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Effect of Music Therapy Combined with Intelligent Medical Equipment on Speech Rehabilitation of Autistic Children

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Abstract: The number of autistic patients is increasing year by year, and the population is mainly concentrated in children. Autism has seriously affected children's language development, and has caused a great burden to children's families and society. The research on the treatment of autistic children has never stopped, but the treatment effect of conventional language training and rehabilitation therapy is poor, and children are often difficult to resume normal language communication. With the development of the medical industry, music therapy has become a new type of therapy. It guides children to communicate with each other through soothing music rhythm. Intelligent medical equipment can help to timely analyze children's psychological conditions, adjust the intensity of music therapy and play appropriate music. This paper has compared the conventional language training therapy with the speech rehabilitation therapy based on music therapy combined with intelligent medical devices. The results showed that the average language communication ability of children with autism who had no language ability was 37.3% and 54.8% respectively under the conventional language training and music therapy. Among the autistic children with partial language ability, the average language communication ability of children with conventional language training and music therapy was 54.9% and 60.9% respectively. Therefore, speech rehabilitation therapy based on music therapy and intelligent medical devices can effectively improve the language communication ability of autistic children.

1. Introduction

The number of autistic children in the world is increasing, and autistic children often show language communication disorders, social difficulties and motor disorders. The emergence of autistic children is a great burden to both the patient's family and the patient himself. His family often needs to spend a lot of time and money to seek medical advice. However, due to the complex etiology of autistic children, which is related to genetics, immune system and living environment, the overall treatment effect is not good. Children's autism is a major psychiatric disease in children's department in clinic. The difficulty of treatment is that children patients show language disorder, and it is difficult for therapists to enter the content world of children to guide them psychologically. From the discovery

of autism to the present, medical methods are constantly expanding, such as game interaction intervention, picture perception intervention, etc. From a large number of clinical observations of autistic children, it can be found that autistic children have special sensitivity to music, and music therapy has become an effective means to treat autistic children. With the continuous development of intelligent medical treatment, many medical devices are full of intelligence. Combining music therapy with intelligent medical devices, the state of patients and adjust music can be intelligently perceived to achieve the best therapeutic effect. Therefore, this paper has research significance.

Autism in children is a common mental disease of children. Autistic children often show language disorders. Many people have studied the speech rehabilitation treatment of children with autism. Among them, Cidav Zuleyha divided autistic children into two groups. The experimental group used a professional language therapist for two years of treatment, while the control group did not carry out any intervention. His results showed that language therapy for autistic children can alleviate children's autism [1]. Colebourn Jennifer A proposed a school based physical therapy method for autistic children. Through throwing activities for autistic children in school, the autistic children's sports and external communication ability were significantly improved after one semester [2]. According to McBain Ryan K's research, the number of autistic children in the United States was very large, and the treatment methods for autistic children were also diverse. The main treatment occupations were children's doctors, speech therapists, and physical therapists [3]. Pan Chien-Yu carried out exercise therapy for autistic children. Twenty two autistic children were divided into two groups. One group received exercise intervention and the other group did not. The communication ability of autistic children who received exercise intervention 12 weeks later was significantly improved [4]. There have been many ways of speech rehabilitation for autistic children, but the effect is not particularly good.

Music therapy is the use of music specific psychological effects to treat patients. Relevant researchers have applied music therapy to the speech rehabilitation of autistic children. Among them, Imankhah Fahimeh's research showed that music is a good psychotherapy method, and applying music therapy and sports therapy to autistic children can effectively improve their motor ability and language communication ability [5]. Broder-Fingert Sarabeth conducted music therapy for children with autism spectrum disorders, and he believed music therapists promoted the rehabilitation of children with autism through music therapy [6]. Marquez-Garcia Amparo V's research showed that the language communication ability of autistic patients is very poor, and improvised music therapy can cause resonance of patients and improve the self-confidence of language communication to achieve the effect of speech rehabilitation therapy [7]. Music therapy provides a new way of speech rehabilitation for autistic children, but it lacks the use of intelligent medical devices to assist music therapy.

