Case report

Identification and revision of a displaced cochlear implant electrode in the internal auditory canal

Ingo Todt, Grit Rademacher, Arne Ernst

Department of Otolaryngology, Head and Neck Surgery and Radiology, Unfallkrankenhaus Berlin, Germany

Objective: The aim of the report is to underline the importance of a radiological technique which allows three-dimensional (3D) imaging of the cochlear implant electrode position postoperatively in cases of cochlear malformation, and to show a technique to prevent a repeat of cochlear implant electrode insertion in the internal auditory canal (IAC).
Clinical presentation: This report describes the management of a case of insertion of a cochlear implant electrode into the IAC in a 1.5-year-old patient with an incomplete partition (IP) III cochlear malformation.
Intervention and technique: The commonly used single plain postoperative X-ray is not sufficient to be certain of detecting the incorrect insertion of a cochlear implant electrode in the case of a malformed cochlea. In this case, 3D radiology allowed the incorrect insertion to be detected. The original cochlear implant electrode was temporarily left in place under the assumption that it would block the entrance to the IAC and prevent IAC insertion of the replacement electrode.
Conclusion: Postoperative 3D radiological observation after cochlear implant surgery should be done in cases of malformation. Leaving the original electrode in place can help to prevent a repeat electrode malinsertion.

Keywords: Cochlear implant, Cochlear malformation, IAC

Introduction

Displacement of an inserted cochlear implant electrode is a rare complication of cochlear implant surgery. Apart from variations of the intrascalar position and folding back of the tip of the array, the most commonly described sites of incorrect insertion are the hypotympanum, mistaken for the round window, and the semicircular canals as the result of an incorrect insertion angle (Tange *et al.,* 2006; Ramalingam *et al.,* 2009).

Malformed inner ears increase the risk of cochlear implant array displacement. The risk of displacement of an electrode array can be related to the type of malformation: incomplete partition type I (IP I), IP III, and common cavity malformations bear an increased risk of electrode insertion into the internal auditory canal (IAC) (Sennaroglu, 2010). In three different types of malformation, insertion of the array into the IAC has been described as follows: common cavities (McElveen *et al.,* 1997; Bloom *et al.,* 2008), IP III with an irregular ossification of the floor of the basal turn (Wooten *et al.,* 2006; Incesulu *et al.,* 2008), and cochlear hypoplasia (Tucci *et al.,* 1995). So far, reinsertion techniques have been rarely described (Bloom *et al.,* 2008; Wooten *et al.,* 2006) since the surgical technique itself and even the identification of an incorrect insertion can be challenging.

The aim of the present paper is to present a case of an IP III malformation with insertion of the electrode array into the IAC. The radiological and perioperative findings, the follow-up, and the surgical techniques are described in detail.

Correspondence to: Ingo Todt, Department of Otolaryngology, Unfallkrankenhaus Berlin, Warener Str. 7, D-12683 Berlin, Germany, Email: todt@gmx.net

Case report

A 1.5-year-old boy was referred to our clinic because he did not accept the cochlear implant (CI) after CI surgery in another center. Audiological fitting of the speech processor was unsuccessful. The child suffered from a severe sensorineural hearing loss without hearing/speech development.

An X-linked association could not be confirmed.

Flat panel-tomographic estimation of the electrode position showed a curled Nucleus Contour Advance array in a single plane (Fig. 1). However, three-dimensional (3D) radiological reconstruction of the array in the temporal bone showed a regular position of the array on the floor of the basal turn but without the

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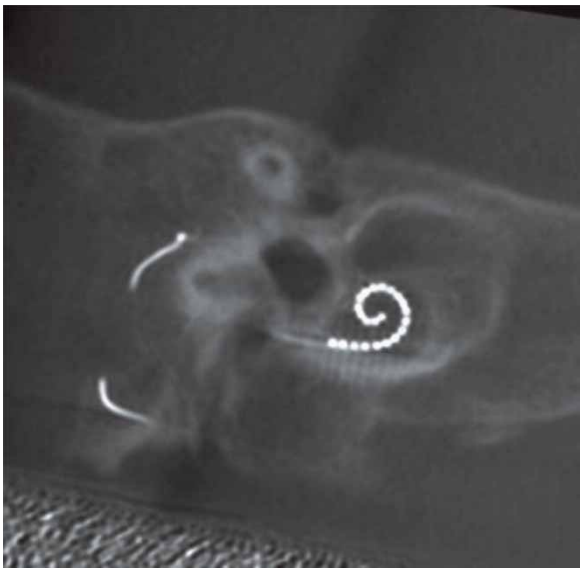

Figure 1 Contour advance electrode apparently curled within the cochlea (coronal plane).

normal ascent of the array entering the first turn. In fact, a downward deflection of the array into the IAC was found (Fig. 2a and b).

