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REVIEW ARTICLE

Voice therapy in paediatric dysphonia

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ABSTRACT

Objective: To review the literature about the current available methods for voice therapy in pediatric patients affected by dysphonia.

Methods: All available articles published in pubmed concerning voice therapy in pediatric dysphonia were considered. Articles not available in English were excluded.

Results: Dysphonia is an extremely common voice disorder in paediatric population, involving up to around 20% of children from 7 to 16 years old. The causes of dysphonia are extremely different, from neurologic disorders to rare syndromic pathologies. Above all, phonotrauma is considered the most common cause of dysphonia, frequently determining the presence of benign lesions of the vocal cords, the nodules. The treatment can be medical, surgical or rehabilitative, but voice therapy is crucial regardless of the chosen approach. All authors highlight the crucial role of voice therapy in order to enhance positive vocal habits and establish correct vocal motor patterns. The role of family and school teachers is extremely important in the rehabilitation in order to limit the progression of the dysphonia or even treat it.

Conclusion: Multiple voice therapy methods are available in the literature, but an organic analysis of these methods is still lacking. The present review takes into account the voice therapy methods detected in the literature highlighting the relative advantages and disadvantages of each of them.

KEYWORDS

Paediatric dysphonia; voice therapy; paediatric voice disorder; dysphonia

Epidemiology of paediatric dysphonia

The term dysphonia characterizes impaired voice production as recognized by a clinician and it refers to a wide spectrum of voice disorders impairing the communication skills of the affected patients [1]. Dysphonia impacts the quality of voice, loudness, pitch or vocal effort thus reducing the voice quality [2]. The estimated prevalence in paediatric population greatly varies in different reports [3–5] and this disease affects most frequently children between 8 to 14 years old [6]. Dysphonia has a tremendous impact in terms of public health resources implicated in the management of the patients and diminished work-related function [7], even if only about 6 percent of the general population (adult and children) seeks for medical intervention/support [1]. The causes of dysphonia are frequently benign or self-limiting conditions, but it may also be the symptom of serious or progressive conditions with severe neurological implications (such as Parkinson's disease, spasmodic dysphonia, vocal tremor, or vocal fold paralysis) [7]. Consequently, a prompt medical evaluation is mandatory in order to choose the best medical, surgical or rehabilitative approach for the correction of dysphonia.

Dysphonia in children is a very common condition, even if it is hard to evaluate its exact prevalence because a great amount of patients does not seek specialistic medical attention. Some recent studies have reported a prevalence of 6-17% in children from 7 to 16-years-old [4,8], even though other Authors provide higher values. This condition can be acute when the symptom lasts up to two weeks, or chronic when it is present for more than three weeks [9]. Acute dysphonia is generally caused by upper airway infection or inflammation, whether chronic dysphonia can have numerous different causes. The physiology and physiopathology of the voice are extremely different in adults and in children, both in terms of anatomical and functional characteristics of the vocal tract as well as the social environment that may lead to dysphonia (work versus game). Anatomically, laryngeal tissues are immature in children and the larynx is located more cranially, so the vocal tract is shorter. For these reasons, the assessment and treatment in children substantially differ from adults.

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Etiopathogenesis of chronic dysphonia in children

The most common condition that leads to chronic dysphonia in children is vocal cord nodules, which are benign lesions that form at the junction between the anterior and the middle thirds of the vocal fold, mainly due to phonotrauma [10]. Different grades of vocal cord nodules can be held responsible for dysphonia in children in nearly 70% of the cases, according to some epidemiological studies [11]. Less frequently, children may develop vocal cord granulomas, benign inflammatory lesions of the posterior glottis, which can be caused either by laryngo-oesophageal reflux disease or by a history of intubation: the endotracheal tube can damage the delicate larynx of a child during the positioning manoeuvre or in case of long-lasting intubation [12]. Another pathology which can cause dysphonia in children is recurrent respiratory papillomatosis [13]. Children affected by this disease develop recurrent exophytic lesions of any region of the larynx that must be surgically treated: the objective is to avoid airway obstruction, and consequently, this may lead to dysphonia due to either the disease itself or to surgical complications. Also, congenital conditions can cause dysphonia. Laryngomalacia can present itself with stridor and dysphonia [14], but also subglottic webs or haemangiomas can cause impairment in vocal fold motility in case of extended involvement [15]; both conditions, in selected cases, are accountable for surgery. Another condition that could lead to dysphonia, even though it is not frequently seen in children, is vocal fold mobility impairment of paralysis due to damage to the laryngeal recurrent nerve. These conditions are often idiopathic, but in some cases, history of locoregional trauma may explain the clinical situation; even in children, in rare cases, vocal fold paralysis can be caused by laryngeal nerve compression or by a medication-induced neuropathy [16]. Finally, children can develop dysphonia even in the absence of anatomical lesions, due to functional abnormalities during phonation.

