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# OCCUPATIONAL VOICE DISORDERS: AN ANALYSIS OF DIAGNOSES MADE AND CERTIFICATES ISSUED IN 1999–2004

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**Abstract**
**Objectives:** It has been decided to identify the most frequent diseases of the larynx in people occupationally exposed to a considerable voice load and to assess the feasibility of using videostroboscopy to diagnose voice disorders and their organic effects in order to improve the reliability of certification of occupational vocal organ diseases as well as to evaluate the functioning of new regulations on diagnosing and certifying occupational vocal organ diseases and to assay the conformity of clinical diagnoses made at voivodeship (provincial) centers (level I) with those made at scientific research institutes (level II). **Materials and Methods:** The study involved an analysis of 1261 cases (1042 women and 219 men) with the vocal organ disorders referred to the ENT Unit, Nofer Institute of Occupational Medicine, Łódź, by voivodeship centers during 1999–2004 for consultation or under the appeal procedure (if applicants were denied the right to be included in the category of patients with occupational disease of the vocal organ). The majority of the patients (65.7%) were primary school teachers, and those aged 51–60 years made 54.8%. Laryngological, phoniatric and videostroboscopic examinations, when necessary, supplemented with other testing procedures (paranasal sinus imaging, allergenic tests) were taken to assess the clinical state of the patients. **Results:** As a result of these comprehensive examinations, organic changes in the larynx were detected in 161 (12.7%) cases, including 139 (11.0%) women and 22 (1.7%) men. According to current diagnostic/certifying criteria those pathologies could be classified into the category of occupational disease of the vocal organ. Paresis of vocal folds due to the insufficiency of vocal fold adductor and tensor muscles with permanent dysphonia was found in 97 (7.6%) patients, vocal nodules in 53 (4.2%) and secondary hypertrophy changes in vocal folds in 11 (0.87%) patients. The most frequent reasons for excluding the occupational etiology of the disease were functional disorders of the voice observed in 82.3% of patients in the form of hyperfunctional dysphonia (64.3%), hypofunctional dysphonia (17.0%) and dysfunctional dysphonia (about 1.0%). In 9.0% of patients, the functional disorders of the voice were accompanied by organic changes in the larynx caused by non-occupational factors. **Conclusions:** The analysis showed that due to new Polish regulations, the number of certified occupational disease of the vocal organ was reduced; videostroboscopic tests proved to be a very helpful tool for discriminating between the functional and organic disorders of the vocal organ; and good agreement between clinical diagnoses issued at both levels (I and II) was also revealed.

**Key words:**
**Occupational diseases of vocal organ, Videostroboscopy, Teachers, Medicolegal regulations, Differential diagnosis**

## INTRODUCTION

In Poland, vocal organ disorders, which are attributable to the excessive voice load in teachers, speakers, singers or actors, are classified as an occupational disease that entitles the patient to a single financial indemnity (calculated proportionally to the experienced loss of health) or/and a pension (if partial or complete work disability due to occupational disease is certified).

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Occupational disease is a medicolegal term. The principles of diagnosing and certifying occupational diseases are set forth in two Ordinances issued by the Council of Ministers, one dated 18 November 1983 [1] and the other dated 30 July 2002 [2]. Both Ordinances include the list of occupational diseases. The definition of occupational dysphonia laid down in the 1983 list of occupational diseases (item 7) is as follows: chronic vocal organ diseases due to excessive voice load lasting for at least 10 years comprise vocal nodules, vocal fold, paresis, and hypertrophic changes.

The time elapsed since the cessation of work under conditions predisposing to the development of the disease should not exceed 5 years.

In the 2002 list of occupational diseases (item 15), this definition is expanded and reads as follows: chronic vocal organ diseases due to excessive voice load lasting for at least 15 years comprise hard vocal nodules, secondary hypertrophic changes in vocal folds, paresis of vocal fold adductor/tensor muscles accompanied by the phonatory insufficiency of the glottis and permanent dysphonia.

