Flexible Laryngoscopy: A Comparison of Fiber Optic and Distal Chip Technologies—Part 2: Laryngopharyngeal Reflux

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Summary: Part 1 of this paper compared fiber optic (FO) and distal chip (DC) flexible technologies in the diagnosis of vocal fold masses and mucosal wave abnormalities. Part 2 of this study was designed to evaluate the usefulness of FO and DC flexible imaging in the diagnosis of laryngopharyngeal reflux (LPR) disease. Thirty-four consecutive patients were examined with either FO or DC flexible stroboscopy followed immediately by rigid stroboscopy. Rigid stroboscopy was considered the "gold-standard" for this study. All stroboscopy segments were evaluated by two laryngologists, an otolaryngologist, a laryngology fellow, and an otolaryngology resident for physical findings of LPR using the Reflux Finding Score (RFS) and Posterior Erythema Grade (PE grade). Both flexible systems underrepresented the physical findings of LPR compared to the rigid examination, but the FO system was frequently more accurate than the DC system. For PE grade, agreement with the rigid endoscope was 95% for the FO system and 73% for the DC system. Total RFSs for both flexible systems were significantly different than RFSs from the corresponding rigid examinations ($P = 0.001$). Raters who used the RFS more often were more consistent. More severe PE grade scores correlated well with increasing RFSs. The number of patients diagnosed with LPR (RFS > 7) showed that despite differences in the category scores, the FO and DC were almost identical in how much LPR was diagnosed compared with their matched rigid examination. Because both flexible platforms significantly underrepresented reflux signs, we recommend that a rigid laryngeal telescope be used when examining the larynx for signs of LPR. If this is not available, these data suggest that a high-quality FO endoscope may be more accurate than a DC endoscope for most otolaryngologists.
Key Words: Laryngopharyngeal reflux–Flexible laryngoscopy–Fiber optic laryngoscopy–Distal chip–Vocal fold–Larynx–Comparison–Reflux finding score–Posterior erythema grade–Stroboscopy–Videostroboscopy–Videoendoscopy.

INTRODUCTION

As physicians become increasingly aware of laryngopharyngeal reflux (LPR), many have attempted to confirm its presence or quantify its severity using physical examination findings. Whether these findings are always reliable remains controversial.[1–4] Still, the vast majority of otolaryngologists decide to treat LPR based on how the larynx appears on flexible endoscopy.[5] It is very important, therefore, to know whether the equipment we use provides valid information.

In Part 1 of this report, we demonstrated that rigid endoscopy provides a more detailed examination of the vocal fold edge than fiber optic (FO) (Olympus ENF-L3, Olympus Medical, Center Valley, PA) or distal chip (DC) (Pentax VNL-1170 with EPK-1000 processor, KayPENTAX, Lincoln Park, NJ) technology. Part 1 expanded on previous research showing that rigid strobovideolaryngoscopy is superior to FO imaging for diagnosing vocal fold lesions.[6] Endoscopy with a rigid telescope has also been shown to represent LPR findings more accurately than FO technology.[7] However, although a rigid examination of the larynx would be ideal, not all patients tolerate rigid laryngoscopy. Those with a sensitive gag reflex, those with limited jaw or neck mobility, and many children may not be able to complete examination with a telescope.[8,9]

Although transnasal flexible laryngoscopy is not comfortable for every patient, with adequate topical anesthesia, it can be tolerated by most patients, including children. The miniaturization of the multichromatic charged coupled device (CCD) and its placement at the distal end of the flexible endoscope seems to provide better images of the larynx than previous technology.[10] However, because the DC endoscope's digital image is created by a processor which manipulates color tones and hues, and because its small lens has problems with barreling (Figure 1, in Part 1), it is important to compare this new technology to a standard. We thus endeavored to compare the performance of a high-quality, large-diameter FO endoscope (Olympus ENF-L3, 4.2-mm diameter) and a high-quality DC endoscope (Pentax VNL-1170K with EPK-1000 processor) relative to a gold-standard rigid laryngeal telescope in the examination of the larynx for signs of LPR.

