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Case Report

The Efficacy of the Cycles Phonological Remediation Approach for A Child with Hearing Loss

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The purpose of this study was to investigate the efficacy of the Cycles Phonological Remediation Approach (CPRA) on improving the speech intelligibility of a hearing-impaired Mandarin-speaking child with a severe speech sound disorder (SSD). In this case study, a four-year-and-7-month-old preschooler was diagnosed as an acoustic neuroma at the age of 3 years, and consequently had severe sensorineural hearing loss with fluctuating thresholds and developed highly unintelligible speech. The child with bimodal stimulation participated in the CPRA program in four cycles with a total of 66 hours of remediation over a period of 1.5 years. The results indicated that the child had exhibited a significant improvement on her speech between pre- and post-treatment evaluation. To assess the child's speech intelligibility, the continuous speech samples of free talking and story retelling was used. Intelligibility based speech samples by three unfamiliar listeners was 75%. The CPRA as well as the hearing technology can be efficacious in modifying a child's speech intelligibility.

Keywords: hearing impairment; children; Cycles Phonological Remediation Approach; phonological patterns; intelligibility

1. Introduction

Various difficulties in language and speech development are commonly experienced by preschoolers with hearing-impairment (HI) [1-2]. Literature indicates that the characteristic speech productions of children with HI are excessive nasal sounds, vowel substitutions, insertions, omission or substitution of consonants, etc. [3-4]. Wiggin indicated that they might retain continuous or permanent speech error productions without speech intervention [5].

Children with speech sound disorders (SSD) may face communication barriers. Research shows that children with SSD often have lower self-confidence and struggle, not only in academic performance, but also in social interactions at school [6-7].

Cycles Phonological Remediation Approach (CPRA) have been investigated for children with mild or moderate HI as well as children with highly unintelligible speech; however, there is a lack of research, which has studied the results of the efficacy of treatment for children with HI in Mandarin [8-10].

In this case study, the participant was diagnosed as an acoustic neuroma and had severe hearing sensory nerve loss. At the age of four, phrases and sentences began to appear in his expressive language. However, his speech was highly unintelligible and therefore the quality of communication was poor.

The patient has now been receiving speech therapy for a year and a half, and speech intelligibility has progressed from extremely unclear to clear. This case report will present the relevant strategies for the individual receiving speech therapy and recommendations for speech therapy for children with HI.

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2. Case

History. According to Xiaoyi's parents' report, he passed the newborn hearing screening at birth and was not diagnosed until the age of three years. Xiaoyi had no obvious abnormalities before, during or after delivery. In addition to language development and hearing, his development and medical history was normal. Xiaoyi was evaluated at the age of three years and one month at the NWL Hearing Health Foundation in Taichung Center.

Xiaoyi began to wear behind-the-ear binaural hearing aids (BTE) and to receive language therapy. While wearing the aids, his hearing status was 25dBHL. In terms of language, he was tested using the Communication and Language Screening Test for Birth to Three Chinese-Speaking Infant-Toddlers [11]. The results fell between PR6 and PR25, indicating that he might fall behind his peers. The results of the Peabody Picture Vocabulary Test-Revised (PPVT-R) were PR18, which was just above -1SD; therefore, he began to receive language therapy [12].

After Xiaoyi received language therapy, his receptive and expressive language improved. However, the problem of poor speech intelligibility gradually emerged after expressive language progress. Then, his mother took him to receive speech therapy. However, because of his frustration with his inability to produce the target sounds during the speech intervention, he refused to continue treatment.

Pre-Treatment Evaluation. Xiaoyi was referred by the NWL Center, he received the first assessment at four years, seven months. The assessment tools included self-edited oral movement, function assessment, as well as Mandarin Articulation and Phonological Assessment Tools. Language samples were collected via free conversation and story retelling. The test results showed that his lips, jaws, saliva control, and eating conditions were normal, his tongue was lifted slightly, the correct /ta/ sound could not be produced in the rotation movement, and the rotation of different sounds was slow.

