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How Long Does It Take to Master Laryngeal Visualization Using Flexible Nasolaryngoscopy in Children?

Abstract

Background: To assess when residents become proficient in performing flexible nasolaryngoscopy (FNL) in the pediatric population.

Objective: To objectively evaluate the quality of FNL by year of residency training.

Methods: Ninety-five pediatric FNL's were performed by otolaryngology residents and pediatric otolaryngology fellows (postgraduate year [PGY] 1 – 6). Three pediatric otolaryngologists rated the FNL videos (anonymized and without sound) using the Modified Cormack-Lehane scoring system (MCLS). Data analysis was performed using two-way ANOVA and Tukey-Kramer adjustment.

Results: Overall, there was a significant difference in the quality of the FNL based on the year of training (p

Conclusion: The quality of pediatric FNL improves after the PGY-1 year. Current training consists of the traditional "see one, do one, teach one" rubric. Future educational goals should focus on developing a curriculum to shorten the time to achieve proficiency in pediatric FNL.

Keywords

Pediatrics, Otolaryngology, Laryngoscopy

How Long Does It Take Residents and Fellows to Master Laryngeal Visualization Using Flexible Nasolaryngoscopy in Children?

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Results: Overall, there was a significant difference in the quality of the FNL based on the year of training ($p<0.0001$). Comparing specific years, there was a statistically significant difference between PGY-1 and PGY-2 ($p=0.004$); however, there was no difference between years of training beyond the PGY-2 year.

Conclusion: The quality of pediatric FNL improves after the PGY-1 year. Current training consists of the traditional "see one, do one, teach one" rubric. Future educational goals should focus on developing a curriculum to shorten the time to achieve proficiency in pediatric FNL.

Keywords

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Introduction

Initially developed by Hirschowitz in 1963, the flexible nasolaryngoscope allows the Otolaryngologist to visualize the nasal cavity, nasopharynx, oropharynx, hypopharynx, and larynx in non-sedated patients.[1, 2] Flexible nasolaryngoscopy (FNL) is a critical skill for otolaryngologists to master during their clinical training. In the pediatric population, FNL is an important diagnostic tool in evaluating laryngomalacia, vocal cord immobility, and subglottic pathology. The procedure is relatively safe with very few contraindications, such as coagulopathic patients or those with impending airway obstruction. However, FNL can be uncomfortable for the patient.[3] It is important to master this technique as efficiently as possible as FNL is a valuable technique for otolaryngologists to diagnose multiple pathologies.

While FNL remains an important diagnostic technique, there are no standardized methods for teaching this skill. Residents gain experience by repetition in clinic or on the inpatient consult service.[4] In children, FNL can be particularly challenging due to patient cooperation and secretions. While there have been studies used to assess resident surgical training, there are limited studies evaluating resident experience with minor procedures such as FNL.[5] The purpose of this study is to correlate the level of resident training with the ability to visualize the larynx using FNL in the pediatric population.

Methods

With institutional review board approval of study #38002 at Texas Children's Hospital, archived videos of inpatient FNL's at a tertiary children's hospital were reviewed. Archived videos included involved PGY-1, PGY-2, PGY-3, and PGY-6 fellows throughout their years of training. All endoscopies were performed using either a 3.4mm or 2.2mm Olympus Fiber Rhinolaryngoscopes (Olympus, Tokyo, Japan) or the 3.5mm or 2.5mm Storz Rhinofiberscopes (Karl Storz, Tuttlingen, Germany) depending on clinical indication and instrument availability. The procedures were recorded using a Storz Tele Pack Rhinofiberscopes (Karl Storz, Tuttlingen, Germany).

