



## Clinical Report

# Endoscopic-Assisted Cochlear Implantation: A Case Series

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The aim of the present study was to describe the use of the endoscopic-assisted cochlear implantation in cases with an unsuccessful standard surgical technique because of not achieving adequate exposure to the round window (RW). Three patients with a bilateral profound hearing loss were operated using an endoscopic-assisted cochlear implant procedure at our tertiary university referral center between 2012 and 2014. In all of the patients, a retroauricular "c" shaped incision was performed and a subperiosteal pocket was created. Standard cortical mastoidectomy and posterior tympanotomy were accomplished using an otomicroscope. However, RW and promontory could not be seen using this approach. The tympanomeatal flap was elevated and the middle ear cavity was entered. A rigid 0 degree endoscope (2.7 mm wide, 18 cm in length) (Karl Storz company, Tuttlingen, Germany) and a connected HD camera system (Karl Storz Company, Tuttlingen, Germany) were used to expose RW through posterior tympanotomy, and a drill was passed through the external ear canal. The RW niche was removed using a diamond burr under endoscopic view; the endoscope was placed through the external ear canal, and electrodes were transferred through posterior tympanotomy. The electrodes were fully inserted under the endoscopic view in all cases. Endoscopic-assisted cochlear implantation may be a safe alternative surgical technique in cases where surgeons are not able to visualize RW and promontory using a microscope.

**KEYWORDS:** Cochlear implantation, rigid endoscope, endoscopic middle ear surgery, endoscopic-assisted cochlear implantation

## INTRODUCTION

Since the early 1980s, rigid endoscopes have been used by otorhinolaryngologists, primarily for sinus surgery. Recently, rigid endoscopes have been introduced as an adjunct to standard otologic and some neurotologic procedures. Because temporal bone has complex anatomic structures, there are some "hidden areas" that are not always possible to be accessed using an otomicroscope in the middle ear and other parts of the bone. Because rigid endoscopes are very useful for the visualization of those hidden areas, endoscopic ear surgery has become popular among surgeons.

Cortical mastoidectomy and the facial recess approach, which was first introduced by House <sup>[1]</sup>, have been standard surgical techniques for cochlear implantation for the past three decades. These techniques have been used worldwide, and otologic surgeons now have a great experience built up over time. However, using these techniques, it is sometimes difficult to access the round window (RW) and promontory via posterior tympanotomy in cases of anatomic diversities, such as an anomalous course of the facial nerve, narrow facial recess, low middle fossa dura, anteriorly located sigmoid sinus, and cochlear and middle ear anomalies. In these situations, although the retrofacial <sup>[2]</sup> or transcanal <sup>[3]</sup> approach is an alternative technique, it is not always possible to proceed with a microscope, and the facial nerve can be at a risk of damage. Thus, rigid endoscope use becomes a better option to visualize these hidden areas.

In this paper, we present endoscopic-assisted cochlear implantation in three cases that underwent an unsuccessful standard cochlear implantation technique in reaching RW and promontory.

## MATERIALS and METHODS

Endoscopic-assisted cochlear implantation was performed by the same surgeon in the three cases between 2012 and 2014 in a tertiary hospital. The follow-up of patients was at least 6 months.

### Surgical Technique

After cleaning the surgical field, a retroauricular "c" shaped incision was performed. A subperiosteal pocket was created, and standard cortical mastoidectomy and posterior tympanotomy were accomplished using a microscope. However, RW and promontory could not be visualized using this procedure (Figure 1). The external ear canal skin was elevated and accessed to the middle ear. A rigid 0° endoscope (2.7 mm wide, 18 cm in length) (Karl Storz Company, Tuttlingen, Germany) and a connected HD camera system (Karl Storz company, Tuttlingen, Germany) were used to expose RW through posterior tympanotomy, and a drill was passed through the external ear ca-

**Presented in:** This study was presented at the 8<sup>th</sup> Cochlear Implantation Neurotology Otology and Audiology Congress, 12-15 November 2015, Samsun, Turkey.

