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AAC intervention using a VOCA for deaf children with multiple disabilities who received cochlear implantation

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ABSTRACT

Objectives: The aim of this study was to examine the efficacy of a new habilitation approach, augmentative and alternative communication (AAC) intervention using a voice output communication aid (VOCA), in improving speech perception, speech production, receptive vocabulary skills, and communicative behaviors in children with cochlear implants (CIs) who had multiple disabilities.
Methods: Five children with mental retardation and/or cerebral palsy who had used CIs over two years were included in this study. Five children in the control group were matched to children who had AAC intervention on the basis of the type/severity of their additional disabilities and chronological age. They had limited oral communication skills after cochlear implantation because of their limited cognition and oromotor function. The children attended the AAC intervention with parents once a week for 6 months. We evaluated their performance using formal tests, including the monosyllabic word tests, the articulation test, and the receptive vocabulary test. We also assessed parent–child interactions. We analyzed the data using a one-group pretest and posttest design.
Results: The mean scores of the formal tests performed in these children improved from 26% to 48% in the phoneme scores of the monosyllabic word tests, from 17% to 35% in the articulation test, and from 11 to 18.4 in the receptive vocabulary test after AAC intervention (all $p < .05$). Some children in the control group showed improvement in the speech perception, speech production, and receptive vocabulary tests for 6 months, but the differences did not achieve statistical significance (all $p > .05$). The frequency of spontaneous communicative behaviors (i.e., vocalization, gestures, and words) and imitative words significantly increased after AAC intervention ($p < .05$).
Conclusions: AAC intervention using a VOCA was very useful and effective on improving communicative skills in children with multiple disabilities who had very limited oral communication skills after cochlear implantation.

1. Introduction

Cochlear implantation (CI) plays a crucial role in speech and language development in children with profound hearing impairment when the benefit of conventional hearing aids is limited [1]. Deaf children with additional disabilities (i.e., autism, cerebral palsy, mental retardation, etc.) tend to have lower speech perception outcomes after CI compared with children who exhibit hearing loss as the sole disability [1–6]. Cognitive and/or motor limitations may make it harder for these children to process, analyze, and organize auditory information effectively [1–3]. However, deaf children with multiple disabilities can benefit considerably from the improvement in quality of life afforded by CI, although their progress was slow and limited compared with general deaf children with cochlear implants [1–3,5].

The benefits and the performance after CI in children with multiple disabilities vary according to the degree of additional disabilities. Lee et al. [3] reported that children with moderate mental retardation (MR) showed lower levels of performance after CI than did children with mild MR. Children with moderate MR made very slow progress and remained at the earliest stages of auditory, speech, and language development. These children were able to communicate only by vocalizations, word approximations, facial expressions, and gestures after CI because of their low cognitive abilities [2,3,6]. This hampers the setting of habilitation goals and the decision regarding the appropriate habilitation approaches for these children by CI teams. Moreover, basic and conventional habilitation approaches, such as auditory–verbal therapy and oral approach focusing on

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audition, are generally ineffective and less successful for the children of this type [7]. Thus, there may be a need to use a multimodal communication approach, such as augmentative and alternative communication (AAC), to engage them in participating in daily communication with sufficient quality and quantity [7,8].

AAC is defined as an area of clinical practice that attempts to compensate temporarily or permanently for the impairment and disability of individuals with severe expressive communication disorders. AAC includes four primary components such as symbols (signs, gestures, facial expression, pictures, etc.), aids (electronic and non-electronic devices), strategies, and techniques [9]. They can express their needs and generate their desired messages easily by using AAC. AAC also benefits family members and significant others by providing a way for them to communicate more fully with their important people [10–13].

A VOCA, which is one of the options of AAC, is an electronic device that assists individuals who are unable to use natural speech to express their needs and to exchange information with others during a conversation. A VOCA translates simple nonverbal behaviors (i.e., pressing a picture, a lexigram, or other symbols on a device board) into synthesized or digitized verbal messages. Thus, the children can learn to request target objects using a VOCA, and they can develop the receptive vocabularies of the target objects [11]. Moreover, the verbal messages produced by the VOCA can be easily perceived and understood by communication partners, including speech therapists, parents, teachers, peers, and unfamiliar people [11–13]. These advantages of using the VOCA use may reinforce communicative behaviors of children with multiple disabilities who have limited oral communicative skills after CI. To the best of our knowledge, little evidence has been published regarding AAC intervention using a VOCA, especially in children with additional disabilities who received CI.

