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The Effect of Cochlear Implant Operation on Child Adaptation Behaviors andQuality of Life from Parent's Perspective*

İsmail DEMİR [1, a]
Erkan KARATAŞ [2, b]
Arzu ÇALIŞKAN DEMİR [3, c]
Özlem ÖZCAN [3, d]

[1] İnönü University, Faculty of Medicine, Department of Otorhinolaryngology Malatya, TÜRKİYE

[2] Gözde Akademi Hospital, Department of Otorhinolaryngology Malatya, TÜRKİYE

[3] İnönü University, Faculty of Medicine, Department of Child Psychiatry Malatya, TÜRKİYE

[a] ORCİD: 0000-0002-4362-795X
[b] ORCİD: 0000-0002-9616-7168
[c] ORCİD: 0000-0002-0835-380X
[d] ORCİD: 0000-0003-3267-2648

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Yazışma Adresi
Correspondence

İsmail DEMİR
İnönü University, Faculty of Medicine, Department of Otorhinolaryngology Malatya - TÜRKİYE

ismail.demir@inonu.edu.tr

Objective: In individuals with sensorineural hearing loss, cochlear implant surgery has emerged as a widespread treatment option in recent years. Considering that developmental areas affect each other, this operation performed in the early period can support all development areas of the child, especially in language development, and the quality of life. This study is aimed to examine the effect of cochlear implant operation on adaptation behaviors and quality of life in children.

Materials and Methods: A total of 40 children aged 3-15 years, with severe sensorineural hearing loss, who underwent unilateral cochlear implantation and used the device regularly for at least 1 year, were included in this study. Before the cochlear implant operation and 1 year after the operation, the parents of the children filled the Sociodemographic data (SDD) and The Pediatric Quality of Life Inventory (PedsQL) forms and Vineland Adaptive Behavior Scales (VABS) were applied, and the results were compared.

Results: Eighteen (45%) of the participants were girls, 22 (55%) were boys, and the mean age was 6.18±3.40. It was observed that all of the participants continued their regular rehabilitation after the operation. When the pre- and post-operative scores were compared, the PedsQL subscale scores and VABS subscale scores(Communication, daily living skills, socialization and motor skils) were found to be significantly higher one year after the operation.

Conclussion: This study shows that cochlear implantation has a positive effect on quality of life, development of language skills, motor skills and socialization in children. Cochlear implant application in children with hearing loss is important in terms of supporting development and increases the quality of life of the child.

Key Words: *Cochlear implant, child, life quality, development, hearing loss*

Ebeveyn Perspektifinden Koklear İmplant Operasyonunun Çocuk Uyum Davranışları ve Yaşam Kalitesine Etkisi

Amaç: Sensörinöral işitme kaybı olan bireylerde koklear implant cerrahisi son yıllarda yaygın bir tedavi seçeneği olarak kullanılmaktadır. Gelişim alanlarının birbirini etkilediği düşünüldüğünde erken dönemde yapılan bu operasyon çocuğun başta dil gelişimi olmak üzere tüm gelişim alanlarını ve yaşam kalitesini destekleyebilir. Bu çalışmada koklear implant operasyonunun çocuklarda uyum davranışları ve yaşam kalitesine etkisinin incelenmesi amaçlanmıştır.

Gereç ve Yöntem: Bu çalışmaya 3-15 yaşları arasında, tek taraflı koklear implantasyon yapılmış ve cihazı en az 1 yıldır düzenli olarak kullanan, ileri derecede sensörinöral işitme kaybı olan toplam 40 çocuk dahil edilmiştir. Koklear implant operasyonu öncesi ve operasyondan 1 yıl sonra çocukların ebeveynleri tarafından sosyodemografik veri formu, Çocuklar için Yaşam Kalitesi Ölçeği (ÇİYKÖ) ve Vineland Uyum Davranış Ölçeği (VUDÖ) doldurularak sonuçlar karşılaştırılmıştır.

Bulgular: Katılımcıların 18'i (%45) kız, 22'si (%55) erkekti ve yaş ortalaması 6,18±3,40 idi. Katılımcıların tamamının ameliyat sonrası düzenli rehabilitasyonlarına devam ettikleri görülmüştür. Operasyon öncesi ve sonrası puanlar karşılaştırıldığında ÇİYKÖ alt ölçek puanları ve VUDÖ alt ölçek puanlarının (İletişim, günlük yaşam becerileri, sosyalleşme ve motor beceriler) ameliyattan bir yıl sonra anlamlı olarak yüksek olduğu saptanmıştır.

