Learning Development Guidelines for Children with Cochlear Implant to Prepare for Early Childhood Learning

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Abstract

The aims of this research were to study: 1) child development before and after cochlear implantation, 2) child development based on learning theory, language development, and learning of early childhood, 3) family circumstances and approaches to caring for cochlear implant children, and 4) learning development guideline for children with cochlear implant to prepare for their early childhood learning. Using mixed methods research that combines the methods of quantitative and qualitative research. The sample group included 78 parents of children undergoing cochlear implantation from birth to 6 years old. A total of 6 parents and 10 experts involved in cochlear implantation and early childhood learning were key respondents. Data were collected through learning development for children with cochlear implant opinion questionnaire and in-depth interviews by using the structured interview form of learning development guideline. The mean, standard deviation, and t-test were used to analyze quantitative data, and content analysis was used to analyze qualitative data. The results of the quantitative research revealed that: 1) Child development before and after cochlear implantation was found that after surgery ($\bar{x}$ = 4.14, S.D. = 0.57), the children developed according to the standards of overall desirable characteristic: physical, emotion and mental, social, and intelligence more than before surgery ($\bar{x}$ = 2.86, S.D. = 0.94), 2) The overall child development based on learning theory, language development, and learning of early childhood was at a high-level ($\bar{x}$ = 4.05, S.D. = 0.60), the first was the learning of early childhood, followed by the child's development according to the learning theory, and language development, 3) The results of the research hypothesis test were as follows: 3.1) A comparative analysis of child development (1) child development in overall (before surgery) was no difference, (2) child development in overall (after surgery) was significantly different (p = 0.050) at the 0.050 level, 3.2) A comparative data analysis of child development differences according to learning theory, language development, and early childhood learning classified by children's age revealed that there was significantly different (p = 0.001) at the 0.050 level. The results of the qualitative research revealed that: 1) The family circumstances and approaches to caring for cochlear implant children revealed that the children were assigned a disabled person's identification in order to access the right to medical care. Their parents were the income earners for the family. Raising children like normal children according to the doctor's advices, 2) The learning development guidelines for children with cochlear implant to prepare for their early childhood learning were as follows: 2.1) The appropriate age for children for cochlear implant surgery was less than 3 years old or 4 years old, 2.2) The first period after the cochlear implantation, parents must bring their children to the hospitals every week because children had to be rehabilitated continuously, 2.3) The assessment of the children with cochlear implant to attend regular schools was as follows: (1) the children could speak the language, (2) the children could communicate reasonably, (3) the children could control himself while studying, (4) the children had self-help, and (5) the children could participate in classroom activities.

Keywords: Learning Development Guideline, Cochlear Implantation, Early Childhood Learning, Language Development

Introduction

UNICEF Thailand (n.d.) stated that early childhood was the period for children aged 0-5 years. These children needed appropriate care. The first year of life was the most important developmental period in a children's life. This was the period when the children rapidly developed their brain, language, social, emotional, and motor skills. It was the age of building the foundation for further growth and learning in life.

James J. Heckman, Nobel Laureate in Economics (Heckman, 2012) found that early childhood, from birth to 5 years old, was the crucial time for productivity as children's brain developed rapidly to form the foundations of the cognitive skills and character traits necessary for success in school, health, career, and life. Early childhood learning fostered cognitive skills along with empathy, energy, motivation, self-control, and socialization. These attributes and skills were transformed into knowledge, then knowledge will turn those persons into productive citizens.

Balancing early childhood development in all aspects: physically, emotionally, mentally, socially, and intellectually, complied with policies, rules, and regulations related to early childhood development and the provision of education for persons with disabilities as follows: According to the Constitution of the Kingdom of Thailand, B.E. 2560, all children received twelve years of education. Young children were cared for and developed prior to their education in order to develop the body, mind, discipline, emotion, society, and intellect according to age. According to National Strategy 2018-2037, developing people in all dimensions and at all ages to become good people, competent and quality, with physical, mental, intellectual, and potential development throughout their lives. According to National Economic and Social Development Plan, No. 12, 2017-2021, empowering people of all ages to grow with quality by developing early childhood groups with good physical, and mental health, brain skills, learning skills, life skills, and social skills.

Early childhood development refers to the cognitive, physical, language, motor, social and emotional development between 0-8 years of age. Early learning is an opportunity for the baby, toddler or child to interact with a person, place or object in their environment, recognizing that every interaction is contributing to the child's brain development and laying the foundation for later learning. In order to improve early childhood development, WHO recommends: 1) responsive caregiving; all infants and children should receive responsive care during the first 3 years of life; parents and other caregivers should be supported to provide responsive care, 2) promote early learning; all infants and children should have early learning activities with their parents and other caregivers during the first 3 years of life; parents and other caregivers should be supported to engage in early learning with their infants and children. (World Health Organization, 2020)

According to statistics of Thai people with disabilities, who registered with the Department of Empowerment of Persons with Disabilities in 2020, there were 385,087 people with hearing or communicating disabilities, accounting for 18.80%, ranked 2nd, of disabled people in Thailand. By age, there were 1,016 early childhood, aged 0-5 years, children. There were 5,155 school age, aged 6-14 years, children. And there were 6,069 adolescents, aged 15-21 years (Department of Empowerment of Persons with Disabilities, 2020).

