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# A new incision for placement of cochlear implants

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**Abstract**

A straight, vertical post-aural incision for the 'Cochlear' multichannel cochlear implant has been evaluated in 52 patients (20 adults and 32 children). Nineteen of the children were under three years of age and five of these were under two years of age.

The 7 cm long incision is placed approximately 3 mm behind the post-auricular crease and runs from the tip of the mastoid to a point 3 cm above the superior attachment of the pinna. The incision heals within several days.

Because the incision is straight interruption of the blood supply to the flaps raised is the least possible. This also minimizes the possibility of scalp necrosis and implant extrusion. The likelihood of infection is reduced by the small size of the incision, minimal soft tissue dissection and small amount of dead space. Rapid healing has occurred in all cases despite infection in one.

**Key words: Cochlear implant; Surgery; Wound infection**

## Introduction

Several incisions have been utilized to place 'Cochlear' brand cochlear implants. These incisions are based on the concept that there should be a wide exposure of the entire cochlear implant when situated on the surface of the skull. To gain this exposure, the following incisions have been used.

(1) A 'C' shaped incision which passes behind the site for the body of the cochlear implant to raise an anteriorly based flap. This incision can compromise the blood supply of the flap especially if the width of the flap exceeds the length of its base. There have been several reports of necrosis of the flap after this incision (Harris and Cueva, 1987; Cohen *et al.*, 1988; Haberkamp and Schwaber, 1992; Harrison and Gibson, 1992). In particular, this incision would seem to be particularly unsuitable in a patient with a previous post-aural incision (Harris and Cueva, 1987) because of interference with the blood supply of the flap by the previous incision.

(2) An 'inverted U' incision (Clark *et al.*, 1979) to create an inferiorly-based post-auricular flap. It can be quite difficult to retract the edges of the incision sufficiently to gain good exposure of the mastoid. Post-operative numbness of an area of scalp superior to the horizontal arm can be a cause of complaint by patients. Necrosis and implant extrusion have also reported using this incision (El-Naggar and Hawthorne, 1995).

(3) Others have utilized an extended endaural incision with a horizontal posterior arm (Franz *et al.*, 1989). This incision gives good exposure of the mastoid tip but usually opens into the external auditory canal. The canal normally harbours commensals but, especially in those who have been using hearing aids, is often contaminated with pathogens even if there is not overt otitis externa. Therefore opening into it may increase the risk of infection of the operative site. Numbness of the scalp can be a problem with this incision also.

Because of his concerns with the problems associated with these incisions, one of the authors (W.P.R.G.) evaluated an almost straight post-aural incision which began 2 cm behind the tip of the mastoid and extended upwards and posteriorly so that it passed behind the site for the body of the implant. This incision required powerful retraction of the scalp edges which occasionally resulted in significant post-operative pain.

Dissatisfaction with all these incisions led to the development of a smaller incision placed almost in the post-auricular crease. Initially the incision extended from the tip of the mastoid to 3 cm above the superior attachment of the pinna but it was soon

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found that the incision could be quite small and still allow sufficient posterior scalp edge retraction to make placement of the implant possible without difficulty.

## Method

The method described has been used solely to place 'Cochlear' brand cochlear implants.

After preliminary infiltration with vasoconstrictor and local anaesthetic, a vertical incision about 7 cm long is made through the skin and subcutaneous tissues approximately 3–4 mm behind the post-auricular crease (Figure 1). The incision extends from the tip of the mastoid to a point about 3 cm above the superior attachment of the pinna. The temporalis fascia and periosteum are exposed and then the subcutaneous tissues are elevated from them both anteriorly for about 2 mm and posteriorly for about 8 mm. Posteriorly the superior and inferior ends are 'squared off' (Figure 2). This allows a vertical incision through the whole length of the exposed deeper tissues (muscle and periosteum) to be made approximately 5 mm posterior to the skin incision (Figure 3). The periosteum is then elevated from the surface of the mastoid anteriorly to the external auditory canal (but without elevation of canal wall skin) and to the mastoid tip; then from the skull posteriorly above the temporo-parietal suture with minimal elevation from the suture line itself (the periosteum is attached to this suture line and it is difficult to extend the dissection inferiorly). By remaining largely above the suture, the possibility of bleeding from emissary veins is minimal; should bleeding occur, caution should be taken when using the monopolar diathermy on the surface of the skull in very young children as the effect of the diathermy can extend through the thin bone into the intracranial tissues (bone wax is preferable).

