Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 12
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Application of Mobile Interactive Platform Combining Games and Picture Books as Carriers in Speech-Language Therapy for Cleft Palate

Xiaoling Weng*, Na Huang, Bihua Zeng, Haiyan Deng

Stomatological Hospital of Southern Medical University, Guangzhou 510280, Guangdong, China

**Corresponding author: Xiaoling Weng, youlanweng@126.com*

Abstract: Cleft palate is a common congenital malformation of the maxillofacial region, and its postoperative speech disorders (such as hypernasality, nasal emission, and articulation errors) can significantly impact patients' communication abilities and psychological well-being. Traditional speech-language therapy faces challenges such as insufficient personalization of training methods, limited scenarios, and low patient compliance, making it inadequate for long-term rehabilitation needs. The innovative intervention model of a mobile interactive platform combined with games and picture books, through immersive experiences, instant feedback, and engaging designs, holds promise for enhancing patient participation and overall treatment outcomes. Therefore, this paper provides a comprehensive review from five perspectives: the pathological mechanisms and treatment needs of cleft palate speech disorders, the advantages of games and picture books as carriers in cleft palate speech therapy, the technological implementation of mobile interactive platforms, clinical application effects, and current challenges and limitations. The aim is to offer valuable insights for clinical practice and technological development in cleft palate speech rehabilitation.

Keywords: Cleft palate; Speech-language therapy; Mobile interactive platform; Game carrier; Picture book carrier

Online publication: Dec 31, 2025

1. Introduction

Cleft palate is a congenital malformation caused by developmental disorders of the mesoderm in the oral palate during the 8–12th week of embryonic development. Cleft palate speech disorder is a common organic speech disorder in oral and maxillofacial surgery [1]. It manifests as hypernasality, nasal emission, consonant omission, or compensatory articulation, which negatively impacts patients' verbal communication and social adaptation. Good velopharyngeal closure function is a prerequisite for achieving normal speech intelligibility [2]. Currently, surgical repair of the palatal anatomical structure is commonly performed clinically to provide a favorable physiological basis for velopharyngeal closure, while speech therapy aims to correct patients' poor articulation

habits and improve their speech intelligibility. Traditional speech-language therapy relies on one-on-one face-to-face guidance from professional therapists (including velopharyngeal closure function training, articulatory organ movement training, and articulation correction). However, there is an extreme shortage of speech therapists in China, with most concentrated in provincial capitals and large medical universities. Patients in western and remote regions face high transportation, accommodation, and food costs, as well as long travel times when seeking medical treatment elsewhere. Moreover, pediatric patients are prone to psychological resistance, leading to low treatment compliance. Based on this, mobile interactive platforms, with their advantages of portability and accessibility, combined with the engaging carriers of games and picture books, hold promise for constructing a more scientific, effective, and personalized rehabilitation model to enhance the overall efficacy of cleft palate speech therapy.

2. Pathological mechanisms and therapeutic needs of cleft palate speech disorders

2.1. Pathophysiological basis

Speech production is a complex process involving the coordinated efforts of multiple aspects (cerebral cortex, respiratory muscles, oral and pharyngeal structures, and cognitive functions). Patients with cleft palate face two core issues in their speech disorders: defective velopharyngeal closure function, resulting in insufficient oral pressure during articulation, nasal emission, and excessive nasal resonance; and abnormal movement of the articulatory organs, with some patients exhibiting insufficient tongue muscle strength, oral muscle coordination issues, and fine differentiation movement disorders, which can affect the correct articulation of consonants or vowels.

2.2. Core therapeutic needs

Cleft palate speech therapy should follow a three-stage logic: functional reconstruction, skill training, and application consolidation. This involves conducting respiratory and soft palate movement training for patients to control nasal emission; carrying out tongue muscle strength and mouth shape control training, as well as articulation position induction, to correct articulation errors of target phonemes; and promoting better real-life application of speech skills through phrase and short sentence training. Children aged 3–6 years are the key population for treatment, and it is crucial to incorporate fun and interactive elements into the therapeutic process.

3. Advantages of games and picture books as media in cleft palate speech therapy

3.1. Rehabilitation mechanisms and application forms of game-based media

Game-based therapy aims to further activate patients' proactive participation by integrating speech training objectives into engaging scenarios. Its advantages are as follows: it provides multisensory integrated stimulation; for example, blowing paper pieces games can help patients better perceive and control the airflow of aspirated consonants, while using funny mirror games can distinguish the differences in air delivery between the oral and nasal cavities. It offers immediate feedback and reinforcement, employing positive incentives such as animated rewards and point systems to reinforce correct pronunciation behaviors. It can also reduce anxiety.

In clinical practice, the designed game-based media align with rehabilitation goals: for respiratory function training, patients are required to blow bubbles continuously for more than 15 seconds; for articulatory organ

training, patients are guided to engage in tactile feedback games such as licking lollipops to control tongue retraction; for speech clarity training, games such as syllable matching and speech challenges are designed to achieve step-by-step training (phonemes, phrases, short sentences).