Dysphonia can also be a symptom of rare genetic or systemic syndromes that require a full medical evaluation by different specialists, frequently involving also a medical geneticist.

Assessment

The first step in the assessment should be the collection of the medical history obtained both by the child and his/her parents. The clinician should ask for the presence of possible risk factors for developing specific laryngeal conditions (such as prolonged intubation or stridor), but also the child's behaviour in ordinary life, in order to identify possible situations of vocal abuse. Some authors report a higher prevalence of dysphonia among children with siblings or with behavioural problems such as attention deficiency and hyperactivity disorder (ADHD) [17]. The impact of voice impairment in the child's life should also be evaluated because it can affect the compliance in the treatment [18]. In addition, for clinical purposes, it is useful to characterize the child's voice, both with perceptual scales and with aerodynamic and acoustic analysis. Among perceptual scales, even though there is no universal agreement, the most frequently used scale is the GRBAS (grade, roughness, breathiness, asthenia, strain), in which every component can get a score between 0 and 3, from normal to severe abnormality, and the overall score suggests the severity of the disease.

The second step consists of the clinical examination of the child, which should be performed by a qualified specialist in order to obtain the patient's collaboration. The neck should be manually inspected in order to identify possible abnormalities in the cartilages or suspicious tumefactions. A videoscopic visualization of the larynx should be obtained, and this often is the most difficult part of the examination, especially in very young children. In these patients, small flexible nasopharyngoscopes are preferable because they are well-tolerated and require less participation in the examination. Some authors even proposed to perform the endoscopic evaluation in conscious sedation [19]. However, videostroboscopy can be efficiently performed only with rigid endoscopes or with high-resolution flexible endoscopes: the first requires substantial collaboration during the exam and adequate expertise by the operator, the second consists of an expensive instrument, not available in all clinical institutions. The aim of the exam is to obtain a reasonably good visualization of the larynx and the subglottis, in order to exclude severe conditions and to guide the diagnostic and therapeutic process.

Indications to voice therapy

Despite the individual therapy plan for each child with dysphonia (medical or surgical), almost all these patients undergo voice therapy, either as a first-choice treatment or combined with others. For example, when dealing with the most common benign lesions

of the vocal cords, the vocal nodules (up to 60–70% of patients with dysphonia present vocal nodules) [11,20], the voice therapy is the primary treatment modality [18] and even the microsurgery of the vocal cords is considered less useful than voice therapy [21]. The role of the voice therapist is crucial in the rehabilitative process of the child. As the most common cause of paediatric dysphonia is phonotrauma, the therapist should help the young patient in developing awareness of his/her voice, enhance positive vocal behaviours, avoid voice abuse and establish new voice patterns that can prevent the progression of the pathology or even treat it.

The clinician should help the therapist with a correct diagnosis, an accurate description of the detected pathology and the role of voice therapy in the treatment of dysphonia. The timing of medical and/or surgical intervention should be stated in order to consequently plan voice therapy. The intervention must be tailored considering the possible clinical course of the pathology. In addition the child's capacity to participate in the diagnostic and treatment workup as well as evaluating the possible impact of the treatment in the child's life [18].

Available methods

In medical literature, few studies are available taking into account voice therapy methods.