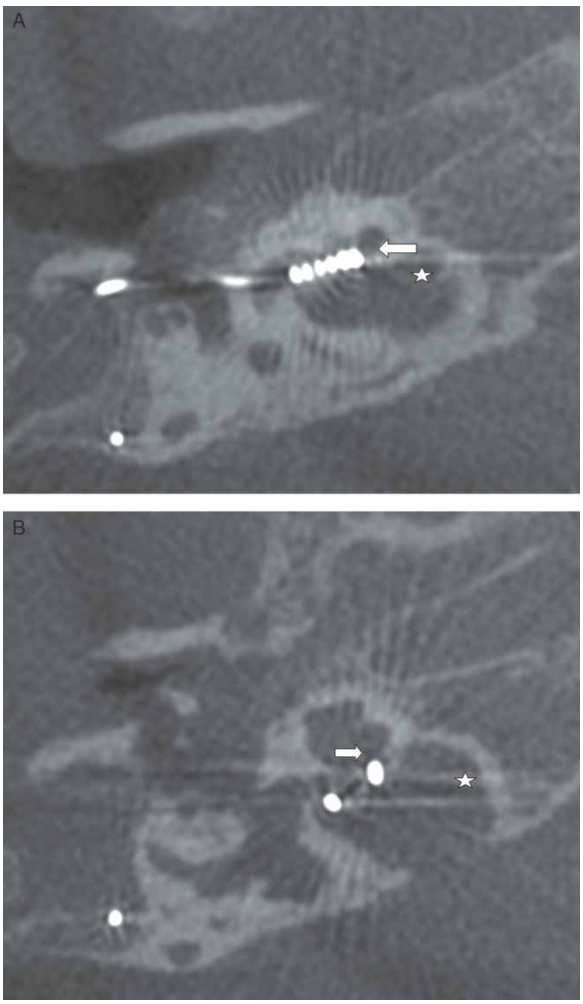

Figure 2 (a) Electrode in the basal turn (axial plane). (b) Passage of the electrode into the IAC (arrow indicates basal turn, star indicates IAC).

Surgery was begun by re-opening of the mastoid and the posterior tympanotomy. The electrode was cut off close to the entrance into the cochlea and left there as a positioner. The initial cochleostomy was found to be at or close to the round window.

A second cochleostomy was drilled anterior to the old electrode (Fig. 3). A gusher occurred and within the cochlea a basilar membrane was visible but no electrode contacts of the first array could be seen. The new electrode (Nucleus Advance) was inserted smoothly using the stylet (Fig. 4). Finally, the old electrode and stylet were pulled out and the round window/cochleostomy packed with fascia and covered with fibrin glue. Intraoperative measurements showed normal neural response telemetry (NRT) response levels only at the apical part of the electrode. Intraoperatively, a single plain X-ray showed normal curling of the new electrode in the cochlea. Flatpanel tomography confirmed the position of the array in

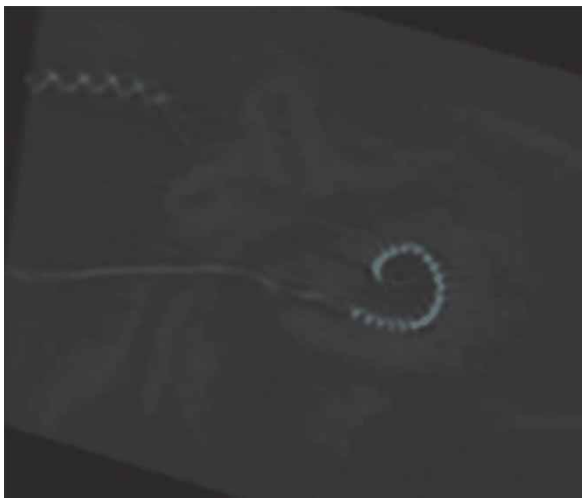

Figure 3 Second cochleostomy placed anterior to the first electrode (arrow indicates second cochleostomy).

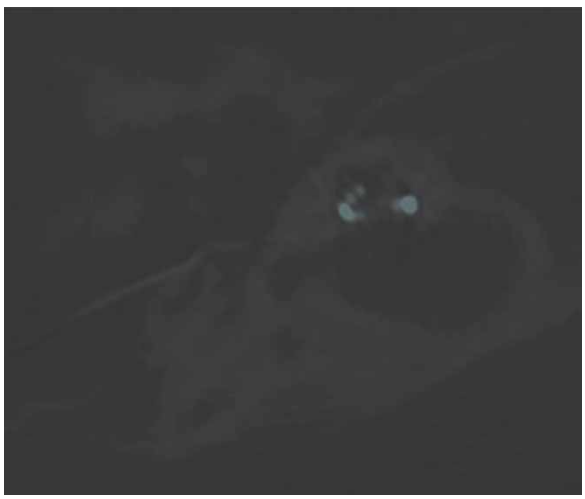

Figure 4 Both electrodes in place (first arrow indicates first electrode, second arrow indicates new electrode).