3.2. Rehabilitation value and design principles of picture book-based media

As a narrative medium that combines images and text, picture books construct language application scenarios through situational storytelling. Their advantages lie in the following aspects: the everyday scenarios depicted in picture books provide a richer variety of phrases and short sentence materials for speech training; the vividly colored images and concise text are well-suited to the comprehension level of young patients; and by reading picture books together, parents can guide patients in imitating pronunciation, thereby enhancing parent-child interaction.

The principles to follow in designing picture books are as follows: select vocabulary centered around frequently mispronounced phonemes; progress from single characters and two-syllable words to short sentences and story retelling; encourage patients to imitate the dialogue of characters in the picture books, incorporating interactivity to further solidify pronunciation skills.

3.3. Technical implementation of mobile interactive platform

The mobile interactive platform integrates artificial intelligence (AI), the Internet of Things, and multimedia technologies to construct a comprehensive rehabilitation system (encompassing assessment, training, feedback, and management).

(1) It employs Praat spectrogram analysis and AI voice feature extraction algorithms to objectively evaluate acoustic characteristics, pronunciation clarity, and the degree of nasal emission.

(2) It combines various interactive forms such as touchscreens, voice commands, and animated displays to provide visual pronunciation guidance (e.g., through oral pronunciation animations that explain tongue movement principles).

(3) Based on the patient's specific age, assessment results, training progress, and other factors, dynamically deliver suitable game and picture book materials; for the younger age group, focus on sensory exploratory games, while for the age-appropriate group, incorporate training content such as retelling picture book stories and voice-based obstacle-clearing challenges.

(4) The platform records relevant data (training duration, accuracy rate, etc.), generates rehabilitation curves, provides strong support for therapists to remotely monitor progress and adjust plans, and offers real-time feedback through the parent portal.

4. Clinical application effects

4.1. Improving speech clarity

Zhang Qing et al. [3] concluded that the gamification method effectively improved the pronunciation clarity in children (with accuracy for alveolar sounds increasing from 8.4% to 98.2%, and for palatal sounds from 24.6% to 97.6%). Zhang Chunguang et al. [4] studied 40 children who underwent cleft palate repair surgery at their hospital from January 2018 to December 2018, all of whom received speech rehabilitation therapy one month after the surgery. The results showed a significant improvement in the vocal quality of the children. Liu Yinghua et al.

conducted an experiment on 80 children who received speech therapy after cleft palate surgery, with the control group receiving conventional intervention and the observation group receiving additional mobile interactive platform intervention [5]. The results showed significant differences in the average speech clarity between the two groups at 3, 6, and 9 months after training, with the observation group outperforming the control group ($p < 0.05$). Min Zhiyun et al. pointed out that combining dynamic motion diagrams, oral models, and demonstrated pronunciation can guide, correct, and reinforce the pronunciation of syllables [6].

4.2. Improving treatment adherence and quality of life

Fun-oriented design is crucial for enhancing adherence. In a related study, 86 patients with cleft palate were divided into a control group (receiving routine intervention) and a research group (receiving speech and voice therapy through games and picture books as carriers), with 43 patients in each group. The study found that the adherence rate in the research group (95.35%) was significantly higher than that in the control group (79.07%), with a notable difference ($p < 0.05$). Moreover, after the intervention, the research group had lower scores in psychological and behavioral status (all $p < 0.05$) and higher quality of life (all $p < 0.05$) [7]. The core reasons lie in the use of games and picture books as carriers, which reduced the monotony of training. The instant feedback mechanism enhanced patients' sense of accomplishment, and it was also beneficial in alleviating patients' social anxiety and improving their social participation abilities. Zou Pingping et al. [8] proposed in their article that speech therapists can fully mobilize children's interest in rehabilitation training by using pictures, animations, and other forms, and promptly encourage them when they make progress, thereby boosting their confidence in completing the treatment course. Yao Yuan et al. [9] took 60 children who had undergone cleft palate surgery as the experimental subjects and concluded that speech rehabilitation training helps restore normal voice in children after cleft palate surgery, improves their psychological state and quality of life, and is thus worthy of active promotion and application. Another report states that during the speech therapy process, in addition to conducting speech training, parents can also foster parent-child relationships, promoting family harmony and social harmony [10].

4.3. Enhancing resource accessibility

Mobile interactive platforms have broken through geographical limitations, providing a low-cost avenue for patients in remote areas to seek medical attention. In recent years, public welfare mini-programs such as "Guanghe Yuyan" have been launched, enabling patients to obtain AI speech assessments and customized training materials for free through platforms like Douyin and WeChat. This eliminates the need for patients to bear travel expenses and accommodation costs associated with seeking medical treatment in different locations, significantly improving the accessibility of rehabilitation resources.

