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Effect Analysis of Self-made Oral Muscle Training Aids in the Rehabilitation of Dysarthria in Children with Cerebral Palsy

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Abstract: Objective: To analyze the application effect of self-made oral muscle training aids combined with games in the rehabilitation of dysarthria in children with cerebral palsy.Methods: A retrospective analysis was conducted on the data of 48 children with cerebral palsy and dysarthria admitted to the Department of Cerebral Palsy Rehabilitation, the Third Affiliated Hospital of Jiamusi University from January 2023 to June 2025. They were divided into an experimental group (26 cases) and a control group (22 cases) according to different treatment methods. The control group received conventional rehabilitation training, while the experimental group added training content with self-made oral muscle training aids on the basis of the control group. Both groups received continuous treatment for 3 courses. The treatment effect, oral motor function and language function of the two groups were compared.Results: The total effective rate of the experimental group was 92.31% (24/26), which was higher than 63.64% (14/22) of the control group. The difference between the two groups was statistically significant (P=0.015 < 0.05). After treatment, the oral sensation, mandible, lip, tongue and total scores of the experimental group and the control group were improved compared with those before treatment, and the scores of the experimental group were higher than those of the control group, with significant differences (all P < 0.05). The developmental quotient and comprehension quotient of the experimental group and the control group were significantly higher than those before treatment, and the developmental quotient and comprehension quotient of the experimental group were higher than those of the control group, with significant differences (all P < 0.05).Conclusion: Rehabilitation training based on self-made oral muscle training aids can improve the rehabilitation effect of dysarthria in children with cerebral palsy, and promote the development of oral motor function and language function.
Keywords: self-made oral muscle training aids; games; children with cerebral palsy; dysarthria.

Introduction

Due to brain damage affecting the motor control pathways, some children with cerebral palsy will have problems such as abnormal muscle tone, limited range of motion, poor coordination and insufficient muscle strength in articulatory organs such as lips, tongue and mandible, which further restrict the accuracy of pronunciation and speech clarity. Such children often have difficulty completing fine articulatory movements such as tip-of-tongue elevation, lip-tooth contact or airflow control, resulting in inaccurate output of initials and finals. At present, the intervention for dysarthria in children with cerebral palsy is mostly oral motor training, that is, stimulating the recovery of muscle and nerve functions through massage around the mouth, and guiding children to carry out reciprocating mechanical movements of the mouth, tongue and mandible. However, this training mode has certain limitations. For example, most children participate passively, and the training compliance and interest are insufficient; due to the lack of professional knowledge, it is difficult for parents to effectively assist their children in practicing in the family environment, resulting in insufficient training intensity and poor training sustainability. In this regard, our hospital has developed special oral muscle training aids for dysarthria rehabilitation in recent years, and matched with corresponding game projects, so that children can better carry out training and achieve articulatory function recovery. The relevant research situation is reported as follows.

Literature Review

Dysarthria is a prevalent and functionally debilitating complication among children with cerebral palsy, arising from central nervous system damage that disrupts muscle tone, range of motion, and coordination of articulatory structures

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including the lips, tongue, and mandible. Conventional oral motor rehabilitation, which relies on passive manual massage and guided mechanical articulatory movements, has long been the standard intervention, but it faces well-documented limitations: low child engagement, poor long-term compliance, and insufficient home-based practice capacity due to parental lack of professional training.[1] These gaps often lead to suboptimal training intensity and sustainability, hindering consistent improvements in speech clarity and communication ability.[2]

Recent research has increasingly focused on custom, child-centered oral motor training aids as a solution to these barriers. Unlike generic rehabilitation tools, purpose-built self-made aids integrate modular components such as mouthpieces, detachable balloons, oral massage sticks, and bite mesh bags, enabling targeted, multi-modal training across respiratory control, tongue mobility, mandibular stability, and lip strength.[3] When paired with game-based activities like patterned balloon blowing, juice-guided tongue exercises, and graded food chewing tasks, these aids transform repetitive rehabilitation into an engaging experience that actively motivates children to participate voluntarily.[4]