Hypothetically, deaf children with multiple disabilities can develop speech and language, and broaden their communicative skills if more frequent and productive communicative opportunities are provided to them, especially when they have very limited oral communicative skills after CI. Thus, the purpose of this study was to investigate the efficacy of AAC intervention using a VOCA in improving general performance and communicative behaviors in children with multiple disabilities after CI.

2. Subjects and methods

Five children (one girl and four boys) with multiple disabilities who received CI were recruited from the Dong-A University Hospital. They were diagnosed with MR and/or cerebral palsy by psychologists and psychiatrists. Preoperatively, all children used conventional hearing aids and received special education for the deaf. They received CI surgery because of the limited benefit afforded by conservative management. Three years after CI, they remained at the earliest stages of auditory, speech, and language development because of their additional disabilities, although they received special education and conventional speech therapy consistently after CI. Consequently, these children were engaged in an AAC intervention using a VOCA. At the beginning of the AAC intervention, their mean chronological age was 105.8 months (SD = 26.49). The average age at implantation was 48.6 months (SD = 12.71). The mean duration of an implant use was 57.2 months (SD = 28.68).

Five children (five boys) were included in the control group. The children were matched individually to children who attended the AAC intervention on the basis of the type/severity of additional disabilities and chronological age (±6 months). The mean chronological age was 105.0 months (SD = 33.19). There was no age difference between the two groups (U = 12.0, $p > .05$). The average age at implant was 65.0 months (SD = 29.03), and the mean duration of an implant use was 38.8 months (SD = 7.12). The demographic data of the children is presented in Table 1.

The children and their parents participated in 1-h sessions of AAC intervention using a VOCA once a week for 6 months. Intervention was given through 24 sessions, which were composed of direct teaching for children and parent training to promote children's communication skills. The KidsVoice device (UBQ Co., Ltd., Seoul, Korea) was used as a tool with a dynamic display for AAC intervention using a VOCA (Fig. 1.). This device is portable (27.65 cm × 19.7 cm × 1.95 cm in size and 1 kg in weight), and its interface is designed to meet the needs of children with multiple disabilities by using 3200 symbolic images. It generates human voices (female and male voices) by touching the picture on the screen. AAC intervention using a VOCA was composed of the VOCA training, instruction of learning symbols, and script-based pragmatic training using auditory–verbal strategies. VOCA training began by teaching children to operate the device, which helped them use the VOCA easily. Children learned symbols by requesting a preferred object by pointing to pictures and photos which were affixed to the VOCA. We used routinized events (e.g., buying items, snack time, and simple board games, etc.) to teach children linguistic and nonlinguistic patterns that accompany routines, such as "What do you want? – I want chocolate". Script-based pragmatic training could reduce the amount of cognitive load required for children to participate. Children learned

Table 1
Individual demographic information for AAC intervention group and control group.

Group	Child no.	Sex	Chronological age (Mo)	Age at implantation (Mo)	Duration of implant use (Mo)	Etiology of deafness	Additional disabilities	Educational setting	Communication mode
AAC intervention group	1	M	133	69	64	Congenital-unknown	MR	Deaf school	Gestures + Signs
	2	M	132	39	93	Meningitis	MR + CP	Deaf school	Vocalizations + Gestures
	3	M	115	42	73	Congenital-unknown	MR	Deaf school	Vocalizations + Signs
	4	M	79	53	26	Congenital-unknown	MR + CP	Deaf school	Vocalizations + Gestures + Unintelligible words
	5	F	70	40	30	Auditory neuropathy	MR	Mainstream kindergarten	Vocalizations + Gestures + Unintelligible words
Control group	1	M	119	73	46	Congenital-unknown	MR	Deaf school	Gestures + Signs
	2	M	138	96	40	Congenital-unknown	MR + CP	Deaf school	Vocalizations + Gestures
	3	M	129	87	42	Congenital-unknown	MR	Deaf school	Vocalizations + Signs
	4	M	73	34	39	Congenital-unknown	MR + CP	Deaf school	Vocalizations + Gestures + Unintelligible words
	5	M	66	35	27	Auditory neuropathy	MR	Deaf school	Vocalizations + Gestures + Unintelligible words

Note. Mo = months; M = male; F = female; MR = mental retardation; CP = cerebral palsy.