The period of time during which evidence of vocal organ disease symptoms may serve as the basis for certifying occupational disease in spite of earlier cessation of occupational exposure is 2 years.

In each case under consideration, the applicable procedure (according either to the 1983 or 2002 Ordinance) depends on the date of starting the diagnostic/certification procedure.

The role of the physician authorized to certify occupational diseases consists in diagnosing the disease on the basis of available medical evidence [3,4].

The procedure of diagnosing/certifying occupational diseases in Poland consists of two stages: the first one (level I) takes place at Voivodeship (Provincial) Centers of Occupational Medicine and the other (level II) at two scientific research institutes, namely the Nofer Institute of Occupational Medicine in Łódź and the Institute of Occupational Medicine and Environmental Health in Sosnowiec.

In Poland, occupational vocal organ diseases make serious health, social and economic problems. The gravity of the problem is testified by relevant statistical data. As many as 2479 new cases of occupational vocal organ diseases were registered in 2002 (33.8% of all occupational diseases; 11.7 new cases per 100 000 employees). The data concerning school and university teachers are even more alarming (18.8 new cases per 100 000 employees and 98.1% of all occupational diseases in this occupational group) [5].

A reduction (by 125 new cases, 10.2% of all occupational diseases) in the number of chronic vocal organ disorders attributable to excessive voice load was first noted in 2003. The reduction was probably due to the implementation of new principles of diagnosing/certifying of occupational diseases [2], as the new regulation includes a more precise definition of changes in the larynx typical of the effects of excessive voice load, and thus provides a sound basis for diagnosing occupational disease.

It is very difficult to compare the incidence of occupational vocal organ diseases in Poland with that in other countries because of large differences in relevant legal regulations currently valid in various countries. In addiction, chronic vocal organ diseases, accounting for 25.2% (in 2003) of all occupational diseases in Poland, are not included in the basic list of occupational diseases specified in the Recommendation by EU Commission of 19 September 2003 [5].

In view of a very high incidence of occupational vocal organ diseases observed in Poland, there is an urgent need to adopt more effective preventive measures as well as to develop effective diagnostic methods able to distinguish between vocal organ disorders resulting from excessive voice load and idiopathic disorders caused by non-occupational factors.

The primary aims of the study was to identify the most frequent diseases of the larynx in people occupationally exposed to excessive voice load and to assess whether videostroboscopy can be used for diagnosing vocal disorders and their organic consequences to improve the reliability of certification of occupational diseases of the vocal organ. The study also aimed at evaluating the functioning of new legal regulations on diagnosing of occupational vocal organ diseases and checking the agreement between clinical diagnoses made at two levels (I and II).

## MATERIALS AND METHODS

The analysis covered 1261 cases (1042 women and 219 men) of vocal organ disorders, referred to the ENT Unit, Nofer Institute of Occupational Medicine, Łodź by voivodeship centers, either for consultation or under an appeal procedure.

Because of different voice load within the study group, the teachers and other professionals experiencing considerable voice load were analyzed separately. The study group comprised 724 (57.4%) occupationally active subjects, while the remaining 537 (42.5%) subjects included retired persons, persons who were temporary occupationally inactive, disability pensioners and persons on one- or two-year sick leave obtainable during the period of two years preceding the date of getting entitled to old-age pension.

According to the diagnostic and certification procedures and in compliance with relevant regulations, in cases of dysphonia with suspected occupational etiology, occupational disease can be certified only on condition that the patient presents a clear proof of having been employed under exposure to a considerable voice loading, based on the detailed analysis of his or her professional career and the data obtained from the sanitary and epidemiological inspection service. In the anamnesis, the following data were taken into account: duration and place of employment, type of the lectured subject or other forms of the employment in the educational system (teacher, educator, teaching method expert, inspector, head master, school librarian, manager of the school club). The actual time of work requiring the use of voice (obligatory teaching hours on weekly or daily basis, adjusted for the duration of maternity leaves, professional training leaves, extra leaves to improve health condition, reduced teaching hours on account of acting as the head master, prolonged sick leave periods, spa treatment) was assessed.