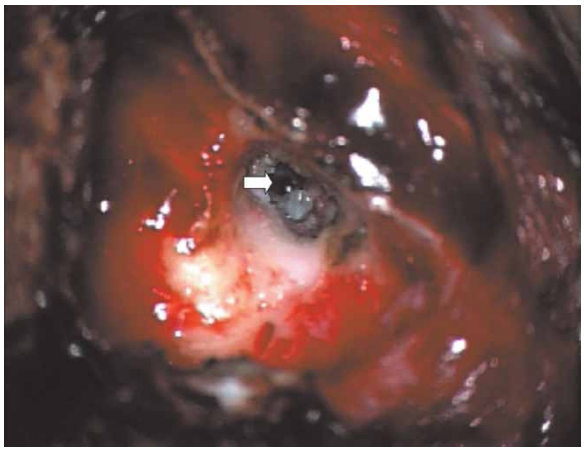

Figure 5 Curled Contour advance electrode after the revision.

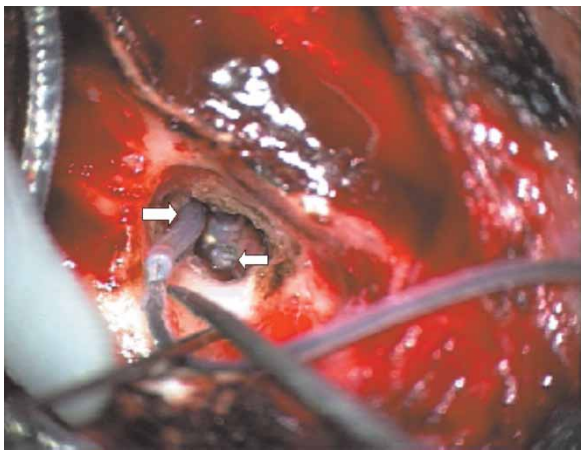

Figure 6 Ascending of the electrode (axial plane).

the scala vestibuli (Fig. 5). Radiological 3D reconstruction showed a correct insertion of the curled array in the first turn (Fig. 6).

The audiological programming of the speech processor (after a healing period of 6 weeks) was successful and the boy fully accepted the CI.

Discussion

Cochlear implantation in a malformed cochlea is associated with an increased risk of complications, e.g. facial nerve lesions, liquorrhoea, meningitis, and displacement of electrode arrays. Sennaroglu (2010) described a classification of cochlear malformations, including three different types of incomplete partition (IP).

Descriptions of IAC-displaced cochlear implant arrays are rare, but bear the risk of multiple insertion attempts (Bloom *et al.,* 2008).

Intraoperative radiological control in malformations is useful in guiding electrode insertion if an intraoperative 3D reconstruction of the array position can be performed (Bloom *et al.,* 2008). This is currently not the case in the majority of CI implanting centers. Relying only on plain postoperative radiography can carry potential medical and medico-legal risks for the surgeon. In our case, the combination of intraoperative findings (NRT, microscopically identified basilar membrane, and 2D X-ray) provided sufficient evidence that we had achieved a correct intracochlear position of the electrode array. Incesulu *et al.*, 2008 described pulling back of an IAC-positioned electrode to reposition the array in an IP III patient. Wooten *et al.*, 2006 used the drill-out technique in an IP III patient. The surgical technique of leaving in place the electrode originally positioned in the IAC in this case of IP III malformation should decrease the risk of repeating the false insertion. Removal of the original wrongly placed array and insertion of the new array into the previous cochleostomy could have led to a reinsertion into the route of the previously misplaced array. The radiographs done preoperatively at our institution showed the old electrode covering the floor of the basal turn so that we used it as positioner to guide the new electrode intracochlearly. The old electrode was left in place while inserting the new one. In this way, the IAC was covered and we could be confident that we were not repeating the previous incorrect insertion.

In our case, it was not clear from the radiology if it was a type I or III IP (Sennaroglu, 2010). In contrast to IP II, these both types have a defect between IAC and cochlea. IP I should have no intracochlear septae. During surgery we were able to identify the basilar membrane, after opening the scala vestibule, but were not able to identify any sign of the electrode array or contacts. This confirmed that this was an IP III case based on the current classification (Sennaroglu, 2010). Intraoperative NRT measurements with normal NRT levels at the apical contacts and a normal intraoperative 2D X-ray with a correct curling angle of the array confirmed a correct position. The preoperative 2D Stenvers view showed a curled Nucleus advance array, which was initially interpreted as a normal curling. Only on reviewing the film was an unusual high curling angle identified. The axial view finally identified the IAC position of the electrode. Review of the radiology shows that a radiological procedure which allows 3D imaging by reconstruction (flat panel tomography, digital volume tomography (DVT), multi slice computer tomography (MSCT)) is strongly recommended postoperatively in this kind of malformation to identify a displaced electrode.

We usually perform a postoperative flat panel tomography for all CI patients at our center and do it for all CI patients admitted to our center for special cases.

Conclusion

This case describes the technique of leaving the electrode incorrectly inserted into the IAC in place. This was helpful during the revision procedure, in order to prevent reinsertion of the new electrode into the IAC. Postinsertional radiological axial and coronal

views are strongly recommended for cases of cochlear malformation with the risk of an IAC displacement.

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