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Pediatric cochlear implant revision surgery and reimplantation: An analysis of 957 cases

Yüksel Olgun *, Asuman Feda Bayrak, Tolgahan Catli, Mehmet Emrah Ceylan, Ruhi Aydin, Ufuk Duzenli, Levent Olgun

Izmir Bozyaka Teaching and Research Hospital, Department of Otorhinolaryngology, Izmir, Turkey

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ABSTRACT

Objective: In this study causes, risk factors, prevention strategies, diffuculties encountered during revision cochlear implant surgery, reimplantation in pediatric age group were evaluated.
Methods: Charts of 957 CI patients younger than 18 years of age implanted at Izmir Bozyaka Teaching and Research Hospital between 1998 and July 2012 and 18 referred CI complications at same age group were retrospectively evaluated. Revision and reimplantation surgeries were systematically reviewed.
Results: We encountered 26 surgical complications in 24 patients and 36 device related problems in 36 patients. Eighteen referred cases including 7 surgical complications and 11 device related problems were also evaluated. A total number of 80 complications were evaluated. In 11 cases conservative management was successful, 19 revision surgery was performed but we failed in 4 cases. We reimplanted 48 cases and 4 additional cases were implanted after failed revision surgery. Implant was extracted in one case. In one case we could implant the other side. Forty-six of reimplantations were done in one stage surgery, 5 cases required second stage surgery.
Conclusions: Surgical complications and device related problems of cochlear implantation may be different in children and majority of them require revision surgery or reimplantation. Although surgical problems leading to revision surgery and reimplantation are expected to diminish by experience every center has to deal with device failures. Both revision surgery and reimplantation require extra care and it should be better carried out by experienced surgeons. Implant performances are expected to be comparable with primary implantations.

1. Introduction

Cochlear implantation (CI) is a well-described procedure with a low surgical complication rate [1–4]. Majority of surgical complications as well as device related problems necessitate revision surgery or reimplantation. Although surgical technique basically same, rate and composition of events lead to secondary surgical intervention may differ among children and adults.

The aim of this study was to evaluate causes, risk factors, prevention strategies, difficulties encountered during revision cochlear implant surgery and reimplantation in pediatric age group.

2. Methods

2.1. Patients

In this study charts of 957 CI patients younger than 18 years of age implanted at our cochlear implant center between 1998 and July 2012 and 18 other referred pediatric CI complications were retrospectively evaluated and reviewed. All our own cases but 9 and all referred cases were unilaterally implanted. Age at implantation, sex, risk factors for complications, type and treatment of complications, time to secondary intervention, problems and important points in revision surgery and reimplantations were analyzed.

2.2. Devices

Currently we use devices of all 4 implant manufacturers. However before the end of study only Nucleus 3, Nucleus 4 and

* Corresponding author. Tel.: +90 506 7021434.
E-mail addresses: yuksel.olgun@deu.edu.tr, yuksel.olgunn83@hotmail.com (Y. Olgun).

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Nucleus 5 devices of Cochlear Company, Clarion 2 and Hi-Focus series of Advanced Bionics Company and Combi40, Combi40+, Pulsar, Sonata and Concerto series of MED-EL Company had been used.

2.3. Surgical technique in revision and reimplantation

Aim of the revision surgery was to solve the problem without causing loss of implant. Every revision cases handled accordingly under magnification. Gusher cases revised by transcanal approach. Soft failure cases required postauricular approach. A plasma knife (Gyrus Dissector Plasma Knife, Gyrus ENT, Bartlett, USA) which cuts and coagulates in bipolar mode with a low tip temperature was used for soft tissue dissection.

If reimplantation was required in most instances the same incision used at primary surgery was preferred and for soft tissue dissection plasma knife was used. All cases were also handled under magnification. In order to reveal factors leading to reimplantation devices were attempted to explant in toto. If it was not possible or a second stage reimplantation was planned electrode array was cut and left in situ.

2.4. Implant performances

Since the ages of implantées differed between 9 month and 17 years evaluation of the implant performances required different approaches. Outcome of the secondary interventions evaluated with age compatible auditory test batteries except for the cases in which a second intervention is required even before first fitting. Monosyllabic word scores were obtained before and after operation in children who were able to adapt these tests. For children in whom speech tests could not be achieved CAP scores obtained before and after revision or reimplant surgery were compared. Latest test results obtained before surgery were compared with results at 6 months or more after secondary intervention.