2. Methods of Speech Rehabilitation for Children with Autism

In essence, autism is a kind of loneliness disorder, which is generally manifested as inability to conduct normal social communication, repetitive behaviors, and narrow interests. Autistic patients tend to have low activity and have language communication barriers. Early studies on autism were all targeted at adults. However, with the development of the medical industry, many children also showed symptoms of autism. Through long-term clinical analysis of children, it was confirmed that children were at high risk of autism. The symptoms of autistic patients are shown in Figure 1.

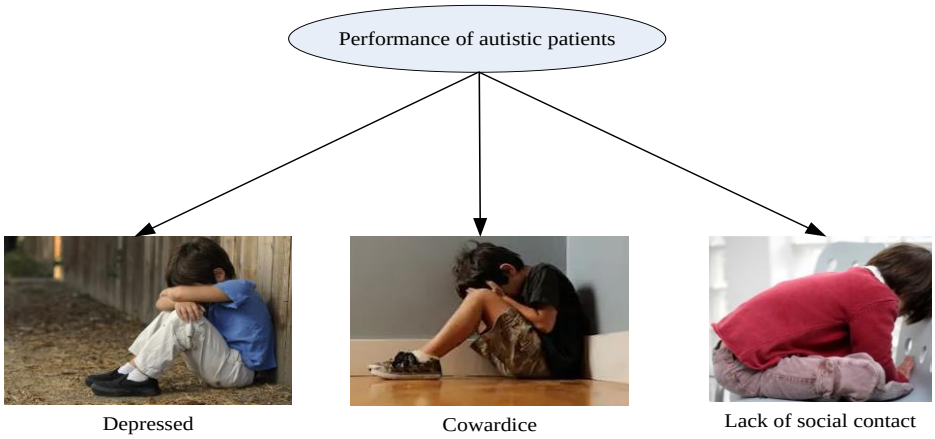


Figure 1 Symptoms of autistic patients

In Figure 1, the symptoms of autistic patients are described. Autism often occurs in children, mainly manifested as depression, timidity and lack of social interaction.

Autism occurs in many age groups. Through the investigation of the age of American autistic patients in 2014, the main age groups of autism occurrence and the incidence rate of each age group were obtained. The incidence rate of autism is shown in Table 1.

Table 1 Incidence rate of autism

Serial number	Age	Incidence rate
1	[1,5)	2%
2	[5,18)	1%
3	[18,30)	0.8%
4	[30,60)	0.3%

Table 1 describes the incidence rate of autism in different age groups in the United States, of which the highest incidence rate of autism is 2% for children aged 1 to 5, 1% for people aged 5 to 18, and 0.3% for people aged 30 to 60.

2.1. Conventional Language Training Treatment for Autism

The language disorder of autistic children is the focus and difficulty of treatment. Before speech rehabilitation treatment for autistic children, it is necessary to analyze the type and characteristics of their language disorder. The characteristics of language disorder in autistic children are shown in Figure 2.

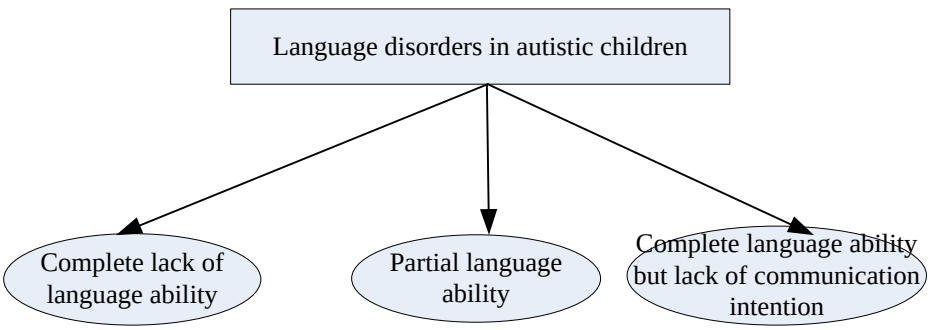


Figure 2 Characteristics of language disorders in autistic children

In Figure 2, the characteristics of language disorders of autistic children are described. The

characteristics of language disorders of autistic children are mainly divided into three categories, namely, complete lack of language ability, partial language ability, and complete language ability but lack of communication intention.