Detailed data on the work environment (noise, air pollution), job characteristics, use of amplifying devices or media were collected.

In all patients, laryngologist, phoniatrician, and occupational medicine physician performed specialistic medical examinations supplemented, when necessary, with additional tests (e.g., sinus x-ray imaging, audiometry).

The examinations were preceded by detailed interview on current vocal organ complaints (voice fatigue, hoarse voice, aphonia), past laryngopathies and the method of their treatment (conservative therapy or surgery). The subjects were also examined for otolaryngological diseases and the effects of employed treatment, endocrinologic (thyroid, sexual gland, adrenal) disorders, changes in the nervous system, neurotic and emotional disorders, and mental diseases. Other diseases (e.g., cancer, allergies) and habits (tobacco smoking, alcohol drinking) were also taken into account.

Laryngological examinations involved the assessment of the nose patency, condition of nasopharynx and throat (palato-pharyngeal insufficiency), hearing disorders (hypoacusis) as well as the appearance and the mobility of vocal folds during phonation and respiration, and vocal fold closure during phonation using indirect laryngoscopy.

Phoniatric examinations included the assessment of some voice characteristics, (hoarse or normal, produced with excessive neck muscle tension), voice range, breathing technique, phonation time, phonation index, and articulation. Then, after the throat and larynx had been locally anesthetized by applying 10% lignocain solution in the form of aerosol, function of vocal folds, both during the phonatory and respiratory phases, was assayed by videostroboscopy. The regularity and amplitude of vocal fold vibration, the presence or absence of mucosal wave, closure of the glottis and possible microlaryngoscopic lesions (e.g., asymmetries, sulcus glottidis) and other malformations, constitutional or acquired as a result of excessive voice load, were also assayed. In doubtful cases, videostroboscopy was repeated after some time. During the second round, the patient was subjected to voice load and videostroboscopy was performed both before and after the voice load episode and acoustic parameters of the voice were analyzed.

Specialistic medical examinations were aimed at diagnosing organic changes in vocal folds, e.g., soft or hard vocal nodules, paresis of vocal fold adductor and tensor muscles, secondary hypertrophic changes due to excessive voice load, to confirm or exclude the occupational origin of dysphonia. The clinical diagnoses made at our Institute (level II) were compared with those made at Voivodeship Centres of Occupational Medicine (level I).

## RESULTS

An analysis of the professional career and occupational exposure showed that teachers (n = 1191, 94.4%), including teachers of nursery schools (n = 240, 20.1%), elementary schools (n = 546, 45.8%), secondary schools and colleges (n = 315, 26.4%), universities (n = 39, 3.2%) and technical universities (n = 51, 4.2%) were the most numerous group.

Of the 70 (5.8%) patients employed outside the educational system, 54 (4.5%) were telephonists, and 16 (1.3%) represented the following professions: organist, priest, speech therapist, psychologist, legal adviser, judge, actress, and singer. In the group of teachers, the majority (n = 635, 55.7%) of them taught basic subjects; educators, teaching method experts, inspectors, school managers with limited teaching hours were less numerous (44.0%). Tables 1 and 2 show the characteristics of the study group by age, gender and duration of employment.

Patients of the 51–60 age group were most numerous, comprising 775 (61.4%) persons including 625 (49.5%) women and 150 (11.8%) men. They were followed by patients of the 41–50 age group – 268 (21.2%) persons, including 227 (18.0%) women and 41 (3.3%) men.

