

Music Therapy and Rehabilitation Training for Children with Speech Impairment

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Keywords: Music therapy, children, aphasia, rehabilitation training

Abstract: Music therapy is significant in improving the language ability of children with speech impairment, strengthening language rehabilitation training, and enhancing the quality of language rehabilitation for children with speech impairment. Through the ethology analysis of children's language disorders, music therapy is integrated into the rehabilitation training of children's language disorders. Therapists use musical patterns to perceive and produce pitch, melodic contour, and uses rhythmic form to image the language function. The perception of musical elements through listening and singing activities is the standard mechanism involved in music and speech to affect the production of speech. Incorporate functional and specific language (vocabulary) into singing through different types of music therapy techniques, and to make musical elements in songs contribute to the production of language. At the same time, the Chinese academic field should first go beyond the possibility study, actively develop experimental research, learn the international advanced method paradigm, and develop the unified theoretical structure of theory and practice. This can better promote the localization process of music therapy intervention in the language rehabilitation for children with language disorders.

1. Introduction

In 1944, sound therapy was officially founded in Michigan State University. After more than half an era of vigorous development, it has become a complete fringe field, covering hundreds of different medical methods and technologies, and has been widely concerned and applied in clinical environments. In recent years, the development of music therapy in Europe, the United States, and other countries has made great progress, and its application field is more extensive, especially in the paediatric field. It can help children to improve their neurodevelopmental disorders, also effectively treat palliative patients, promote the psychological development of special children groups, and provide support for the mental health of adolescents. The international music therapy community has made a bold attempt and carried out a large number of practices in the early intervention of music therapy for children with speech and language development disorders.

Similarly, music therapy in the paediatric field in China has developed rapidly in the past ten years and has explored a unique path of music therapy in some fields. However, concrete intervention in children with developmental disorders, especially in children's language pathology and speech and language rehabilitation of special children, is still in a relatively disadvantaged state. In order to effectively organize and put the relevant music therapy theory and application technology into the

children's speech and language rehabilitation training, the author will rigorously summarize and sort out the relevant literature to help children with speech disabilities to obtain early, scientific and systematic intervention in music therapy.

2. Etiology and Diagnosis of Speech Disorders

2.1 Language retardation

“Language retardation” is a common clinical problem that, due to different reasons, children cannot express understanding as normally and cannot carry out everyday communication as ordinary children. It is a common problem in children's language development, and boys are more likely to be impacted than girls. However, the causes of this problem are complex.

2.2 According to the etiology classification, language retardation can be divided into primary disorders and secondary disorders.

2.2.1 Primary disorders

A primary disorder is a common speech disorder in which the patient's hearing, intelligence, and vocal areas are normal, but there is no clear primary disorder. The “big tongue” belongs to this species. It may occur due to poor ability or adaptability of the muscles involved in making sound and can be restored to normal sound with corrective training.

2.2.2 Secondary dysarthria

Secondary dysarthria is a common speech difficulty that may result from dysfunctions of vision, hearing, intelligence, autism, malformation of the vocal organs (such as cleft palate), dysplasia of the brain, or other brain damages.

2.2.2.1 Impact of visual impairment.

Without vision at birth, the visual afferent process will be inhibited. Therefore, visual perception, visual thinking, and visual memory of external objects will be difficult, resulting in children's lack of understanding of the basic concepts of language, which leads to the stagnation of language development.

2.2.2.2 Effects of hearing impairments.

Hearing loss at birth can cause auditory language input to be blocked. Human language development requires normal hearing, but the use of some drugs, such as gentamicin and diuretics. In early childhood, this can cause inner ear poisoning, reduced hearing, and thus impaired language development.

2.2.3 Effects of autism.

The inability to express language is typically one of the three most critical clinical symptoms in children with autism. People with severe autism do not have oral communication for a lifetime. It is characterized by:

- 1). Language growth and development lag behind that of children of the same age, often accompanied by screams or self-talk, and turn a deaf ear to the verbal instructions of others.
- 2). Pronoun confusion often occurs, and the lack of the ability to communicate with each other one

by one during the conversation, and the answer is different from what is asked.