Different speech rehabilitation treatment methods should be used for different autistic children with language disorders. The autistic children have no language ability at all. Although their vocal cords are intact and they can cry normally, they lack language expression ability, which is similar to that of deaf mutes in terms of performance. Autistic children are generally born without language ability, or their language ability deteriorates during the growth of children.

2.2. Music Therapy

Music therapy is a treatment based on music, which is a systematic intervention method to guide patients' psychology with music as the center. Because the vast majority of patients have unique feelings for music, music therapy is an effective means of speech rehabilitation for autistic children. The process of music therapy is shown in Figure 3.

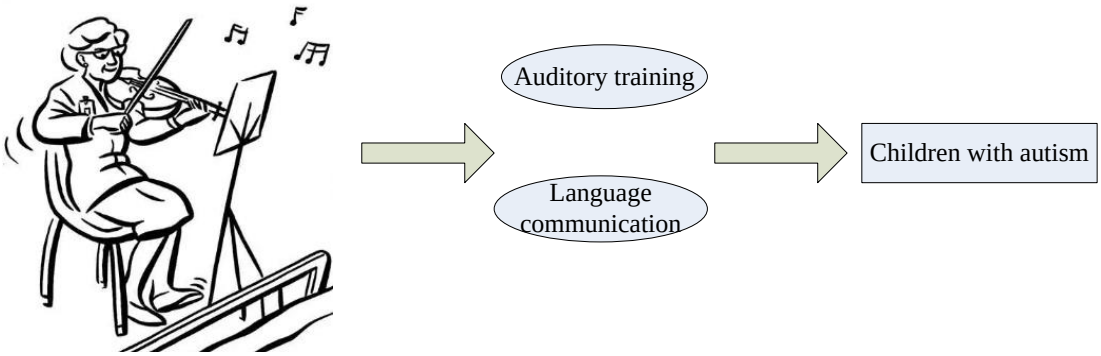


Figure 3 Process chart of music therapy

In Figure 3, the process of music therapy is described, in which children with autism receive auditory training and language communication through music intervention.

Speech rehabilitation therapy for children with autism has the following characteristics:

The children are guided to auditory learning through music. The training method is mainly to sing along with the melody of music and beat rhythmic drums in the background music. The therapist and the child sit facing each other, and under the stimulation of music, the therapist guides the child to make a sound following the music.

The selection of music is generally rhythmic music, and music with life lyrics is selected. Under the guidance of the therapist, the children are made to actively clap their hands to the music and sing the target lyrics. Corresponding encouragement should be given to children's performance to enhance their confidence in language communication.

Music guides children's psychology, and the selection of background music must be soothing music, because in fast-paced music, children are often unable to keep up with the rhythm of music and are often unwilling to express their own voice.

2.3. Intelligent Medical Treatment

With the continuous development of information technology, medical means have also been rapidly improved. Medical information platforms can be realized by using various intelligent devices. Intelligent medicine combines patients, hospitals and medical methods. The structural model of intelligent medical treatment is shown in Figure 4.

Intelligent medical treatment

Figure 4 Structural model diagram of intelligent medicine

In Figure 4, the structural model of intelligent medical treatment is described. With the help of intelligent medical devices, information exchange among hospitals, patients and treatment methods is realized.

When using music therapy for speech rehabilitation of autistic children, intelligent medical devices can be combined to improve the treatment effect. For example, using intelligent medical devices can help to monitor the psychological condition of children and intelligently switch the background music according to the degree of language communication of children, so as to improve the treatment effect of music therapy.