**Table 1.** Characteristics of patients by age and gender

| Age (years) | No. of women (%) | No. of men (%) | Total (%) |
|---|---|---|---|
| 31–40 | 20 (1.5) | 10 (0.8) | 30 (2.3) |
| 41–50 | 227 (18.0) | 41 (3.3) | 268 (21.2) |
| 51–60 | 625 (49.5) | 150 (11.8) | 775 (61.4) |
| >60 | 170 (13.4) | 18 (14.9) | 188 (28.3) |
| Total | 1042 (82.6) | 219 (17.3) | 1261 (100) |

**Table 2.** Duration of employment by gender

| Duration of employment (years) | No. of women (%) | No. of men (%) |
|---|---|---|
| <20 | 14 (1.1) | 0 |
| 21–30 | 353 (27.9) | 52 (4.1) |
| >30 | 675 (53.5) | 167 (13.2) |
| Total | 1042 (82.6) | 219 (17.3) |

All examined persons reported vocal organ complaints, attributing them to excessive voice load at work; hoarse voice was reported by the great majority of the patients (90%); other most frequently reported symptoms were: dry throat, raspy throat, lump in the throat, tight throat, occasional pain, voice fatigue, changed pitch of the voice and periodical aphonia. The majority of the patients received ambulatory treatment provided by family doctors or laryngologists. Only about 10% of persons could present documents confirming their regular visits to a phoniatrician. Most of the patients visited a phoniatrician for the first time after they had started the procedure of diagnosing and certifying vocal organ occupational disease. Instead, most of the patients took the opportunity of spa treatment (3–4 times or more during their whole professional career). In the study group, the majority (95%) availed themselves of the right (by virtue of the regulations on the teaching profession) to take a 2-year health recovery leave; in most cases however they did so directly before their retirement in order to reduce the duration of employment under excessive voice load entitling to the retirement. An anamnesis on hormonal treatment conducted among women in the menopausal period revealed that only 10% of them had used hormonal therapy to restore comfort and prevent osteoporosis, while most of them had undergone short hormonal treatment after gynecological surgery. The obtained information on habits revealed 35% of patients who smoked cigarettes in small quantitites (10–15 per day) 10% of patients smoking about 20 cigarettes daily, and 55% of non-smokers. The anamnesis also showed that 80% of subjects had never had any training in voice emission techniques, and only 20% of patients had some training during their health recovery leave.

Table 3 shows the frequency of laryngeal diseases detected during laryngological and phoniatric examinations and confirmed by videostroboscopy. Figures 1–7 show selected images of the larynx obtained during the laryngeal videostroboscopy.

The analysis of the conformity of clinical diagnoses made at the Nofer Institute of Occupational Medicine with those issued by the Regional Centres of Occupational Medicine