The FNL videos were divided into four groups based on the performing physician's level of training. Three fellowship trained pediatric otolaryngologists, who we not involved in the clinical care of the patients, reviewed the anonymized FNL videos (without sound) in random order. The quality of FNL were rated based on the modified Cormack-Lehane grading scale (scores 1-5)[6]: (1) unable to visualize the larynx throughout the video with poor control of the camera, (2) glimpse of the larynx/vocal folds but unable to assess the vocal fold movement, (3) able to fully visualize the larynx/vocal folds but not continuous with difficulty to assess the vocal fold movement, (4) able to fully visualize the larynx /vocal folds continuous for more than 3 seconds but not able to visualize the subglottis, and (5) able to fully visualize the larynx / vocal folds continuous for more than 3 seconds and also able to clearly visualize the subglottis.

Additionally, we recorded the time from the entrance of the nose to the postnasal space and from the nose to visualization of the vocal fold based on the physician's level of training. We also assessed patient ages based on level of training, since FNL can be more challenging in younger patients.

Statistical Analysis

In order to incorporate three raters' ratings, instead of taking the average of three ratings, two-way ANOVA was applied to study the effect of level of experience on the study quality. Additionally, the least square means of the ratings of the different level of experience were reported as well as their standard errors with each level of experience compared. A Tukey-Kramer adjustment for multiple comparisons was applied to compare each level of training to each other. Finally, a one-way ANOVA was applied to study the effect of level of experience on timings from entrance of nose to postnasal space, from entrance of nose to visualization of vocal fold, and patient ages. All the statistical analysis was performed using SAS software (Statistical Analysis System for Windows, Version 9.4. Cary, NC: SAS Institute Inc; 2014.).

Results

A total of 95 FNL videos were included for analysis; post graduate year (PGY)-1 (n=22), PGY-2 (n=24), PGY-3 (n=24), and PGY-6 fellows (n=25). Two-way ANOVA analysis demonstrated that there was a significant difference based on the level of training and the quality of nasolaryngoscopy (p<0.0001). Additionally, the inter-rater reliability in grading was statistically insignificant, thus showing that there was consistency between the raters (p=0.85). Finally, a comparison between the rater and the level of training was assessed and found to be insignificant for additional factors (p=0.89).

In the least squares mean analysis the average modified Cormack-Lehane score from all 3 raters were combined in each level of training group along with standard error to compare the scoring between different PGY levels. PGY-1 residents were found to have the lowest average score among raters at 3.7 ± 0.12 while PGY-2 residents scored 4.33 ± 0.12 **(Table 1)**. Furthermore, we compared the p-values of pairwise comparisons, using a Tukey-Kramer adjustment to individually compare and analyze if there was a significant level of statistical difference between each level of training compared to each other. The results demonstrated that there was a statistically significant difference between PGY-1 residents and PGY-2 residents (p=0.004) and PGY-6 (p=0.004) **(Table 2)**. Thus, showing that PGY-2 and PGY-6 residents were able to visualize laryngeal structures more effectively compared to PGY-1 residents.

Table 1. Modified Cormack-Lehane grading score by level of training

Level of experience	Least squares Mean ± Standard error
PGY 6	4.32 ± 0.12
PGY 1	3.70 ± 0.12
PGY 2	4.33 ± 0.12
PGY 3	4.04 ± 0.12

Additionally, we evaluated if the level of experience affected timings from entrance of the nose to postnasal space and from the entrance of the nose to visualization of the vocal fold. After a one-way ANOVA analysis, there was no significant effect of the level of experience and the times to visualize the postnasal space and the larynx. **(Table 3)** Lastly, the assessment of patient age demonstrated that PGY-6 residents performed FNL on patients with an average age of 15.7 months while PGY-1, PGY-2, PGY-3 residents scoped patients at 42.2, 46.6, and 40.7 months respectively. However, analysis showed there was no statistical significance between the average age and level of training between groups (p=0.48). **(Table 4)**.

Discussion

FNL is one of the practicing Otolaryngologist's most commonly performed procedures. In the pediatric population, FNL can be difficult to master due to excessive secretions, constant movement, and obstructing supraglottic structures. To date, there have been no publications in the literature to assess resident level of training and the quality of pediatric FNL.