Hearing is an important factor in the development of spoken language. Hearing is stimulated by sound for communication. Therefore, hearing loss is a communication barrier for learning, work, and everyday life. The quality of life of the hearing impaired people decreased. (Ministry of Public Health, Sirindhorn National Medical Rehabilitation Institute, Department of Medical Services, & Department of Empowerment of Persons with Disabilities, 2012)

The greatest happiness was that children with hearing loss could attend regular schools. That was the quality of human life as a global citizen. There were two approaches to correcting hearing loss in children: 1) the use of a hearing aids, and 2) cochlear implant surgery. The most successful outcome of cochlear implant surgery was that the children were able to communicate normally in listening and speaking, and that the children were able to attend regular schools. (The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand, 2012)

Cochlear implantation is a procedure that allows people with severe hearing impairments, both adults and child who are unable to use hearing aids, to be able to hear their natural voice and speech. Cochlear implant is a medical device that converts sound waves, functioning as hair cells in the inner ear. The cochlear implant has two major components: 1) the part that is implanted within the body, known as the audio receiver, and 2) the part that is outside the body, known as the audio codec. (Bumrungrad International Hospital, n.d.)

The Children who undergo cochlear implant surgery were able to hear voices. Their comprehension and perception would be increased by 50%. Effectiveness was significantly improved during six months after the surgery. Children who had cochlear implant surgery had better quality of life compared to before surgery (Bond et al., 2009). Consequently, United Healthcare Community Plan (2022) accepted cochlear implantation in children with congenital hearing loss. Because hearing impaired children could greatly improve their cognitive skills, they were able to attend regular schools. They did not attend the schools for the deaf. In Thailand, The Foundation for the Deaf under the Royal Patronage of Her Majesty the Queen (n.d.) stated that if the deaf were taught and trained in a special academic way, as a result, they would have the opportunity to be educated. This created opportunities for deaf children to hear and to develop their life with more balanced physical, emotional, mental, social, and intellectual qualities. Moreover, the most important thing is that after the children had cochlear implantation, they would be able to prepare themselves for quality early childhood learning. Therefore, The Foundation for the Deaf project was established to benefit deaf children as following: 1) to help deaf children who benefit from cochlear implantation to be able to hear, 2) to help improve the communication skills of deaf children undergoing cochlear implantation to be able to listen and speak, and 3) for children who had cochlear implant to undergo rehabilitation and attend regular schools.

From the importance of early childhood, children needed appropriate care. During childhood, children rapidly developed their brain, language, social, emotional, and motor skills. It was the age of building the foundation for further growth and learning in life. But hearing loss impeded communication, learning, and daily living. The cochlear implantation was a treatment allowing people with severe hearing impairments who could not use hearing aids to be able to hear natural sounds and speech. Children who had cochlear implant had a better quality of life compared to before surgery. After the cochlear implantation, hearing rehabilitation and learning development were required for them, so that they could speak or communicate properly to their age in order to study alongside other children in a regular school. Therefore, it was necessary to conduct this research on the learning development guideline for children with cochlear implant to prepare for early childhood learning.

Research Questions

The research consisted of four research questions:

1. What is the level of child development before and after cochlear implantation?

2. What is the level of child development based on learning theory, language development, and learning of early childhood?

3. What are the family circumstances and approaches to caring for cochlear implant children?

4. What are the learning development guideline for children with cochlear implant to prepare for early childhood learning?

Research Objectives

The present study aimed to address four research objectives:

1. To study and compare child development before and after cochlear implantation.

2. To study child development based on learning theory, language development, and learning of early childhood.

3. To study family circumstances and approaches to caring for cochlear implant children.

4. To study the learning development guideline for children with cochlear implant to prepare for early childhood learning.

Research Hypothesis

The child development before and after cochlear implantation was different.

Literature Review

Concept of Early Childhood

Children in early childhood were young human beings in the early stages of life. The period during 0-3 years old was the most important age in laying the foundation in every aspect. This period brought the most changes. Therefore, parents needed to focus and followed up and encouraged physical, self-help, social, emotional, and intellectual development, including children's language and speech development. Various skills should be promoted to the fullest at every age, such as playing, reading, or singing, and practice helping themselves by: 1) children's language can be learned from birth by listening to parents' responses, which would be developed according to the age range, and 2) stimulating the development of language and communication in daily life would help develop the basics of speaking. (The Royal College of Pediatricians of Thailand, Pediatric Society of Thailand, 2020)

