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CASE REPORT

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Cochlear reimplantation from mid-scala to lateral wall electrode array: Surgical and hearing outcome

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Abstract

A mid-scala cochlear implant electrode array, which was inserted with an atraumatic round window approach, could be replaced with longer lateral wall electrode array. Deeper electrode insertion seems to have beneficial influence on the hearing quality.

KEYWORDS

cochlear reimplantation, deeper insertion, device failure, fibrous tissue, lateral wall electrode array, mid-scala electrode array

1 | INTRODUCTION

It is unclear which electrode array design is optimal in cochlear implantation. Insight could be gained from a patient who has a different implant reimplanted in the same ear following device failure. However, the new device is usually from the same manufacturer not only because of the electrode design, which offers similar insertion depth and position but also offers the sound coding strategy that the patient is used to.[1] To the authors' best knowledge, there are no scientific reports on changing devices for reimplantation surgery from precurved mid-scala electrode array (MS-EA) to straight lateral wall (LW-EA) longer length electrode array. The greatest surgical challenge in such cases is potentially fibrous tissue due to the previous implantation, which could collapse and occlude the cochlear lumen.[2] With this background information, we would like to present the following case report.

2 | CASE REPORT

In 2017, a 38-year woman with Usher's syndrome and progressive bilateral asymmetrical sensorineural hearing loss who no longer had benefit from conventional hearing aid on her right ear was unilaterally implanted at a tertiary referral center with HiRes™ Ultra (Advanced Bionics), cochlear implant (CI) with MS-EA. Postoperative computer tomography (CT) showed an angular electrode array insertion depth of 360° covering the cochlear basal turn. In the axial view, the apical portion of the MS-EA appeared to have translocated from the scala tympani to the scala vestibuli as shown in Figure 1A. The hearing performance one year after the first implantation as determined by the Hochmair-Schulz-Moser (HSM) sentences test in noise[3] was 73.58% correct, and 60% correct on the German Freiburg monosyllabic word test in quiet[4] (Figure 2).

Three years later, the patient presented at our clinic reporting a decrease in hearing performance. The HSM test score in noise had dropped to 31% correct and the German Freiburg monosyllabic word score in quiet to 45% correct. An implant check showed the typical constellation of electrophysiological measurements including low electrode impedances in combination with lack of increase in loudness growth perception, suggesting technical device failure as already published in a similar case with this implant series.[5] Detailed unbiased counseling about all technical options and surgical risks has been carried out. The patient was concerned that the problem with the hermetic seal may not have been successfully resolved with the new implant series and therefore chose to change the device manufacturer and hereby the electrode array type (Synchrony 2 implant coupled with FLEX^{28} electrode, MED-EL). One of our concerns was the implantation of a longer length LW-EA in a

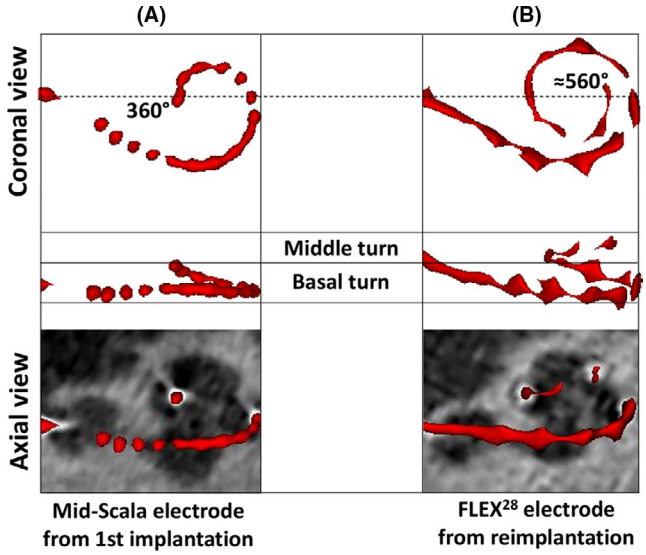

FIGURE 1 Postoperative CT images from the first implantation (A) and the reimplantation (B) showing the electrode array angular insertion depth and scalar position. Three-dimensional segmentation of the electrode array was performed using advanced free and open-source software 3D Slicer (version 4.10.2; https://www.slicer.org/)

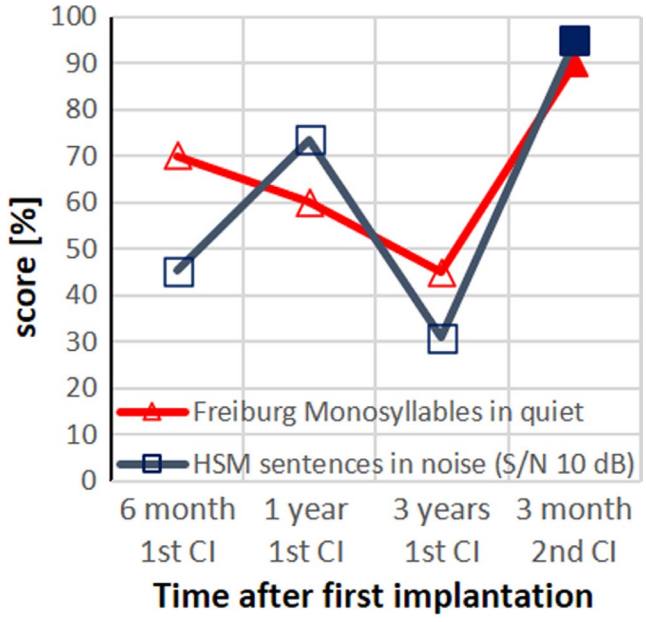

FIGURE 2 Speech comprehension scores with the first implant (open symbols) and with the reimplanted device (filled symbols). The German Freiburg Monosyllables and Hochmair-Schulz-Moser (HSM) sentences test in quiet and in noise (10 dB SNR) were used as test battery

