 1. Two images of cysts are presented. (**A**) Image taken during preoperative rigid stroboscopy. (**B**) Image taken during direct laryngoscopy.

DISCUSSION

DL is considered the "gold standard" examination for defining vocal fold lesions. Stroboscopy is a fundamental and an essential clinical tool in the evaluation of vocal fold structural and functional pathologies.[8] It has been shown that most children over 10 years of age and even younger may tolerate RS quite well.[3,7]

RS is not widely used in children due to its inherent limitations. Nonetheless, a significant advantage of RS over FOL was observed when comparing the accuracy of each test: 64% and 30%, respectively ($z = 0.01$). This may be attributed to low-quality images obtained by pediatric, small diameter, flexible fiberoptic laryngoscopes. The accuracy of the newer distal chip flexible laryngoscopes needs to be studied. A nonnegligible rate of inconsistency (36%) was found between preoperative RS and DL findings in our cohort, much alike the study of Poels et al that involved adult patients.[10]

The results of our study are in accordance with previous studies demonstrating vocal fold nodules as the most frequent pathology in children with voice disorders, followed by vocal fold cysts.[3,13,14] Although vocal fold nodules are commonly attributed to phonotrauma and thereby more common in males, more vocal fold nodules were diagnosed, in our study, in females (eight females and five males). It should be clearly stated, however, that our center is a tertiary referral center, hence our sample does not represent the incidence of nodules in the general population, nor does it represent typical gender distribution.

Mortensen et al[14] highlighted the presence of multiple findings in a single child. They described 132 laryngeal pathologies in 78 dysphonic children, mostly attributed to bilateral vocal fold nodules. Similar findings were noted in our cohort; 39 children presented with 53 lesions, dominated by bilateral vocal fold nodules.

A high incidence of cysts and sulci was encountered in our study compared with others.[13,14] It may be explained by a selected group of children who failed conservative treatment prior to their referral to our tertiary voice clinic. A noticeable overdiagnosis was prominent for vocal cord cysts, which may be attributed to the limitations of stroboscopy in children and to the similarity of stroboscopic features between cysts and nodules in children. Sulci were detected almost merely under DL, presumably due to technical limitations.

In conclusion, RS accuracy in children was found to be similar as that encountered in adults. We encourage the implementation of RS in the pediatric population, especially in the older age group.

CONCLUSIONS

The accuracy of RS in the evaluation of children with voice disorders was found to be similar with previous reports in adults; therefore, we advocate its use in children.

APPENDICES

TABLE A1.
Distribution by Age

Age (Years)	4–7	8–9	10–11	12–13	14–16	17–18
No. children	9	4	10	6	8	2

TABLE A2.
Distribution of Vocal Fold Findings by Direct Laryngoscopy

Nodule	Cyst	Sulcus	Polyp	Ant web	Other	Normal
21 (38%)	15 (27%)	9 (16%)	2 (4%)	3 (5%)	3 (6%)	2 (4%)

TABLE A3.
Direct Laryngoscopy Versus Preoperative Evaluation

	Preoperative (n)			True Positive (n)		False Positive (n)	
	RS (n)	FOL (n)	DL (n)	RS (n)	FOL (n)	RS (n)	FOL (n)
Nodule	14	9	21	11	7	3	2
		5			4		1
Cyst	25	19	15	13	12	12	7
		6			1		5
Polyp	2	1	2	1	1	1	0
		1			0		1
Sulcus	1	1	9	1	1	0	0
		0			0		0
Other	9	3	3	1	1	8	2
		6			0		6
Normal	2	1	2	0	0	2	1
		1			0		1
Anterior Web	2	1	3	2	1	0	0
		1			1		0

Abbreviations: DL, direct laryngoscopy; FOL, fiber-optic laryngoscopy; RS, rigid stroboscopy.

REFERENCES

1. Hirschberg J, Dejonckere PH, Hirano M, et al. Voice disorders in children. *Int J Pediatr Otorhinolaryngol*. 1995;32:109–125.
2. Dejonckere PH. Voice problems in children, pathogenesis and diagnosis. *Int J Pediatr Otorhinolaryngol*. 1999;49:311–314.
3. Akif Kiliç M, Okur E, Yildirim I, et al. The prevalence of vocal fold nodules in school age children. *Int J Pediatr Otorhinolaryngol*. 2004;68:409–412.
4. Martins RH, Santana MF, Tavares EL. Vocal cysts, clinical, endoscopic, and surgical aspects. *J Voice*. 2011;25:107–110.
5. Papsin BC, Pengilly AJ, Leighton SE. The developing role of a paediatric voice clinic: a review of our experience. *J Laryngol Otol*. 1996;110:1022–1026.
6. Hartnick CJ, Zeitels SM. Pediatric video laryngo-stroboscopy. *Int J Pediatr Otorhinolaryngol*. 2005;69:215–219.

7. Wolf M, Primov-Fever A, Amir O, et al. The feasibility of rigid stroboscopy in children. *Int J Pediatr Otorhinolaryngol*. 2005;69: 1077–1079.
8. Dejonckere PH, Bradley P, Clemente P, et al. A basic protocol for functional assessment of voice pathology, especially for investigating the efficacy of (phonosurgical) treatments and evaluating new assessment techniques. Guideline elaborated by the Committee on Phoniatrics of the European Laryngological Society (ELS). *Eur Arch Otorhinolaryngol*. 2001;258:77–82.
9. Gray SD, Smith ME, Schneider H. Voice disorders in children. *Pediatr Clin North Am*. 1996;43:1357–1384.
10. Poels PJ, de Jong FI, Schutte HK. Consistency of the preoperative and intraoperative diagnosis of benign vocal fold lesions. *J Voice*. 2003;17:425–433.
11. Sataloff RT. Professional Voice: The Science and Art of Clinical Care. Third Ed. California: Plural Publishing; 2005.
12. Merati AL, Bielamowicz SA. Text Book of Voice Disorders. California: Plural Publishing; 2006.
13. Martins RHG, Hidalgo Ribeiro CB, Fernandes De Mello BMZ, et al. Dysphonia in children. *J Voice*. 2012;26:17–20.
14. Mortensen M, Schaberg M, Woo P. Diagnostic contributions of videolaryngostroboscopy in the pediatric population. *Arch Otolaryngol Head Neck Surg*. 2010;136:75–79.