Int. Adv. Otol. 2011; 7:(1) 31-34

ORIGINAL ARTICLE

Our Experience with Bilateral Cochlear Implantations Using a Suprameatal Approach

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Objective: To evaluate a modified suprameatal transepitympanic approach for cochlear implantation in bilateral simultaneous and sequential cochlear implantation.

Study design: Retrospective study of 17 patients who were implanted sequentially (5) and simultaneously (12) with a functional cochlear implantation method in a university medical center. All clinical and surgical data were stored in a database and analyzed by microcomputer.

Results: In all cases a total insertion could be performed. The average overall operation time was 3 : 26 ± 20 (hr:min) for the simultaneous cases. No major complications were encountered as a result of our modified implantation method. There were no taste disturbances, vertigo complaints or headache postoperatively. All patients benefit from a good hearing result after cochlear implantation.

Discussion: Simultaneous and sequential bilateral cochlear implantation with the suprameatal non - mastoidectomy approach is our opinion safe and less time consuming method to implant a cochlear prosthesis compared with the classic mastoid approach. The method is less invasive and avoid the risk of facial nerve injury. Another great advantage of the suprameatal approach with all its variations is the possibility to switch over when needed to the classic surgical approach introduced many years ago.

Submitted : 30 August 2010 *Revised: 01 February 2011* *Accepted : 02 February 2011*

Introduction

House introduced the classic surgical technique for cochlear implantation [1]. This surgical technique consists of a mastoidectomy and a posterior tympanotomy and this approach is still worldwide the most frequently used technique for cochlear implantation. This classic surgical technique uses a simple mastoidectomy. After the complete mastoidectomy a posterior tympanotomy is performed with special attention to the facial nerve (facial nerve monitoring is mandatory) and the chorda tympani. Through the large posterior tympanotomy a cochleostomy can be performed for electrode insertion. The classic technique has proven to be sufficient in the vast majority of cochlear implantations. Still complications concerning the facial nerve can occur. Perioperative facial nerve paralysis is rare but has been reported in the Cochlear Corporation and Clarion data. In all these cases the posterior tympanotomy was performed via the facial recess drilling within a millimeter of the facial nerve.[2,3].

To avoid negative side effects as a temporary or permanent injury to the facial nerve new cochlear implantation techniques were introduced by Kronenberg [4] and Kiratzidis [5] without a mastoidectomy and a posterior tympanotomy. It is a functional approach leaving the delicate structures of the pneumatized mastoid intact. It is almost impossible to injure the facial nerve or the chorda tympani with this approach. Bilateral simultaneous cochlear implantation using this alternative approach is possible demonstrated by Migirov & Kronenberg [6].In the present study we present our experience with the suprameatal cochlear implantation technique in bilateral cochlear implantations in children and adults with a focus on the reduction of surgery time.

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Patients and Methods

From 2003 up until 2009 we have implanted 180 cochlear implants in 163 patients using a modified suprameatal approach. All clinical and surgical data were stored in a database. In 17 cases bilateral cochlear implantation was performed. The group bilaterally implanted existed of 12 children (7 men 5 women) and 5 adult patients (2 men & 3 women). In 11 cases simultaneous bilateral cochlear implantation was performed while in five cases the second cochlear implant was placed sequentially. The causes of the deafness in this group studied were congenital deafness, cytomegalovirus infection in pregnancy, meningitis, otosclerosis bilateral temporal bone fracture and the Chudley-McCullough syndrome. The data are documented in Table I . All our patients were operated according the suprameatal approach [6,7] with some small modifications after studying the preoperative CT-scans. The surgical technique approach consisted out of a small classic retroauricular skin incision to open up the middle ear endaurally. In the middle ear the position of the basal coil of the cochlea determined between the oval and round window for the cochleostomy. In next step a suprameatal tunnel is created drilling towards the antrum and the incus. Subsequently, a groove through the suprameatal tunnel was drilled lateral to the body of the incus to connect the antrum with the middle ear for introducing the electrode array after the receiver-stimulation package. A second incision was made temporo laterally to perform the well for the implant body. The electrodes were introduced towards the suprameatal tunnel subperiostally via a cannula between the two small incisions. In a combined matter the electrode array was introduced in the cochleostomy created through the external auditory canal. The method is described in detail by Postelmans et all recently [8]. In all patients an intraoperative 3D X-ray image with a mobile digital x-ray C-arm was used to verify the position of the electrode array in the cochlea [9] In one adult case two Nucleus CI24RCA Contour implants were implanted sequentially. In 15 cases a Nucleus CI24RE(CA) Freedom was implanted and in one cases two Advanced Bionics CI-1400-02H implants were placed simultaneous. The surgical time inclusive the general anesthesia was documented by our OR staff in the general hospital computer. Intraoperatively impedance measurements and neural response telemetry and neural response imaging were performed.