There were two aspects of language and speech development in children: 1) language comprehension, which was how children understood what others were saying, and 2) language expressions, communication, or speech, which was how children communicated through the use of facial expressions and body language gestures (Department of Communication Sciences and Disorders, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, n.d.). The language and speech development of the children come from learning, whether it would be slow or fast development depending on their age. The children, age between 2-5 years, were more develop their language skill than those in other age (Jicko, 2019). There were four aspects of child development: 1) physical development; body grown properly to their age and had good health, 2) emotional and mental development; good mental health and happiness, 3) social development; life skills and behave, and 4) intellectual development; language to communicate and ability of learning. (Bureau of Academic Affairs and Educational Standards, Office of the Basic Education Commission, Ministry of Education, 2018)

Concept of Cochlear Implantation

The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand (2012) study, it stipulated that cochlear implant surgery was the only method at the present to correct those who were deaf because of malfunctioning inner ear or those who were born with disabilities to hear. Deaf children who received cochlear implantation before 12 months of age were able to learn to understand spoken language faster, and were more

likely to develop spoken language in a children's specific communication style. (Ann & Robert H. Lurie Children's Hospital of Chicago, 2019)

After the surgery, children would be required to undergo listening and speaking training and testing with hearing rehabilitation team (Cochlear Implant Association (Thailand), n.d.). The first day the cochlear implants activated was the first day the children heard, after that, the children must be trained in listening and speaking for the next two years until they could speak normally (TTB Foundation, 2018). In accordance with Kingkaew et al. (2009) found that the hearing-impaired children could greatly improve their cognitive skills, and were able to attend regular schools.

The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand (2012) established guidelines for cochlear implant and for post-surgery rehabilitation services. Specialized medical personnel must be trained to provide surgical services and rehabilitation after cochlear implantation. The audiologists would make the appropriate sound adjustments for each patient. Post-surgery rehabilitation was an important step in which the surgical recipients must undergo rehabilitation therapy and learn to interpret the sounds produced by hearing and become familiar with the different sounds. This took different recovery time for each patient. This process required the cooperation of families and medical team.

Conceptual Framework

The conceptual framework was the study of the policies, rules, and regulations related to early childhood development and education for people with disabilities, the study of child development: physical, emotion and mental, social and intelligence from The Early Childhood Education Program (Bureau of Academic Affairs and Educational Standards, Office of the Basic Education Commission, Ministry of Education, 2018), Language development and early childhood learning in accordance with learning theory by synthesis of academic concepts and theories, and the study of guidelines related to cochlear implantation taken from The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand (2012).

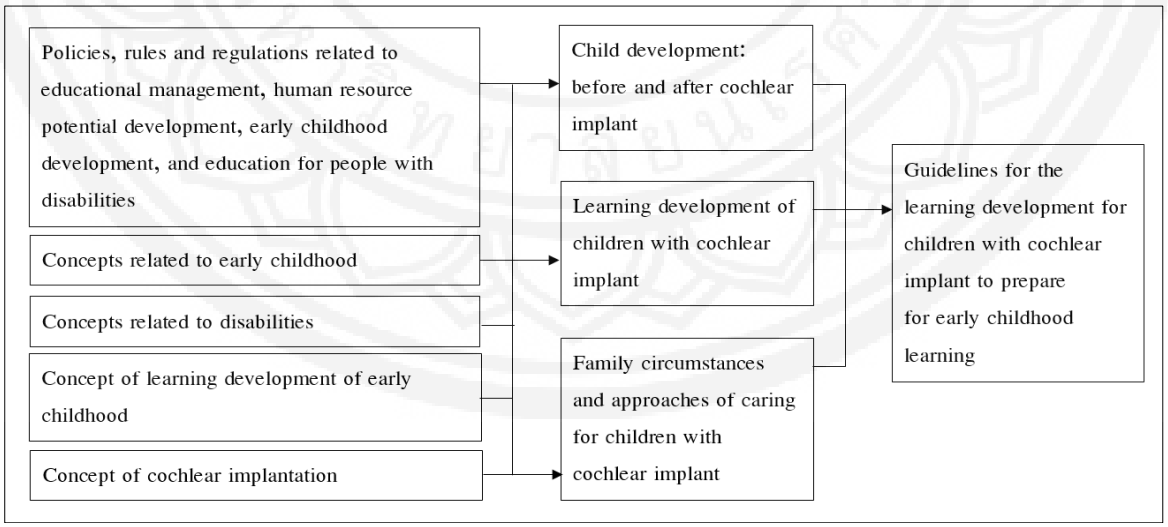

Figure 1 Conceptual Framework.

Research Methodologies

Mixed methods research is a research method for this research that combines quantitative and qualitative research.

Quantitative Research

The research population was 96 parents of newborn-to-6 years old children undergoing cochlear implantation from the support of The Foundation for the Deaf. All of them expressed their consent to participate in the research study.

The sample group was determined by using Taro Yamane's formula with a 95% confidence level. A total of 78 parents were used in the research study; 34 parents whose children, aged from birth to 3 years, with cochlear implant, and 44 parents whose children, aged over 3 years to 6 years, with cochlear implant. Systematic sampling was used for a proportion of the sample size, and then simple random sampling was performed using a random number table. The sample group expressed their consent to participate in the research.