Xiaoyi produced five early-developed consonants (/p, m, k, k^h, x/), four vowels (/i, u, a, ɛ, ɤ/) and four diphthongs (/ai, ei, ɑu, ou/). The phonological deviation analyses of phonetic errors included omission of initial consonants, such as O/$tʂ^h$, O/t, O/l; omission of final consonants, such as O/n, O/ŋ; backing, such as k^h/ p^h, t^h, l; g/l, ʐ; k/ t^h, f, tʂ, x/ p^h; and frication, such as x/p^h, k^h; ɕ/ p^h etc. These are listed in Table 1. His speech intelligibility was 8%. The whole sentence was ambiguous in the continuous speech samples, and even close relatives had difficulty understanding it.

Remediation. Xiaoyi received intervention via the CPRA. The CPRA is based on cognitive psychology principles and on developmental and clinical phonology research findings. The target goals for the CPRA are decided by phonological patterns which match the children's development. For each pattern, two to six target productions are chosen to enhance children's phonological systems. After targeting several phonological patterns, re-evaluation is executed. According to the results of reassessment, the phonological patterns are recycled, till the speech intelligibility level approaches clear.

Xiaoyi's phonological remediation consisted of four cycles, over a period of one-and-a-half years. Xiaoyi participated in 66 weekly, 60-minute sessions, following guidelines in the CPRA. Each week's session started with a review of the previous week's production-practice words. Next, he had an auditory stimulation with slight amplification for the new target phoneme for the session, and then he practiced the carefully-selected target words, by drawing pictures of them containing the week's new target phonemes on index cards. Following this, four or five

Table 1. Xiaoyi's speech productions before the treatment

Phonological Deviation	Examples
Initial consonant omission	li → i;
Final consonant deletion	lan → ka; lun → gɤ; ɕɔŋ → kɔ; lin → gi
Backing	p^hu→ k^hu; tɕy → gi; tswei → kwei; sɔŋ → kɔŋ
Frication	k^hɔŋ → xɔŋ; ts^{h}au → xa

Table 2. Xiaoyi's speech productions after the treatment

Phonological Deviation	Examples
Stopping	/x/ → /t^h/
Backing	/k/ → /t/
Affricate	/ʂ/ →/tʂ/

target related activities were executed for practice. Stimulated phoneme productions were probed to choose the optimal phoneme within a pattern that would then be designated as the target for the next session. Finally, an auditory bombardment was repeated. After each session, he was given the target word cards and listening list for daily homework.

During the listening task, the SLP used a personal FM device (that was set to provide slight amplification) to read a word list containing the week's target pattern, and provide an effective learning environment. While practicing, the FM device would be put in front of his mouth, and then he produced all the target words for the session, by simultaneously listening to and focusing on his own productions.

3. Result

The results of post-intervention were listed in Table 2. The percentage of consonants correct in the naming task was 95% after the intervention. Xiaoyi could self-correct when he found he produced error sounds. The intelligibility of continuous speech samples in free talk and story retelling was 75%. Some errors were found in his continuous speech. For example, he substituted /x/ for /t^h/, /ʂ/ for /tʂ/, /k/ for /t/. However, listeners could understand the content from the context. His communication efficacy increased.

4. Discussion

Xiaoyi's HI was atypical because his listening thresholds were inconsistent, and fluctuated. His case history indicated that a number of changes might influence the efficacy of intervention. His atypical HI appeared to have an adverse effect on his progress and his overall intelligibility. After the cochlear implant, his hearing seemed to be more stable. Additionally, he could listen to more high frequency messages. Although Xiaoyi made a number of gains, he still was not completely clear to understand in spontaneous conversation at the age of six years. However, it was noted that even unfamiliar listeners were able to recognize 75% of his words in a spontaneous conversational speech sample, in contrast with identifying 8% of intelligibility that had been obtained at the onset of phonological remediation two years earlier. It cannot be stated definitively that the amplification provided by the hearing aids made a critical difference in his speech progress. Nonetheless, the CPRA did substantially improve Xiaoyi's phonological systems and self-monitoring skills, and his overall intelligibility increased noticeably during his last few months taking part in the intervention.

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