METHODS

The methods used are detailed in Part 1 of this report. In summary, at our center, new patients with voice complaints sequentially undergo both flexible and rigid laryngeal examinations, and videostroboscopy is performed routinely with both endoscopes on the patient's initial visit. Subjects in the study were evaluated retrospectively. Equipment settings were set by the manufacturer at the time of installation, and cameras were white balanced to the xenon stroboscopic light source and black

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balanced (for cameras that had a black-balance feature) at the beginning of each patient day. As in most centers, no other color adjustments of our equipment were made routinely. The FO and rigid endoscopes each have a dedicated camera optimized for that particular endoscope. Each of the three endoscopes was connected to the same xenon stroboscopy light source for a portion of the examination using that endoscope; this segment was used for comparison. One laryngologist (Y.H.A.) exclusively used FO technology and another (R.T.S.) exclusively used DC technology for the flexible portion of the examination. Seventeen consecutive patients from each laryngologist were included. Six patients (three FO and three DC) were randomly chosen to be presented twice in each group to allow assessment of intrarater reliability.

To represent both experts in laryngology and otolaryngologists with other areas of interest, all stroboscopy segments were evaluated individually by two laryngologists, a general otolaryngologist, a laryngology fellow, and an otolaryngology resident. For each examination, the raters were asked to assign a Posterior Erythema Grade (PE grade) and to calculate the Reflux Finding Score (RFS)[11] (Table 1). The PE grade (Figure 1) is used in our practice and is a four-point scale ranging from no erythema (0 points) to severe erythema (three points). It focuses on the arytenoid complex, interarytenoid area, and the posterior supracricoid area. Because of LPR, erythema is seen most commonly in these areas.[12] The RFS was chosen because it is a measure which was validated against pH-probe data and is familiar to most laryngologists. In the initial validation study, RFSs greater than 7 were found to be 95% sensitive for LPR against pH monitoring.[11]

The PE grade and RFSs obtained using the rigid laryngeal telescope were used as the basis for comparison in this study because the rigid telescope is widely regarded as the gold-standard for awake laryngeal imaging. The FO and DC flexible endoscopes were compared based on the degree of similarity of the result between the flexible endoscope and its matched rigid examination. The data were cataloged using *Microsoft Excel* (Microsoft Corp., Redwood, WA) and analyzed using *SPSS* software (*SPSS* Inc., Chicago, IL) with the assistance of a biostatistician (D.L.). Statistical analysis was completed using Pearson's chi-square test, Pearson correlation coefficients, McNemar test, and Cronbach's alpha calculation when appropriate.

TABLE 1.
RFS Criteria[11]

Subglottic edema	0 = Absent 2 = Present
Ventricular obliteration	0 = Absent 2 = Partial 4 = Complete
Erythema/hyperemia	0 = Absent 2 = Arytenoids only 4 = Diffuse
Vocal fold edema	0 = None 1 = Mild 2 = Moderate 3 = Severe 4 = Polypoid
Diffuse laryngeal edema	0 = None 1 = Mild 2 = Moderate 3 = Severe 4 = Obstructing
Interarytenoid thickening	0 = None 1 = Mild 2 = Moderate 3 = Severe 4 = Obstructing
Granuloma/granulation tissue	0 = Absent 2 = Present
Thick mucous	0 = Absent 2 = Present

Scores > 7 are 95% sensitive for LPR.

RESULTS

Reliability measures

To evaluate interrater reliability, Cronbach's alpha coefficients were calculated for the PE grade and the RFS total and the category scores (Table 2). An alpha value greater than 0.7 is desirable. For the total RFS, the mean alpha for all FO, DC, and rigid endoscopes was 0.785. Some of the subcategories of the RFS, such as glottic edema, had very good reliability (alpha = 0.934), whereas other categories had much more variation between reviewers. For the PE grade, the mean alpha score across endoscopes was 0.685. The DC endoscope brought this average down.

When evaluating intrarater reliability, the senior author (R.T.S.) was extremely consistent (Pearson coefficient for PE grade = 1.0; RFS = 0.94 for rigid examinations; and 0.87 for flexible examinations). Other authors were more variable, but acceptable (Table 3). Some of the variability might be because of the small number of cases that were viewed twice. When looking more specifically at intrarater reliability by endoscope, results were less consistent. For the PE grade, some raters had very diverse scores. The RFSs were better, and generally fell along the lines of experience (Table 4).

PE grade

We evaluated the flexible endoscopes' performance using the PE grade in three different ways: (1) the ability to distinguish the absence or presence of erythema, (2) the ability to quantify the erythema, and (3) the mean score.