Data were collected through learning development for children with cochlear implant opinion questionnaire, which was 5-level Likert's Scale questionnaire (Likert, 1967), and was created by the researcher. The questionnaire consisted of: part 1 demographic data; total 4 items, part 2 child development according to the desirable characteristics standard (before and after surgery), which were physical, emotional, mental, social, and intellectual aspects; total 59 items, and part 3 child development according to learning theory, language development, and learning of preschool children; total 54 items. Consider the content validity by 3 experts; early childhood education, special education, and research. The Item Objective Congruence value of each item was 1.00, researcher adjusted according to the expert's recommendations. Cronbach's Alpha Coefficient = .9874. The interpreting the mean level were as follows: 4.50-5.00 the highest level, 3.50-4.49 the high level, 2.50-3.49 the moderate level, 1.50-2.49 the low level, and 1.00-1.49 the lowest level. The statistics used in the quantitative data analysis were mean, standard deviation, and statistical hypothesis t-test.

Qualitative Research

1. Key respondents for study family circumstances and approaches to caring for cochlear implant child consisted of 3 parents whose children, aged from birth to 3 years, with cochlear implant, and 3 parents whose children, aged more than 3 years to 6 years, with cochlear implant.

Data were collected through in-depth interviews by using the structured interview form of the family conditions and methods of caring for children with cochlear implant surgery. The researcher created the structured interview from the quantitative data analysis and related researches. Consider the content validity by 3 experts. The researcher interviewed key informants individually and data were analyzed by content analysis. The inspection data consistency used triangulation both in data and in theory to provide accurate, reliable, and error-preventing data.

2. Key respondents for study learning development guidelines for children with cochlear implants to prepare for early childhood learning consisted of 2 parents whose children with cochlear implant, who attended regular schools, 2 early childhood teachers who taught in regular schools, 2 academics who practiced speaking or related to cochlear implantation, 1 doctor, 1 nurse, 1 psychologist, and 1 expert in language development.

Data were collected through in-depth interviews by using the structured interview form of learning development guideline for children with cochlear implant to prepare for early childhood learning. The researcher created the structured interview from guidelines related to cochlear implantation taken from The Royal College of

Otolaryngologists-Head and Neck Surgeons of Thailand (2012). Consider the content validity by 3 experts. The researcher interviewed key informants individually and data were analyzed by content analysis. The inspection data consistency used triangulation both in data and in theory to provide accurate, reliable, and error-preventing data.

Data Collection and Human Research Ethics

1. Conducting requests for cooperation in data collection by The Foundation for the Deaf. Quantitative data collected though questionnaires in June-August, 2021, 100% of data collection. Qualitative data collected though in-depth interviews: 1) 6 parents in September, 2021, and 2) 10 experts in October, 2021. The researcher respected the privacy of sample group and key respondents, and kept confidentiality of information.

2. Letter of consent to participate in the research for parents with dependents under 7 years of age by parents of children undergoing cochlear implantation signed.

3. Certificate of approval: Ethical review subcommittee for human research in science, humanities and social sciences, Research and development, Institute Suan Dusit University. COA.NO: SDU-RDI-SHS 2021-009. Protocol No: SHS011/2021. Principal Investigator: Supaporn Tungdamnernsawad.

Research Results

The research results were presented below according to the research objectives.

The Results of the Quantitative Research:

1. Demographic data were as follows: 1) The age range of children cochlear implant, most of the respondents had surgery at the age of over 3 years to 6 years (n = 44, 56.40%), and from birth to 3 years (n = 34, 43.60%), 2) Parents' age range, most of them were 30-39 years (n = 35, 44.90%), 3) Parents' educational level, most of them graduated with a bachelor's degree, (n = 38, 48.70%), 4) Parents' occupations, most of them were permanent employees or private employees (n = 25, 32.10%), and 5) Parents' monthly income, most of them earned less than 15,000 baht (n = 28, 35.90%), the results were illustrated into the Table 1.

Table 1 Frequency and Percentage of Demographic Data

	Demographic Data	Frequency (n = 78)	Percentage (%)
Age Range of Children Cochlear Implant	Birth to 3 years	34	43.60
	Over 3 years to 6 years	44	56.40
Parents' Age Range	20 - 29 years	4	5.10
	30 - 39 years	35	44.90
	40 - 49 years	29	37.20
	50 - 59 years	10	12.80
Parents' Educational Level	Primary school	9	11.50
	Junior high school or vocational education	12	15.40
	High school	10	12.80
	Bachelor's degree	38	48.70
	Higher than bachelor's degree	9	11.50

Table 1 (Cont.)

