Chapter 22
Videokymography analysis in injection laryngoplasty

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Abstract

This chapter describes videokymography application in assessing vocal fold (VF) kinematics resulting from augmentation of the glottis with injection laryngoplasty. All visual images were captured transorally with Xion EndoSTROB E system and processed with DiagNova’s DiagnoScope Specjalista® software. Results showed improvement in glottic closure, which was well visualized by videokymography.

Keywords: videokymography, videostroboscopy, glottis augmentation, VF paralysis

Introduction

The main goal of glottic augmentation (medialization) in patients with unilateral vocal fold paralysis and/or glottic insufficiency is to improve glottic closure. This must result in elimination of breathiness and should result in a more normal voice quality. Glottic augmentation can be performed in the operating room or as an office procedure under local anesthesia with laryngovideostroboscopy (LVS) control to improve the outcomes. Using kymography enables more informative analysis of VF kinematics than by LVS alone [1].

Materials and methods

EndoSTROB E system by Xion GmbH

In our work we use the Xion EndoSTROB E system (Pankstr. 8-10, 13127 Berlin, Germany). This system is delivered in a tower configuration (see Figure 1). The components include: stroboscopy unit, rigid 70° laryngoscope witch integrates optics, camera, and microphone in a single instrument. The camera runs on PAL video system with resolution 470 x 576 pixels. The MATRIX LEDduo light source delivers 6500 K light color. The stroboscopy system has double strobe effect-shutter and flash stroboscopy, which enable sharpening of the anatomical structure edges during video capture. The response frequency of the stroboscopy is 80-1000 Hz.

DiagnoScope Specjalista® by DiagNova (Poland) – Videokymography

Although the Xion EndoSTROB E system provides a built-in analytical software package, we prefer to use the DiagnoScope Specjalista® software package by DiagNova (Wrocław, Poland). LVS video sequences can be used as source material thanks to image stabilization functions [2]. This advanced kymography module allows objective functional diagnostics of VF by parameterizing their motion through a semi-automatic glottal gap detection function and by determining numerical coefficients that describe local amplitudes, asymmetries, and phase differences between the left and right VF along the glottal gap axis. The results are presented in parameter graphs and as phonovibrograms [2].
Below we present the model of monitoring the glottis augmentation by videokymography in a patient with complete left VF paralysis. The patient was a 64-year-old male who experienced left VF paralysis for 14 months. The etiology was surgery for cancer of the left lung.

After local anaesthesia with topical lidocaine (10%) spray and lidocaine drip applied onto the base of the tongue, the posterior pharyngeal wall, the supraglottis, and the VF, the patient was asked to hold his tongue with gauze. Dynamic visualization of the glottis was obtained with a transoral rigid 70° scope (Model Xion Video Laryngoscope, Pankstr. 8-10, 13127 Berlin, Germany) connected to Xion’s EndoSTROB E system. Augmentation involved an injection of Radiesse (Calcium hydroxylapatite, Merck, USA) into the paraglottic space of the left VF via a custom curved needle.

**Results**

LVS was obtained before, during, and after the procedure. The images were then processed. Figures 2 a-i show kymography imaging just before procedure, during augmentation procedure, and just after the procedure (Figures 3 a-i). These images enabled us to assess the accuracy of this in-office based surgery. Kymography performed two weeks after augmentation allowed objective analysis of the final effect of the injection laryngoplasty (Figures 4 a-i).
Figure 2a. Video frame from the LVS sequence with marked kymography location (blue line).

Figure 2b. Kymography section made from the posterior part of the glottis from Figure 2a.

Figure 2c. Video frame from the LVS sequence with marked location of the section for kymography.
Figure 2d. Kymography section made from the medial part of the glottis from Figure 2c.

Figure 2e. Video frame from the videostroboscopic sequence with marked location of the section for kymography.

Figure 2f. Kymography section made from the anterior part of the glottis from Figure 2e.
Figure 2g. Visual presentation of both VF edges (dark blue line - right VF edge, turquoise line - left VF edge) for one vibration cycle from the kymography.

Figure 2h. The percent of incomplete glottis closure during one vibration cycle cycle.

Figure 2i. The phonovibrogram expresses incomplete glottis closure mainly due the left VF.
**Figure 3a.** Video frame from the LVS sequence with marked location of the section for kymography.

**Figure 3b.** Kymography section made from the posterior part of the glottis from Figure 3a.

**Figure 3c.** Video frame from the LVS sequence with marked location of the section for kymography.
Figure 3d. Kymography section made from the medial part of the glottis from Figure 3c.

Figure 3e. Video frame from the LVS sequence with marked location of the section for kymography.

Figure 3f. Kymography section made from the anterior part of the glottis from Figure 3e.
Figure 3g. Visual presentation of both VF edges (dark blue line - right VF edge, turquoise line - left VF edge) for one vibration cycle from the kymography.

Figure 3h. The percent of incomplete glottis closure during one vibration cycle.

Figure 3i. The phonovibrogram expresses complete glottis closure.
Figure 4a. Video frame from the videostroboscopic sequence with marked location of the section for kymograph.

Figure 4b. Kymography section made from the posterior part of the glottis from Figure 4a.

Figure 4c. Video frame from the videostroboscopic sequence with marked location of the section for kymograph.
Figure 4d. Kymography section made from the medial part of the glottis from Figure 4c.

Figure 4e. Video frame from the videostroboscopic sequence with marked location of the section for kymography.

Figure 4f. Kymography section made from the anterior part of the glottis from Figure 4e.
**Figure 4g.** Visual presentation of both VF edges (dark blue line - right VF edge, turquoise line - left VF edge) for one vibration cycle from the kymography.

**Figure 4h.** The percent of incomplete glottis closure during one vibration cycle.

**Figure 4i.** The phonovibrogram expresses complete glottis closure in the anterior and medial part of the glottis.
References
