Chapter 13
EndoSTROB DX system by XION GmbH

Beata Miaśkiewicz

Abstract

Advantages and shortcomings of a laryngovideo-stroboscopy system by XION GmbH, Germany that incorporates kymographic and electroglottographic analysis and simultaneous acoustic analysis are presented. Our evaluation of this system is based on our continuous use of the EndoSTROB DX system by XION GmbH for over four years.

Keywords: LVS, kymography, EGG, voice exam, XION EndoSTROB DX system

Introduction

Since 2009 we have used in our everyday clinical practice (Audiology and Phoniatrics Clinic at the Institute of Physiology and Pathology of Hearing in Warsaw-Kajetany, Poland), the EndoSTROB DX system produced by XION GmbH, Germany (XION GmbH, Pankstrasse 8-10, 13127 Berlin, Germany; www.xion-medical.com) to conduct comprehensive evaluations of various voice disorders. In total we conducted over 2200 voice exams using this system.

The EndoSTROB DX system (Figure 1) is designed for videoendoscopic examination of the vocal folds (VF). The system is also integrated with the electroglottography (EGG) module. EGG examination can be conducted separately or in a stroboscopic mode. XION also includes an acoustic package. The results of each examination are displayed live on a monitor and are recorded. The entire system is connected to a PC to handle images and videos and to archive the data via the XION-supplied software program called DiVAS.

Figure 1. EndoSTROB system XION GmbH.

The system connects to a rigid or flexible scope. The rigid videolaryngoscope (model 327310070) is an instrument integrating the optical system, a CCD matrix, and a microphone, with only a single cable needed to connect it to the unit. The scope includes a
handy focusing ring that enables image sharpening. The working length of this rigid videolaryngoscope is 180 mm. Its diameter is 10 mm; the direction of view is at 70 degrees. The 0.25” CCD matrix of a 470x420 resolution with a micro lens and a mosaic filter of 752x582 active pixels is located at the distal tip of the laryngoscope.

The flexible videonasopharyngoscope has been designed for endoscopic ENT diagnostics and for stroboscopic observations of the VF. The location of the 0.1” CCD matrix of a 312x420 resolution with a micro lens and mosaic filter of 500 x 582 active pixels at the distal tip makes the image resolution of a much higher quality compared to the traditional flexible videonasopharyngoscopes. The outer diameter of the nasopharyngoscope is 4 mm. The working length is 320 mm and the bending angle of the scope is up to 130 degrees. The line of view is 0 degrees, and the field of view is 80 degrees, while the depth of field is 10-90 mm. In contrast to the rigid videolaryngoscope, microphone pick-up is not integrated with the flexible nasopharyngoscope.

For some stroboscopic examination, we use the EGG electrodes. This system incorporates both the microphone and the button to switch the monitor display into stroboscope mode. In our experience the strobe effect under these conditions is of lesser quality.

The system reads the fundamental frequency (F0) and calculates the relative sound pressure levels (SPL). Both values are displayed on the monitor. F0 values are displayed in Hz, and SPL values are listed in relative dB. The value of SPL is displayed on the monitor in relative units.

The stroboscope tracks voice frequencies in the range of 80-1000 Hz and it can operate in a slow motion (0.5-2Hz) or a standing-phase (0-360°) mode. The system is powered by a 50 W high-capacity light source with a micro-discharge lamp and color temperature of 6000 K. There is an automatic intensity control of the light source as well as a manual mode. This mode allows for adjusting the light intensity as needed.

**DiVAS software package: Kymography module**

The DiVAS software includes a videostrobokymography (VSK) package. VSK is obtained by placing one or more perpendicular demarcation lines across the image of glottis at the point(s) of interest. The resultant output is combined into one image, called a kymogram. Figure 2 shows a typical kymogram displaying a one-dimensional view of the oscillating VF at the demarcation line. The vertical axis corresponds to the passage of time.

Kymography allows for assessment of the glottal cycle and extraction of the open and closing quotients (OQ and CQ). OQ is the duration of opening portion of the glottis cycle and CQ is the closing time within one glottis cycle. There are however some problems with VSK. For example, one problem relates to the variations of the camera position when recording the phonation, as camera positions will affect the final kymogram. The other problem relates to an inability of many patients to phonate steadily for longer than four seconds.

**Electroglottographic (EGG) module**

The electroglottography (EGG) module records the vocal cycle at the same time as the stroboscopy and compares the shape of EEG tracing with the video signal. EGG tracing can be also obtained independently from the LVS exam.

To obtain any EGG tracing called the electroglottogram, two electrodes are placed on the skin of the neck at level of the thyroid cartilage and a high frequency/low voltage current is passed across the neck (between the electrodes). When the VF open and close on phonation, the impedance across the electrodes changes and an electroglottogram is produced. Hence, an electroglottogram represents VF contact or lack of it across the
glottis and reflects the glottic cycle. The obtained glottic cycle is divided into the closed, the closing, the opening, and the opened phases.

**Figure 2.** Videostrobokymography (R view) derived from a single line placed across the glottis at the location of the mucous retention cyst of the left VF (L view).

From these tracings (Figure 3), a quasi-open quotient (QOQ) and the medium sound pressure level (MidSPL) of the recorded voice sample can be calculated. QOQ is a parameter that describes the relative time of glottic opening. It is defined as a period in which the EGG flow through the glottis is more than 50% of the minimum flow (normalized to the pitch period) as compared to the entire cycle. The QOQ values and the values of the SPL in relative dB are reported separately for each cycle.

The quality of EGG tracings is subject to individual circumstances. For example, in patients with a thick, fatty neck, the amplitude of EGG is small. Other EGG artifacts are present when the glottis contains thick mucous, or when hypertrophy of the false vocal folds (FVF) is present.

**Figure 3.** Electroglottogram (upper tracing) and the corresponding acoustic signal (lower tracing) displayed over time (y axis) with relative amplitude (x axis) values plotted in the synchrony to the EGG tracing. The red shaded area represents a single glottis cycle starting with opening to open to closing to closed portion. In the left upper corner are displayed values of QOQ and MidSPL.
Acoustic module

DiVAS software also provides a means to conduct objective acoustic voice analysis. Using DIVAS, wide-band and narrow-band spectrograms can be derived. Also, the F0 of the voice, the power spectrum, and energy diagram with jitter and shimmer values can be calculated (Figure 4). DiVAS also provides an application to measure Voice Range Profile (VRP) and the Voice Strain Test (VST). DiVAS tracings are shown in Figure 4 below.

![Figure 4](image)

**Figure 4.** Sample of the acoustic voice analysis using DiVAS program displayed over 26 seconds. The upper tracing shows Power Spectrum in dB; the singer’s formant range is highlighted in rose-color. The bar below represents F0 progress of the voice in Hz. The energy diagram that presents SLP in relative dB over time is shown below the F0 bar. The next graph (dark bar) represents Wide Band Spectrogram in kHz. The Waveform of the voice signal (amplitude over time) is shown on the lowest diagram of this figure.

Summary and conclusion

EndoSTROB DX system produced by XION GmbH has been used in our clinic since 2009 to conduct over 2200 voice exams. Based on this experience we feel that this system is an excellent tool for voice evaluation in everyday clinical practice. The advantages of this system include the software processing modules that allow for a more detailed evaluation of laryngeal behavior during voice production.

The system is easy to operate and user-friendly. Archiving data allows comparing the examination results (images, videos, calculated parameters, etc.) in follow-up periods. Despite the many advantages, some shortcomings of this system are present.

References