Clinical evidence confirms that such assistive device-supported training outperforms conventional therapy: it significantly enhances total oral motor function scores, including oral sensation, mandibular control, lip dexterity, and tongue mobility, while also driving greater gains in language developmental quotient and comprehension quotient. Critically, the simple, user-friendly design of these aids allows untrained parents to safely and effectively continue structured practice at home, extending rehabilitation beyond clinical settings and creating a continuous, consistent intervention environment that maximizes long-term speech outcomes for children with cerebral palsy.[5]

Description of the Study Area:

A retrospective analysis was performed on 48 children with cerebral palsy and dysarthria admitted to our hospital from January 2023 to June 2025.

Inclusion criteria for children: ① Meet the diagnostic criteria for cerebral palsy in Chinese Guidelines for Rehabilitation of Cerebral Palsy (2015): Part 1, and are confirmed to have dysarthria through professional assessment; ② Aged 1 to 12 years old; ③ Able to cooperate with basic instructions and training; ④ Without severe intellectual disability, and have basic comprehension and communication skills; ⑤ Without other severe progressive neurological diseases or oral organic lesions.

Exclusion criteria for children: ① Severe visual or auditory impairments that affect the development of training activities; ② Uncontrolled frequent epileptic seizures; ③ Combined with severe organic abnormalities of articulatory organs such as cleft lip and palate, and ankyloglossia; ④ Received other systematic oral muscle training or related surgical interventions in the past 6 months; ⑤ Parents cannot guarantee to participate in the treatment on time or complete family training tasks; ⑥ Dropped out or lost to follow-up for various reasons during the study period. The guardians of all included children were informed and agreed.

All children were divided into the control group (n=22 cases) and the experimental group (n=26 cases) according to the random number table. In the control group, there were 16 males and 6 females; the age ranged from 2 to 10 years, with an average age of (4.68±0.61) years; the course of disease ranged from 1 to 4 years, with an average course of (1.98±0.52) years. In the experimental group, there were 16 males and 10 females; the age ranged from 1 to 10 years, with an average age of (4.85±0.87) years; the course of disease ranged from 1 to 4 years, with an average course of (2.04±0.56) years. The above data of the two groups were compared, and the differences were not statistically significant ($P > 0.05$), indicating comparability. This study was approved by the Ethics Committee of our hospital.Methods

Control Group: Conventional rehabilitation training was carried out, mainly including tongue muscle movement guidance, lip movement guidance and breathing gymnastics guidance. Each intervention lasted for 30 minutes, 5 times a week, 4 weeks as a course of treatment, for 3 consecutive courses.

Experimental Group: On the basis of the control group, the training scheme with self-made oral muscle training aids was added. As shown in Figure 1, the self-made oral muscle training aids are composed of a mouthpiece, a connectable balloon, an oral massage stick, a nebulizer mask, and a connectable bite mesh bag. Four types of training are carried out relying on the aids.

First, breathing training. Guide children to blow balloons of different colors, shapes and printed with different patterns through the mouthpiece, and adjust the size and thickness of the balloons according to their respiratory function, so that children can complete exhalation training with the help of interesting balloon blowing games.

Second, tongue muscle training. Prepare the fruit juice that the children like. Dip the oral massage stick of the aids in the fruit juice, then adjust the length and direction of the massage stick according to the children's tongue muscle ability, and guide them to complete coordinated training such as lifting, pressing down, pushing forward and pushing sideways of the tongue muscle; during the training process, different flavors of fruit juice are replaced to give children diverse taste stimulation.

Third, mandibular oral training. Select food with moderate hardness according to the child's chewing ability, and adjust the food temperature. Put the food into the mesh bag of the aids, and guide the child to put it into the mouth for chewing practice. During the training process, replace the food of different hardness levels as appropriate to exercise the masticatory muscles and mandibular muscles.

