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Multimodal Voice Rehabilitation in Paralytic Dysphonia. A Case Study

Wielomodalna rehabilitacja głosu w dysfonii porażennej. Studium przypadku

Keywords: paralytic dysphonia, paresis of the vocal fold, voice rehabilitation, thyroidectomy
Słowa kluczowe: dysfonia porażenna, porażenie fałdu głosowego, rehabilitacja głosu, tyreoidektomia

Abstract

The article presents a case study of a 56-year-old patient with paralytic dysphonia. Based on medical records and a speech therapy assessment, a voice rehabilitation programme was developed and implemented. The aim of the therapy was to restore proper laryngeal function lost as a result of left vocal fold paralysis. A multimodal therapeutic approach was applied, including techniques to stimulate glottal closure, breathing exercises, articulatory motor training, body awareness exercises, education on vocal hygiene and voice production, as well as scar therapy. After a four-month therapy period, reassessment confirmed improvement in all laryngeal functions, full recovery of mobility of the paralyzed vocal fold, reduction of hyperfunctional behaviors, enhanced well-being, and the patient's ability to return to professional activity.

Streszczenie

Artykuł przedstawia studium przypadku 56-letniego pacjenta z dysfonią porażenną. Na podstawie dokumentacji medycznej oraz diagnozy logopedycznej opracowano i wdrożono program rehabilitacji głosu. Celem terapii było przywrócenie prawidłowej funkcji krtani, utraconej

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wskutek porażenia lewego fałdu głosowego. Zastosowano wielomodalne podejście terapeutyczne, obejmujące techniki stymulujące zwarcie fonacyjne, ćwiczenia oddechowe, trening motoryki narządów artykulacyjnych, ćwiczenia świadomości ciała, edukację w zakresie higieny i emisji głosu oraz terapię blizny. Po czteromiesięcznej terapii rediagnoza potwierdziła poprawę we wszystkich funkcjach krtani, w tym pełne odzyskanie ruchomości porażonego fałdu głosowego, redukcję zachowań hiperfunkcjonalnych, poprawę stanu psychosomatycznego pacjenta oraz możliwość powrotu do pracy zawodowej.

Introduction

Paralytic dysphonia is an organic voice disorder resulting from damage to the vagus nerve or its branches, along the pathway from the cerebral cortex to the neuromuscular junctions. There are four kinds of paralysis and paresis, depending on the anatomical location of the damaging factor: central, mixed, spastic, and flaccid types [cf. Pruszewicz, Obrębowski, 2019; Kasperczyk, Markowski, 2024].

Central paralysis accounts for approximately 10% of cases and is usually the result of strokes, inflammatory processes or brain stem tumors [cf. Maniecka-Aleksandrowicz, Domeracka-Kołodziej, 2007; Wiskirska-Woźnica, Domeracka-Kołodziej, 2015]. Far more common are peripheral pathologies caused predominantly by injuries following surgical procedures (especially thyroidectomy), with idiopathic cases being less frequent [cf. Wiskirska-Woźnica, Domeracka-Kołodziej, 2015; Kasperczyk, Markowski, 2024][1].

The functions of the larynx – namely phonatory closure, respiratory opening, positioning and tension of the vocal folds – depend on the location and type of damage. The clinical picture may change as a result of secondary processes such as atrophy, fibrosis, scarring, or synkinetic reinnervation, all of which significantly affect the healing process [Ivey, 2019; Czesak, Osuch-Wójcikiewicz, Niemczyk, 2020]. The pathogenesis of the vagus nerve damage may include neuropraxia, or temporary conduction disorder (e.g. due to compression), axonotmesis, or damage to axons with preserved nerve continuity, and neurotmesis, or complete disruption of continuity [cf. Pruszewicz, Obrębowski, 2019].