Two approaches that can be considered are direct and indirect therapy. The direct treatment uses the stimulus, response, antecedent paradigm and incorporates more shaping and practice, while indirect treatment focuses more on education/discussion of voice principles [22]. However, it should not be assumed that 'indirect' treatment does not contain any element of direct therapy: in fact, both therapy arms contain direct therapy techniques.

In particular, Hartnick et al. [22] compared direct therapy Adventures in Voice (AIV)—designed by Katherine Verdolini-Abbott with indirect therapy My Voice Adventure (MVA)—designed by Catherine L. Ballif. The direct involved 8 therapy modules addressed at weekly sessions over a course of up to 12 weeks with the aim of establishing new voice patterns through motor learning principles, including resonance training and behavioural modelling and/or shaping, while simultaneously overriding existing phonotraumatic vocal patterns. Biomechanics of resonant voice training involves optimal glottal configuration, wherein vocal folds are barely adducted, or barely abducted, during voice use. A second aim is the generalization of new motor control patterns to settings outside of the clinic in varying environments, via homework and at-home practice. The indirect therapy involved 6 sessions over 8–12 weeks that focussed on reducing or eliminating vocal behaviours that resulted in dysphonia; MVA was based on a vocal hygiene programme combined with generally accepted practices for addressing phonotraumatic behaviours in school-aged children. Treatment involved games and other activities to increase awareness and change phonotraumatic vocal behaviours. Specific areas of focus included basic education of the vocal mechanism, normal function, and general care, identifying phonotraumatic behaviours, as well as environments and/or situations and ways to avoid or modify behaviours, discussion of 'undesired' and 'desired' voice quality and production. Both direct and indirect voice therapy approaches improve voice-related quality of life in children with vocal fold nodules although neither significantly showed a difference to each other.

Ramos et al. in 2017 [23] tried to verify the effects of execution time on auditory-perceptual and acoustic responses in children with dysphonia completing Semi-Occluded VocalTract Exercises (SOVTEs), in particular straw phonation exercises. SOVTEs are commonly employed in vocal training. Straw phonation is an included exercise encompassed by this technique. The mechanisms underlying the favourable effects of these exercises are thought to be increased supraglottic pressure and vocal tract impedance resulting in reduced glottal pressure. The main goal of this technique is to reduce phonatory effort and increase vocal efficiency. Increased supraglottic pressure and decreased glottal pressure yield slight abduction of the vocal folds. This phenomenon establishes an ideal correspondence of impedance, reducing collision forces between the vocal folds and balancing source-filter interactions to improve the vocal economy. Ramos et al. [23] showed that straw phonation exercises favourably affected auditory-perceptual and acoustic parameters in children with vocal fold nodules and cysts. Improvement in roughness and breathiness parameters after 3 min of straw phonation and improved overall grade of dysphonia and roughness after 5 min. These data suggest that the ideal duration of straw phonation in children with dysphonia is from 3–5 min.

Şenkal et al. [24] studied three-voice therapy approaches. First, hygienic voice therapy techniques are designed to improve behaviours that can lead to injury of the vocal folds; the total period of the

hygienic therapy ranged from one to four sessions. Second, symptomatic voice therapy techniques are designed to treat abnormal voice quality; the total period of the symptomatic therapy ranged from two to six sessions. Third, Physiological voice therapy techniques are designed to optimize voice production; the total period of the physiological therapy ranged from four to 11 sessions. Data from this study suggest that all these techniques can successfully restore the normal voice, but symptomatic voice therapy was found to be the most successful method of therapy. Şenkal et al. [25] also showed that a detailed medical history, which is collected from family during the examination, affects the processes of choosing the voice therapy method and its positive application. Active collaboration of parents is fundamental for achieving objectives. Additionally, the scholastic environment is very important. Therefore, a voice therapist should consider the importance of teachers on vocal behaviour, because they are the first vocal models for children away from home.