**Table 3.** Clinical picture of pathological changes in the larynx of the study group (n = 1261)

| Pathological changes | No. of women (%) | No. of men (%) | Total (%) |
|---|---|---|---|
| Organic changes | | | |
| 1. Soft vocal nodules | 6 (0.4) | 3 (0.2) | 9 (0.7) |
| 2. Hard vocal nodules | 45 (3.5) | 8 (0.6) | 53 (4.2) |
| 3. Secondary hypertrophic changes | 5 (0.3) | 6 (0.5) | 11 (0.8) |
| 4. Paresis of vocal fold adductor/tensor muscles | 85 (6.7) | 11 (0.8) | 96 (7.6) |
| 5. Polyps on vocal fold | 17 (1.3) | 2 (0.1) | 19 (1.5) |
| 6. Reinke's edema | 42 (3.3) | 14 (1.1) | 56 (4.4) |
| 7. Pachydermia | 3 (0.2) | 7 (0.5) | 10 (0.7) |
| 8. Papilloma | 1 (0.07) | 0 | 1 (0.07) |
| 9. Laucoplakia | 1 (0.07) | 2 (0.1) | 3 (0.2) |
| 10. Laryngeal cancer | 1 (0.07) | 1 (0.07) | 2 (0.1) |
| 11. Chronic laryngitis | | | |
| Simplex | 300 (23.7) | 22 (1.7) | 322 (25.5) |
| Sicca | 58 (4.5) | 39 (3) | 97 (7.6) |
| Atrophic | 45 (3.5) | 32 (2.5) | 77 (6.1) |
| Edematosus | 12 (0.9) | 10 (0.7) | 22 (1.7) |
| 12. Malformations: | | | |
| Sulcus glottidis | 2 (0.1) | 0 | 2 (0.1) |
| Palatopharyngeal insufficiency | 3 (0.2) | 0 | 3 (0.2) |
| Laryngeal dysplasia | 2 (0.1) | 0 | 2 (0.1) |
| Laryngeal asymmetry | 4 (0.3) | 0 | 4 (0.3) |
| 13. Post-traumatic displacement of cricoarytenoid joint | 0 | 1 (0.07) | 1 (0.07) |
| 14. Neurogenic paralysis of vocal fold after strumectomy | 23 (1.8) | 0 | 23 (1.8) |
| Paresis of left vocal fold due to other causes | 5 (0.3) | 1 (0.07) | 6 (0.5) |
| 15. State after microsurgical removal of hypetrophic changes | 11 (0.8) | 2 (0.1) | 12 (0.9) |
| 16. State after complete removal of larynx due to cancer | 0 | 1 (0.07) | 1 (0.07) |
| 17. State after removal of tumor from subglottical region of larynx | 0 | 1 (0.07) | 1 (0.07) |
| Functional voice disorders | | | |
| 1. Hyperfunctional dysphonia | 667 (52.8) | 144 (11.4) | 811 (64.3) |
| 2. Hypofunctional dysphonia | 158 (12.5) | 57 (4.5) | 215 (17.0) |
| 3. Dysfunctional dysphonia | 13 (1.0) | 0 | 13 (1.0) |
| Other coexisting pathologies | | | |
| 1. Thyroid diseases | 10 (0.7) | 0 | 10 (0.7) |
| Hyperthyreosis | 8 (0.6) | 0 | 8 (0.6) |
| Hypothyreosis | 2 (0.1) | 0 | 2 (0.1) |
| 2. State after strumectomy | 30 (2.3) | 0 | 30 (2.3) |
| 3. Past apoplexy with dysphasia | 1 (0.07) | 0 | 1 (0.07) |
| 4. Sclerosis multiplex | 2 (0.1) | 0 | 2 (0.1) |
| 5. Mental diseases | 10 (0.7) | 1 (0.01) | 11 (0.8) |