In the treatment of peripheral dysphonia, it is crucial to initiate conservative therapy as early as possible to prevent secondary changes in the vocal muscles. Pharmacotherapy, voice therapy, physiotherapy and sometimes electrostimulation are used to stimulate conduction in damaged fibers at the stage of neuropraxia or partial axonotmesis [cf. Zehnhoff-Dinnesen et al., 2019; Kasperczyk, Markowski, 2024]. In the absence of results, surgical interventions are considered [Maniecka-Aleksandrowicz, Domeracka-Kołodziej, 2007; Laccourreye et al., 2021]. Importance is attached to reinnervation methods [cf. Lee et al., 2007; Dzodic et al., 2016] and the use of a laryngeal pacemaker (LP) [cf. Mueller et al., 2016].

1 More information on the causes of intracranial and extracranial damage can be found in publications by Barbara Maniecka-Aleksandrowicz and Anna Domeracka-Kołodziej [2007] or Katarzyna Kasperczyk and Jarosław Markowski [2024].

Methodology of the study

The subject of the study was the functions of the larynx in a patient with left-sided vocal fold paresis. A clinical-experimental approach was used to establish a speech therapy diagnosis and plan a therapeutic program based on the multimodal therapy model developed by Renata Gliwa-Patyńska [2024], which is aimed at achieving optimal laryngeal function parameters. The effectiveness of the interventions was assessed comparatively on the basis of the results of preliminary and final tests conducted after sixteen therapeutic sessions and regular independent home exercises performed by the patient according to instructions (3–4 times a day for approx. 10 minutes), covering a period of four months.

The following research question was posed: to what extent does the use of a multimodal speech therapy approach, involving diverse and individually tailored techniques, improve the laryngeal function in patients with left vocal fold damage, with particular emphasis on phonation and respiratory-phonatory coordination?

Diagnostic procedure

The diagnostic process involved an analysis of treatment documentation (results of phoniatric and laryngological examinations and videolaryngostroboscopy), observation and a speech therapy interview, the Vocal Tract Discomfort (VTD) scale, the Voice Handicap Index (VHI), the GRBAS scale, the original card for palpation assessment of the larynx[2], neck, shoulder girdle and the temporomandibular joint [Mierzwińska-Nastalska, 2016; Gorzechowski, 2024]; diaphragm examination, voice examination card with linguistic material [cf. Kowalewska, Walencik-Topiłko, 2015]; as well as measurements of the S/Z ratio and maximum phonation time (MPT).

Therapeutic programme objectives

The therapeutic programme was focused on:

1. Learning and applying the principles of correct voice production and hygiene.
2. Developing the ability to recognise abnormal vocal habits and muscle imbalances in the facial skeleton, shoulder girdle, chest, diaphragm and the entire body; mastering techniques for regulating muscle tension (self-massage, massage, relaxation exercises).
3. Developing and consolidating correct breathing patterns.

2 Some of the tests were taken from the Laryngeal Manual Therapy Palpatory Evaluation Scale (LMTPE) [cf. Woźnicka et al., 2017, pp. 349–359].

4. Restoring the function of the left vocal fold by using methods that promote nerve regeneration.
5. Improving coordination between breathing, phonation, articulation and resonance.
6. Automating the skills acquired.

Patient description

The patient, a 56-year-old male, a doctor and an academic teacher, was referred to a speech therapy clinic with a diagnosis of left-sided vocal fold paralysis and paralytic dysphonia following a thyroidectomy. The first speech therapy consultation took place six weeks after the operation.

Phoniatric and laryngological examination

The patient's general condition was assessed as good. His vital parameters were normal, and body structure was correct. His mental state was described as poor. Audiometry results were within the normal range for his age. The otolaryngological examination revealed no nasal obstruction or changes in the oral cavity. The back of his throat was pale, and the palatine tonsils appeared normal. A phoniatric examination and videolaryngostroboscopy revealed normal laryngeal structure and no changes in the epiglottis. The left vocal fold remained immobile in the medial position; the left arytenoid had limited mobility and was tilted forward. The right vocal fold was smooth, tense, mobile, with preserved mucosal wave. Phonatory insufficiency was observed along the entire length of the vocal folds with a respiratory-efficient glottic opening. No abnormalities were observed in the vestibular folds, arytenoid structures, arytenoid fossae, pyriform sinuses or subglottic region. The laryngeal mucosa showed some signs of drying and visible vascular pattern. The voice was described as dull, voiceless, hoarse, quiet, strained, periodically diplophonic, fading and unable to modulate intensity.