Trani et al. [26] evaluated the efficacy of voice therapy according to Borragan's method [27,28] associated with S. Magnani's [29–31] vocal counselling in functional dysphonia in children. Voice therapy may be helpful in treating functional dysphonia in children. It is a valid alternative to surgery, and in the cases where surgery is needed, it may prevent subsequent voice problems by changing the child's speaking behaviours and attitudes. It has been shown that family and scholastic environment must be involved in the treatment to change the vocal behaviour.

Braden et al. [32] tried to determine whether videos of practice exercises would increase adherence to voice therapy in children with a voice disorder. All therapies involved a combination of vocal health education, SOVTEs, and resonant voice therapy; the exact exercises and activities were clinician- and patient-dependent. The research design used for this study was a randomized, double-crossover trial comparing two separate weeks of home practice supported by written instructions with pictures as appropriate for younger children (no video condition), with 2 weeks of home practice supported by mobile digital media players containing treatment videos (video condition). In this study, the provision of voice exercise video examples on MP4 players did not increase practice frequency in children. Qualitative data indicated some helpfulness in video examples for recall of practice, but also dislike of the simple MP4 gadgets and video procedure. Furthermore, preliminary qualitative data suggested that paediatric patients have more self-efficacy for practice than adults.

Valadez et al. [33] described measurements of vocal parameters including fundamental frequency, shimmer, and jitter, videonasolaryngoscopy examination and clinical perceptual assessment, before and after voice therapy in children with vocal nodules. Voice therapy sessions were provided twice a week, 45 min in each session. Voice therapy was provided using the Speech Viewer III (SV-III-IBM) software, in a Gateway computer, GT 3010. The software provided visual support of acoustic parameters during voice therapy. All patients were subjected to the same therapy protocol, including voice presence and awareness, phonation duration and vocal attack. Each item was practiced for 10 min for a total time of 30 min per session. The remaining 15 min of each session were used for talking to the family about the characteristics of the voice problem and basic vocal hygiene education. Voice therapy with visual support provided by computerized images seems to be a safe, reliable and effective procedure in these patients. The results of the study showed that voice therapy using visual support provided by Speech-viewer software appears to be useful for helping children to recognize their voice characteristics and disorders. With the visual cues provided by the software used in this study, children may learn to produce relaxed phonation.

Discussion

Different methods for voice therapy in children with dysphonia have been found in the literature. Most of this highlight that voice problems in children have an important environmental component that cannot be overlooked during therapy. A fundamental part of voice therapy in dysphoric children consists in the re-education of the child's vocal habits in the environments of daily life. This is only possible by involving the family and the school and promoting awareness of vocal production. Both direct and indirect therapeutic approaches have proven to be effective. All the studies that reported effective vocal therapy showed the use of techniques for reducing dysfunctional aspects in the production of the voice, an aspect highlighted in particular in the studies of Şenkal et al. [24,25] All studies have demonstrated the need for the patients to be autonomous in the daily execution of the exercises learned during therapy sessions. The only exception is voice therapy using Speech Viewer III (SV-III-IBM) [33] which requires a frequency of therapy with the speech therapist twice a week for

20 weeks, twice the amount of other methods. Voice therapy using Semi Occluded Vocal Tract Exercises appears to be particularly effective and efficient [23]. With this approach, it is possible to obtain significant results by performing 3–5 min of exercise. Finally, the use of videos to support voice therapy in the daily performing of exercises is not useful for the rehabilitation of the voice in children with dysphonia.

Conclusions

The present review highlights that studies concerning the use of different voice therapy methods are scarce and frequently not homogenous in terms of approach and number of patients involved. Moreover, the studies do not compare the obtained results with other available methods reported in the literature. As the success of the treatment depends on the capacity of the child and the family to cooperate in the rehabilitative process, it is easy to understand that multiple confounding factors might interfere with a strong influence on the possible outcome. To be honest, the capacity of the therapist to involve the patient in voice therapy is not less important and it might be operator-dependent. All studies highlight the role of the parents and the school in the rehabilitative process in establishing positive vocal habits.

In the end, nowadays a consensus in terms of voice therapy methods is far to be achieved. The aim to compare the results of different methods, limiting the afore-mentioned bias, will be crucial to standardize the rehabilitative approach in paediatric dysphonia.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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