Fourth, lip training. Apply the child's favorite fruit juice on the mouthpiece, and guide the child to exercise the strength and coordination of the lip muscles by clamping the mouthpiece with lip pursing and lip rounding movements. The children were intervened 5 times a week, 20-30 minutes each time, 4 weeks as a course of treatment, for 3 consecutive courses of intervention.

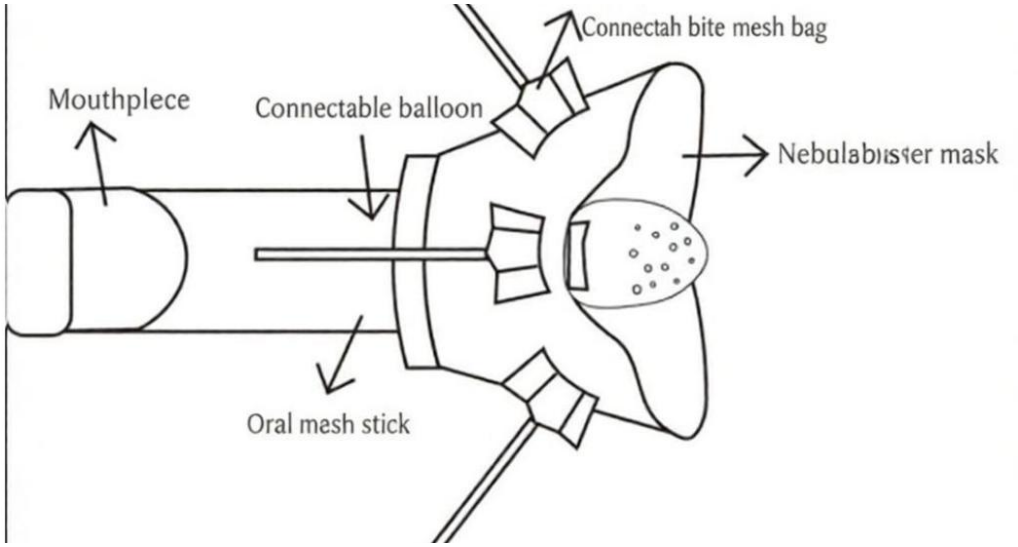

Figure 1 Self-made oral muscle training aids

Self-Made Modular Detachable Oral Motor Training Assistive Device

This self-made oral motor training assistive device adopts a modular detachable structure, which is easy to carry and supports the practice of different functional targets. By removing the nebulizer mask, the mouthpiece (which reduces the difficulty of blowing and facilitates operation for pediatric patients) can be connected to balloons (available in different colors and thicknesses) to practice respiratory function, and can also be connected to a food feeder (filled with food of varying hardness) to exercise the masticatory muscles and labial muscles. After connecting the nebulizer mask to the mouthpiece, insert the oral massage stick (which can be dipped in fruit juice to increase the compliance of pediatric patients) into the nebulizer mask, and adjust its length and orientation according to the tongue muscle strength of the child, so as to practice the functions of tongue elevation, depression, protrusion and lateral deviation.

The self-made oral motor training assistive device supports four standardized training programs:Respiratory Training: Balloons of different thicknesses can be selected according to the child's respiratory function. The frequency of blowing is fixed daily, and the single longest expiratory duration is recorded.

Tongue Muscle Training: The length of the massage stick is adjusted according to the child's tongue mobility. Each movement of elevation, depression, protrusion and lateral deviation is maintained for 3 seconds. Two different flavors of 100% additive-free pure fruit and vegetable juice are replaced weekly to provide taste stimulation.

Mandibular Oral Training: Food hardness is divided into three gradients: soft (steamed pumpkin), medium (steamed carrot) and hard (fresh apple strips). The training starts uniformly with soft food. The chewing ability is evaluated after each treatment course before upgrading the food hardness, and the single chewing practice duration is controlled at 8 minutes.

