Vocal Fold Videokymography: New Approach for the Analysis of Vocal Fold Vibratory Pattern

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Abstract

We developed a new analysis technique for the assessment of irregular vibratory movement of vocal folds. Successive frames of pre-recorded video images from videostroboscopy were transferred to computer memory and a vibratory tract of one selected point was described as a waveform by displaying the same lines of all frames along the y-direction. By applying this technique, irregular vibratory patterns of multiple regions, such as asynchronized registration of glottal cycles, could be easily visualized. It would be possible to monitor and analyze the pathologic changes of vocal fold movement by means of this newly developed system.

Introduction

So many techniques have been used for the examination and evaluation of the irregular function of larynx. Stroboscopy make it possible to visually assess the movement of vocal fold during the phonation by lightening the vocal tract with a stroboscopic light source that is triggered with a fundamental frequency of vocal fold vibration. However, it is impossible to visualize successive vibratory cycles and quantify irregularity of vocal fold movement by only visual assessment using stroboscopy.

Most recently, a high-speed imaging technique called videokymography was newly developed to overcome these drawbacks of stroboscopy. By using this new technique, irregular vibratory patterns of vocal folds, such as asynchronized registration of glottal cycles, could be easily visualized. However, this system needs modified high-speed CCD camera to acquire one line images of vocal folds with a rate of almost 8000 line images per second and has a shortcoming that only one line is able to be selected and displayed during the monitoring of vocal fold vibration.

In this study, we modified this technique such that it is possible to select region of interest and monitor vibratory patterns of multiple regions by analyzing pre-recorded video images using conventional videostroboscopy.

Method

During the comfortable phonation task, cine images of vocal fold movement were recorded using commercial videostroboscopy. Fundamental frequency of vocal fold vibration was detected using electroglottography (EGG), which reflects the variations in electrical impedance that theoretically results from the changes in vocal fold contact area during phonation.

User-friendly software was designed to analyze the video images from videostroboscopy. Successive 128 frames of video signal were captured and loaded on the computer memory

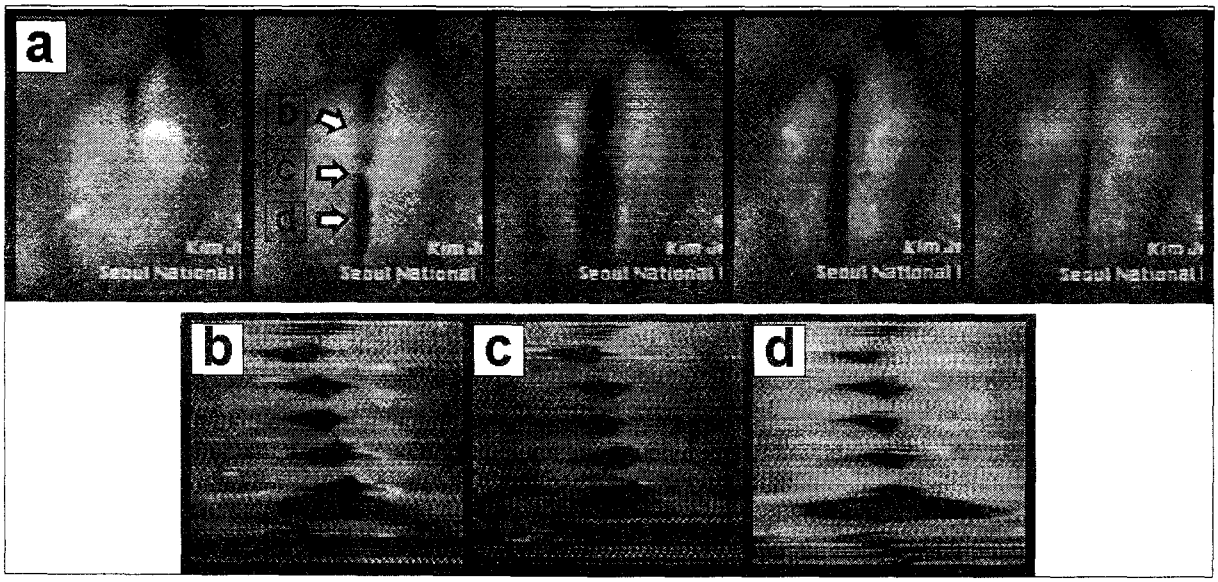

Fig 1. Videostroboscopy and videokymogram of normal volunteer.
a) videostroboscopy: regular vibratory pattern were shown
b), c), d) videokymogram of multiple regions: periodic waveforms represented the regular vibration.