case previously implanted with a MS-EA with scalar translocation. Intraoperatively after explantation of the MS-EA, we administered a mixture of hyaluronic acid (2 mg/mL) and dexamethasone (8 mg/mL) intracochlearly to reduce friction forces and to protect the neural structures. Cochlear patency was checked with an insertion probe, as shown in Figure 3. Its flexible end was inserted without resistance to its full length (31.5 mm), and the FLEX[28] was subsequently also fully inserted. Postreimplantation, the CT image showed electrode array position with an angular insertion depth of approximately 560° as shown in Figure 1B. In the axial view, the FLEX[28] electrode array appears to follow the same path as that of the MS-EA from the previous implantation. The hearing performance has rapidly improved, and after three months, scores were similar to those with the first CI before the technical failure was diagnosed (Figure 2). Vestibular function remained intact. With the second implant, the patient reported hearing quality more similar to the contralateral ear, aided with a conventional hearing aid. We administered the Med El Hearing Implant Sound Quality Index Questionnaire ($HISQUI_{19}$) with a result of 95, which describes a good sound quality.[6] The test of the explanted CI confirmed device failure due to an electrode short in the electrode pocket.

3 | DISCUSSION

This case report shows that it is possible to insert a longer LW-EA in a cochlea following explantation of a precurved MS-EA due to device failure. Technical device failure is the most common indication for CI revision surgery in adults.[7] A recent systematic review paper showed that despite constant advances in CI technology, the failure rate has not significantly changed since 1982 with an overall rate of 5.5%.[8] This underlines the importance of applying soft surgical techniques and choosing atraumatic electrode arrays at the first implantation, which minimize intracochlear trauma and reactive scare tissue formation. The round window insertion during the previous surgery contributed essentially to the success of the second surgery. The use of an insertion probe to check the cochlear patency aids electrode selection especially when the electrode design has to be changed.

The considerably deeper electrode array insertion did not lead to significant quantitative difference in the hearing outcome compared with the first CI (Figure 2). However, subjectively the reimplantation enabled better hearing quality. This difference could be the result of electrical stimulation covering a greater number of neuronal cell bodies. Literature reports that almost 25% of the total number of spiral ganglion neuronal bodies are distributed beyond the basal turn of the cochlea.[9] A recent report on CI reimplantation in five subjects implanted with the same CI but with shallower electrode array insertion in the reimplantation surgery resulted in inferior hearing performance compared to the first implantation.[10]

Another potential explanation for this subjective perception could be the wider contact separation distance of 2.1 mm between the electrode channels in the FLEX[28] electrode array, which may minimize the cross-channel interaction.

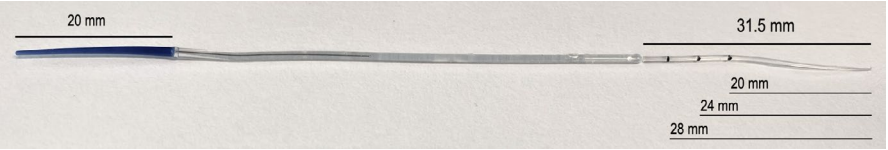

FIGURE 3 Insertion probe with one end being flexible to check the patency of cochlear lumen (right side) and the other end being stiff to widen the fibrotic sheath (left side) (MED-EL)

Finally, besides of the electrode array position and insertion depth, there are also other factors such as the signal coding strategy that could influence the hearing quality. Therefore, findings from this single case should be carefully evaluated in further similar cases.

4 | CONCLUSION

Cochlear reimplantation from precurved mid-scala to longer straight lateral wall electrode array is possible. An important requirement is atraumatic electrode insertion during the first implantation. An insertion probe with similar properties to the flexible electrode array enables reliable intraoperative assessment of the cochlear patency. Despite insignificant difference in the quantitative hearing outcome between the two different electrode array designs, it seems that deeper insertion could have beneficial influence on the hearing quality.

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Published with written consent of the patient.

CONFLICT OF INTEREST
The authors have no conflict of interest to declare.

AUTHOR CONTRIBUTIONS
SL: designed the study and wrote the manuscript with input of all authors. NZ: collected the data and analyzed the hearing outcome. RH: involved in cochlear implant fitting and data interpretation. PJ: reviewed the literature and helped drafting the manuscript. MB: performed the surgery and supervised the study. All authors discussed the results and contributed to the final manuscript.

ETHICAL STATEMENT
The patient's consent is available in the medical record and with the corresponding author.

DATA AVAILABILITY STATEMENT
All data regarding the above case are presented within this manuscript.

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