3). Monotonous tone, lack of change in intonation rhythm, lack of emotional expression, and other phenomena.

2.2.4 Effects of low intelligence.

Intellectual disability is also called intellectual retardation. The child's language development depends on the level and nature of the child's intellectual development.

1). Usually, language development starts late, develops slowly, and reaches a low degree. Those children are usually slower than others in understanding and expressing speech and phonation.

2). It is difficult to express the views and requirements clearly, and the speech could be more logical and coherent. Therefore, it is difficult to understand the meaning of their expression.

3). The pronunciation of the language is incorrect, and the speech needs to be clarified.

As children with retardation of intellectual development have a lower level of language hearing, and the movement of the articulation parts is defective, their correctness of the speech will be impaired, and even the incidence of stuttering can be relatively high.

2.2.5 Influence of dysplasia of vocal organ structure (congenital cleft lip and palate) on language development.

Laryngeal deformity is a rare malformation of the vocal organs. It can be caused by accidents such as cleft palate, cleft lip, malformation of the tongue, or traffic accidents. Patients will be able to pronounce but the speech is unclear. To help children regain normal pronunciation, the medical professionals recommend that the deformity be corrected as much as possible before the age of three to reduce the patient's speech problems. After systematic training, the patients' dysarthria may be greatly recovered.

2.2.6 Influence of dysarthria on speech due to motor disorders.

Due to brain trauma, encephalitis sequelae, cerebral palsy, and other factors, the six activities have been seriously affected, resulting in dysarthria movement, affecting the language. In recent years, due to natural disasters caused by the increasing number of dysarthria, including car accidents, major strikes and other disasters, such accidents are usually reversible, but there is no cure.

2.3. Diagnosis of language disorders

(1) Regardless of the cause, the actual age of delayed language development is usually defined as follows: language development delay of more than 0.5 years corresponding to the actual age (including delayed speech expression and communication, delayed understanding of things, and language level) can be defined as language development delay.

(2) For neural control, the excitation of the sympathetic nervous control system improves the biological awakening ability of the human body. However, the excitation of the parasympathetic nervous control system reduces the physiological awakening ability of the human body (relax), which will also have an impact on language.

(3) Breathing is language's support function, even though its primary function is still to supply oxygen to the body and activate body functions. The beneficial events caused by breathing at the level of bodily functions, including removing carbon dioxide, supplying oxygen, activating metabolic functions, enhancing the immune system, regulating heartbeat, blood pressure, and body temperature, reducing body pressure (relaxing muscles), regulating autonomic nervous system, enhancing lung function, relieving pain (promote brain endorphin secretion), helping eliminate waste in the body

(eliminate constipation). Therefore, problems with respiratory function can also directly affect speech function. These contents meet the music medical requirements at the supportive level of the music therapy goals.

3. Intervention of Music Therapy for Children with Speech Disorders

3.1. The mechanism of music therapy

Both music and speech are fundamental forms of auditory communication. Since music and speech shares the same acoustic and auditory parameters, including frequency, intensity, waveform and timbre, duration, rate, contour, rhythm, and rhythm factors, international researchers agree that developmental speech and language training tools can be supported through music. Research suggest that regions of the right hemisphere involved in music processing are capable of language and can compensate for damage to the left hemisphere, which is responsible for language. The therapeutic musical experience in an impaired DSLM can range from simple singing exercises to associating sounds or pictures with words to trigger the correct vocalization of the target word. Functional words that children with autism can use effectively in everyday interactions during the DSLM music therapy intervention. Children with autism have a strong interest in music and enjoy listening to rhythm, tone, harmony or timbre, which allows them to communicate with others more easily. [1] In addition, children can improve various phonological elements such as semantics, pragmatics, phonology, and prosody. The positive changes produced by these learning experiences and their speech may result in improved communication skills, more dialogue, and enhanced interactions. Improved relationships with others and increased social exchange experiences may help children get more cognitive stimulation for optimal development and independence. It can also improve semantic or phonological skills, which can help a child gain reading skills.