	Demographic Data	Frequency (n = 78)	Percentage (%)
Parents' Occupations	Not working	10	12.80
	Government officer	13	16.70
	Employees or daily employees	9	11.50
	Permanent employees or private employees	25	32.10
	General sales or business owners	14	17.90
	Farmers, gardening, farming	7	9.00
Parents' Monthly Income	Less than 15,000 baht	28	35.90
	15,000 – 20,000 baht	9	11.50
	20,001 – 30,000 baht	20	25.60
	30,001 – 40,000 baht	7	9.00
	40,001 – 50,000 baht	8	10.30
	More than 50,000 baht	6	7.70

2. Child development before and after cochlear implantation was found that after surgery ($\bar{x}$ = 4.14, S.D. = 0.57), the children developed according to the standards of overall desirable characteristic: physical, emotion and mental, social, and intelligence more than before surgery ($\bar{x}$ = 2.86, S.D. = 0.94). The details were as follows:

2.1 **Physical:** The children's body grown properly to their age and had good health habits such as playing and doing activities safely. They took good care of their hygiene. Both gross motor and fine motor development were strong and could be used fluently and coordinated.

2.2 **Emotion and Mental:** The children had good mental health and happiness, as well as the courage to speak up. They appreciated and expressed themselves in art, music, and movement. They had integrity, ethics, and a good heart.

2.3 **Social:** The children had life skills and behave according to their parents' advices, loved nature and the environment, and lived happily with others.

2.4 **Intelligence:** The children used language to communicate properly to their age, had the ability to think, which was fundamental to learning, had imagination and creativity, had a good attitude towards learning, and could learn properly to their age. The results were illustrated into the Table 2.

Table 2 Mean and Standard Deviation, and Level of Child Development Before and After Cochlear Implant

Child Development	Before Cochlear Implant			After Cochlear Implant		
	$\bar{x}$	S.D.	Level	$\bar{x}$	S.D.	Level
Physical	3.47	0.97	Moderate	4.26	0.55	High
Emotion and Mental	3.07	1.07	Moderate	4.32	0.56	High
Social	3.00	1.11	Moderate	4.27	0.57	High
Intelligence	2.29	0.88	Less	3.85	0.77	High
Total	**2.86**	**0.94**	**Moderate**	**4.14**	**0.57**	**High**

3. The overall child development based on learning theory, language development, and learning of early childhood was at a high-level ($\bar{x}$ = 4.05, S.D. = 0.60), The first was the learning of early childhood, followed by the child's development according to the learning theory, and language development. The details were as follows:

3.1 **Child development based on learning theory,** overall, was at a high level ($\bar{x}$ = 4.20, S.D. = 0.52) in psychosocial, relationship, personality, social, and intelligence: 1) the psychosocial, the children learned that they received love from their parents, and the children learned to do various activities on their own, 2) the relationship, the children wanted to be close to their parents or caregivers, 3) the personality, children learned to excrete, and had a better personality, 4) the social cognition, children received positive motivations such as compliments when showing good behavior, and 5) intelligence, children were able to use sensory perception and movement, and began to learn how to use the language.

3.2 **Language development,** overall, was at a high level ($\bar{x}$ = 3.69, S.D. = 1.02) in both language comprehension and language expression: 1) language comprehension, children knew the names of family members, and were able to understand short, uncomplicated sentences, or commands, and 2) language expression, children were able to tell when they need to go to the bathroom, able to speak short sentences of 2-3 syllables, able to understand their own nicknames, and can communicate their needs.

3.3 **Development of early childhood learning,** overall, was at a high level ($\bar{x}$ = 4.27, S.D. = 0.55) in external behavior change, intellectual process or thought, and good values: 1) the external behavior change, children were able to show the behaviors that the parents wanted, such as answering short questions and doing what they were told, 2) intellectual process, children desired to do more things or wanted to learn more when they were praised, and 3) on the value of goodness, children were able to learn that they did good things, and want to develop themselves properly to their age. The results were illustrated into the Table 3, 4, 5 and 6.

Table 3 Mean and Standard Deviation, and Level of Child Development based on Learning Theory, Language Development, and Learning of Early Childhood

Child Development	$\bar{x}$	S.D.	Level
Child Development Based on Learning Theory	4.20	0.52	High
Language Development	3.69	1.02	High
Learning of Early Childhood	4.27	0.55	High
Total	**4.05**	**0.60**	**High**

Table 4 Mean and Standard Deviation, and Level of Child Development: Learning Theory

Child Development: Learning Theory	$\bar{x}$	S.D.	Level
Psychosocial	4.16	0.60	High
Relationship	4.25	0.59	High
Personality	4.22	0.66	High
Social Cognition	4.13	0.62	High
Intelligence	4.22	0.60	High
Total	**4.20**	**0.52**	**High**

Table 5 Mean and Standard Deviation, and Level of Child Development: Language Development

Child Development: Language Development	$\bar{x}$	S.D.	Level
Language Comprehension	3.77	0.91	High
Language Expression	3.61	1.19	High
Total	**3.69**	**1.02**	**High**

Table 6 Mean and Standard Deviation, and Level of Child Development: Learning of Early Childhood

Child Development: Learning of Early Childhood	$\bar{x}$	S.D.	Level
External Behavior Change	4.28	0.66	High
Intellectual Process	4.02	0.60	High
Value of Goodness	4.52	0.57	Highest
Total	**4.27**	**0.55**	**High**