The patient was prescribed pharmacotherapy (20 injection of Nivalin, Larimax T on the back of the throat three times per day) and voice rehabilitation.

Speech therapy interview and examination

The speech therapy interview provided detailed information about the patient's condition before and after the operation as well as his lifestyle. According to the patient, prior to the thyroid resection surgery his voice was normal. It was only after the surgery that he experienced severe difficulties with phonation, increased fatigue during physical exertion, the sensation of shortness of breath when speaking, and a significant shortening of the phonation phase. The interview excluded any significant chronic diseases or previous surgical procedures. The patient had not suffered

any injuries to the neck, head, spine or abdomen. He assessed his physical condition as average. He emphasised that he paid attention to healthy eating yet the nature of his work involved numerous stressful situations and physical strain. He reported chronic fatigue and awareness of ingrained poor posture habits.

The patient does not smoke and only occasionally drinks alcohol and coffee. He strives to drink an adequate amount of water although he admits that this can be challenging during periods of intense work. He describes his sleep as insufficient, with a tendency to reduce the amount of night-time rest. In terms of previous voice complaints, he has not reported episodes of hoarseness or loss of voice nor has he suffered from recurrent throat or larynx infections. The patient's voice environment is demanding, which involves prolonged and intensive use of the voice, often under conditions of stress and fatigue.

The patient has some rudimentary knowledge of how the vocal organ functions but never paid attention to conscious voice work or voice hygiene principles. However, he emphasised his motivation to undergo therapy and his expectation of regaining vocal fitness that would enable him to fully perform his professional duties.

Posture and muscular system

During the interview, the patient confirmed having deformities in the cervical and lumbar spine. The assessment of his posture revealed a closed chest, a head protruding forward, shoulders shifted forward, and a slight shift in the body's centre of gravity. There were significant limitations in head rotation relative to the shoulder line: rotation in both directions was half the norm, lateral movements and forward bending were limited, and backward bending was further inhibited by the post-thyroidectomy scar.

A palpation examination of the larynx revealed a forward displacement of the voice box associated with deformation of the cervical section, with a generally proportional structure. There was tenderness in the soft tissues of the neck, especially around the scar. On the LMTPE scale, the patient scored 11 points. The space between the arytenoid and cricoid cartilages was inflexible and inactive during phonation. The examination showed excessive tension of the suprahyoid, sternocleidomastoid and anterior oblique muscles as well as compensatory elevation of the larynx, leading to weakening of neck extensors. The trapezius muscles, suboccipital muscles, erector spinae (cervical section) and levator scapulae muscles were stiff and inflexible.

No static anomalies were observed in the temporomandibular joint yet the dynamic examination revealed that mandibular opening was restricted and masticatory muscle tension was increased [cf. Gorzechowski, 2022]. The muscles of the tongue were characterised by increased tension and reduced elasticity, which could induce compensatory tension in the suprahyoid muscles and obstruct proper resonance. An approximate assessment of the soft palate revealed no significant abnormalities: reflexes were normal and the palatal arches were symmetrical at rest and

during phonation. However, excessive tension at the root of the tongue restricted the mobility of the soft palate, indirectly inducing compensatory tension in the palatal and pharyngeal muscles, which could lead to resonance disorders. The facial muscles, particularly in the lower and middle parts of the face, showed limited mobility in most motor tests [cf. Jauer-Niworowska, 2009].

Breathing and phonation mechanisms

The patient used incorrect peak breathing with clear activation of additional respiratory muscles. On palpation, the diaphragm was tense and tender, but symmetrical. Breathing at rest was mainly oral-pharyngeal while dynamic breathing was audible and preceded by a deep inhalation, which led to excessive tension and disorders of the suprasegmental plane of speech.

Voice assessment: survey and questionnaire results

Voice examination revealed severe symptoms of paralytic dysphonia. During phonation, excessive neck muscle tension and vasodilation were observed. The patient's voice was dull, quiet, voiceless, strained, lacking modulation, with a tendency to fade during stress tests.