Method 1—normal versus abnormal. In the FO group, 95.2% of the matched examinations were in agreement for both endoscopes; 3.5% of the matched examinations were abnormal for the rigid and normal for the flexible endoscopes ($P = 0.3$, McNemar test). Thus, there was no significant difference in the abilities of the FO and rigid endoscopes to detect an abnormality in these 84 pairs of examinations.

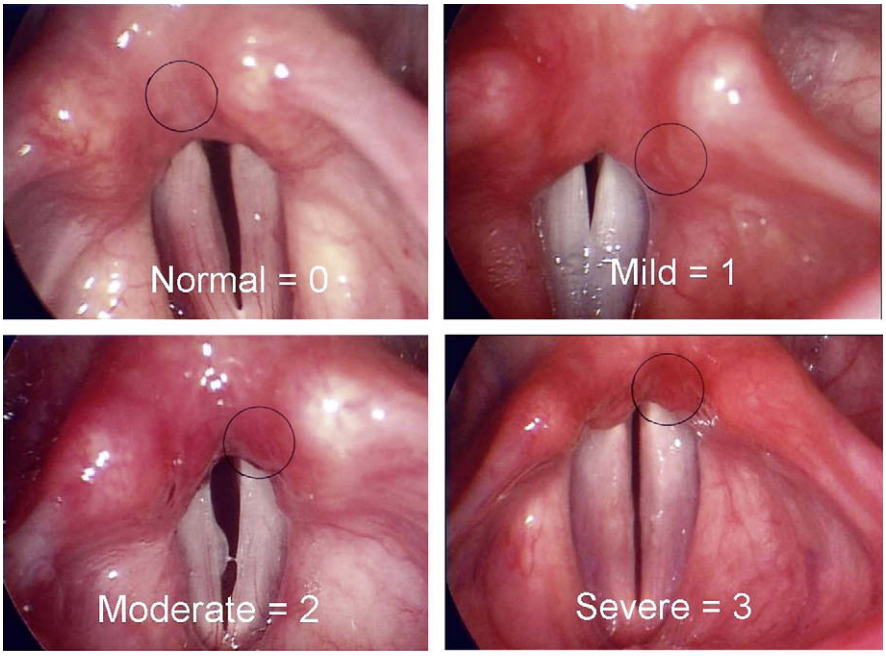

FIGURE 1. PE grade scores and examples. Normal = 0, Mild = 1, Moderate = 2, Severe = 3.

In the DC group, 72.9% of the matched examinations were in agreement for both endoscopes. An abnormality was detected in 21.2% of the rigid examinations when one was not detected by the flexible examinations. Thus, the rigid endoscope detected significantly more erythema than the DC flexible endoscope ($P = 0.004$, McNemar test) in these 85 pairs of examinations.

There is significantly more agreement between the flexible and rigid examinations in the FO group than in the DC group (95.3% vs 72.9%, $P < 0.001$, chi-square test).

To reduce the impact of inexperience on this analysis, the most internally consistent reviewer (Laryngologist 1 [L1]) was analyzed independently. For him, when using the FO endoscope (n = 17), there was 100% agreement between endoscopes. When the DC endoscope was used, there was only 58.9% agreement between endoscopes (n = 10). There were six (35.3%) cases where the flexible examinations were normal and the rigid abnormal and one (5.9%) case where the flexible examination was abnormal and the rigid was normal ($P = 0.014$, McNemar test). Thus, his results were similar to those we found for the entire set of reviewers.

Method 2—comparison of level of abnormality detected. Table 5 reports the distribution of PE grade by endoscope. For the FO group, there is no significant difference in the degree of abnormality scored on each examination between the rigid and flexible endoscopes ($P = 0.20$, chi-square test). The percentage of abnormalities scored as moderate or severe was 76.2% for rigid and 69.4% for FO.