Oral Lip Training: The outer side of the mouthpiece is evenly coated with the same fruit juice. The child is required to complete two movements of lip pursing and lip rounding to clamp and fix the device, and each movement is maintained for 5 seconds to exercise the lip closure strength and coordination.

Safety Design Details: All parts in contact with the oral cavity are made of food-grade and medical-grade consumables. All edges are free of sharp structures. The component sizes are adapted to different age groups to eliminate the risks of choking, aspiration and oral scratch. After using the assistive device, the child can complete the four training sessions without resistance and no discomfort feedback.

Observation Indicators

Therapeutic Effect: According to the changes of the children's pronunciation, the therapeutic effect was divided into markedly effective, effective and ineffective. Markedly effective means that all pronunciation errors are corrected, the language expression is normal, and the speech is clear; effective means that the pronunciation errors are significantly reduced, daily communication can be carried out and the pronunciation is basically normal; ineffective means that the pronunciation errors have no obvious improvement, or even aggravated, daily communication is difficult and the pronunciation is unclear. The total treatment effective rate is the proportion of the sum of markedly effective cases and effective cases in the total number of cases.

Oral Motor Function: The oral motor ability of children was assessed according to the Simple Oral Motor Function Scale and its rules.

Language Function: Before and after treatment, the S-S language retardation rating scale and its rules were used to determine the developmental quotient and comprehension quotient of children.

Statistical Methods: SPSS 26.0 was used for analysis. Among them, enumeration data such as therapeutic effect were tested by chi-square test; measurement data such as oral motor function and language function were expressed as "mean ± standard deviation" and tested by t-test. $P < 0.05$ was taken as the judgment standard for statistically significant difference.

Results

Comparison of Therapeutic Effects

As shown in Table 1, the total effective rate of the experimental group was 92.31% (24/26), which was higher than 63.64% (14/22) of the control group. The difference between the two groups was statistically significant (P=0.015 < 0.05).

Table 1 Comparison of therapeutic effects

Group	Markedly effective	Effective	Ineffective	Total effective rate
Experimental group (n=26)	15 (57.69%)	9 (34.52%)	2 (7.69%)	24 (92.31%)
Control group (n=22)	9 (40.91%)	5 (22.73%)	8 (36.36%)	14 (63.64%)
/	/	/	/	5.939
P	/	/	/	0.015

Oral Motor Function

As shown in Table 2, before treatment, there were no significant differences in oral sensation, mandible, lip, tongue and total scores between the experimental group and the control group (all P > 0.05). After treatment, the oral sensation, mandible, lip, tongue and total scores of the experimental group and the control group were improved compared with those before treatment, and the scores of the experimental group were higher than those of the control group, with significant differences (all P < 0.05).

Table 2 Comparison of oral motor function scores

Group	Oral sensation	
	Before treatment	After treatment
Experimental group (n=26)	7.62±1.94	10.85±1.83^a
Control group (n=22)	6.91±1.97	9.50±1.57^a
t	1.254	2.752
P	0.108	0.004
Note: Compared with that before treatment, ^aP < 0.05		

Note: Compared with that before treatment, aP < 0.05

2.3 Language Function

As shown in Table 3, before treatment, there were no significant differences in developmental quotient and comprehension quotient between the experimental group and the control group (all P > 0.05). After treatment, the developmental quotient and comprehension quotient of the experimental group and the control group were significantly higher than those before treatment, and the developmental quotient and comprehension quotient of the experimental group were higher than those of the control group, with significant differences (all P < 0.05).