On the GRBAS scale, the subject scored G2 (voice significantly distorted, with forced phonation being possible); R2 (presence of hoarseness and irregular vibrations); B2 (moderate voice breathiness resulting from the central position of the left vocal fold and glottal insufficiency); A1 (weak tense voice); S3 (strained phonation, constricted voice, with episodes of loss of voice).

The maximum phonation time was 3 seconds. In the S/Z ratio test, the voice faded after approximately 3 seconds.

In the VHI questionnaire, the patient obtained 22 points (functional condition), 30 points (emotional condition) and 33 points (physical condition). Overall, these results are indicative of a significant voice impairment. On the VTD scale, the subject reported tension, pain, dryness, scratching and a feeling of a 'lump in the throat', which gives 41 points (20 – severity, 21 – frequency).

Respiratory and phonatory disorders resulted in abnormal respiratory-phonatory-articulatory coordination.

The psychosocial aspect

In addition to the aforementioned somatic disorders, paralytic dysphonia resulted in serious psychosocial consequences. The patient was excluded from professional work, which led to the development of psychogenic disorders and almost complete withdrawal from social life.

Speech therapy

Vocal fold paresis impairs the laryngeal function, therefore the aim of the therapy was to restore its efficiency. The programme provided for two variants of phonation recovery: satisfactory (compensation of the healthy fold) and optimal (full mobility of the paralysed fold with normal vibration amplitude) [cf. Gliwa-Patyńska, 2024].

The therapy was conducted in accordance with the multimodal model described by Renata Gliwa-Patyńska [2024], taking into consideration the patient's individual needs. It involved stimulating the paralysed fold, supporting compensation of the healthy side, improving respiratory-phonatory-articulation coordination and the work of the resonators [cf. Schindler et al., 2012; Verdolini et al., 2014; Krasnodębska et al., 2018; Śliwińska-Kowalska et al., 2018; Gliwa-Patyńska, 2024].

The programme comprised the following modules:

I. Learning and applying the principles of correct voice production and hygiene: discussion of the impact of vocal fold paralysis on breathing, phonation, articulation, and overall well-being [cf. Rosenberg, 2020].
II. Body awareness exercises:
    1) posture correction and control,
    2) regulation of muscle tension in the larynx, shoulder girdle, facial skeleton and the entire body using manual techniques, massage, self-massage, relaxation and mindfulness training to restore balance to the voice-producing structures; the module used elements of the Feldenkrais method, Jacobson relaxation training, mindfulness exercises and cognitive therapy techniques [cf. Magiera, 2007; Paszkowski, 2010; Teasdale et al., 2016; Regner, 2019; Bordoni, Zanier, 2020; Ladyne, 2021; Lowen, 2021; 2023; Płoczańska-Godek, 2021].
III. Scar therapy[3]: manual scar therapy was administered [cf. Magiera, 2007; Bordoni, Zanier, 2020; Lubczyńska, Garncarczyk, Wcisło-Dziadecka, 2023]. In addition to voice rehabilitation therapy sessions, the patient also underwent botulinum toxin injections into the scar [cf. Kim et al., 2014; Bae et al., 2020].
IV. Breathing exercises: their aim was to develop correct lower rib cage and diaphragmatic breathing both at rest and during phonation. Exercises included conscious but not hyperfunctional activation of the inspiratory and expiratory muscles, maintaining adequate subglottic pressure and avoiding peak breathing, phonation on residual air and hyperfunctional compensation [cf. McKeown, 2015; Szkiełkowska, Kazanecka, 2022; Gliwa-Patyńska, 2023; 2024; Ramig et al., 2023; Chukwu et al., 2025].
V. Exercises to improve the motor skills of the articulatory organs to regulate muscle tension and prevent additional strain on the larynx (e.g. its high position).

3 After thyroidectomy, the pre-laryngeal muscles are the only support for the laryngotracheal segment. The postoperative scar limits its mobility in the vertical plane and each incision of the muscles and fascia promotes permanent adhesions, exacerbating neuromuscular imbalance [cf. Misiołek et al., 2014; Berger, Kosztyła-Hojna, Chyczewski, 2018].