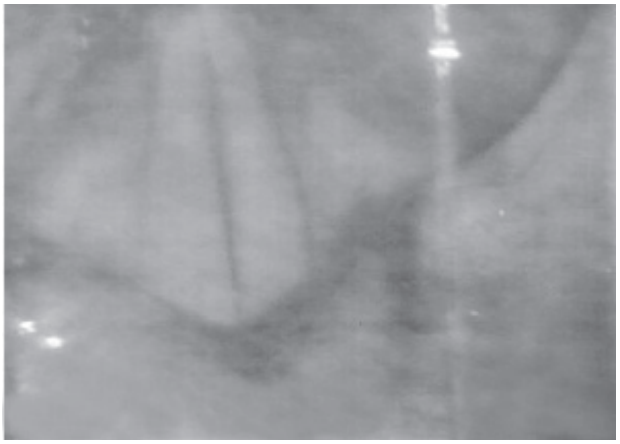

**Fig. 1.** Phonatory phase – complete closure of vocal folds along their whole length.

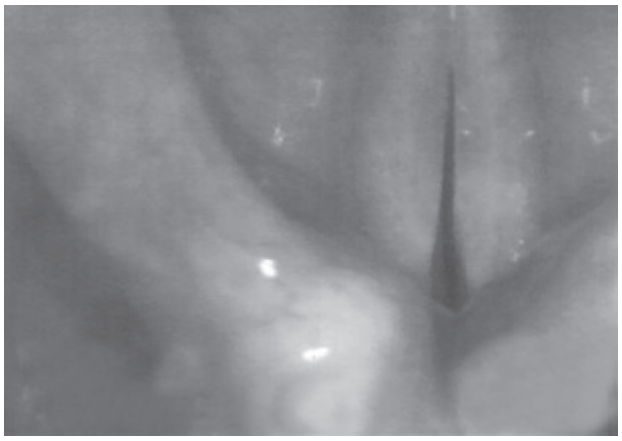

**Fig. 2.** Phonatory phase – incomplete phonatory closure along the two third of rima glottidis length (paresis?).

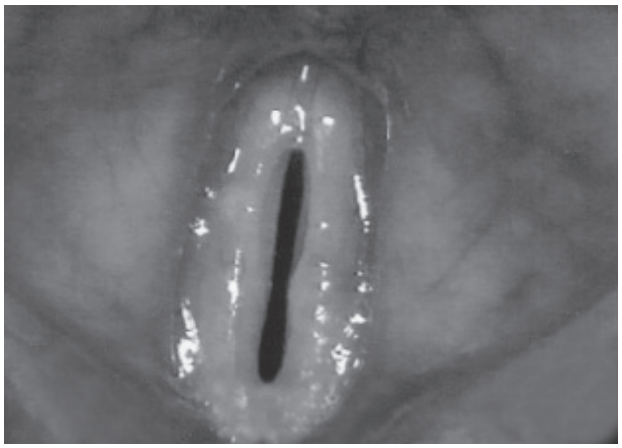

**Fig. 3.** Phonatory phase – incomplete phonatory closure due to paresis of vocal fold adductor and tensor muscles.

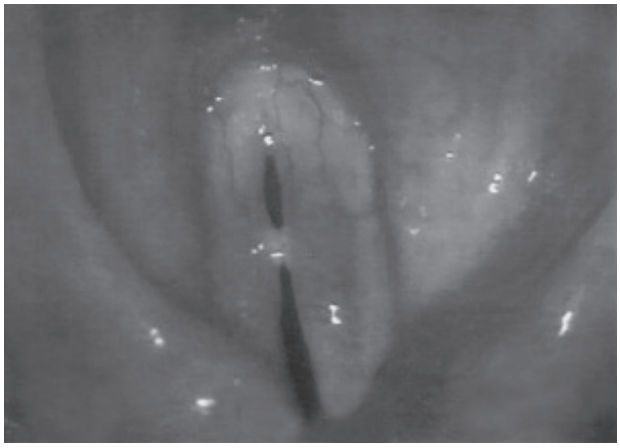

**Fig. 4.** Phonatory phase – soft vocal nodules. Hourglass-shaped rima glottidies.

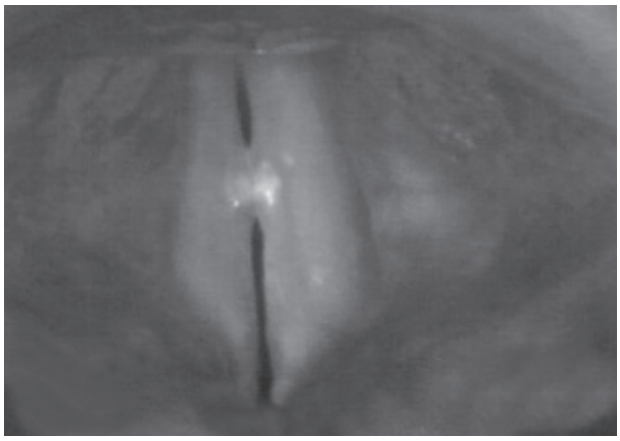

**Fig. 5.** Phonatory phase – hard vocal nodules. Hourglass-shaped rima glottidis.

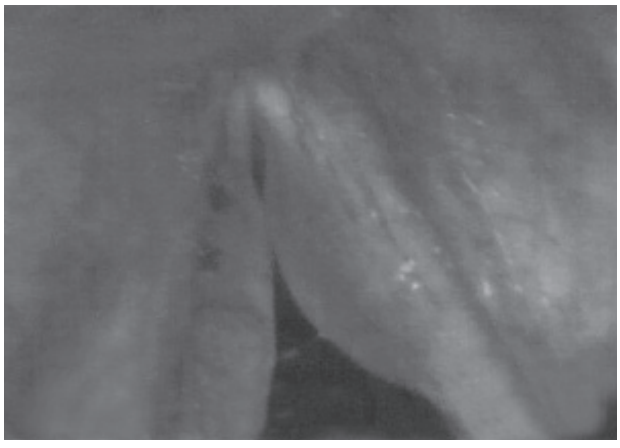

**Fig. 6.** Respiratory phase – Reinke's edema-type hypertrophic changes visible on both vocal folds.

showed good agreement, almost 87.3% of diagnoses were identical. In the remaining 12.7% of cases, the disagreement was due to different videostrobscopic images taken at different times; this was usually the case in persons whose diagnostic/certifying procedures continued for several years after termination of their occupational activity.

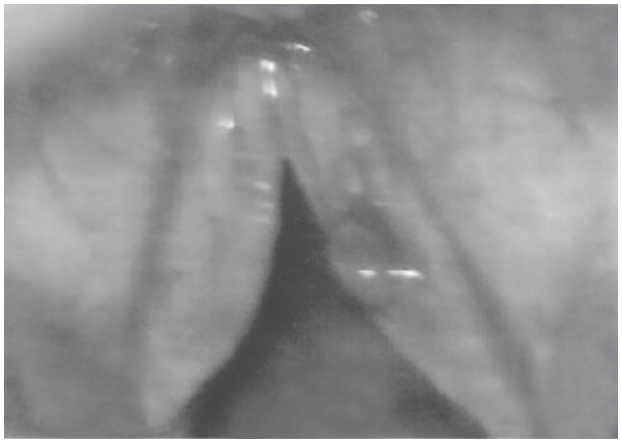

**Fig. 7.** Repiratory phase – hypertrophic change (laryngeal polyp) visible on the right vocal fold.

## DISCUSSION

The analysis of 1261 cases of vocal organ disorders in people occupationally exposed to excessive voice load show that due to numerous specialistic tests at the Nofer Institute of Occupational Medicine in Łódź it was possible to verify medical opinions issued by voivodeship certifying centres and diagnose the occupational disease of the vocal organ as specified under items 7 and 15 of the 1983 and 2002 lists of occupational diseases in additional 12.7% of persons.

Our earlier experiences and analyses [3,7] show that the diagnosis of occupational dysphonia is not always an easy task. It required written evidence (documents) that the applicant had been employed in conditions of the prolonged heavy vocal organ load lasting for at least 15 years. The development of the disease depends to a large extent on individual