ORIGINAL ARTICLE

Laryngostrobovideography Using a Flexible Laryngofiberscope Performed in Conjunction with the Phonatory Examination

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Abstract. The phonatory examination was performed while monitoring vocal fold vibration by laryngostrobovideography. Vocal fold vibration was video-taped by a laryngostroboscope and flexible laryngofiberscope inserted through the nasal cavity. Simultaneously, the phonatory examination was conducted with a phonation analyzer. The data were entered into a personal microcomputer via an A/D converter and analyzed to obtain the parameters of sound pitch, sound intensity and mean expiratory air flow volume, which were superimposed on the color video monitor screen. (Keio J Med 39(2): 102-105, June 1990)

Key words: laryngostrobovideography, phonatory examination, laryngofiberscope, laryngostroboscope, home color video camera

Introduction

The brighter laryngostroboscopes that are now commercially available have facilitated the video-taping of clear images of vocal fold vibration by laryngostrobovideography using a flexible laryngofiberscope in combination with a video-tape recording (VTR) system. In addition, development of the phonation analyzer has enabled simultaneous measurements of sound pitch, mean expiratory air flow volume and sound intensity on phonation, enabling frequent use of the phonatory examination.

Because results of the phonatory examination are comparatively difficult to reproduce, it would be ideal if vocal fold vibration could be simultaneously monitored on a VTR system.

In conjunction with the phonatory examination, we attempted to monitor vocal fold vibration by laryngostrobovideography using a flexible laryngofiberscope inserted endonasally. We report herein the results of this clinical study and discuss the problems involved and points to be improved.

Instruments

Laryngostroboscope

The laryngostroboscope used was a Rhino-Larynx Stroboscope Type 4914 (Bruel & Kjaer). Illumination was sufficient to enable clear images to be obtained by a home video camera even when a flexible laryngofiberscope was employed (Fig. 1-a).

Laryngoendoscope

Since there is little limitation on phonation at the time of observation, the flexible laryngofiberscope is well suited to the observation of vocal fold vibration on loaded phonation when the phonatory examination is performed simultaneously. In this clinical study, a flexible laryngofiberscope (MACHIDA FLT-6) was employed (Fig. 2).

Color video camera and mount adapter

The color video camera employed was a home-use JVC GX-N4CH equipped with a MACHIDA adapter (Nagashima Medical Instruments Co., Ltd.) capable of being connected to the flexible laryngofiberscope (Fig. 2).

Device for phonatory examination

The device used for the phonatory examination was a...
Fig. 1 The laryngostroboscope and device for the phonatory examination used in this clinical study.

a: Front panel of Rhino-Larynx Stroboscope Type 4914 (Brüel & Kjaer)
b: Phonation Analyzer Type PA-500 (Minato Medical Science Co., Ltd.)

Fig. 2 Flexible laryngofiberscope MACHIDA FLT-6 and home color video camera JVC GX-N4CH equipped with a MACHIDA adapter

Phonation Analyzer Type PA-500 (Minato Medical Science Co., Ltd.) (Fig. 1-b). The three parameters, namely, sound pitch, mean expiratory air flow volume and sound intensity on phonation, were simultaneously measured by this device.

As shown in the block diagram of Fig. 3, the data obtained by the phonation analyzer were entered into a personal microcomputer (SHARP x1-turbo) via an A/D converter. The three parameters, sound pitch (P), mean expiratory air flow volume (F) and sound intensity (I), were superimposed on the image of vocal fold vibration on the color video monitor screen, digitally displayed and programmed in such a way that they changed once every second. In addition, the date of examination, patient number, sex, age and disease were also programmed for digital display.

Methods and Subjects of Video-taping and Measurement

Surface anesthesia of 4% lidocaine HCl was applied to the nasal cavity and pharynx. Surface anesthesia of the laryngeal cavity was omitted in order to minimize the influence of anesthesia on phonation. After anesthesia, the laryngofiberscope was inserted through the nasal cavity. A slow-motion image of vocal fold vibration was recorded under the light source of the laryngostroboscope and displayed on the color video monitor screen.