The speech rehabilitation information set of autistic children is set as $K=(k_1,k_2,\cdots,k_n)$. The information processing process of artificial neural network is based on artificial neuron. If the connection weight value between the dataset and artificial neuron is expressed as $W=(w_1,w_2,\cdots,w_n)$, then the process of artificial neuron processing speech rehabilitation information of autistic children is as follows:

$$M=\sum_{i=1}^{n}w_i k_i \quad (1)$$

The processing results of artificial neurons need to be processed through activation functions. Common activation functions are as follows:

$$F(x)=\frac{1}{1+e^{-x}} \quad (2)$$

The result of Formula (1) is taken as the input variable and substitute it into Formula (2) to get:

$$F(M)=\frac{1}{1+e^{-M}} \quad (3)$$

The intelligent medical device can predict and analyze the speech rehabilitation information of various autistic children. The back propagation neural network can adjust the results of the neural network according to the error, so as to analyze the best speech rehabilitation treatment mode for autistic children. The expression process of error is:

$$E=\frac{1}{2}\sum_{i}(y_{ia}-y_{ib})^2 \quad (4)$$

In Formula (4), y_{ia} represents the expected output of the *i*-th neuron, and y_{ib} represents the actual output of the *i*-th neuron.

The basis for accurate analysis of speech rehabilitation information of autistic children by using error judgment intelligent medical equipment is:

$$E \le t \quad (5)$$

3. Experiment of Speech Rehabilitation Therapy for Autistic Children

3.1. Data Sources of Music Therapy

Music therapy is a special therapy based on music, which can promote the emotion of autistic children and guide them to actively communicate with each other through soothing music. To effectively analyze the impact of music therapy on speech rehabilitation therapy for autistic children, this paper used the analytic hierarchy process to build a speech rehabilitation therapy system for autistic children. Through a questionnaire survey of 200 autistic speech rehabilitation therapists, the indicators that affected the effect of speech rehabilitation therapy for autistic children were obtained, and the impact of each indicator was compared. By constructing a judgment matrix, the relative weight of each indicator was analyzed. The speech rehabilitation treatment system for children with autism is shown in Table 2.

Table 2 Speech rehabilitation treatment system for children with autism

Target	Indicator	Weight
Effect of speech rehabilitation therapy on autistic children	Language understanding	25%
	Language expression ability	25%
	Language cognitive ability	24%
	Language communication ability	26%

In Table 2, the speech rehabilitation treatment system for autistic children was described. A total of four indicators were calculated, of which the highest weight of language communication ability was 26%, and the lowest weight of language cognitive ability was 24%. Since the weights of these four indicators were not much different, these four indicators could be used as indicators to evaluate the effect of speech rehabilitation therapy for autistic children.

In this paper, 200 autistic children were randomly selected as the experimental subjects of speech rehabilitation therapy for autistic children. All the selected children needed to meet the relevant diagnosis of autism in the hospital, and their health needed to be guaranteed. The details of children with autism are shown in Table 3.

Table 3 Details of children with autism

Autism type	Gender	Number of people	Percentage
No language ability	Male	30	15%
	Female	40	20%
Partial language ability	Male	64	32%
	Female	66	33%

In Table 3, the details of autistic children are described. The autistic children in the experiment were divided into two categories: autistic children with no language ability and autistic children with partial language ability. Among them, the maximum number of female autistic children with partial language ability was 66, and the minimum number of male autistic children without language ability was 30.

3.2. Experimental Design of Speech Rehabilitation Therapy for Autistic Children

This article analyzed the speech rehabilitation treatment of autistic children by setting up a control group, in which the control group used conventional language training treatment. During the music therapy, the Chinese children's song "Hello Song" was used as the performance song of this experiment to improve the children's language understanding ability by playing music with soft rhythm for speech rehabilitation intervention.