susceptibility, and thus it is difficult to determine the minimum exposure, which may increase the risk of the disease development. For the purpose of certifying the occupational disease, it has been assumed that for teachers, the minimum exposure quoted above is equivalent to the effective time of voice use corresponding to the working time specified by relevant regulations on teachers' working time. For other jobs, full-time work under continuous vocal effort is required [6,7]. It is also important to note the typical clinical picture of the effects of the excessive vocal organ loading and to eliminate other possible factors more likely to cause the disease than the vocal effort. Therefore, it is necessary to obtain a precise anamnesis of the symptoms of vocal organ dysfunction (disease) and run detailed otolaryngological, phoniatric and videostroboscopic tests. If a physician performing videostroboscopy is in doubt about the interpretation of the result, videostrobosopy should be performed 2–3 times at intervals not shorter than 2 months [3,6,8].

According to current regulations (vide items 7 and 15 of the 1983 and 2002 lists of occupational diseases), the possibility of certifying occupational disease of the vocal organ is limited to cases with specific morphological changes in the larynx, which are an essential criterion applied in the clinical assessment.

Those specific changes include vocal nodules. The first stage of the disease is associated with the development of soft vocal nodules manifested by swelling in vocal fold mucosa, different from "hard" vocal nodules in that the subepithelium cicatrization is absent and the changes are reversible after conservative treatment, and voice rehabilitation in particular [9,10]. Hard vocal nodules are characterized by whitish callous-like growths found on the edge of the vocal folds in their front part. Videostroboscopic examination during phonation shows characteristic hourglass-shaped rima glottidis with reduced or absent mucosal wave, and lower amplitude of vocal fold vibrations. Hard nodules are treated with microsurgery, however, they sometimes tend to recur [3,6,8,11].