The results of the research hypothesis test were as follows:

1. A comparative analysis of child development differences according to desirable characteristic standards, the results (before and after surgery) classified by age of children undergoing cochlear implant surgery revealed that: 1) child development in overall (before surgery) was no difference, 2) child development in overall (after surgery) was significantly different ($p = 0.050$) at the 0.050 level, newborn-to-3 years old children with cochlear implant ($\bar{x} = 4.29$, S.D. = 0.42) has more development than those over 3-6 years old ($\bar{x} = 4.03$, S.D. = 0.65)

2. A comparative data analysis of child development differences according to learning theory, language development, and early childhood learning classified by children's age revealed that there was significantly different ($p = 0.001$) at the 0.050 level, newborn-to-3 years old children with cochlear implant ($\bar{x} = 4.31$, S.D. = 0.50) has more development than those over 3-6 years old ($\bar{x} = 3.86$, S.D. = 0.61).

The Results of the Qualitative Research:

1. The family circumstances and approaches to caring for cochlear implant children:

The research results of the family circumstances and approaches to caring analyzed data with content analysis from in-depth interviews of 6 parents who had a child with cochlear implant. The results revealed as follows:

1.1 The family circumstances of the cochlear implant children found that cochlear implantation were funded by The Foundation for the Deaf. Children were issued their disability identification to access rights to medical care such as surgery and rehabilitation. For family income, it was found that the father and/or mother were the regular income earners and the parents' families supported the children's medical expenses.

1.2 The approaches to caring for children undergoing cochlear implantation were discovered to be: 1) most families raised their children as if they were normal children, followed the doctor's advices, took their children to the hospitals on regular basis, and checked physical and intellectual development. The whole families helped to observe the children in hearing, moving, and eating, including in communication approaches and face expression, 2) auditory and speech training after cochlear implantation, children together with parents and family members had to practice hearing and speaking at the hospitals with speech correctors so that they were able to review training at home. For monitoring the physical health and development of the children, the physical examinations, ear examinations, and machine adjustments were performed once a year or once every 6 months, including an assessment of the children's cognitive development.

1.3 Preparing for children to enter early childhood were discovered that: 1) hospitals, training centers, or special teachers assisted children in learning to help themselves in listening and speaking, language, and vocabulary in order to be ready for early childhood, 2) parents were advised to assess the children with team of medical personnel, training centers, or special teachers to ensure that the children were able to attend normal schools so that the children could learn society and had more opportunities, 3) the children were prepared for

self-help in eating and going to the bathroom, 4) the children were prepared in listening and speaking to be able to speak in words and short sentences, and 5) the children were prepared to adjust to their peers and playing with friends.

2. The learning development guidelines for children with cochlear implant to prepare for early childhood learning:

The research results of learning development guidelines analyzed data with content analysis from 1) in-depth interviews of 10 experts who involved in cochlear implantation and early childhood learning, and 2) the guidelines related to cochlear implantation taken from The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand (2012). The results revealed as follows:

2.1 There were two approaches to correcting hearing loss in children: 1) the use of hearing aids, and 2) the cochlear implant surgery. The most successful outcome of the cochlear implant was that the children were able to communicate normally by listening and speaking, and that the children were able to attend regular schools. The appropriate age for children for cochlear implant surgery was less than 3 years old or 4 years old, and if cochlear implantation was required, it should be done at the age of 4 for best results in order to communicate by speaking and attend regular schools.

2.2 For the first period after the cochlear implantation, parents must bring their children to the hospitals every week because children had to be rehabilitated continuously by the medical teams and speech editors. The hospital where children were undergoing cochlear implant surgeries offers rehabilitation programs and hearing and speech training.

2.3 The children who had cochlear implant surgery could hear the sound immediately after turning on the auditory implant. When the children had undergone rehabilitation and had sufficient communication skills, they would be able to attend regular schools because regular schools would help the children to use their listening and speaking skills.

2.4 The assessment of the children with cochlear implant to attend regular schools was as follows: 1) the teams of healthcare professionals assessed the children's development, intelligence, body, hearing, and speaking, 2) self-help assessments for children: the children could tell the teachers what they want, could take responsibility for their own hearing, knew that their machines malfunctioned, and knew that the battery was dead, and 3) language assessments were the most important, therefore the children must be able to listen and speak.

Discussions

The research discussions were presented below according to the research objectives and results.