Sonuç: Bu çalışma, koklear implant uygulamasının çocuklarda yaşam kalitesi, dil becerilerinin gelişimi, motor beceriler ve sosyalleşme üzerinde olumlu etkisi olduğunu göstermektedir. İşitme kaybı olan çocuklarda koklear implant uygulaması gelişimin desteklenmesi açısından önemlidir ve çocuğun yaşam kalitesini artırır.

Anahtar Kelimeler: *Koklear implant, çocuk, yaşam kalitesi, gelişim, işitme kaybı*

Introduction

Hearing loss is one of the most common problems in society, causing serious health problems and stress for both children and their families (1). It is thought to affect one out of every 5 children in the 0-18 age range (2). Congenital or emerging hearing loss in the early stages of life negatively affects all development areas, especially language development, and causes the child to differ from peers. This situation

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significantly affects the quality of life of both the child and family and makes the current situation even more difficult (3). Considering the difficulties that may arise in language, developmental, social and cognitive areas in these children,it is important to diagnose hearing loss at an early stage and plan the treatment.

Cochlear implants are electronic devices applied to provide hearing in individuals with severe or very severe sensorineural hearing loss (SNHL), who do not benefit from the devices used in hearing loss. Although the most important indication of this operation is the hearing loss detected in the pre-lingualistic period, it is beneficial to apply it in all age groups where an implant is required.

Although the age of cochlear implantation varies regionally, in some countries it is determined as the individuals over one year of age (4). The most important benefit of this operation is hearing gain that supports speech language development (5). Developmental areas (language, cognitive, social and physical) regularly progress in interaction with each other. Changes in one area of development affect others positively or negatively.

It has previously been shown that hearing impaired children also exhibit atypical performance in a range of motor skills such as balance, eye-hand coordination, running and throwing compared to control children of the same age (6). Conversely, improvement in hearing may lead to improvement in other development stages.

This in turn, supports motor development and may result in an improvement in the person's quality of life. The number of publications investigating quality of life associated with cochlear implant surgery has increased recently (7, 8). The common result of these studies is that devices or cochlear implantation can prevent problems and contribute positively to quality of life.

However, when we look at the literature, there are few studies examining the effects of cochlear implantation on general development and adaptive behaviors in children. In this study, it was aimed to evaluate the pre- and post-operative general development and compare the quality of life of children with severe sensorineural hearing loss who were planned for cochlear implant operation.

Materials and Methods

Research and Publication Ethics: The study protocol was approved by the Ethics Committee of İnönü University Institute of Health Sciences Non-Invasive Clinical Research (approval number: 2015/186).

Participants: When the difference between the preoperative and postoperative scale score averages of the participants was predicted as 1±1.8, when alpha two-sided = 0.05, 1-beta (power) = 0.90, it was calculated that at least 37 participants should be included in the study. This study included 40 children who were brought to the otorhinolaryngology clinic of a university hospital between May 2014 and September 2015 with the complaint of hearing loss who were diagnosed with bilateral very severe SNHL in the audiological evaluation and planned for cochlear implantation. Anomalies in the central auditory pathways and cochlear anomalies of the patients were investigated using radiological imaging methods (axial, coronal thin-section temporal Computed Tomography and Ear Magnetic Resonance Imaging) and their psychiatric examinations were performed. Patients who did not develop inner ear, whose presence of cochlear nerve could not be detected, and who were determined not to be suitable candidates for implant in psychiatric examination were excluded the study. Written informed consent was obtained from the families of all cases, and the VABS, PedsQL and SDD form were applied to the parents in the preoperative period. Unilateral cochlear implant operation was performed on these patients, and fitting adjustments were made by inserting a speech processor four weeks later in the post-operative period and afterwards, these patients were followed up regularly.

All patients used the cochlear implant device and continued their education in this process. VABS and PedsQL were re-administered to the patients one year after the operation and the results were compared.

