The Journal of Laryngology and Otology
September 1996, Vol. **110,** pp. 881–883

Explantation of a nucleus multichannel cochlear implant and re-implantation into the contralateral ear. A case report of a new strategy

STEFAN MAAS*, MANOHAR BANCE M.SC., F.R.C.S.(C)*, MARTIN O'DRISCOLL, M.SC.†, DEBORAH MAWMAN†, RICHARD T. RAMSDEN, F.R.C.S.*

Abstract

We present a unique case in which a multichannel cochlear implant device was explanted and the same device was re-implanted into the contralateral ear. A patient with bilateral total deafness secondary to head injury received an implant in his left ear but developed severe facial nerve stimulation. Because this stimulation could not be eliminated effectively with change of programming, it was decided to implant the contralateral ear. Since the device itself was functioning well, it was explanted from the left ear and re-implanted successfully into the right ear. Facial nerve stimulation was minimal in this ear and the patient demonstrated very good speech discrimination. To our knowledge, this is the first description of this strategy.

Key words: Cochlear implant, complications; Facial nerve; Temporal bone; Fractures

Introduction

Cochlear implantation is now an accepted and well established mode of rehabilitation for certain groups of profoundly deaf or deafened individuals (Summerfield and Marshall, 1995). The majority of carefully selected post-lingually deafened adults may be expected to augment their communication skills by enhancing their lip-reading abilities or even by audition alone in favourable acoustic surroundings. Nevertheless, there are some individuals who do less well than others, or who experience unwanted side-effects from electrical stimulation of the cochlea.

The factors which may influence outcome relate to duration of deafness, neuronal survival, central processing and cognitive abilities, as well as factors inherent in the device, especially extent of insertion, programming strategies and limitations of stimulation frequency. Cochlear implantation has also been shown to be a safe surgical procedure with few immediate or long-term complications (Babighian, 1993). Unwanted effects include electrical stimulation of the facial nerve. This may result from current spread from electrodes which lie outside the cochlea, and if so, can be corrected by programming out the channels which stimulate the nerve. Alternatively, it may result from current spread from electrodes which are well situated inside the cochlea. Otosclerosis and temporal bone fracture are the two conditions which are most likely to be associated with this phenomenon. We present a case of cochlear implantation following skull fracture in which stimulation of the facial nerve was so marked as virtually to prevent day to day use of the device. A normally functioning device was explanted and at the same operation re-implanted into the contralateral ear with a good result. As far as we have been able to determine this is the first account of such a strategy.

Case report

A 70-year-old man was left with total bilateral sensorineural deafness, following a cycling accident two years earlier in which he was presumed to have sustained a skull base fracture. Prior to his accident he described his hearing as being normal. At the time of the injury, he developed left CSF otorhinorrhoea which settled on conservative management. He had no facial weakness. There was no evidence of vestibular dysfunction at the time of our evaluation and the patient was otherwise healthy.

He was evaluated and considered a suitable candidate for cochlear implantation. High definition CT scanning of the temporal bones at the time of evaluation did not reveal any fractures and indicated patent cochleas on both sides. The patient underwent electrical stimulation of the ear canal which revealed good auditory responses at 85 and 125 Hz in both ears. Promontory stimulation was not performed. The patient preferred the left side for implantation because he felt it would be easier for him to use the telephone.

Prior to implantation, the patient was a poor lipreader and relied on his wife to interpret information for him. His score on pre-operative tests of lip-reading ability using the Bamford Kowal Bench (BKB) sentences was 0 per cent. He was well motivated and psychological evaluation revealed no adverse features. The short duration of his total deafness was considered a good prognostic parameter.

The original intention was to insert a Med-El Combi 40 cochlear implant device. At surgery it proved impossible to insert this either via cochleostomy into the scala tympani or via scala vestibuli fenestration because the anterior part of the basal turn of the cochlea was narrowed by new bone deposition. We were, however, able to insert all 22

From the Department of Otolaryngology*, Manchester Royal Infirmary, and the Manchester Cochlear Implant Programme†, Centre for Audiology, University of Manchester, Manchester, UK.
Accepted for publication: 16 June 1996.

channels of the narrower Nucleus 22 cochlear implant device into the scala tympani via a basal turn cochleostomy. Post-operative plain X-rays showed normal position of the implant.