The Discussions of the Quantitative Research:

1. The development of the children before and after cochlear implant surgery was found that after surgery ($\bar{x}$ = 4.14, S.D. = 0.57), the children developed according to the overall desirable characteristics standard more than before the surgery ($\bar{x}$ = 2.86, S.D. = 0.94). The children grew up properly to their age, had good health habits, and used both gross motor and fine motor fluently and harmoniously. They had healthy and happy life, had life skills and behaved according to their parents' advices, had the intelligence to use language to communicate properly to their age, and was able to learn on an age-appropriate basis. In according with Ann & Robert H. Lurie Children's Hospital of Chicago (2019) study, it found that children with a cochlear implant from infancy was more likely to be unable to speak. Experts claimed the early implantation of deaf babies was

the priority public policy. Deaf children who received cochlear implantation before 12 months of age were able to learn to understand spoken language faster, and were more likely to develop spoken language in a children's specific communication style. Children having cochlear implantation since infancy progressed rapidly and tended to use spoken language as their sole means of communication. Cochlear implantation was better in helping children hear high-pitched consonants than using hearing aids. The sooner the children could hear, the more likely they were able to learn and to speak clearly. In accordance with the findings by Bond et al. (2009) about the effectiveness and cost-effectiveness of cochlear implant surgery, it was found that children who had cochlear implant surgery were able to hear. Voice comprehension and perception were increased by 50%. Effectiveness was significantly improved during six months after the surgery. Children who had cochlear implants had better quality of life compared to before surgery. The group who received the pre-school cochlear implantation had higher learning effectiveness than the group who received the cochlear implantation during school age.

2. Child development according to learning theory, language development, and learning of early childhood, overall, was at a high level ($\bar{x}$ = 4.05, S.D. = 0.60): 1) development according to the learning theory; in psychosocial aspect, children learned to do various activities on their own; in relationship aspect, children learned that they received love from their parents; in personality aspect, children learned to excrete; in social aspect, children exhibited good behavior, and in intelligence aspect, children were able to use their sensory perception and movement, and began to learn to use language, 2) language development was found that children were able to understand short sentences or commands, and children were able to communicate their want, 3) Learning development of early childhood was found that children were able to show behaviors that parents wanted. In accordance with The Royal College of Pediatricians of Thailand, Pediatric Society of Thailand (2020), it stated that intellectual development was the sum of all aspects of development. Various skills should be promoted to the fullest at every age, such as playing, reading, or singing, and practice helping themselves by: 1) children's language can be learned from birth by listening to parents' responses, which would be developed according to the age range. Some children might develop early or late. It depended on the promotion and stimulation of family development and hearing problems played an important role in language and speech development, and 2) stimulating the development of language and communication in daily life would help develop the basics of speaking, in accordance with Jicko (2019) research. He said that the language and speech development of the children come from learning, whether it would be slow or fast development depending on their age. The children, age between 2-5 years, were more develop their language skill than those in other age. Words were learned from things around children. Development of perception and language was due to children's ability to relate the sounds they heard and things they saw and felt.

The Discuss of Research Hypothesis Test were as Follows:

1. A comparative analysis of child development differences according to desirable characteristic standards, the results (before and after cochlear implant surgery) classified by child age revealed that: 1) child development in overall (before surgery) was no difference, 2) child development in overall (after surgery) was significantly different at the 0.050 level. Bond et al. (2009) found that the Children who undergo cochlear implant surgery were able to hear voices. Their comprehension and perception would be increased by 50%. Children who had cochlear implant surgery had better quality of life compared to before surgery. Consequently, United Healthcare Community Plan (2022) accepted cochlear implantation in children with congenital hearing loss. Because

hearing impaired children could greatly improve their cognitive skills, they were able to attend regular schools. They did not attend the schools for the deaf.

2. A comparative data analysis of child development differences according to learning theory, language development, and early childhood learning classified by child age revealed that there was significantly different at the 0.050 level. It conformed with the research of The Royal College of Pediatricians of Thailand, Pediatric Society of Thailand (2020), stating that the period during 0-3 years old was the most important age in laying the foundation in every aspect. This period brought the most changes. Therefore, parents needed to focus and followed up and encouraged physical, self-help, social, emotional, and intellectual development, including children's language and speech development. Bond et al. (2009) found that children who had cochlear implant surgery had better hearing abilities. Voice comprehension and perception were significantly improved during six months after the surgery. Children who had cochlear implantation had better quality of life compared to before surgery.

The Discussions of the Qualitative Research:

1. The family circumstance and the approaches to caring for the cochlear implant children revealed that the parents were the income earners and planned the cost of a children's treatment. Parents were advised to assess their children by medical teams so that the children could attend regular schools. Children were prepared by listening and speaking. In accordance with Kingkaew et al. (2009) in a review of the literature pertaining to cochlear implant abroad, it was found that Australia determined funding for cochlear implantation, which prioritized for children first. In United Healthcare Community Plan, cochlear implant surgery was acceptable in children with congenital hearing loss. Because the hearing-impaired children could greatly improve their cognitive skills, and were able to attend regular schools, children did not have to attend schools for the deaf. So, children could help themselves and function normally in daily life. Children were receptive and expressive language skills that played important parts in child development. In accordance with The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand (2012) study, it stipulated that children could undergo cochlear implant surgery if they were in good health and their level of intelligence and mental health were normal because learning to listen and speak required their own concentration and intelligence together with the help of their family and rehabilitation team.