Measures

Socio-demographic Data Form (SDF): It is a form prepared by researchers who question information such as age, gender, number of siblings, age of parents, education level of the child, education level of parents, family structure, place of residence, income level.

Vineland Adaptive Behavioral Scales (VABS): This scale, which was developed by Sparrow et al. (1984), is used to evaluate the adaptation behaviors of children with or without developmental delay consisting of 297 items. In the scale four fields about; Communication (Receptive and Expressive Language), Daily Life Skills (Personal, Domestic, Social Skills), socialization (Interpersonal relations, play, leisure and coping Skills) and motor skills(Fine and Gross Motor) are available. Items for each sub domain of Vineland start at birth, which is the lowest developmental level, and increase to 18 years and 11 months. Scoring at three levels; It is scored as 2 (always able), 1 (occasionally able) and 0 (don't know). The 7 items that the individual can always do (get 2 points out of 7 consecutive items) are determined as the "Base Score", which is the lowest level of development, and the 7 items that the individual cannot do (get 0 points from 7 consecutive items) are determined as the "Ceiling Score", which is the highest level of development. Therefore, while scoring the items, they progress from the lowest developmental level (baseline score) to the highest developmental level (ceiling score). Then, raw scores for each domain and its sub-areas and Total Scores are converted into standard scores, and the level of age-related and adaptive behavior is determined accordingly. In this study, the statistical evaluation of VABS results was made by calculating the difference between the expected development level and the current development level according to the patient's calendar age, both before and after the operation.

The Pediatric Quality of Life Inventory (PedsQL): The scale, which was developed by Varni et al. in 1999, aims to measure the general quality of life in the 2-18 age group (9). This scale has been prepared for four different age groups. The scale prepared for the 2-4 age group has only a parent form. The school subsection of this form, unlike other forms, consists of three items instead of five. The scale, which was developed for the 5-7 age group, has a parent and child form. The child form is filled by the researcher with the help of a diagram representing happy, neutral and sad facial expressions with the child. There is a parent and child form of the scale prepared for the 12-year-old group. The parent form is completed separately and simultaneously by the caregiver and the child form by the child included in the study. The scale, which was developed for the 13-18 age group, has a parent and adolescent form. The total score is obtained by adding the scores and dividing by the number of items filled. The psychosocial health total score, which consists of the scale total score, the physical health total score and the item scores evaluating emotional, social and school functionality is calculated. The higher the total PedsQL score, the better the health-related quality of life is perceived (9). In this study, PedsQL parent forms were used for all age groups.

Statistical Analysis: The data of the study were evaluated with the SPSS "Statistical Package for Social Sciences (SPSS17.0)" program. Data related to qualitative variables are given as number and percentage. Normal distribution of data related to quantitative variables was investigated with the Kolmogorov Smirnov normality test. Data related to quantitative variables (age, number of siblings, maternal and paternal age) that do not show normal distribution are given as median and min-max. PedsQL and VABS scores show normal distribution, and the preoperative and postoperative scores of these two scales were compared with the paired sample t-test. In the evaluations, $p<0.05$ was accepted as the level of significance.

Results

Demographic Data of Participants: Eighteen female (45%) and 22 males (55%) 40 patients who underwent cochlear re-implant operation were included in the study. The mean age of the participants was 6.18±3.40 (min-max:3-15) and the number of siblings was 2.57±0.84 (min-max:1-5). It was determined that 15 (37.5%) of the children were not attending school, 11 (27.5%) were in pre-school, 7 (17.5%) were in primary school and 7 (17.5%) were in secondary school education. Looking at the places where the participants lived, it was determined that 6 (15%) lived in the village, 7 (17.5%) lived in the district, 27 (67.5%) lived in the city. It was found out that 40 (100%) of the children participating in our study immediately started rehabilitation training, 2 (5%) received regular training 1 day a week, and 38 (95%) 2-3 days a week.

Demographic Data of Families: It was determined that 33 (82.5%) of the participants had a nuclear family and 7 (17.5%) had an extended family structure. Maternal age was 31.55±4.47 (min- max:23-41) and father's age was 34.45±3.94 (min-max: 28-43). Considering the monthly income of the families: 21 of them (52.5) were found to be low, 15 of them were moderate (37.5), and 4 of them were high. (low: less than 2000 TL, moderate: 2000-5000 TL, high: more than 5000 TL).