3.2. The importance of musical and verbal fields in early child development.

As part of the same developmental sequence, music and speech are complementary and can influence each other in several ways. The researchers point out that the hearing and the performance of a piece of music require a precise grasp of the sound and its length. In fact, for rhythmical music, the process of appreciation stimulates not only the hearing system but also the sensorimotor system. The beta band of the nerve (15 to 30 Hz) determines the audio production process. [2]

3.3. The combination of music therapy and other therapies

Music therapy is an effective method of speech disorder rehabilitation. It can improve the articulation of the voice by controlling breathing, adjusting the frequency of speech, exercising vocal strength, and matching the rhythm and beat. This treatment can help patients to better understand and cope with speech disorders.[3] Moreover, music therapy is often not carried out in a single and isolated way but pays more attention to multi-disciplinary and multi-field cooperation such as:

3.3.1 Musical electroacupuncture therapy.

A combination of music therapy, acupuncture and speech rehabilitation therapy can effectively help children release their emotions and heal better, thus obtaining positive effects, both physically and mentally. In addition, the clinical treatment of pronunciation exercises and singing methods can significantly improve the speech ability of motor aphasia patients.

3.3.2 Music drama therapy.

Music therapy and drama therapy are both “art therapy.” They complement and contain each other. Combining music therapy with drama therapy can increase the therapist's acceptability and provide a broader and more creative perspective for children (post-traumatic stress disorder, autism, learning disabilities).

4. Types of Music Therapy Intervention Techniques for Speech Rehabilitation

4.1. Melodic intonation therapy

Melodic intonation therapy is an approach advocated by American speech pathologists that is entirely different from traditional therapy. It has been recognized as effective by the American Academy of Neurology and has been used worldwide. [4] The theory is that stress, tone, and prosody are all controlled by the right side of the brain, so people with left brain disorders can be treated through stress, tone, and prosody.[5] The music tone therapy mainly uses rhythmic sentences for reciting exercises and boldly express them in the discourse of ordinary people with phonology, stress, and rhythm. At the same time, when the patient has not fully accepted the damage to the language expression awareness and ability, using some common words with the rhythm singing method can promote the patient learned to speak naturally and independently. At the beginning of the treatment, the therapist and the patient can sing a short ballad. The therapist would then say a few words, and the patient imitates them. Later, the patients will be able to slowly transit to the point where they could explain the problem by singing. In the next stage, the patients are trained to sing rhymes and songs closely related to the speech of ordinary people. Finally, the patients' voice can return to the voice of a normal person speaking.[6]

The advantage of this method is that it allows the patient to sing out the words in rhythm. Rhythmical voice prompt, through the practice of the song's rhythm, so that the patient's language pronunciation of intelligibility and clarity has been enhanced. Using rhythm to play out everyday words is to sing short sentences from the patient's life into a song so that the patient can practice the rhythm and tone of normal speech in the song.

4.2. Therapeutic singing

4.2.1 The relationship between therapeutic singing and children's language.

Children's speech production is often impaired due to neurological injury or disease. People use voice to communicate basic needs and emotions, so a decline in speech ability can devastate many aspects of a child's life. This functional communication deficit can also negatively impact emotional health, self-esteem, and social connections. There are many shared neural resources, physiological mechanisms, and structural similarities between singing and speaking. From a neurological perspective, singing involves activation of the motor cortex, basal ganglia, cerebellum, and regions involved in producing intonation in speech. Therapists offer corrective programs based on problems with the patient's voice and singing techniques. The diagnosis of vocalization disorders focuses on various aspects, such as the control of breathing, the timing of vocalization, and the intensity, timbre, melody, beat, and articulation of the vocalization.[7] Therefore, when singing too fast is easy to produce problems in phonology, melody, and vocabulary, the therapist needs to guide the patient to slow down the singing speed. Since the problems of tone, volume, and sound quality are closely related to the vocal technology, the therapist can use the recording comparison to guide and help the patient find the best tone and volume standard and carry out control training. Since the fluency, clarity,

and accuracy issues of singing are associated with the use of manual ventilation, it can help patients improve the coordination of vocal and ventilating actions, effectively use ventilating sound, reduce the length of spoken words, and reduce the abuse of sound delivery systems or lack of sound. Music therapists can incorporate sound vowel training on wind instruments to enhance oral movement, posture, and articulation.