Table 3 Comparison of developmental quotient and comprehension quotient

Group	Developmental quotient	
	Before treatment	After treatment
Experimental group (n=26)	48.12±6.14	67.77±8.58<sup>a</su
Control group (n=22)	51.27±9.08	57.95±6.58<sup>a</su
t	1.426	4.485
P	0.080	< 0.001
Note: Compared with that before treatment, ^aP < 0.05		

Note: Compared with that before treatment, aP < 0.05

Results and Discussion

Due to central nervous system injury, children often have a series of problems such as inflexible movements of opening and closing lips, pouting, and puffing cheeks, low tongue motor function, and difficulty in opening and closing the mandible, which seriously affect their articulation clarity and speech expression ability. Although current rehabilitation training methods have certain effects, there is a lack of systematic training aids targeting the characteristics of dysarthria in children with cerebral palsy. Assistive devices are essential for children with special needs to improve their quality of life and achieve rehabilitation, while the research, development and application of aids specifically for oral muscle training of children with cerebral palsy are still blank. At the same time, as non-professionals, it is difficult for parents to master the professional essentials of oral muscle training. In addition to the lack of their own care ability and social support, they face many challenges in the care process, and it is difficult to insist on completing standardized rehabilitation training at home. Based on the characteristics of dysarthria in children with cerebral palsy, this paper designs a set of oral muscle training aids, and combines interesting games to carry out four trainings of breathing, tongue muscle, mandible and lip, aiming to improve children's oral motor function and articulation clarity through personalized aids that can be operated at home.

The research results show that the therapeutic effect of the experimental group is better than that of the control group. It shows that the rehabilitation training method based on self-made oral muscle training aids can effectively correct the pronunciation errors of children with cerebral palsy, and improve their articulation clarity and daily communication ability. The analysis shows that the self-made oral muscle training aids are specially designed for children with cerebral palsy and dysarthria, with simple structure and easy operation for parents. In addition, the training integrates highly interesting games such as blowing balloons, tasting fruit juice, chewing different foods, and imitating animal lip movements, which stimulates the enthusiasm of children to participate, makes them willing to actively cooperate with the training, and thus improves the rehabilitation effect. After treatment, the oral sensation, mandible, lip, tongue and total scores of the experimental group are higher than those of the control group. It shows that self-made oral muscle training aids training can effectively improve the oral motor function of children with cerebral palsy. The analysis shows that the four trainings based on the aids specifically enhance the strength and coordination of each group of oral muscles: breathing training enhances respiratory support by blowing balloons; tongue muscle training guides the flexible movement of the tongue by dipping in fruit juice; mandibular oral training exercises the masticatory muscles by chewing food of different hardness; lip training strengthens the strength and coordination of the lips through actions such as sipping straws, blowing bubbles and imitating animal lip movements. The developmental quotient and comprehension quotient of the experimental group are higher than those of the control group. It shows that the application of self-made oral muscle training aids can improve the language function development of children with cerebral palsy. The analysis shows that in the training of self-made oral muscle training aids, the mouthpiece, oral massage stick, bite mesh bag and other components are used to carry out targeted training of breathing, tongue muscle, mandible and lip, which directly improves the muscle strength and coordination of the oral muscles necessary for articulation, and provides a physiological basis for clear pronunciation. At the same time, the aids are easy to operate and convenient for parents to use continuously at home, which can guarantee the frequency and effect of training and promote the overall and stable development of children's language function.

Study Limitations

Sample size limitation: The total sample size of 48 children with cerebral palsy and dysarthria is relatively small, and the single-center retrospective design may introduce selection bias, which limits the generalizability of the conclusions to broader populations of children with different severity levels of cerebral palsy or from diverse regional backgrounds.

Aid iteration limitation: The self-made oral muscle training aids in this study are still in the initial application stage, and there is no standardized ergonomic optimization and large-scale safety verification, which may have hidden risks such as accidental injury for children with uncoordinated movements.
In conclusion, the application of self-made oral muscle training aids can improve the rehabilitation effect of dysarthria in children with cerebral palsy, and promote the development of oral motor function and language function.

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