For the DC group, there is a significant difference in the severity of the abnormality detected. For the rigid examinations,

TABLE 2.
Interrater Reliability Measures for Each Score (Cronbach's Alpha > 0.7 Desirable)

Group	FO	FO Rigid	DC	DC Rigid
PE grade	0.759	0.703	0.528	0.751
Total RFS	0.807	0.588	0.862	0.884
RFS category				
Subglottic edema	0.373	0.758	0.568	0.396
Ventricular obliteration	0.309	0.521	0.765	0.825
Erythema	0.495	0.04	0.598	0.639
Glottic edema	0.69	0.579	0.934	0.802
Generalized edema	0.611	0.421	0.765	0.789
Posterior cobblestoning	0.707	0.255	0.837	0.705
Granulomas*	—	—	—	—
Thick mucous	0.654	0.178	0.244	0.126

* No granulomas identified.

TABLE 3.
Intrarater Reliability (Pearson Coefficient)

Variable	Reviewer	Flexible with Duplicate Flexible	Rigid with Duplicate Rigid
Reflux finding score	L1	0.86	1.00
	L2	0.51	−0.42
	General otolaryngologist	0.61	0.59
	Fellow	0.78	0.59
	Resident	0.38	0.71
PE grade	L1	1.00	1
	L2	0.23	0.61
	General otolaryngologist	0.00	0.95
	Fellow	0.48	0.76
	Resident	0.88	0.86

TABLE 4.
Intrarater Reliability: Pearson Coefficients by Endoscope for PE Grade and RFS

	PE Grade			RFS		
	FO	DC	Rigid	FO	DC	Rigid
No of cases	3	3	6	3	3	6
L1	1	1	1	0.92	1	1
L2	NC	0.19	0.61	0.19	0.87	−0.42
General otolaryngologist	NC	NC	0.95	0.97	−0.65	0.59
Fellow	0.5	NC	0.76	0.81	0.97	0.59
Resident	NC	0.87	0.86	0.41	−0.28	0.71
ALL	0.46	0.49	0.81	0.7	0.4	0.67

Abbreviations: L1, laryngologist 1; L2, laryngologist 2; NC, not able to calculate.

65.9% are graded as moderate or severe compared to only 21.2% of the flexible examinations ($P < 0.0005$).

Based on these data, we can conclude that the PE grades based on the FO and rigid endoscopes were similar, whereas the PE grades based on the DC and rigid endoscopes differed in the severity of the erythema (Figure 2).

Method 3—comparison of mean grades. The mean PE Grade values are provided in Table 6. Although in practice individual scores are used, the mean is helpful in evaluating the endoscopes for this study. For these data, the mean PE grade is significantly higher for rigid endoscopes in both the FO and DC groups. However, the resident's scores make a major contribution to the FO group's mean and when only the data from L1 is considered, the FO group flexible and rigid scores are the same. Overall, the average differences in PE grade between the rigid and flexible endoscopes are 0.21 points for the FO group and 0.69 points for the DC group ($P < 0.001$, t test). We can conclude that the difference between the results on the flexible and rigid examinations is greater for the DC group.

Reflux finding score

The mean total RFS by the five raters was significantly lower for both the FO and DC groups compared with the scores given

TABLE 5.
Distribution of PE Grade Scores

	FO Group		DC Group	
	Flexible (n = 85)	Rigid (n = 84)	Flexible (n = 85)	Rigid (n = 85)
0	3.5% (3)	1.2% (1)	22.4% (19)	5.9% (5)
1	27.1% (23)	22.6% (19)	56.5% (48)	28.2% (24)
2	55.3% (47)	51.2% (43)	18.8% (16)	55.3% (47)
3	14.1% (12)	25.0% (21)	2.4% (2)	10.6% (9)
P value (chi-square test)	0.218		<0.0005	

Values based on n = 85 (17 patients per group × 5 reviewers).

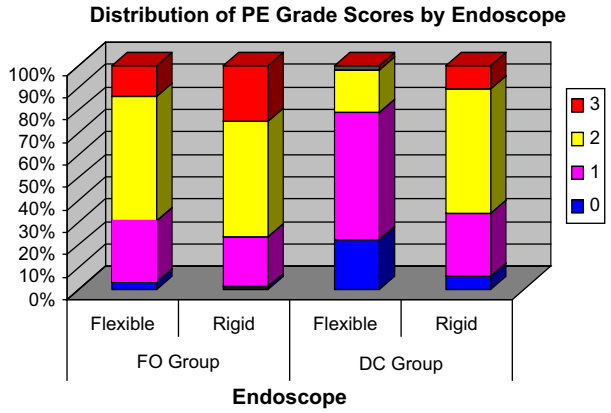

FIGURE 2. Distribution of PE grade scores by endoscope. FO group: $P = 0.22$; DC group: $P = 0.0005$.

to the matched rigid images ($P < 0.001$). However, the findings vary by rater. For the FO group, there is no difference in mean RFSs for L1, laryngologist 2 (L2), and Fellow, and also no difference in the DC group for L1 and Fellow. Table 7 shows the average RFS by each rater. The RFSs are discussed under the following categories.