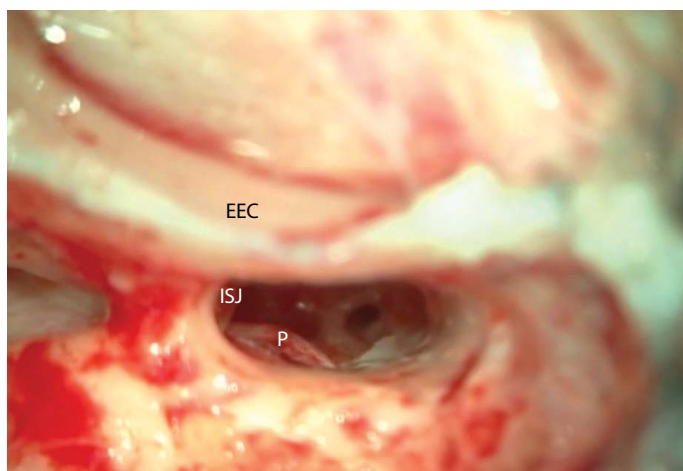
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**Submitted:** 28.08.2015

**Revision received:** 13.04.2016

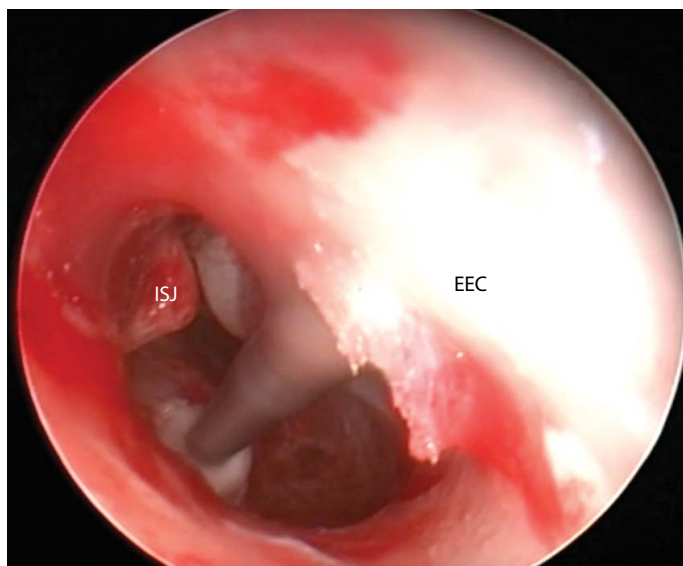
**Accepted:** 26.04.2016

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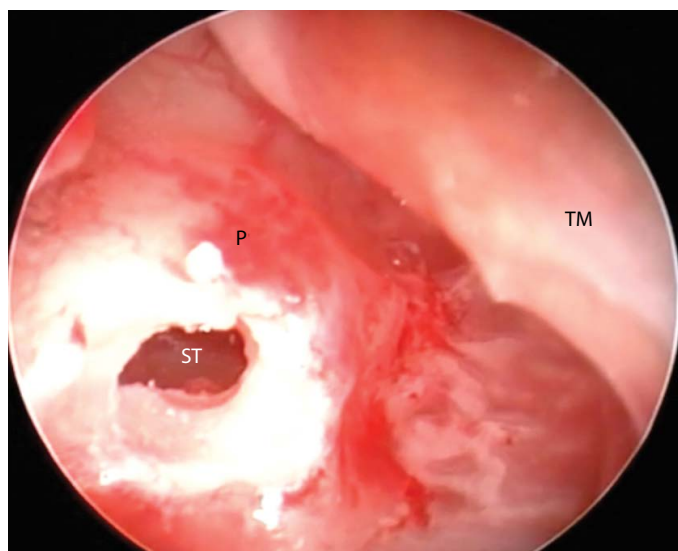
**Figure 1.** Round window and promontory were not exposed in the microscopic view.