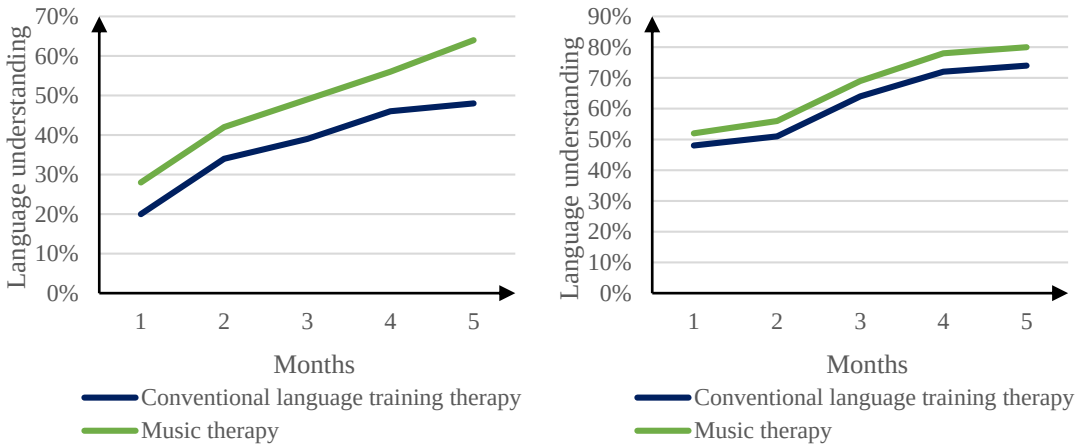
Because the effect of speech rehabilitation therapy for autistic children was slow, this paper needed to set a longer treatment cycle for speech rehabilitation therapy for autistic children. A total of five courses of treatment were set up, and each month was a course of treatment. After each course of treatment, the indicators of the therapeutic effect of speech rehabilitation for autistic children needed to be measured. The therapeutic effect of speech rehabilitation for autistic children was mainly analyzed from four aspects: language understanding, language expression, language cognition and language communication.

The experimental population of children with autism in this paper was divided into children with autism who had no language ability at all and children with autism who had partial language ability. In this paper, comparative experiments were conducted on these two groups. For the convenience of subsequent experiments, children with autism who had no language ability at all were classified as group A, and children with autism who had partial language ability were classified as group B.

4. Results of Speech Rehabilitation Treatment for Children with Autism

4.1. Language Understanding

Speech rehabilitation therapy includes many aspects, among which the training of language understanding ability is the most basic. Language understanding mainly refers to the understanding of others' words when talking, including literal meaning understanding and implicit meaning understanding. The comparison of language comprehension between conventional language training therapy and music therapy is shown in Figure 5.



(a) Language understanding ability of group A (b) Language understanding ability of group B

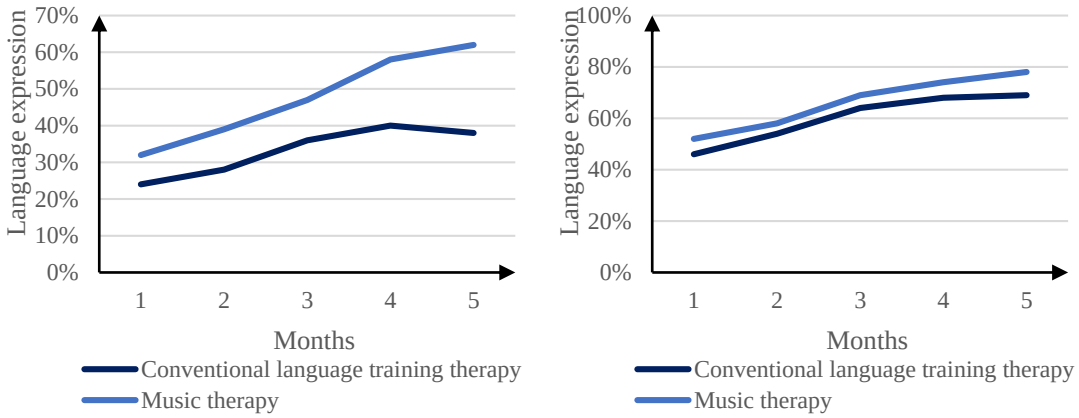
Figure 5 Comparison results of language comprehension

Figure 5(a) describes the impact of two speech rehabilitation treatments on the language understanding ability of group A. The children's language understanding ability under the conventional language training treatment mode reached a minimum of 20% in the first month and a maximum of 48% in the fifth month. The children's language understanding ability under the music

therapy mode was constantly improving, and the speed of the children's language understanding ability improvement during the experimental period was faster than that of the conventional language training mode. The children's language understanding ability under the music therapy mode reached the highest of 64% in the fifth month. Figure 5(b) describes the impact of two speech rehabilitation treatments on the language understanding ability of group B. The children's language understanding ability under the conventional language training treatment mode reached the minimum of 48% in the first month and the maximum of 74% in the fifth month. The children's language understanding ability under the music therapy mode reached a minimum of 52% in the first month and a maximum of 80% in the fifth month. Therefore, the combination of music therapy and intelligent medical devices can effectively improve the language understanding of autistic children.