Subglottic edema. Subglottic edema, also known as pseudosulcus, was detected less often by both types of flexible endoscopes than by the rigid examinations. The FO detected subglottic edema in 21% of the cases, whereas the rigid telescope detected subglottic edema in 36% of the cases. This difference reached significance ($P = 0.03$). The DC endoscope was only slightly better at detecting subglottic edema (24% of DC cases vs 34% or rigid cases); the difference was not significant ($P = 0.1$).

Ventricular obliteration. Ventricular obliteration was identified slightly more with the rigid telescope (FO 7.1%, FO rigid 8.3%; DC 14.1%, DC rigid 15.7%), but these results were not statistically significant (FO: $P = 0.6$, DC: $P = 0.2$).

Erythema. Overall for erythema, both flexible endoscopes differed significantly from their associated rigid examinations (FO: $P = 0.03$, DC: $P = 0.006$). The images produced by the FO system were similar to those produced by the rigid telescope than to those produced by the DC system, but both flexible endoscopes underrepresented erythema. The biggest difference for the FO endoscope was that fewer patients were rated as having diffuse erythema than was suggested by the rigid examination (46% vs 65%). For the DC endoscope, the difference was more apparent by looking at the number of cases that was determined to be free of erythema: 27% of DC patients were rated as not having any erythema, whereas only 10% of the rigid patients were rated that way.

Glottic edema. The scores for glottic edema were significantly less for the flexible endoscopes than the rigid endoscope. On the FO endoscope, 21% were rated as normal, compared to 10% with rigid endoscope. With the DC endoscope, 27% were normal, compared to 7% with rigid endoscope. When looking at the reviewers' overall rating for glottic edema, the FO deviated slightly further than the DC (FO: $P = 0.03$, DC: $P = 0.01$).

TABLE 6.
Comparison of Mean PE Grade by Endoscope

	DC	DC Rigid	FO	FO Rigid
All reviewers				
Mean	1.01 (n = 85)	1.71 (n = 85)	1.79 (n = 84)	2.00 (n = 85)
SEM	0.078	0.08	0.078	0.079
Paired *t* test	7.329		2.234	
P value	0		0.028	
L1 only				
Mean	0.65 (n = 17)	1.65 (n = 17)	1.76 (n = 17)	1.76 (n = 17)
SEM	0.147	0.191	0.136	0.161
Paired *t* test	4.4		0	
P value	0		1	

Generalized edema. The scores for both flexible endoscopes were essentially the same in this category. Both the FO and DC images were rated as having less edema than the corresponding rigid images, but the FO scores were less accurate (FO: $P = 0.001$, DC: $P = 0.03$).

Posterior cobblestoning. The FO scores corresponded well with those from the associated rigid examinations, as the difference was insignificant ($P = 0.5$). The DC images were consistently rated more normal than their corresponding rigid images, a significant difference ($P = 0.001$).

Granulation. There were too few granulomas to analyze for this report.

Thick mucous. Neither flexible endoscopes differed significantly from their corresponding rigid examination findings.

Overall diagnosis of LPR

LPR was diagnosed if the RFS for the examination was greater than 7. The diagnosis was made in 77 examinations in the FO group and 78 examinations in the DC group.

Tables 8A and 8B compare the diagnosis of both the flexible endoscopes to that on the matched rigid examination. For all reviewers combined, the overall agreement between flexible and rigid is similar for both endoscopes. But singling out the most consistent reviewer, the same diagnosis was made using the flexible and rigid examinations in 92.8% of cases using FO and in only 60% of the cases with DC.