Next a pocket for the body of the implant is fashioned immediately above the temporo-parietal suture and behind the line of the incision in the deeper tissues between the periosteum and bone (Figure 4). It is possible to make a blunt dissection with the finger in children but a periosteal elevator often has to be utilized in adults because the periosteum is more adherent than in children.

The incision can then be held open with a standard mastoid retractor. The authors use a Cawthorne or a Fisch retractor.

The mastoid is opened, a posterior tympanotomy fashioned and the round window exposed. The authors try to avoid exposing the sheath of the facial nerve as this could predispose to facial paresis should the implant ever have to be exchanged for another.

After resetting the mastoid retractors the site for the body of the implant (Figure 5) is drilled (the

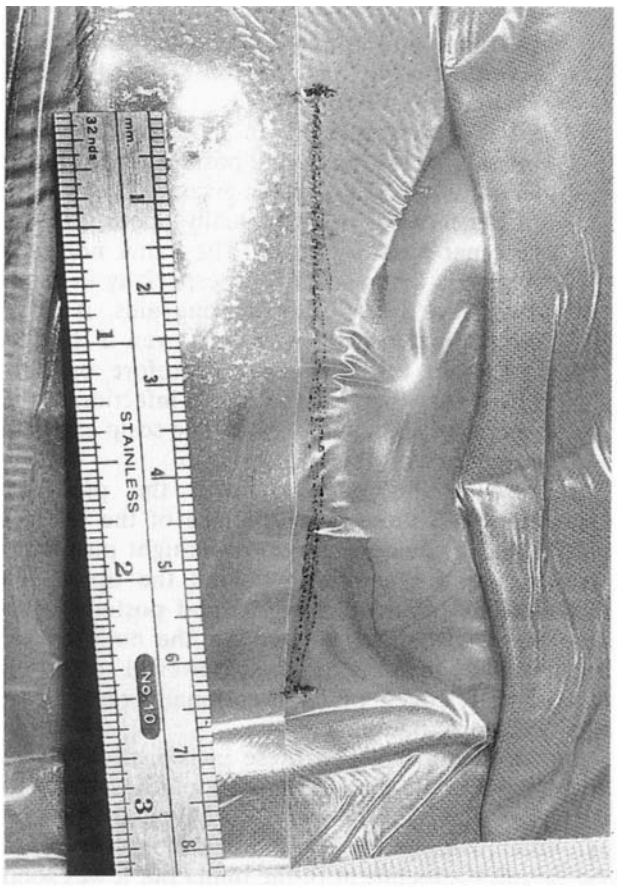


FIG. 1

Surface marking for 7 cm vertical incision through skin and subcutaneous tissues 3–4 mm behind post-auricular crease of a 22-month-old girl. All Figures from the same patient.

FIG. 2

Elevation of subcutaneous tissues 'squared off' superiorly and inferiorly.

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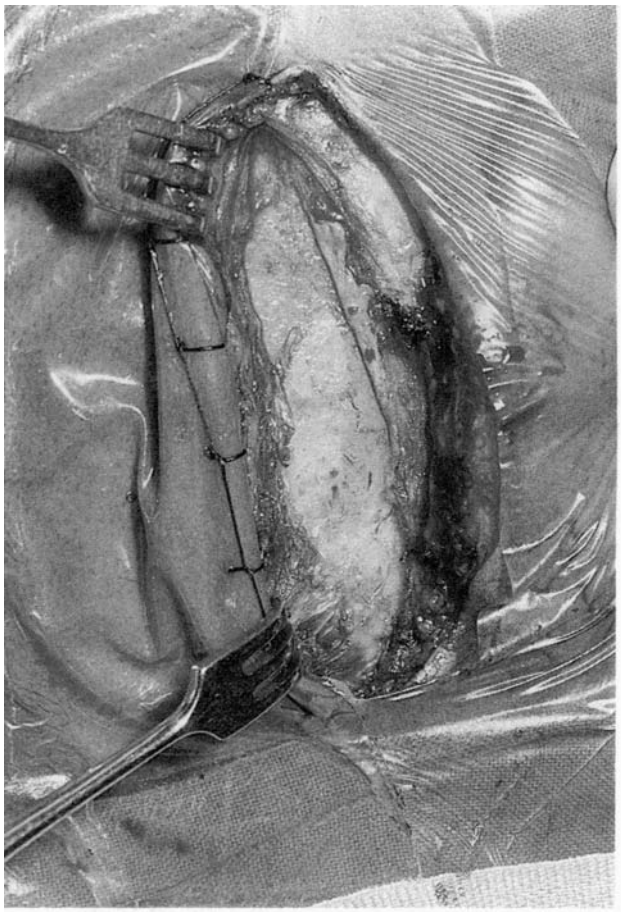

FIG. 3
Vertical incision through periosteum and muscle 5 mm posterior to the skin incision.