4.2. Language Expression

The language expression ability reflects the language expression and application of autistic children. The higher the language expression ability of children, the better the effect of speech rehabilitation treatment. The comparison of language expression ability between conventional language training treatment and music treatment is shown in Figure 6.



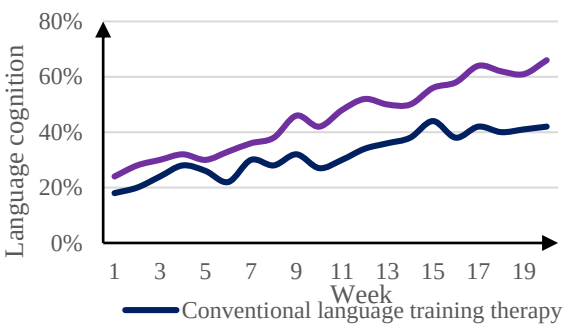
(a) Language expression of group A (b) Language expression of group B

Figure 6 Comparison results of language expression

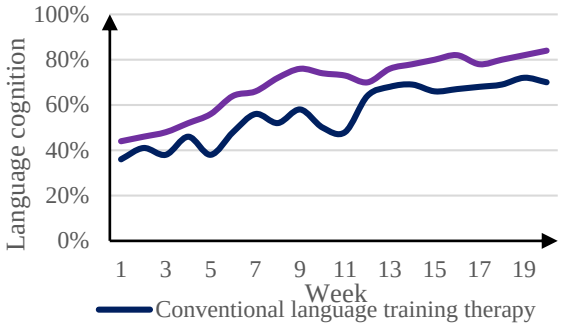
Figure 6(a) describes the impact of two kinds of speech rehabilitation therapy on the language expression ability of group A. The children's language expression ability under the conventional language training therapy was slowly improved, reaching a minimum of 24% in the first month and a maximum of 40% in the fourth month. The children's language expression ability under music therapy was improved rapidly, from 32% in the first month to 62% in the fifth month. Group A had basic language expression ability under five months of music therapy. Figure 6(b) describes the impact of two kinds of speech rehabilitation therapy on the language expression ability of group B. Both the conventional language training therapy and music therapy could improve the children's language expression ability, but it is obvious that the children's language expression ability was improved faster under the music therapy.

4.3. Language Cognition

Language cognition is the further understanding of language, including the use of language grammar and the analysis of language use situations. The comparison of language cognitive ability between conventional language training therapy and music therapy is shown in Figure 7.