EEC: External ear canal, ISJ: Incudo-stapedial joint, P: Promontory



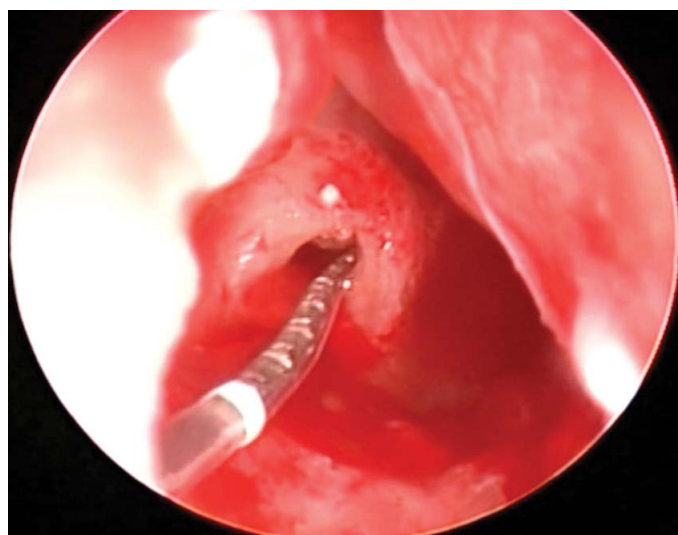
**Figure 2.** Endoscopic view shows removal of the round window niche using a diamond burr passed through the external ear canal.

ISJ: Incudo-stapedial joint, EEC: External ear canal



**Figure 3.** Endoscopic view shows round window cochleostomy.

ST: Scala tympani, TM: Tympanic membrane, P: Promontory



**Figure 4.** Endoscopic view, which is placed into the external ear canal, shows insertion of the electrodes through posterior tympanotomy.

**Table 1.** Patients' demographics

Patients	Gender	Age	Inner ear abnormality	Facial nerve location	Brand of implant	Other abnormalities
1	F	31 months	None	More anterior	Nucleus	High jugular bulb
2	F	16 years	None	More anterior	Nucleus	None
3	M	3 years	None	More anterior	Advanced Bionics	Waardenburg Syndrome, low middle fossa dura, high sigmoid sinus

F: female, M: male

nal. After elevating the tympanomeatal flap, a diamond burr was used to remove a niche of RW by exposing it using an endoscope (Figure 2). The antero-inferior bony portion of RW was removed by drilling, and scala tympani was reached (Figure 3). In the next step of the surgery, the receiver and stimulator of the implant were placed at the subperiosteal pocket. The endoscope was placed to the external ear canal, and electrodes were transferred through posterior tympanotomy. The electrode was inserted under endoscopic view (Figure 4).

## RESULTS

Three patients, aged between 2.5 and 16 years (2 females and 1 males), were included the study. The brands of implants were Nucleus (Cochlear Ltd., Lane Cove, Australia) in two cases and Advanced Bionic (Advanced Bionics Corp., Valencia, CA, USA) in one case. All the electrodes were fully inserted (Table 1). No major or minor complications were observed at an early or late period.

## DISCUSSION

In the standard technique, cochlear implant electrodes were inserted into the cochlea via the cortical mastoidectomy cavity and posterior tympanotomy. RW insertion using the posterior tympanotomy approach can be more challenging in some cases with limited visibility of the RW. This restricted exposition occurs in 11–22% of children, and conventional bony cochleostomy may then be required<sup>[4]</sup>. Facial nerve injury is the most concerning complication due to bony overhangs or an abnormal course of the facial nerve<sup>[4-6]</sup>. Since the avoidance of such complications is one of the major concerns of the surgeon, complementary techniques are considered. Hence, Kronenberg et al.<sup>[7]</sup> presented a suprameatal approach to avoid facial nerve injury. The ratio of facial paralysis following cochlear implantation has been reported as 0.07–1.1% in the literature, and most of these reported cases were delayed onset paralysis<sup>[8-10]</sup>. In our previous cochlear implantation case series, we did not observe early or immediate facial paralysis after cochlear implantation. Only one case had facial stimulation and a following facial paralysis at the second year of cochlear implantation. Therefore, we believe that facial paralysis is very rare with standard cochlear implantation technique by experienced clinics<sup>[11]</sup>.