VI. Achieving phonatory closure: the aim was to stimulate the paralysed vocal fold, prevent muscle atrophy, control tension and maintain mobility of the laryngeal joints. The module used the following:
   1) laryngeal manual therapy (LMT): improvement of laryngeal closure, balancing muscle tension and stimulating joint mobility. The techniques used included relaxation of the supra- and subglottic muscles, mobilisation of the larynx in various planes, manoeuvres supporting phonatory closure and exercises combined with breathing and phonation [cf. Rubin, Lieberman, Harris, 2000; Kosztyła-Hojna et al., 2008; Mathieson et al., 2009; Marszałek et al., 2011; Woźnicka et al., 2016; 2017];
   2) exercises using Voice Onset Time (VOT): gradual transition from positive VOT-based sounds to negative ones to improve phonatory closure, activate the CT and TA muscles and reduce hyperfunctional voice; the exercises also supported speech tempo, rhythm, and intelligibility [cf. D'Alatri et al., 2008; El-Banna, Youssef, 2014; Leiria, Vaz Freitas, Manso, 2021];
   3) Semi-occluded vocal tract exercises (SOVTE): improving proprioception and reducing muscle tension through the back pressure effect; the exercises enabled safe phonation with minimal effort, improved respiratory efficiency and resonance quality, which increased voice projection despite insufficiency [cf. Titze, 2002; 2006; 2015; Tyrmi et al., 2017; Kaneko et al., 2019; Santana da Matta et al., 2021; Gliwa-Patyńska, 2023; 2024].

VII. Voice production training: it involved improvement of breathing, phonation and articulation coordination as well as activation of resonators.

Individual modules of the programme were implemented in accordance with the patient's capabilities and condition. The entire therapeutic cycle consisted of 16 sessions with a speech therapist and it lasted over four months. The patient received sets of exercises to perform independently: approximately 10 minutes several times a day.

A comparative analysis of test results before and after voice rehabilitation

The rehabilitation enabled the therapeutic goal to be achieved, improving the laryngeal function by restoring full mobility to the previously paralysed vocal fold.

Stroboscopy revealed improvement in most parameters, including normal symmetry, regularity and frequency of vibrations. The mucosal wave was also present on the previously damaged vocal fold and the amplitude of vibrations was bilaterally normal. The glottic closure in the anterior and posterior commissures was complete (previously present only in the anterior commissure). No phonatory compensation or secondary pathological changes were found. The response to changes in voice pitch and intensity was close to normal for the patient's age and sex.

On the GRBAS scale, all parameters have become normalised: G2 vs G0, R2 vs R0, B2 vs B0, A1 vs A0, S3 vs S0. In the VHI questionnaire, the score dropped from 85 to 11 points, while in the VTD scale it decreased from 41 to 7 points. The maximum phonation time increased to 15 seconds, and the S/Z ratio was 1.07 (previously not measurable). The LMTPE score fell from 11 to 2 points, and the position of the larynx was neutral.

The elimination of hyperfunctional voice production and the introduction of resonance exercises improved respiratory-phonatory-articulatory coordination. The patient learned to recognise inappropriate vocal habits and consciously select vocal tasks.

Conclusion

The research paper presents a case study of a 56-year-old patient with paralytic dysphonia. Based on an analysis of medical records and a speech therapy diagnosis, a voice rehabilitation programme was implemented. After approximately four months of therapy, a re-diagnosis was performed to assess the effectiveness of the treatment.

The main goal of the therapy was to restore the functional capacity of the larynx lost as a result of paralysis of the left vocal fold. A multimodal rehabilitation model was implemented, comprising complementary modules: techniques aimed at achieving phonatory closure through stimulation of the paralysed vocal fold, breathing exercises, motor training of the articulatory organs combined with the development of body awareness in order to regulate muscle tension and reduce strain on the larynx as well as education and training in voice hygiene and production, coupled with scar therapy. The programme required the patient's active involvement and was supplemented with pharmacological treatment.

The treatment made it possible to achieve the therapeutic goal, namely improvement of laryngeal function through restoration of full mobility of the paralysed vocal fold. An improvement in the patient's mental state was noted: he learned the principles of correct voice production, eliminated hyperfunctional behaviours and was able to return to professional activity.

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