(a) Language cognition of group A



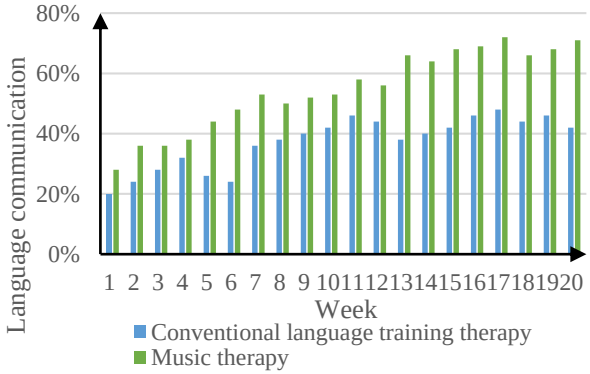
(b) Language cognition of group B

Figure 7 Comparison results of language cognition

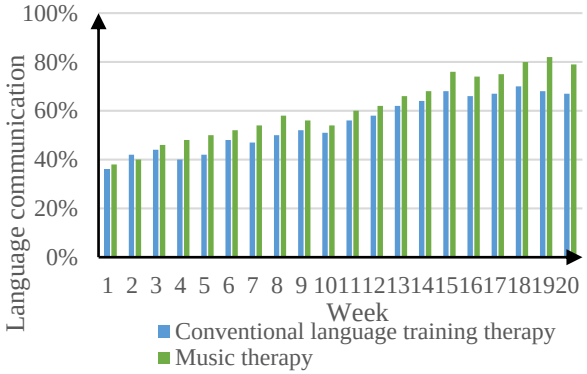
Figure 7(a) describes the impact of two types of speech rehabilitation therapy on the language cognitive ability of group A. The data of 20 weeks of speech rehabilitation therapy were recorded. The language cognitive ability of children under the conventional language training therapy was improving as a whole, reaching a minimum of 18% in the first week and a maximum of 44% in the fifteenth week, with an average of 32%. The language cognitive ability of children under music therapy was also improving as a whole, reaching a minimum of 24% in the first week and a maximum of 66% in the twentieth week, with an average language cognitive ability of 45.3%. Figure 7(b) describes the impact of two kinds of speech rehabilitation therapy on the language cognitive ability of group B. The children's language cognitive ability under the conventional language training therapy mode reached the lowest 36% in the first week and the highest 72% in the nineteenth week, and the average language cognitive ability was 56.2%. The children's language cognitive ability under music therapy reached a minimum of 44% in the first month and a maximum of 84% in the twentieth week.

4.4. Language Communication

The language disorder of autistic children is mainly manifested in language communication disorder, which has a great impact on children's life. The language communication ability between conventional language training therapy and music therapy was compared, and the comparison results are shown in Figure 8.



(a) Language communication of group A



(b) Language communication of group B

Figure 8 Comparison results of language communication

Figure 8(a) describes the impact of two kinds of speech rehabilitation therapy on the language communication ability of group A. The children's language communication ability under the conventional language training treatment mode reached a minimum of 20% in the first week and a

maximum of 48% in the seventeenth week, and the average language communication ability was 37.3%. The children's language communication ability under the music therapy mode reached a minimum of 28% in the first week and a maximum of 72% in the seventeenth week, with an average language communication ability of 54.8%. Figure 8(b) describes the impact of two kinds of speech rehabilitation therapy on the language communication ability of group B. Both of them could improve the language communication ability of children with autism, but music therapy could improve the language communication ability of children more quickly. The children's language communication ability under the conventional language training treatment mode reached a minimum of 36% in the first week and a maximum of 70% in the eighteenth week, with an average language communication ability of 54.9%.

5. Conclusions

This study investigated speech rehabilitation therapy in autistic children with no language ability and those with partial language ability. After five months of treatment, music therapy combined with intelligent medical devices effectively improved the language comprehension, expression, cognitive, and communication abilities of autistic children. Music therapy provides a novel approach to language therapy for autistic children. Through music, children can be guided to communicate, improving their language comprehension. Music therapy can also promote the rehabilitation of language function in autistic children.

References

[1] Cidav, Zuleyha. "Cost offset associated with Early Start Denver Model for children with autism." Journal of the American Academy of Child & Adolescent Psychiatry 56.9 (2017): 777-783.
[2] Colebourn, Jennifer A., Ann C. Golub-Victor, and Arsenio Paez. "Developing overhand throwing skills for a child with autism with a collaborative approach in school-based therapy." Pediatric Physical Therapy 29.3 (2017): 262-269.
[3] McBain, Ryan K. "Systematic review: United States workforce for autism-related child healthcare services." Journal of the American Academy of Child & Adolescent Psychiatry 59.1 (2020): 113-139.
[4] Pan, Chien-Yu. "The impacts of physical activity intervention on physical and cognitive outcomes in children with autism spectrum disorder." Autism 21.2 (2017): 190-202.
[5] Imankhah, Fahimeh, Abbas Ali Hossein Khanzadeh, and Ahya Hasirchaman. "The effectiveness of combined music therapy and physical activity on motor coordination in children with autism." Iranian Rehabilitation Journal 16.4 (2018): 405-412.
[6] Broder-Fingert, Sarabeth, Emily Feinberg, and Michael Silverstein. "Music therapy for children with autism spectrum disorder." Jama 318.6 (2017): 523-524.
[7] Marquez-Garcia, Amparo V. "Music therapy in autism spectrum disorder: A systematic review." Review Journal of Autism and Developmental Disorders 9.1 (2022): 91-107.