2. The learning development guidelines for children with cochlear implant to prepare for early childhood learning were as follows: There were two approaches to correcting hearing loss in children: using hearing aids, and cochlear implant surgery. During the first period after the cochlear implant surgery, parents must bring the children to the hospitals every week because children needed to be rehabilitated continuously by teams of medical personnel and speech editors. After the surgery, parents or guardians were required to supervise the children to practice continuous hearing and speech. When children communicated adequately, they would be able to attend regular schools. Family support was the most important circumstance for children who undergo cochlear implant surgery. The family must be able to care for and dedicate themselves, especially after the surgery. The warmth and empathy of the family encouraged the child to be able to say words and to be able to speak. In accordance with The Royal College of Otolaryngologists-Head and Neck Surgeons of Thailand (2012) study, it stipulated that cochlear implant surgery was the only method at the present to correct those who were deaf because of malfunctioning inner ear or those who were born with disabilities to hear. In accordance with the Cochlear Implant Association (Thailand) (n.d.) study, it stated that approximately 3 weeks after the surgery,

the cochlear implant could be turned on and used. Children would be required to undergo listening and speaking training and testing with hearing rehabilitation team and the supervision of speaking and listening with their family in order to improve hearing and listening. In accordance with United Healthcare Community Plan (2022), it accepted cochlear implant surgery in children with congenital hearing loss because the hearing-impaired children could greatly improve their cognitive skills and were able to attend regular schools. After cochlear implantation, whether the child development would be slow or fast depended on the care of their parents and the readiness of the children himself. Therefore, parents needed to provide support and promote their children's learning. The emphasis was on listening and speaking practices to help the children develop to their full potential and, finally, to be able to attend regular schools.

Conclusions

The conclusions were presented below according to the research objectives and results.

1. The appropriate age for children for cochlear implant surgery was less than 3 years old or 4 years old, for best results in order to communicate by speaking and attend regular schools.

2. In the first period after the cochlear implantation, parents had to bring their children to the hospitals every week because children had to be rehabilitated continuously, adjusted to the sound, and trained in hearing and speaking.

3. The family should raise their children as if they were normal children, follow the doctor's advice, take children to the hospital on a regular basis, and check their physical and intellectual development.

4. The family support was the most important circumstance for children who undergo cochlear implant surgery. The warmth and empathy of the family encouraged the child to be able to say words and to be able to speak.

5. The assessment of the children with cochlear implant to attend regular schools was as follows: (1) the children could speak the language, (2) the children could communicate reasonably, (3) the children could control himself while studying, (4) the children had self-help, and (5) the children could participate in classroom activities.

6. In order to improve early childhood development, WHO recommends: 1) responsive caregiving; all infants and children should receive responsive care during the first 3 years of life; parents and other caregivers should be supported to provide responsive care, 2) promote early learning; all infants and children should have early learning activities with their parents and other caregivers during the first 3 years of life; parents and other caregivers should be supported to engage in early learning with their infants and children. (World Health Organization, 2020)

Recommendations

From the key research results and discussion, there were recommendations for public and private organizations, schools, education-related agencies, people involved with hearing-impaired children including and parents, which could be implemented or assisted to develop and promote learning development for cochlear implant children in order to prepare early childhood learning to be more effective as follows:

1. If the parents suspected that their children had hearing problems such as their children still couldn't say the first word even if they were 1 year and 6 months old, or their newborns were not shocked or turn their face

towards the sound, Immediately, parents had to take their children to see doctors. Don't wait until the children were two or three years old, because it might be too late for children's hearing and speech development after cochlear implant surgery.

2. National Health Security Office Increased the benefits of hearing screening in high-risk newborns and cochlear implant surgery in cases of screening and deaf problems. This would help the children develop appropriately and not lose social opportunities.

3. Rehabilitation after surgery by specialized medical team and adjusting the converter was very important. However, support from families and parents was the most important. Especially after the surgery, the families had to provide the full time for their children's rehabilitation. The children's ability to speak depended on the family's continued love, warmth, and care to help foster the children's voice to pronounce words and to speak.

4. The methods of listening and speaking practice for children with cochlear implant were very important. Normal children should receive continuous speech trainings from the age of 3 years. After cochlear implantation, children needed a year to develop their spoken language. In addition, children undergoing cochlear implantation needed to be physically and mentally prepared to live in a normal hearing society.

5. Children who had cochlear implant surgery were able to hear and communicate adequately and could attend regular schools. Regular schools would support the children to use listening and speaking. But if the children attended special schools, the hearing will not be used at all. Studying at a regular school was better. However, the children must receive assistance from teachers and related persons who understand the children's existing hearing loss and support the children's learning development.

Recommendations for Future Research

Recommendations for future research were as follows:

1. Future research should be studying the additional factors that affect the learning development for children undergoing cochlear implant surgery, and should be analyzing which will help to acquire new knowledge in the development of children's learning, including the development of children intellectually, socially, emotionally, mentally, and physically.

2. The model of family responsibility for rehabilitation after cochlear implant surgery should be researched in order to develop the ability to listen, speak, and engage in effective self-help.

3. There should be research on the readiness of regular schools that provide early and/or primary education for children with cochlear implant surgery and children with hearing impairments.

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