DISCUSSION

Because of their availability and convenience, most otolaryngologists make the diagnosis of LPR using a flexible laryngoscope[5] even though a rigid telescope more accurately displays laryngeal pathology.[7,13–17] We need to know that the tools we use allow us to make accurate clinical judgments. We therefore sought to compare the tools we use often. To determine which flexible endoscope provides a more valid image, it would be best to compare the FO, DC, and rigid endoscopes sequentially on the same patient. This was not possible in this retrospective analysis. However, the flexible endoscopes can be compared with each other in light of each endoscope's performance against the rigid telescope. This study was not designed to prove LPR, but rather to assess the ability of the endoscopes to image the same larynx in the same way. Although many of our patients

TABLE 7.
Comparison of RFS Totals Between Flexible and Rigid Examinations by Reviewers (Mean ± SEM)

	FO Group			DC Group		
Reviewer	Flexible	Rigid	*P* Value	Flexible	Rigid	*P* value
L1	9.4 ± 0.9	10.5 ± 1.0	0.096	9.8 ± 1.5	10.1 ± 1.1	0.753
	n = 14			n = 15		
L2	7.2 ± 0.8	7.3 ± 0.8	0.903	6.7 ± 1.1	9.2 ± 0.9	0.027
	n = 17			n = 17		
General otolaryngologist	8.4 ± 0.9	13.6 ± 0.5	<0.001	9.6 ± 1.2	15.1 ± 0.9	0.002
	n = 14			n = 14		
Fellow	9.9 ± 1.0	9.7 ± 1.1	0.884	9.9 ± 1.4	10.1 ± 1.4	0.796
	n = 15			n = 16		
Resident	8.2 ± 1.1	11.1 ± 0.8	0.02	7.0 ± 1.4	11.4 ± 1.0	0.006
	n = 17			n = 16		
Overall	8.6 ± 0.4	10.3 ± 0.4	<0.001	8.5 ± 0.6	11.1 ± 0.5	<0.001

P values are based on paired *t* tests.

TABLE 8A.
RFS Results for FO and Rigid Examinations

	Diagnosis by Rigid Examination		
FO diagnosis	No LPR	LPR	*P* Value
No LPR	11	19	0.007
LPR	5	42	

*RFS > 7 denotes LPR; Shading denotes disagreement between endoscopes.
P values determined by McNemar test.

did have pH-impedance data confirming their reflux, these data were not considered for this study.

Table 9 summarizes our findings. Our overall data suggest that images from a high-quality FO endoscope better approximate the color of images from a rigid laryngeal telescope than those created with DC technology, but that otherwise the two kinds of flexible endoscopes are equally useful to the otolaryngologist. This is somewhat surprising to us, as we generally thought that the image produced by the DC system was superior to that of the FO endoscopes. The FO endoscopes used in this study were high-quality, large-diameter (4.2 mm) endoscopes (Olympus ENF-L3) and cameras that cost approximately $16,000 at the time of this writing. Smaller diameter (usually 3.4 mm) endoscopes are used more commonly in otolaryngology offices and provide a comparatively inferior image. If these smaller endoscopes were used, perhaps we would see more differences between the FO and DC systems.

This study was not designed to validate the PE grade. However, using this measure, these data are conclusive that FO technology provides a better color match with rigid technology. Furthermore, our data suggest that PE grade severity correlates with increasing RFSs (Figure 3). Previous research using computerized color analysis in LPR demonstrated a correlation between posterior laryngeal erythema and reflux. In the study by Hanson et al, patients without laryngeal symptoms had lower erythema scores. Also, those with higher initial scores improved after treatment with omeprazole, especially for the true vocal folds.[12] The good correlation between our PE grade data and RFS data supports the notion that evaluating erythema is useful in diagnosing LPR.

If one includes erythema in his or her formula to identify or determine the severity of LPR, the capture system must be properly color-adjusted and each examination performed under uniform circumstances. Screen choice and camera settings are very important and need to be standardized between patients and examination rooms.[18] It is concerning that both flexible endoscopes, but especially the DC endoscope, consistently underrepresented erythema for most users as it may lead to a failure to diagnose LPR. However, we must also consider that the image from the rigid telescope allows us to overcall the abnormality. Without an objective test with very high specificity and sensitivity (such is not currently widely available), we cannot know for certain which system is more accurate. We just know that the images produced by the flexible systems were dissimilar to those produced by the rigid in this category.

In addition, our observations of the current DC images suggest the presence of some color inconsistencies across examinations that may be because of equipment variability. We believe that additional research is necessary to establish a standard protocol to assure consistent color adjustment from examination to examination (and among different monitors and printers used during a single examination), to be certain that clinical color assessments are valid and reliable.