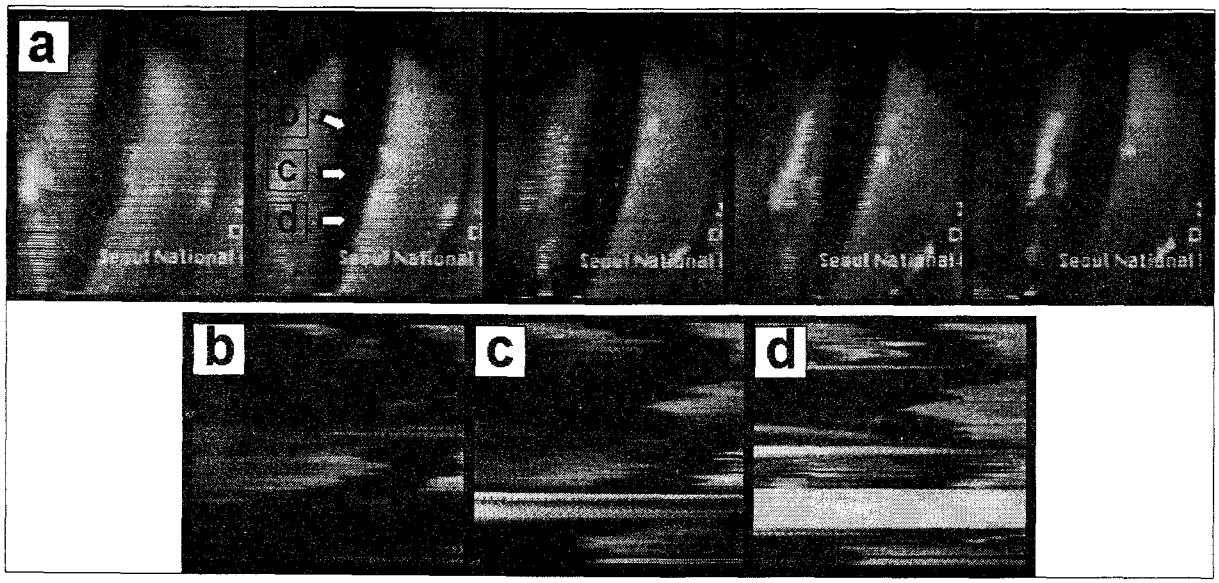

Fig 2. Videostroboscopy and videokymogram of patient with vocal palsy.
a) videostroboscopy: abnormal vibratory pattern, incompletely closed, was shown.
b), c), d) videokymogram of multiple regions: irregular vibratory pattern was well described.

using a image grabbing board. One static frame and one line of the frames were selected, and same lines of all frames were displayed along the y-direction so that the vocal fold vibration could be described vertically as a waveform. By selecting the different region of interest, watching the entire image of most upper plane of vocal folds, we could display the vibratory patterns of multiple regions simultaneously. Values such as asymmetry index of vocal fold

vibration and open quotient were calculated for the quantitative assessment of the vocal ford movement.

For the validation of usefulness, videokymographic investigations were performed on one male normal control and one female patient with vocal palsy.

Result

Videostroboscopy images and videokymogram of multiple regions are shown in Fig 1 (normal control) and Fig 2 (patient with vocal palsy).

Videokymogram of normal control showed regular periodic waveforms as Fig 1. In case of patient, abnormal vibratory pattern, vocal folds were not completely closed, was shown in videostroboscopy and videokymogram could well described this irregular pattern (Fig 2).

Conclusion

This system is simply modified version of videokymography, a unique technique to analyze the irregular movement of vocal fold. It would be possible to monitor and analyze the pathologic changes of vocal fold movement by using this newly developed system.

Reference

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