In the phonatory examination, the mean expiratory air flow volume was measured by a respiratory flowmeter using the hot-wire principle. A transducer was equipped with a mouthpiece to achieve a consistent state of mouth opening. The sound intensity and pitch were measured with a 20 cm distance between the microphone and lips. The subjects held the mouthpiece of the phonation analyzer between their teeth and produced a voiced /a/ by virtue of easy, maximum and minimum phonation within the upper and lower vocal range (Fig. 4).
In this clinical study, four subjects consisting of one volunteer with normal vocal folds and three patients each with vocal fold polyp, vocal fold nodules and polypoid vocal folds underwent observations and recordings.

**Results**

The result of easy phonation in the subject with normal vocal folds is presented in Fig. 5. The slow-motion image of vocal fold vibration depicted by laryngostroboscopy was shown in the center of the color video monitor screen. At the same time, the date of examination, patient number, age, sex and disease were superimposed on the left portion of the screen, and sound pitch (P), sound intensity (I) and mean expiratory air flow volume (F) on phonation were superimposed on the right portion of the screen. Figure 6 shows images of the upper vocal range of normal vocal folds, easy phonation of vocal fold polyp, easy phonation of vocal fold nodules and the upper vocal range of polypoid vocal folds.

**Discussion**

At present, laryngostroboscopy is extensively used in the clinical field to observe vocal fold vibration. Laryngostroboscopic observation of vocal fold vibration with a flexible laryngofiberscope has been reported by Saito et al.4 Laryngostroboscopy with a flexible laryngofiberscope was first performed clinically by Yoshida et al.5 In the past, the intensity of illumination of the laryngostroboscope was limited, necessitating the use of an expensive color video camera with high quality and sensitivity. However, brighter laryngostroboscopes like the Rhino-Larynx Stroboscope Type 4914 (Bruel & Kjaer) that we employed in this clinical study are now commercially available, and it has become possible to...
record clear magnified slow-motion images of vocal fold vibration by laryngostrobovideography using a flexible laryngofiberscope equipped with an inexpensive home video camera.\textsuperscript{1,2,6}

In addition, attempts have been made to objectively evaluate phonatory function in diagnosing dysphonias. A device to simultaneously measure sound pitch, mean expiratory air flow volume and sound intensity on phonation (phonation analyzer) has been developed and applied clinically.\textsuperscript{3,7}

Laryngostrobovideography using a flexible laryngofiberscope and phonatory examination were done separately in the past. However, it may be preferable to conduct the phonatory examination while monitoring vocal fold vibration video-taped by laryngostrobovideography. The method used in this clinical study required the subjects to hold the mouthpiece of the phonation analyzer between their teeth so that a flexible laryngofiberscope could be inserted through the nasal cavity to monitor vocal fold vibration endoscopically. Laryngostrobovideography using a flexible laryngofiberscope is suited for the observation of vocal fold vibration on loaded phonation in that there is little limitation on phonation. The data obtained by simultaneous measurement by the phonation analyzer, namely, sound pitch, mean expiratory air flow volume and sound intensity on phonation, were superimposed on the color video monitor screen; each of these parameters was digitally displayed. It is usual to block air flow with a nose-clip in order to prevent leakage of expiratory air flow through the nasal cavity when measuring mean expiratory air flow volume.\textsuperscript{7} With our method, this blockade cannot be done since a laryngofiberscope is inserted through the nasal cavity. This must be kept in mind when determining mean expiratory air flow volume. At the same time, the fact that data obtained by the phonation analyzer are digitally displayed once every second creates the problem that data are not necessarily displayed on a real-time basis. Therefore, a program is being considered which superimposes analogue data on the color video monitor screen.

In this clinical study, results were obtained from four subjects, including a volunteer with normal vocal folds. It is thought that new interpretations of the phonatory examination will be made possible by increasing the number of the subjects.

\textbf{References}