5. Current challenges and limitations

5.1. Technology

For patients with severe nasal emission and low speech intelligibility, there is still a need to further optimize the accuracy of AI algorithms in identifying articulation errors. The intelligence level of personalized recommendation algorithms needs to be improved; current platforms mostly recommend relevant content based on patients' age and basic assessment results, without dynamically adapting to their learning progress, interests, and preferences. Current multimodal interaction technologies primarily rely on two-dimensional animations and lack immersive

experiences such as VR and AR, resulting in relatively low attractiveness for younger patients.

5.2. Clinical application

The existing research data is limited, with no long-term follow-up data available to confirm the durability of treatment efficacy. The applicable population is restricted, showing low adaptability for complex cases involving hearing impairments or neurological disorders. Additionally, variations in parents' guidance capabilities affect rehabilitation outcomes.

5.3. Industry standards

There is a lack of unified technical standards and efficacy evaluation systems. The design of training content and speech assessment metrics vary across different platforms, preventing cross-platform comparisons. Issues related to data security and privacy protection are becoming increasingly prominent.

6. Future development directions and prospects

6.1. Technological innovation and upgrading

Effectively integrate AI large models with speech rehabilitation technology to enhance the accuracy of pronunciation error identification. Promptly introduce VR/AR immersive technology to create virtual rehabilitation scenarios, providing three-dimensional visualization of speech organ movements to make training more intuitive and engaging. Develop wearable device connectivity features to obtain physiological data through oral pressure sensors and tongue position monitoring equipment.

6.2. Expanding clinical applications

Conduct multi-center, large-sample, long-term follow-up studies to further validate the efficacy of this model in cleft palate patients of different age groups and varying severities; broaden the range of suitable populations by designing multidisciplinary collaborative rehabilitation modules for special cleft palate patients; provide training for parents, offering speech knowledge courses and at-home training guidance videos through the platform to enhance their expertise.

6.3. Building an industry ecosystem

Establish technical standards and ethical guidelines for mobile rehabilitation platforms, unify speech assessment indicators and efficacy evaluation criteria; strengthen collaboration among hospitals, enterprises, and public welfare organizations to expand the coverage of public welfare platforms and reduce rehabilitation costs; establish regional rehabilitation data centers to integrate treatment data and provide strong support for scientific research innovation and policy formulation.

7. Conclusion

The innovative model combining mobile interactive platforms with games and picture books has improved treatment compliance, speech clarity, psychological well-being, and quality of life for cleft palate patients, while enhancing the accessibility of treatment resources. Going forward, further improvements in the model's efficacy

are needed through technological innovation, clinical validation, and industry standardization, with the goal of promoting the rehabilitation of more cleft palate patients.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Lin S, Ma S, Huang Q, et al., 2024, A Cross-Sectional Study on the Social Competence of Children with Cleft Palate Speech Disorders and Functional Speech Disorders. Stomatology, 44(11): 837–840 + 855.

[2] Jiang L, Liu Q, Lou Q, et al., 2021, Evaluation of the Effectiveness of Blowing Training in Speech Therapy for 74 Patients with Cleft Palate. Chinese Journal of Oral and Maxillofacial Surgery, 19(5): 445–448.

[3] Zhang Q, Li J, 2022, Application of Game-Based Approach in the Treatment of Abnormal Apical Dental and Lingual Sounds in Young Children After Cleft Palate Surgery. Journal of Practical Stomatology, 38(5): 644–648.

[4] Zhang C, Zhao Z, Yao Y, et al., 2021, Analysis of Speech Intelligibility and Speech Rehabilitation Treatment Outcomes in Children with Speech Disorders After Cleft Palate Surgery. Journal of Oral and Maxillofacial Surgery, 31(5): 314–318.

[5] Liu Y, Zhou X, 2024, Application of a Mobile Interactive Platform Combined with Offline Training Mode in Cleft Palate Speech Therapy. Ningxia Medical Journal, 46(11): 1002–1004.

[6] Min Z, Li F, Zhang Y, et al., 2020, Research on Speech Training Methods for School-Aged Children and Adult Patients with Speech Disorders After Cleft Palate Surgery. Journal of Audiology and Speech Pathology, 28(4): 395–398.

[7] Zhang Y, Liu H, Li M, et al., 2025, The Impact of Speech and Voice Therapy Using Games and Picture Books as Carriers on the Speech Intelligibility of Patients After Cleft Palate Surgery. International Journal of Nursing, 44(7): 1272–1276.

[8] Zou P, Hu M, Li X, 2021, Speech Characteristics and Rehabilitation Training for Tongue-Surface Sound Abnormalities in Patients After Cleft Palate Surgery. Journal of Audiology and Speech Pathology, 29(2): 168–173.

[9] Yao Y, Zhao Z, Wang C, et al., 2021, The Impact of Speech Rehabilitation Training on Phonetic Changes, Psychological State, and Quality of Life in Children After Cleft Palate Surgery. China Medical Guide, 18(3): 132–135.

[10] Wang X, Kuang H, He H, et al., 2025, Research and Analysis on the Effectiveness of Speech Therapy for Cleft Lip and Palate and Related Factors. International Journal of Stomatology, 52(5): 627–633.