In our material, soft vocal nodules were 0.7% more frequent in women than in men. Hard vocal nodules were found in 4.2% of cases, including 3.5% of women, in whom the pathology served as the basis for diagnosing occupational disease of the vocal organ.

The assessment of detected paresis of vocal fold adductor and tensor muscles is a major diagnostic problem. An impaired function of vocal muscles, resulting from chronic functional disorders of the vocal organ in the form of hyperfunctional dysphonia, is the substance of the disease. The voicing is accompained by tension and hyperkinesis of neck muscles. Videostroboscopy shows incomplete closing of the intermembranous part of the glottis [6,8,10,11].

The lesions, however, may also be due to causes other than intensive vocal effort. In any case, other (e.g., neurogenic)

damage to the neuromuscular organ of the larynx have to be excluded [3,6,7,11].

In our material, the paresis of vocal fold adductor and tensor muscles, diagnosed in 7.6% of patients, provided the basis for certifying occupational disease of the vocal organ in those patients.

The identification of secondary hypertrophic vocal fold changes, resulting from intense vocal effort may be difficult even to an experienced phoniatrician. The disease ivolves hypertrophy of mucoral membrane of vocal folds along the free margine, occurring usually as a secondary form resulting from hyperfunctional dysphonia. Pathological changes may assume different forms, e.g., polypoid degenerations on the edge of vocal folds or subepithelial swelling. These changes have to be distinguished from Reinke's edema, laryngeal papilloma, precancerous changes or malignant tumors [3,6,11,12]. In our material, the secondary hypertrophic changes detected only in 0.8% of patients were reliably attributable to intense voice load, which enabled the diagnosis of occupational disease of the vocal organ.

The pathogenesis of occupational dysphonia, detected in 12.6% of our patients, is complex in its nature.

The contribution of the prolonged daily voice load to the development of the disease may also be enhanced by diseases of the upper respiratory tract, constitutional characteristics, hormonal imbalance (thyroidism, menopasue), smoking habit, allergic diseases, duodenal or gastric ulcer with reflux and the presence of Helicobacter Pylori frequently causing chronic inflammation in the posterior part of the larynx, diseases of the central nervous system, emotional states, and mental disorders [4,6,7,9–11].

Therefore, suitable treatment and phoniatric rehabilitation started in due time in combination with suitable preventive measures may significantly reduce the number of new cases of occupational diseases of the vocal organ identified each year.

## CONCLUSIONS

1. New regulations of diagnosing occupational diseases (effective from 2002), specifying both the type and the degree of pathological changes in the larynx have reduced the number of diagnosed occupational diseases of the vocal organ, because some hypertrophic changes in the vocal folds are no longer considered to be connected with excessive voice load (until 2002, hypertrophic changes classified as the occupational disease accounted for 5.1%; at present the corresponding value is less than 1%).
2. Soft vocal nodules are no longer suffice to diagnose the occupational disease, contrary to "hard" nodules (compared to 2002, the number of occupational diseases diagnosed on account of vocal nodules dropped by 0.6%).
3. Long years of our observations confirm the feasibility of using videostroboscopy for diagnosing the laryngeal function and vocal disorders. This method, particularly when supplemented with voice load testing (including the assessment of the vocal field and vocal parameters) facilitates distinction between the functional and organic changes, resulting from occupational and non-occupational causes.
4. In the majority of the subjects, the most frequent reasons for excluding the occupational etiology of the disease were functional voice disorder detected in 82.3% of patients: in the form of hyperfunctional dysphonia (64.3%), hypofunctional dysphonia (17.0%) and dysfunctional dysphonia in about 1.0% of patients. In 9.0% of patients, the functional disorders were accompanied by organic changes in the larynx attributable to non-occupational factors.

## ACKNOWLEDGEMENTS

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