4.2.2 Therapeutic poetry and thematic speech stimulation.

The therapist sings the first five and a half lines of a ballad or melodic fragment that the patient has learned. The patient completes the second five and a half lines by memory, which triggers a similar reflexive statement using the poetic material to play a useful role. [8] Although all aphasia patients cannot develop goal/autonomic utterance reflexes, they sometimes form statements spontaneously in response to stimuli. Musical material, such as poetry, can also be memorized easily without practice. While using “fill in the blanks” or “sing in response” to induce the patient to respond, the music should be chosen from the patient's most familiar music to get the patient through pronunciation training and complete the sentences.

4.2.3 Therapeutic singing skills.

Therapeutic singing skills aims to address problems with singing and speech breathing comprehensively. Vocal exercises include stretching exercises, oral movement breathing exercises, and pitch and intensity exercises. Include continuous exhalation and vocalization exercises to develop respiratory endurance and increase the ability to inhale. Many exercises target intensity variations, using crescendos, crescendos, and accentuated rhythm pulses. Instruct participants to explore new ways to increase the recruitment of spare respiratory muscles in the neck and shoulders by supporting or pushing the upper body, thereby can provide more of a support base for exhalation efforts. The singing portion of the intervention incorporates techniques for improved breathing support and the control (practiced during vocal training) of familiar songs. Each session will be ended with impromptu singing that focuses on maximizing sustained vocalization and exploring vocal range. The results showed that the method can also effectively increase background noise and speech projection for maximum vocal time.

4.3. Therapeutic Chanting

Therapeutic chanting is the main method of training soft intonation. At the moment of closure, the band of soft intonation is essentially the same or exactly the same as the exhaled air passing through the glottis. [9] When pronouncing, the air inhaled needs to be moderate, and the tendons at the root of the tongue, the soft palate, the tongue's tip, and the mouth's lower palate needs to be automatically relaxed. When the air enters the glottis smoothly and the glottis is automatically closed, the speech heard will become softer, more natural and rounded, producing greater flexibility and intensity. [10] This method can effectively change the rigid pronunciation caused by spasmodic dysarthria if applied to daily life and conversation. Speech disorders are also the most common aftereffects of brain injury and often interfere with everyday interactions. Music therapy can improve the function of the respiratory system, the sensitivity of the tongue, speech articulation, speech speed, and the nervous system's function. It is the most important and effective treatment method in language rehabilitation training. For young children, “pronunciation song” is a nursery rhyme designed especially for children. It is designed based on the position of children's tongue while pronouncing, including the tongue tip, tongue surface, tongue root and rhotic sound, so that children can sound more natural and smoother. Meanwhile, with animation, let the children sing nursery rhymes while assistance movement to develop their interests in singing.

4.4 About the lyrics and speech structure organ training

4.4.1 Tongue motor function training

In training, first let the tongue out, then let it back in. This will train the tongue to stretch, thereby increasing its dexterity and agility. For example, the tip of the tongue is pushed against the lower teeth, and the base of the tongue supports the tip of the tongue to push outward. “Ei” vowels with step 5 degrees downward practice in C major 4/4 beat / 543 / 1 - / “the power needs to be gradually increased. Therapists can also use repeated interval training at ordinary times such as “C major 4/4, step upward practice / 1111 // 3333 / 4444 / and rise two degree per section”. Younger kids can use a lollipop to guide the tongue to bobbing around stretch as far as possible. This exercise trains tongue movement function and strengthens and improves respiratory function. It should be noted that the length of each group of syllables can be gradual according to the current situation of respiratory function.