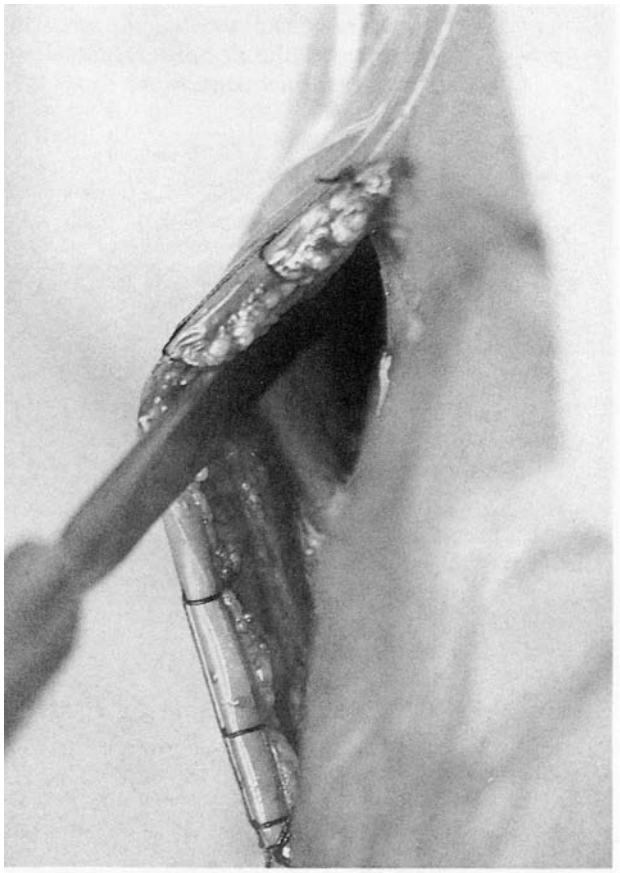

FIG. 4
Pocket for body of implant deep to periosteum above temporo-parietal suture.

authors drill down to dura leaving a thinned central 'island' of bone) with the outer rim being of slightly smaller diameter than the inner rim to aid retention of the implant. The authors use cutting burrs to drill the site and protect the dura by holding it medially, away from the burr, with a small duck-billed elevator; they have never torn the dura but care should be exercised if this technique is used. A 'canal' for the electrode array is fashioned between this site and the mastoid cavity (Figure 5); the 'canal' should be deep (down to dura and lateral sinus posteriorly) with straight or, if possible, overhanging sides so that the array will stay in it. The implant is then inserted (Figure 6), the fit being snug so that it stays in place as well as possible and the incision is adequate to allow placement of ties to aid retention. The electrode array is positioned to run a tortuous course deep to the margins of the mastoid cavity (Figure 6) which are not bevelled and therefore, being straight or overhanging, may serve to retain the array without use of sutures. However, it is possible to drill holes in the skull for stay sutures, if the surgeon wishes to place them to secure the implant body or the electrode array, and care should be taken to ensure that neither the body of the implant nor the electrode array has any tendency to lift beneath the flap as this may eventually result in extrusion or sinus formation. It may be important that the implant be positioned fairly deeply in the skull to minimize tension on the closure of the deeper tissues; this is one reason for the authors' technique of drilling the site down to dura.

Closure is in two layers - periosteum or muscle (which is important) and skin; the skin is closed with interrupted subcuticular sutures. The authors use plain catgut or 'Vicryl' for all sutures. The closure is reinforced with adhesive surgical tapes such as 'Steristrips' and a pressure dressing applied until the next morning when it is removed. Many patiens go home that morning.

The healed incision is unobtrusive.

The new modified straight post-aural incision for the insertion of cochlear implants has been used by the authors in 20 adults and 32 children. Nineteen of the children were under three years of age and, of these, five were under two years of age. It has also been used by others for two adults and three children with one of the authors (W.P.R.G.) in attendance.

Healing in all patients has been rapid with the skin incision healed by the fifth post-operative day. There has been only one complication to date which was an infection in an adult which settled after antibiotic therapy.