Bilingualism was found in 19 (47.5%) of the families of the participants. When asked about kinship in the parents of the participants, it was seen that the parents of 21 children (52.5%) were related.

Data on the demographic characteristics of the participants and their families are given in Table 1.

Findings Related to Scale Scores: When the PedsQL Physical Functioning, Emotional Functioning, Social Functioning, and School Functioning scores were compared, post-operative scores were found to be significantly higher in all subscales ($p<0.05$).

Looking at the VABS scores, communication (receptive and expressive language), daily life skills (personal, domestic, social), socialization skills (interpersonal relations, play and leisure time and coping) and motor skills (Fine and Gross Motor) both total scores and subscale scores were found to be significantly higher after the operation ($p<0.05$). Information on PedsQL and VABS scale scores is given in Table 2.

Table 1. Clinical characteristics

Characteristics		n= 40	%
Gender	Girl	22	55
	Boy	18	45
Familiy structure	Nuclear	33	82.5
	Extended	7	17.5
Residental area	Village	6	15
	Town	7	17.5
	City	27	67.5
Bilingualism	Yes	19	47.5
	No	21	52.5
School	No	15	37.5
	Preschool education	11	27.5
	Primary school	7	17.5
	Secondary school	7	17.5
Family income	Low	21	52.5
	Moderate	15	37.5
	High	4	10
Kinship between parents	Yes	19	47.5
	No	21	52.5
	Median		Min- Max
Age	6.18		3-15
Number of siblings	2.57		1-5
Maternal age	31.55		23-41
Paternal age	34.45		28-43

Table 2. Scales scores

	Subscales Scores	Preoperative Mean±SD	Postoperative Mean±SD	P
PedsQL	Physical Functioning	0.77±1.14	4.15±2.27	<0.001
	Emotional Functioning	1.67±1.04	4.97±2.03	<0.001
	Social Functioning	1.97±1.22	6.20±2.55	<0.001
	School Functioning	1.30±1.18	4.25±2.23	<0.001
VABS	Recipient Language	-7.42±1.92	-2.80±3.22	<0.001
	Expressive Language	-6.07±1.73	-3.02±2.15	<0.001
	Written Language	-1.50±2.25	-0.47±2.15	0.001
	Communication Total Score	-6.55±1.75	-2.82±2.14	<0.001
	Personal Skills	-2.57±2.17	-0.80±1.85	<0.001
	Home Related Skills	-2.47±2.23	-0.62±1.61	<0.001
	Social Skills	-3.07±2.61	-1.15±1.98	<0.001
	Daily Life Skills Total	-2.57±2.09	-0.90±1.80	<0.001
	Interpersonal Relations	-4.52±1.94	-1.77±1.49	<0.001
	The Game	-4.02±2.33	-1.72±1.50	<0.001
	Coping	-3.62±2.00	-1.50±1.39	<0.001
	Socialization Total	-3.22±1.80	-1.37±1.39	<0.001
	Gross Motor Skills	-1.02±2.36	0.65±2.33	<0.001
	Fine Motor Skills	-0.87±2.45	0.75±2.29	<0.001
	Total motor Skills	-0.75±2.33	1.02±2.18	<0.001

PedsQL: The Pediatric Quality of Life Inventory, VABS: Vineland Adaptive Behavioral Scale

Discussion

A total of 40 children aged 3-15 years with advanced SNHL who underwent unilateral cochlear implants and used the device regularly for at least 1 year were included in this study. It was aimed to determine how the quality of life and general developments (language development, motor skills, social relations and daily living skills) were affected before and after the operation. In the evaluation made for this purpose, a significant increase was found in both the quality of life subscales and all of the Vineland Adaptive Behavior subscales 1 year after the operation. It has been shown in previous studies that the cochlear implant has positive effects on language development (10, 11).

Although several demographic factors, including age at implantation and modality of communication, have been found to affect coclear implant operation outcomes in deaf children, a large portion of the variance remains unexplained (6).

The patient's age, operation age, implant model, time spent with hearing loss before using a hearing aid, patient's gender, and the child's psychiatric and behavioral status are the most common factors affecting the results of the operation. (5, 12, 13). In this study, the mean age of the patient was 6, and it was observed that implantation performed in the relatively early period and regular continuation of rehabilitation significantly reduced the difference between the calendar age and the current development level in both receptive and expressive language.