4.4.2 Lip motor function training

Start by closed oral practice, the training can let the child finish “lips closed hum with step 5 degrees downward practice 4/4 shoot / 543 / 1 - /” against the problem of difficult in closing his/her lips. The therapists can use unique props such as acoustic lips clamped on a slip of paper as much as possible to maintain more time to improve the child’s ability to close his/her lips tight. The next stage is lips’ activity training. The child’s lips need to starch as far as possible, trying to go on both sides, like the shape of his/her teeth. Have the child make the “Wu” and “Yi” sounds and close their lips. This can also be used in C major “4/4, step upward practice / 1111 // per section 3333 / 4444 / rise second” repeated interval training to increase the flexibility of the lip movement.

4.4.3 Training of the soft palate

Massage regularly, using your hands to push the soft palate against the back pharyngeal wall, and practice repeatedly. The child can also use this to practice chewing, yawning, swallowing, coughing, sighing, and other movement patterns. If yawning, try to open the mouth wide so that the upper jaw is raised, the lower jaw is lowered, and the mouth is closed. Cooperate with step 5 degrees downward practice “in C major 4/4 beat / 543 / 1 - /” like a yawn, makes an “a” sound, make an “EI” sound and slowly repeat 3-5 times, then take a rest. According to the actual level of children, make the adjustments within three to five tones then turn to lower tones. Practice by having your child stick their tongue out of their mouth can avoid the base of the tongue being near the soft palate. Sigh → make “a” sound → make plosive and open vowel sounds “pa” “da” → make fricatives and closed vowel sounds “si” “shu” → exchange exercises such as “C major /4 beat 51/51/51/51/51/” to stimulate the soft palate and increase its flexibility.

4.4.4 Laryngeal training

Let the children touch the throat of their father or mother, listen to the sound they make, and then the children's body against the wall, feel their own throat so that the vocal cord vibration and sound production can be connected. Try to bring out his/her more natural voice without any extra tension. Let children feel the resonance of the chest—let children put their hand on your chest to feel when the voice. Sound production relies on expiratory aspiration (the chest contracting inward). Practitioner can use small group practice steps down to 5 degrees C major / 4 shoot / 543 / 1 - / at starting point. Make blasting sound with a vowel “pa”, or children can choose “low pitch sound area (piano keyboard small “da”)”. The duration of the voice can be gradually increased.

4.4.5 Singing breath and vital capacity training.

If the child's speaking is unclear, it is important to consider the child's breathing. If the speaking is drawing, the practitioner should focus on training the child's lungs capacity. One of the most effective ways to train lungs capacity is to practice “singing breathing—compound breathing”, in which the child breathes in through the mouth and nose while his ribs expand. Find the feeling of deep breathing and combine it with the above exercises. The lips, tongue, soft palate, larynx, and breathing can be trained in a focused and unitive way through the Therapeutic Singing Technique. The voice will be louder and the lips, tongue, soft palate, and larynx will all function better.

5. Conclusions

Music therapy is not the only way to intervene in children's speech impairment, but it has a good effect and is a training method with more fun. It can be applied in rehabilitation, at the same time, improving the sense of music for disabled children. They can therefore receive person centred care and gradually form a good habit during their life and the journey of rehabilitation. The author introduced relevant techniques and principles of music therapy intervention in children's speech rehabilitation from etiology analysis, diagnosis, intervention training, and other dimensions of paediatric speech disorders. Since children with special needs and ordinary children can both try these interventions to improve their language ability and improve the effectiveness of language rehabilitation, this article is considered to have an insightful practical value. Due to individual differences, children should be trained step by step according to the characteristics of their disorder and the actual situation. Practitioners should follow the idea of “acceptance - training - acceptance - integration,” and respect every individual, and love for the essence of life. Through the summary conclude of music therapy techniques in this field and their application in children, the author proposed a general introduction to the public to improve their understanding of music therapy technology. This can also promote the development and popularization of music therapy intervention in children's speech and language rehabilitation therapy technology in China.

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