Vocal Fold Abnormalities in Laryngeal Tension-Fatigue Syndrome

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Abstract: This study sought to use videostrobolaryngoscopy to clarify possible biomechanical causes of dysphonia in patients with laryngeal tension-fatigue syndrome, a chronic functional dysphonia due to vocal abuse and misuse. The videostrobolaryngoscopic records of 301 laryngeal tension-fatigue syndrome patients were reviewed. The focus of observation was the visual characteristics of the mucous layer, vessel dilatation or neovascularization on the surface of vocal folds, abnormal glottal closure, and bilateral vibratory asymmetry. Abnormal findings on the vocal folds, especially during vibration, were noted in 270 cases (89.7%). Most patients (222, 73.8%) had multiple abnormalities. The results of this study suggest that chronic vocal overuse under excessive laryngeal muscle tension can cause phonotrauma and result in biomechanical property changes in the vocal fold’s cover. These changes would hinder the regular vibration of the vocal folds, increase irregularities in voice signals, and worsen the symptoms of dysphonia.

Materials and Methods

The videostrobolaryngoscopic records of 301 patients with laryngeal tension-fatigue syndrome diagnosed at our voice clinic from July 1991 to December 1999 were reviewed. There were 68 male and 233 female patients aged from 18 to
66 years old. The diagnosis was based on a history of chronic dysphonia due to prolonged voice overuse without overt organic lesions on the vocal folds. Patients with a history of acid reflux or whose dysphonic symptoms started immediately after an upper respiratory tract viral infection were excluded from the study.

The videostrobolaryngoscopic examination was performed following the standard procedure described previously [11–13]. The recordings were reviewed twice separately. The focus of observation was the manifestation of the mucus layer, vessel dilatation or neovascularization on the surface of the vocal folds, abnormal glottal closure, and bilateral vibratory asymmetry during vibration.

### Results

In this series, 250 patients (83%) showed an uneven mucus surface on the vocal folds either during vibration (Fig. 1A) or at rest. Thicker distal vessel and new vessel formation perpendicular to the free vocal fold margins or in a spiral shape were considered vascular abnormalities (Fig. 1), and were found in 162 cases (53.8%). During vocal fold vibration, abnormal glottal closure was identified as a bowing of the vocal folds with incomplete glottal closure, hourglass-shaped closure (Fig. 1C), or anterior or posterior glottal chink. At least one of these four abnormal closure types was found in 131 patients (43.5%). Bilateral vocal fold motion asymmetry during vibration was noted in 26 patients (8.6%). It included an asymmetric vibrating phase (Fig. 2) or an asymmetric amplitude of the bilateral vocal folds or both. No vocal fold abnormalities were found on videostrobolaryngoscopic examination in 31 patients (10.3%) with dysphonic symptoms.

In most patients (222, 73.8%), multiple abnormalities were visible in the videostrobolaryngoscopic recordings. Only a single abnormality of the possible four (uneven mucus layer, vascular abnormality, abnormal glottal closure, and vibratory asymmetry) was identified in 48 patients (15.9%). Among these, 44 cases had an uneven mucus surface and four cases showed abnormal vessels.

### Discussion

Functional dysphonia is thought to be a voice disorder that arises from the abuse or misuse of the vocal apparatus. Clinically, functional voice disorders should be suspected if the diseased voice is disproportionately poor compared to the laryngeal findings [6]. Phonotrauma due to long-term excessive vibration damages the tissues of vocal folds in many ways, especially in the cover. Heat dispersing in the cover [14] and shearing force applied to the vocal mucosal and submucosal tissues during high-frequency vibration [15] can cause local tissue injury and an inflammatory reaction. The overall effects alter the biomechanical characteristics of the vocal folds and make the formation of the mucosal wave more difficult and irregular. If the destruction reaches beyond the self-repairing ability of the vocal fold tissue, macroscopic organic lesions may appear [16, 17]. Then biomechanical...
Fig. 2. Sequential pictures reveal bilateral asymmetry in phase during vocal fold vibration.

causes of dysphonia in patients with organic vocal fold lesions become easily observable.

Clinically, high-resolution motion pictures of vocal fold vibration in videostrobolaryngoscopy facilitate the identification of factors that may aggravate the perturbation in the voice [11–13]. An uneven mucus surface on the vocal folds during vibration or in the rest position is one factor that may aggravate the symptoms of dysphonia [18]. It was found in 83% of cases in our series.

The vocal folds have a unique alignment of blood vessels. The blood vessels normally run parallel to the free margin of the vocal folds. This allows the vibration of vocal folds without affecting blood flow [1]. Vascular abnormalities may be secondary to phonotrauma and local inflammation [15, 19]. In this series, vessel dilatation or neovascularization was identified in 162 cases (53.8%). These lesions may be a manifestation of repeated inflammation and trauma [15]. They altered the biomechanical characteristics of vibration of the vocal folds and made the stiffness of the cover greater, which hampered the formation of the mucosal wave [15].

Abnormal extrinsic and intrinsic laryngeal muscle tension may cause abnormal glottal closure such as bowed folds, hourglass-shaped closure, and anterior or posterior glottal chink during vibration [9]. In abnormal glottal closure, a nozzle may form in the glottis, which can generate turbulence in the glottal air-stream and deteriorate the symptoms of dysphonia [4]. In this retrospective study, 43.5% of patients showed abnormal glottal closure during vocal fold vibration. Excessive muscle tension may play an important role in causing laryngeal tension-fatigue syndrome.

During normal phonation, bilateral vocal folds vibrate symmetrically in phase and amplitude. The presence of asymmetry in the vibration phase or amplitude may become a source of irregularity in the voice signals [4]. Differences in vertical wave conduction velocity or tension between bilateral folds may result in vibration phase asymmetry. The amplitude asymmetry in vibration may be caused by mass differences in the bilateral vocal folds. These biomechanical properties of vocal folds usually cannot be measured by their morphologic appearance. In observing the vibration under the videostrobolaryngoscope, some of the asymmetry can be detected qualitatively. Bilateral vibratory phase and/or amplitude asymmetry in the recordings was found in 26 (8.6%) patients in this series.

In the normal voice, there are still irregularities in the voice signals coming from different sources [4], but the perturbation and fluctuation are much greater in diseased voice signals than in the normal voice. Any biomechanical attribute changes that hinder the regular vibration of vocal folds will increase irregularities in the voice signals and worsen the symptoms of dysphonia. By using videostrobolaryngoscopic examination, some biomechanical changes in the vocal folds during vibration became detectable. In our retrospective review, 89.7% (270) of patients with laryngeal tension-fatigue syndrome had at least one abnormal finding in their videostrobolaryngoscopic recordings, and 222 cases (73.8%) had at least two abnormalities. These data indicate that chronic vocal overuse under excessive laryngeal muscle tension can cause phonotrauma and result in biomechanical property changes in the vocal fold’s cover.

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References