Table 1. Types of implantation and causes of deafness

	Child	Adult
# Bilateral Cochlear implantation	12	5
Male/Female	7 / 5	2 / 3
Type of implantation		
Sequential implantation	2	3
Simultaneous implantation	10	2
Causes of deafness		
Congenital deafness	8	1
CMV infect pregnancy	1	
Meningitis	2	1
Otosclerosis		2
Bilateral temporal bone fracture		1
Syndrome deafness	1	

Results

In all cases good functioned implants could be implanted bilaterally. There were no intraoperative complications. It was in all patients possible to perform the small suprameatal tunnel and create the cochleostomy through the external auditory canal. In all cases studied the introduction of the array into the cochlea using the suprameatal technique was without problems. The intraoperative image with the mobile digital x-ray C-arm demonstrated in all cases a correct position of the electrode array into cochlea on both sides. (Fig 1.) The postoperative ct-scans after three months of the mastoid and the cochlea's according our protocol showed no reactions of the mucosa in mastoids bilaterally The intraoperative impedance measurements showed a good functioned implant in all bilateral implantations and neural response telemetry and neural response imaging presented good responses in all cases. The average overall operation time inclusive anesthesia was 3 hours and 26 minutes ± 20 in the group simultaneous implanted (Table II.) There were no taste disturbances, serious vertigo complaints or headache postoperatively. All patients stayed in the hospital for only three standard days. None of the adults or children had any intra- or post-operative complications. All patients benefit from a good hearing result after cochlear implantation.

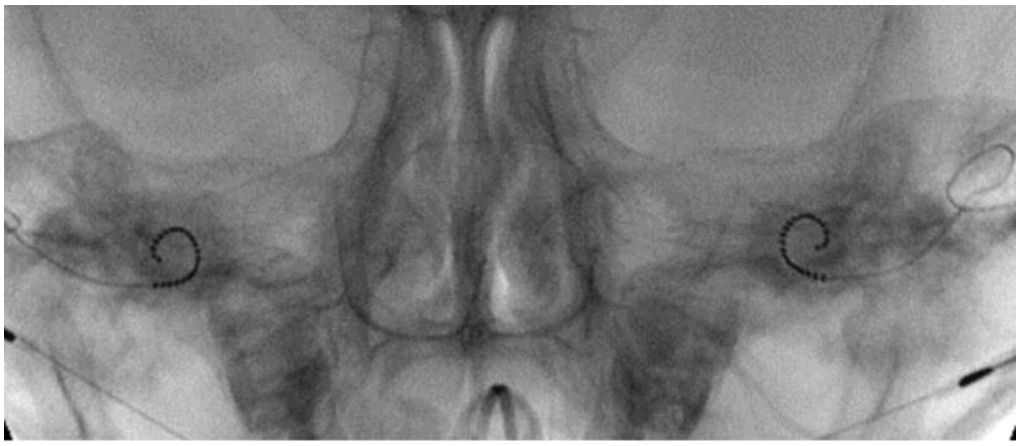

Figure 1. Intraoperative 3D X-ray image with the mobile digital x-ray C-arm showing the correct position of both electrode arrays into the cochlea of each ear.

Table 2. The types of implants used.