On the third post-operative day, a routine electrode check was carried out. Stimulation in common ground mode and bipolar +1 (BP+1) mode resulted in facial twitching on all electrodes, more noticeable at the apical end of the electrode array. The implant was switched on one month after surgery. Stimulation in BP+3 mode produced facial nerve stimulation on all electrodes, more noticeable at the basal and apical ends of the array. These channels were switched off. It was only possible to programme five active channels in the middle of the array, and these only to a medium soft loudness percept.

Wider modes of stimulation failed to improve the overall percept of sound or eradicate the problems of facial stimulation. At one month the patient was able to identify 7.5/20 common environmental sounds. Connected discourse tracking (Tye-Murray and Tyler, 1988) scores showed an enhancement in his lip-reading skills using the implant, but no open set speech discrimination was achieved. The limiting factor in his performance was our inability to provide an optimal programme due to facial nerve stimulation. Because the patient was in danger of becoming a non-user, it was felt that implantation of the contralateral ear warranted serious consideration. It was felt that this might circumvent the problem of facial nerve stimulation and allow better programming of the implant. One option would have been to implant a new device in his contralateral ear. However, this would have involved substantial further expense. Since the device already in place was technically undamaged, we considered the option of explanting this device and re-implanting it into the contralateral ear. This was discussed carefully with the patient, who accepted this option.

At the time of the second surgery, it was noted that there was dense fibrous tissue filling the mastoid and surrounding the electrode array. This was carefully dissected off the electrode array. At the level of the posterior tympanotomy, the fibrous tissue gave way to the middle ear space which was lined with thin endothelium.

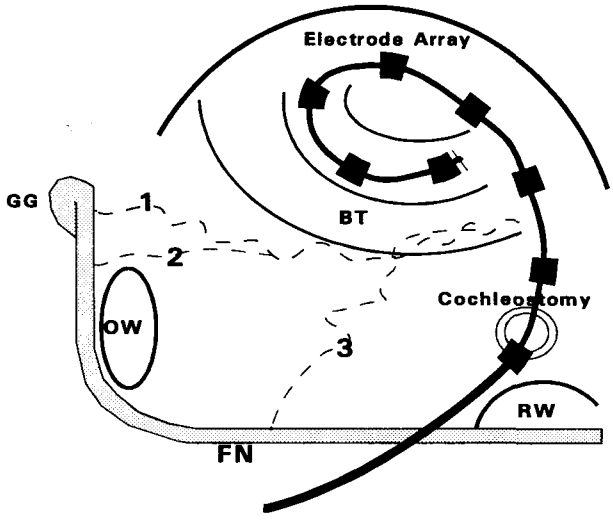

FIG. 1

Possible pathways for current spread along microfracture lines. Pathway 1 leads to the geniculate ganglion (GG), pathway 2 to the horizontal portion of the facial nerve (FN), and pathway 3 to the vertical portion of the facial nerve. Not shown is a possible pathway to the lateral end of the internal auditory canal. RW = round window, OW = oval window, BT = basal turn of cochlea.

The electrode array was easily removed from the cochlea without apparent damage. All 22 electrodes of the same device were then easily inserted into the right scala tympani via a standard posterior tympanotomy cochleostomy approach. Post-operative X-rays again showed good electrode position.

Following this relocation, a successful switch on was achieved using a BP+1 mode of stimulation. Only one electrode produced facial nerve stimulation, and this was switched off. The remaining electrodes were successfully programmed. At one month the patient was able to identify 17.5/20 of everyday sounds and connected discourse tracking revealed a high level of open set speech discrimination. Four months after implant relocation the patient reported a loss of clarity of sound. Integrity tests of implant function were normal. Reprogramming using different stimulation modes and pulse widths failed to improve the sound perception. However, at his nine month assessment, he scored 90 per cent using BKB sentences in the implant alone condition.