When looking at overall and individual RFS data, our data suggest that experience makes a difference. For the reviewers who use the RFS often, there was no significant difference between either endoscope's matched scores. Adding in the reviewers who were less familiar with the RFS, we see that both flexible platforms underrepresented findings from the rigid telescope. Because there are several scoring systems in the literature to grade LPR, we recommend that practitioners adopt one system for evaluating the signs of LPR and use that system consistently. Furthermore, if several practitioners work together, there should be agreement as to what findings correlate to which grade within the system.

TABLE 8B.
RFS Results for DC and Rigid examinations

	Diagnosis by Rigid Examination		
DC diagnosis	No LPR	LPR	*P* Value
No LPR	13	27	0.001
LPR	3	35	

RFS > 7 denotes LPR; Shading denotes disagreement between endoscopes.
P values determined by McNemar test.

TABLE 9.
Superior Flexible Endoscope by Grading System

Criteria	Superior Endoscope (FO vs DC)
PE grade	*FO*
Method	
Normal vs abnormal	FO
Degree of abnormality	FO
Mean score	FO
RFS	*Same*
Total	Same
Diagnosis of LPR (RFS > 7)	Same
Category	
Subglottic edema	DC
Ventricular obliteration	Same
Erythema	FO
Glottic edema	DC
Generalized edema	Same
Posterior cobblestoning	FO
Granuloma	N/A
Thick mucous	Same

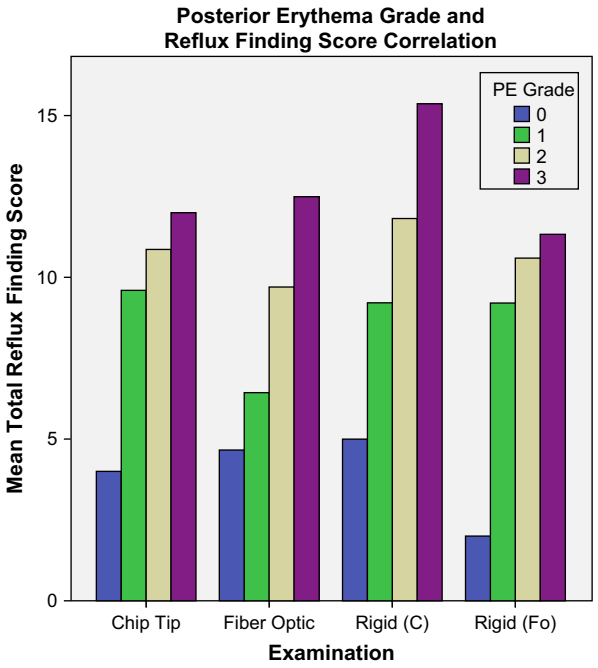

FIGURE 3. Comparison of PE grade and RFSs on patients by scope. Increasing erythema correlated well with increasing RFSs.

Our RFS data vary from those in other publications comparing LPR findings between endoscopes. Milstein et al compared FO and rigid technology and reported that pseudosulcus, interarytenoid irritation, arytenoid complex irritation, ventricular obliteration, and vocal fold edema were identified in more patients using flexible FO technology.[7] Our data suggest the opposite. In this study, we identified RFS findings less often using flexible technology of either type, with the DC endoscopes being further off the mark.

Perhaps the most useful data concern those examinations where the RFS was greater than 7. This showed that for the whole group, both flexible platforms basically agreed with the matched rigid examinations, but when looking at the most senior and most consistent reviewer, the FO performed much better than the DC system.

CONCLUSION

The LPR findings with a high-quality FO endoscope were more similar to those viewed using the rigid telescope. DC technology for flexible laryngoscopy holds promise in transnasal diagnosis of laryngeal disorders. Although the picture appears to be clearer, it significantly underrepresented many of the physical signs of LPR when compared to the rigid laryngeal telescope in this study. Because both flexible platforms significantly underrepresented reflux signs, we recommend that a rigid laryngeal telescope be used when examining the larynx for signs of LPR. If this is not available, these data suggest that an FO endoscope may be more accurate than a DC endoscope. These issues need to be evaluated in a prospective, head-to-head comparison of FO and DC technology.

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