Implant	Simultaneous implantation	Sequential implantation	Child	Adult
Nucleus CI24RCA	-	1		1
Nucleus CI24RE(CA)	11	5	12	4
Adv.Bionics CI-1400-02H	2	-		2
Av. operation time hr/min	3 : 26 ± 20	1 : 32 ± 25	-	-

Discussion

Surgical rehabilitation by cochlear implantation has become more or less a routine procedure in cases of severe deafness where conventional rehabilitation is not helpful anymore. Unilateral cochlear implantation is still the routine nowadays. To understand speech better in silence and noisy environments binaural hearing is important. Furthermore benefits as sound localization, more natural hearing and reduced listening effort are basic in binaural hearing. To improve the quality of hearing and therefore the quality of life of severe deaf patients with one cochlear implant bilateral input into the auditory system for adults and children is important. Bilateral cochlear implantations especially in children furnish a surplus value in binaural function and hearing comfort. In adults the gain by bilateral cochlear implantation depends of the moment deafness (pre- or post-lingual).[10,11] In children the benefits of bilateral implantation are the best in cases in which the time delay between the sequential implantation is as short as possible [12]. In adults also the best results with a second cochlear implant is achieved when the interval between the implantations is short [13]. Therefore simultaneous bilateral cochlear implantation will result in the most optimum results. The indication for simultaneous bilateral cochlear implantation in children is deafness present at birth and acquired profound bilateral hearing loss due to meningitis with the risk of obliteration of the cochlea. In adults also deafness as a result of meningitis is an important indication for bilateral cochlear implantation because with the risk of cochlear obliteration. In adults contrast with children far advanced cochlear otosclerosis resulting in bilateral deafness is an important indication for bilateral implantation.[14]

Simultaneous implantation of two cochlear prostheses is preferable to sequential cochlear implantation. Peters et al [15] studied the trends in bilateral cochlear implantation and concluded that in 70% bilateral cochlear implantation was performed in children and that in more than 75% the surgery in adults were performed sequentially. Unfortunely this recent overview did not document the type of surgical approach for neither cochlear implantation nor the surgery time. Gantz et al demonstrated in a prospective study that simultaneous bilateral cochlear implantation did not cause postoperative problems in adults using the classic surgical approach with mastoidectomy and facial recess [16].

The advantages of a simultaneous cochlear implantation are an intervention of only one procedure instead of two surgeries and greater cost-effectiveness. In cases where a bilateral cochlear implantation is indicated the surgeon can chose between the classic mastoidectomy approach with a posterior tympanotomy or the mastoid saving suprameatal surgical approach. Comparing the two surgical cochlear implantation method Postelmans et al [8] demonstrated significantly shorter duration of surgery for the suprameatal approach method in sequentially implanted cases.

Concerning the major and minor complications there was a trend that the suprameatal method had fewer side effects. Possible disadvantages of a simultaneous implantation procedure might be a doubling of the risk of complications and longer surgery time [6]. Das S. & Buchman C.A. calculated the surgery time for bilateral simultaneous CI implantation with the classic mastoidectomy approach with a posterior tympanotomy and found an average time of 4:16 ± 25 (hr:min) in adult cases [16]. In a recent study Ramsden et al [18] documented the same surgery time of more then four hours for the bilateral simultaneous using the classic approach in children. Basura et al (2009) discussed that long surgery time as a disadvantage in bilateral simultaneous CI implantation and pointed on the importance of short time surgery especially in young children [19]. The alternative non-mastoidectomy suprameatal approach for cochlear implantation reduces the surgery time in children according Migirov & Kronenberg [6].

In our present study we have demonstrated that sequential and simultaneous bilateral cochlear implantation can be performed in children and adults using the suprameatal approach with good results. The average surgical time for simultaneous bilateral CI implantation demonstrated in this study is substantial reduced compared with the data [17,18] of the classic mastoidectomy with posterior tympanotomy technique (4:16 ± 25 vs 3:26 ± 20. hr:min). In our opinion non-mastoidectomy approach without a posterior tympanotomy is a good safe and less surgery time consuming alternative to the classic surgery technique for cochlear implantation even in bilateral sequential and simultaneous cochlear implantations in children and adults.

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