Endoscopic ear surgery has been used for chronic otitis media with cholesteatoma in recent years<sup>[12-14]</sup>. Roughly at similar times, endoscopic cochlear implantation surgery was also reported, although it is a relatively new entity<sup>[15-17]</sup>. Hiraumi et al.<sup>[17]</sup> reported transcanal endoscopic cochlear implantation in temporal bone. Dia et al.<sup>[15]</sup> reported 25 cases of endoscopic cochlear implantation with an endoscopic transcanal technique from two different clinics. In this study, an electrode was inserted via a transcanal approach by an endoscope without mastoidectomy. They covered the electrode by a fascial graft at the external ear canal. In the following period, the electrodes were visualized at the external canal in 6 of 25 cases. Although they had no complication in these cases, it should be kept in mind that there may be a risk of infections, electrode exteriorization, etc. Marchioni et al.<sup>[16]</sup> reported six cases of cochlear implantation by endoscopic transcanal technique, but they created a small bone groove on the facial recess and also created an intramastoid tunnel parallel to the external ear canal from behind Henle's spine to the facial recess and connected to the bony groove. They inserted the electrodes through this tunnel to avoid the complications. This technique seems to be safer for an electrode at the external ear canal. Migirov et al.<sup>[3]</sup> used an endoscope with a microscope in their 13 case series. They performed cortical mastoidectomy in all cases. A small hole was created with the help of a microscope between the chorda tympani nerve and incus in order to access the middle ear in 7 cases. RW was visualized using an endoscope through the external ear canal and the electrode was transferred through the tunnel from the mastoid to the epitympanum. In another six cases, they modified the surgical technique, whereby a bony groove was created in the external ear canal and electrodes were inserted through this tunnel. Bone dust and temporal fascia were used for reconstructing the external ear canal defect to avoid cholesteatoma formation.

Most otologic surgeons concerns about endoscopic cochlear implantation are because it involves one-handed surgery, needs experience, and has no depth perception. But it is very useful for implantation in cases carrying an anatomical abnormality, including high sigmoid sinus, low middle fossa dura, narrow fascial recess, and facial nerve

with anomalies, in which it is not always possible to do surgery using a microscope.

As readers will notice, the present work describes an auxiliary technique, providing the visibility of RW and promontory. We did not aim to compare this technique with conventional microscopic technique. However, endoscopic assistance may help in cases with difficult anatomic variations and we believe that it may be helpful being in armamentarium for the surgeon. It should be kept in mind that the endoscopic-assisted approach should not be considered as a primary modality and should be preferred in only selected cases.

**Ethics Committee Approval:** Ethics committee approval was received for this study from the ethics committee of Istanbul University School of Medicine.

**Informed Consent:** Written informed consent was obtained from patients/patients' parents/ the parents of the patients/patient who participated in this study.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept - K.S.O., M.Ç.; Design - K.S.O., M.Ç.; Supervision - K.S.O., M.Ç., B.P.; Resources - B.P., S.Ç.; Materials - K.S.O., Y.G.; Data Collection and/or Processing - M.Ç., B.P.; Analysis and/or Interpretation - M.Ç., B.P.; Literature Search - K.S.O., M.Ç.; Writing Manuscript - K.S.O., M.Ç., S.Ç.; Critical Review - K.S.O., Y.G.; Other - S.Ç., B.P.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study has received no financial support.

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