2.5. Statistical analysis

Statistical analyses were performed using SPSS 15.0 software program. Kaplan–Meier curve is used to show distribution of complications by the time. To analyze categorical variables Chi-square and Fischer's exact test was used. $P < 0.05$ was considered statistically significant.

3. Results

In Izmir Bozyaka Training and Research Hospital, Turkey 1421 cochlear implantation were done between 1998 and July 2012. Nine hundred fifty seven of these cases were children aged between 9 months and 17 years with a mean age of 4.3 years. There were 489 boys and 468 girls. Eleven cases were lost to follow up (Table 1). Postoperative follow up time ranged from 12 months to 14 years with a mean time of 65 months.

Twenty six surgical complications in 24 children and 36 device related problems in 36 children were seen (Graphic 1). Neither gender and age does not seemed to be a risk factor for overall complications in children ($p > 0.005$). Age ($p > 0.005$) and gender ($p > 0.005$) were also not a factor for surgical complications however male gender ($p = 0.023$) and older age ($p = 0.014$) seem to be a risk factor only for hard failures in which trauma was the reason.

In 49 of this 60 patients one or more surgical interventions required. Our overall complication rate was 6.5% among children. In the first 7 years (1998–2005) our overall complication rate was 9.3% and in the last 7 years (2005–2012) our overall complication rate dropped to 3.9%. Our complication rate diminished by experience ($p < 0.005$).

Table 1
Distribution of patients by age and gender.

Gender	Child	Adolescents	Total
Male	449 Mean/Median age (3.8/4)	31 Mean/Median age (12.7/12)	480 Mean/Median age (4.4/4)
Female	426 Mean/Median age (3.46/3)	40 Mean/Median age (13.5/13)	466 Mean/Median age (4.3/3)
Total	875 Mean/Median age (3.6/3)	71 (13.2/13)	946 Mean/Median age (4.3/4)

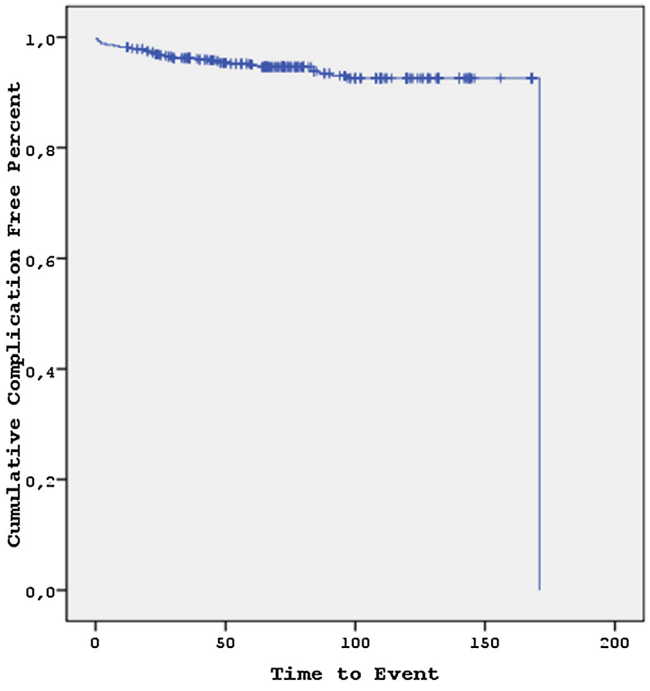
Our overall complication rate in children was 6.5% and 7.9% in adults. Surgical complication rate for children was 2.7% and for 6.03% adults. Device related problems were seen in 3.8% of children (36/946) and 2.5% of adult cases.

Moreover 18 cases were also referred from other centers for revision surgery or reimplantation. Finally 67 pediatric cases in which any surgical intervention necessitated were analyzed. Thirty-eight of them were male and 29 were female.

Time to surgical intervention from first implantation varied between 7 h and 14 year 3 months with a mean time of 31 months.

3.1. Surgical complications

In our series we have seen 10 minor complications (2 minor wound infection, 8 late seroma formation) and 16 major surgical complications within 24 patients. Major complications were two flap necrosis, one electrode exposure, one transient facial paralysis, one epidural hematoma, three late perilymp gusher, two meningitis, two iatrogenic cholesteatoma, one acute mastoiditis and three misdirection of electrode array. Seven cases (3 flap necrosis, 3 misdirection of electrode array and one iatrogenic cholesteatoma) were referred from other centers (Table 2).



Graphic 1. Kaplan–Meier curve showing distribution of complications by the time. *y* axis: patients with complications free percent. *x* axis: complications occurrence time (months).