Our data indicates that the quality of pediatric FNL improves after the PGY-1 year, indicating that residents are becoming competent performing FNL and visualizing most aspects to the larynx during the PGY-2 year. The PGY-6 fellows generally take care of the Neonatal intensive care unit (NICU) and Pediatric intensive care unit (PICU) patients and thus the average age of their patients is lower. This could explain why there were no greater differences seen with PGY-6 fellows compared to residents.

In the current literature, there has been one study focusing on a resident's training level to read and diagnose FNL videos in the adult population. A 2015 study, by Book et. al, used medical students, residents, and attending physicians to view 25 FNL videos and rated abnormalities within the pharynx, larynx, and subglottis.[7] They found that a resident's reliability of rating FNL videos to be statistically similar to attending physicians by the PGY-3 year.

The Accreditation Council for Graduate Medical Education (ACGME) has placed more focus on the use of milestones to measure residents' skills and competencies throughout their residency training. With increased attention on these objective measurements, otolaryngology residency programs have placed more focus on educational advancement.[8] The use of various educations tools such as simulations, videos, online modules are gaining more attention in medical training to achieve competency-based learning objectives.[9] Within otolaryngology there have been improvements in skill and decreased procedure time using these educational tools.[10] For example, a study by Russell et. al selected 10 PGY-1 otolaryngology residents to view FNL videos and rate abnormalities. After they performed their initial grading, a laryngoscopy teaching video was then administered to the interns and then they rated another set of FNL videos. They found that residents were better able to recognize vocal cord abnormalities after the intervention.[11] Taken together, videos, hands on simulation, online modules, and didactic lectures have been shown to be effective in resident training and can be implemented to shorten the time needed to achieve proficiency conducting FNL.

Table 2. P-values of pairwise comparisons for level of training

	Fellow	PGY 1	PGY 2	PGY 3
PGY 6		0.004	1.000	0.488
PGY 1	0.004		0.004	0.299
PGY 2	1.000	0.004		0.449
PGY 3	0.488	0.299	0.449	

Table 3. Comparison of FNL timings based on level of experience.

		Timing from entrance of nose to postnasal space in seconds		Timing from entrance of nose to visualization of vocal fold in seconds	
	N	Mean ± Standard Deviation	25/50/75 Percentile	Mean ± Standard Deviation	25/50/75 Percentile
PGY 6	25	16.2 ± 12	9.5/12/21.5	48.2 ± 34.4	25.5/35/60.5
PGY 1	22	19.4 ± 14.5	9/13.5/29	65.7 ± 43.1	37.3/52/103
PGY 2	24	16 ± 11.9	8.25/12.5/24.8	43.5 ± 21.3	21.3/43/61.8
PGY 3	24	20.5 ± 20.4	8.25/13/23.8	49.3 ± 33.1	22.8/40.5/64.5
P-Value		0.08		0.26	

Table 4. Average Patient Age Undergoing FNL Based on Level of Training.

Groups	Average Age in Months
PGY 6	15.7
PGY 1	42.2
PGY 2	46.6
PGY 3	40.7
P-Value Between Groups	0.48

Limitations

There are several limitations to this study. Many residency programs have differing amounts of exposure to otolaryngology during their first year of residency training and thus will have varied amounts of experience performing FNL. At the time of this study, PGY-1 residents at our institution have 6 months of otolaryngology experience. Lastly, this study was performed at a single hospital, in a single residency program, which makes the results of this study difficult to extrapolate to other clinical settings.

Conclusion

Our study demonstrates that the quality of pediatric FNL improves after the PGY-1 year. Current training remains standardized with the traditional "see one, do one, teach one" method. While this educational technique is largely used in many facets of medicine, pediatric FNL remains a challenging procedure. Adding simulation training can allow residents to practice in a safe and controlled environment, leading to more effective and efficient pediatric FNL. A standardized curriculum should focus on highlighting pediatric anatomy, pathology, and important procedural techniques for FNL. Taken together the development of a standardized curriculum and high-quality simulation would allow for earlier proficiency in pediatric FNL. ■

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