Discussion

The Manchester cochlear implant programme was established in 1988 and the paediatric programme in 1990. To date, we have implanted 95 adult and 42 paediatric patients. Although facial nerve stimulation following cochlear implantation is well described in otosclerosis (Shea and Domico, 1994), we can find no reference in the literature to the occurrence of this complication in temporal bone fractures. Hypothetically, such unwanted stimulation could result from cross current spread through the low electrical resistance of the fracture line(s) or otospongiotic bone. Figure 1 illustrates some possible pathways for current spread from the electrode array to the facial nerve. One possible pathway not illustrated is that from the cochlea to the lateral end of the internal auditory meatus. It is interesting to speculate why in this patient there was such marked facial nerve stimulation in the absence of fracture lines on the CT scan. It may be that the size of the fracture line is not as important as its location. It is possible that very small fractures (beyond the resolution of the CT scanner) are significant if they pass very close to the facial nerve. There may have been a fracture line at the site of osteoneogenesis in the basal turn leading to the geniculate ganglion in the left ear (pathway 1 in Figure 1). This is the suggested mechanism in this case. Interestingly, there is some support for this hypothesis from a report of facial nerve stimulation arising after cochlear implantation following middle fossa resection of an acoustic neuroma (Tsuboi *et al.*, 1996). In this case, there was a small defect of the cochlear capsule which was presumed to be due to a small defect of the cochlear capsule, which was presumed to be secondary to surgical trauma or the tumour. It was suggested that this may have led to a low impedance current pathway from the scala tympani to the internal auditory canal or labyrinthine segments of the facial nerve.

An unusual combination of factors allowed us to use our explant/re-implant strategy in this case. It is unusual to be faced with both a functioning implant and failure of use secondary to local factors in the implanted ear. More commonly, the factors causing failure (such as poor motivation, poor cerebral plasticity) would not be mitigated by changing the side of implantation.

There is a natural reluctance to jeopardize the results of the second implantation by re-using an implant, with all the attendant trauma to the device of explantation and re-implantation. Nevertheless, with current funding problems, the economic advantage of reusing the implant are

https://doi.org/10.1017/S0022215100135236 Published online by Cambridge University Press

substantial. In this case, the results of the second implant were very good and seem to justify our decision. No damage was demonstrable to the device from the re-implantation procedure.

It may be argued that the loss of clarity experienced four months after the second implant may be a sign of subtle damage to the implant. If this is the case, however, it is unlikely to be related to the surgery since it occurred so late after re-implantation. The patient continues to derive great benefit from his (re)implant and maintains a high level of performance on objective testing despite this subjective symptom.

Conclusion

In suitable cases, explantation of a cochlear implant and its re-implantation into the contralateral ear is an effective strategy, both clinically and economically. We suggest that this strategy should be considered as a viable option.

References

Babighian, G. (1993) Problems in cochlear implant surgery. In *Cochlear Implants: New Perspectives.* (Fraysse, B., Geguine, O., eds.). Basel: Karger, 1993: pp 65–69.

Shea, J. J., Domico, E. H. (1994) Facial nerve stimulation after successful multichannel cochlear implantation. *American Journal of Otology* **15:** 752–756.

Summerfield, A. Q., Marshall, D. H. Cochlear implantation in the UK 1990–1994. Report by the MRC Institute of Hearing Research on the evaluation of the National Cochlear Implant Programme.

Tsuboi, Y., Tetsuya, T., Yasuaki, U., Morimitsu, T. (1996) Facial nerve stimulation following cochlear implant. Abstract in Proceedings of the Politzer Society Meeting, Budapest.

Tye-Murray, N., Tyler, R. S. (1988) A critique of continuous discourse tracking as a test procedure. *Journal of Speech and Hearing Disorders* **53:** 226–231.

Address for correspondence:
Professor R. T. Ramsden,
Department of Otolaryngology,
Manchester Royal Infirmary,
Oxford Road,
Manchester M13 9WL.

https://doi.org/10.1017/S0022215100135236 Published online by Cambridge University Press