Previous studies suggest that the close connections between language and motor systems may be the result of shared neural processing in the pre-motor cortex (6).

Again, due to the close connection between the hearing organ and the vestibular system, damage to one of the organs may affect the other, negatively affecting musclecontrol and motor functions. Although all these factors are well known, studies examining the effect of the cochlear implant on motor and other developmental areas are limited in the literature.

In the study of Horn et al. (6); While the gross motor skills of hearing- impaired children who had cochlear implantation before the age of 5 without intellectual disability or developmental delay were found close to their chronological age, these children's fine motor skills were found to be delayed. In our study, it was shown that the cochlear implant provides significant improvement in both gross and fine motor skills. However, there are studies in the literature showing that the effects of early auditory deprivation may be far-reaching and that some cognitive, motor, and social functions may continue to be impaired in children using cochlear implants (14, 15).

The difficulties they experience in communication skills also negatively affect the social and emotional development of children with hearing loss in their daily lives. These children lag behind their normally hearing peers in their emotional development, which includes recognizing and understanding words that express emotions (16). It has also been shown in previous studies that the social and emotional development of children after cochlear implants increases (17, 18).

Huttunen et al., in their study with 36 families, reported that in children whose average age of implantation was two and when reached to average age of 5, the subjects that families were most satisfied with increased: Social relations, increased communication, spoken language and general function (19). In our study, the post-operative socialization subscales (interpersonal relations, play and leisure time activities, and coping skills) and total scores were found to be significantly closer to their peers, supporting the literature in this aspect.

In this study, both subcategories and total scores of VABS Daily living skills were found to be significantly higher after the operation. This section consists of questions on personal skills such as “How does the child eat, dress and take care of himself?” household skills such as "What are the child's household duties?", and social skills such as “How is the child's use of time, money, telephone, computer?”. Based on this, it is possible to deduce that developments in cognitive, social and motor areas also have a positive effect on daily life skills.

The World Health Organization (WHO) defined the quality of life in 1997 as how individuals perceive their positions in life in line with their goals, expectations,

interests and living standards within the culture and value system in which they live. The general view about cochlear implantation operation and quality of life is that such devices and a successful rehabilitation process will prevent many problems and contribute positively to the quality of life. By applying a life questionnaire consisting of 22 questions prepared by Edward et al. (20) to 89 parents, they stated that the cochlear implant had a positive effect on the quality of life of the patients, and that the children's communication skills and freedoms increased. Tavares et al. (21) Also reported that cochlear implant had a positive effect on quality of life in a 40- question survey conducted with mothers of 10 implanted children. Vidas et al. (22), in their study with the families and therapists of 4 children, emphasized that children are good at hearing and perceiving sounds, but the effect on the quality of life is not one-to-one, so tests for quality of life are necessary. In a study, they stated that there were differences in the quality of life between children with normal hearing and hearing loss, and these differences were especially prominent in school or social environments (23). In this study, a significant increase was found in all subscales of the quality of life (Physical Functioning, Emotional Functioning, Social Functioning, and School Functioning) of children who underwent surgery, and the results are consistent with previous findings in the literature.

Our study has some strengths and limitations. First of all, this study is one of the few prospective

studies evaluating general development and adaptation behaviors from a parent perspective in cochlear implantation. The relatively large number of samples in the study, the fact that all the patients were followed up for one year continue to the regular rehabilitation program, and the fact that patients with psychopathology were not included are the other strengths of this study. However, the lack of a causal relationship between the results, the fact that information was only taken from parents, results were evaluated with scales and thatit consisted of only patients with unilateral cochlear implants are the limitations of the study. The fact that evaluation of motor development does not include a physical examination is another limitation of the study. Another important limitation is that data reached after one year cannot be generalized to all stages of life. Taking this issue into account in the future, longer- term follow-up studies will provide clearer information on this issue.

In conclusion, this study shows that cochlear implantation has a positive effect on an increase in the quality of life, the development of language skills, motor skills and socialization in children. Considering that developmental areas affect each other, this operation should be performed in the early period to support the development of the child in all of the mentioned areas.

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