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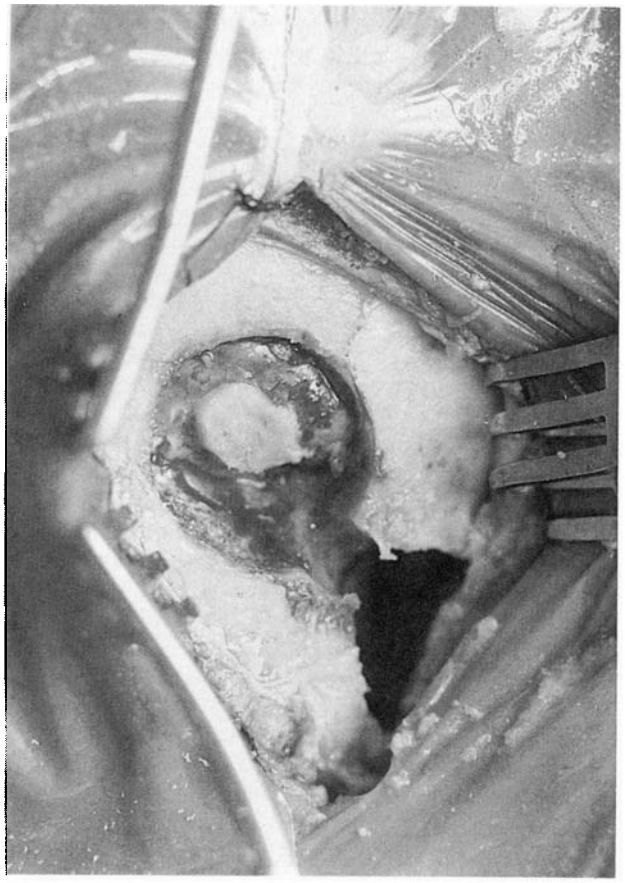

FIG. 5
Site drilled for body of implant with bony 'canal' connecting it to mastoid cavity.

FIG. 6
Implant in situ with electrode array coursing tortously through mastoidectomy cavity to posterior tympanotomy.

## Discussion

The most common complications of cochlear implant surgery involve haematoma formation, infection and necrosis of the incision and flap used to cover the implant and consequent extrusion of the implant which can require its removal (Cohen *et al.*, 1988; Harrison and Gibson, 1992) or re-siting (Haberkamp and Schwaber, 1992).

The new straight post-aural incision minimizes any risk of compromising the blood supply in contrast to the other commonly used incisions which interrupt blood supply to the flap on at least two sides. These incisions are also relatively long so that satifactory access for cochlear implantation using them requires the lifting of large flaps of skin, subcutaneous tissue, muscle and periosteum with inherent risks of haematoma formation and consequent infection.

The total length of the new incision is usually only about 7 cm but one of the advantages of this incision is that it can easily be extended if the initial exposure is inadequate. The minimal retraction of the scalp and deeper tissues plus minimal soft tissue dissection lessen post-operative pain considerably.

The incision involves a major conceptual change. Previously surgeons had designed flaps which avoided the incision passing over any part of the implant or its array but this incision does so. The skin incision crosses the mastoidectomy anteriorly but the array is deep to the incision at this point. The body of the implant is accommodated in a pocket situated behind the skin incision because the incision is stepped between the periosteum and skin. Thus the periosteal incision crosses the body of the implant but the skin incision does not. The electrode array passes, in a bony 'canal' (Figure 5) then through the mastiod cavity (Figure 6), deep to the incision and is also separated from the skin by periosteum and muscle and subcutaneous tissue. In this way no part of the implant lies close to the undersurface of the skin incision and the risk of erosion of it is minimized.

The pocket for the body of the implant is situated beneath a flap of periosteum, muscle, subcutaneous tissue and skin which is well vascularized because its blood supply is interrupted only at the base of the flap. The periosteal layer of the flap is attached to bone all around the implant except in the line of the incision in the periosteum and this, plus minimal dead space make significant haematoma formation unlikely. These factors provide more security against extrusion than other incisions involving the raising of wide flaps using curved incisions.

The new incision is suited for use in patients with a pre-existing post-aural incision which cna be incorporated in it.

Initially the authors were cautious in utilizing the new incision for very young children but subsequent experience has shown that the limited incision works especially well for these children and it has been

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used successfully in a 14-month-old child. To minimize the risk of extrusion when using the 'C' incision, two of the authors have previously advised of the desirability of bending the body of the implant in its middle in very young children so that it will better conform to the curvature of the skull (Harrison *et al.*, 1995). However, they feel that this is not necessary using the new incision due to less curvature of the skull above the temporo-parietal suture and the extra security which the pocket for the body of the implant provides.

Having evaluated the new incision in over 50 patients (including young children) since January 1994, the authors believe that it is safe and reliable in their hands. Nevertheless some caution should be exercised in implementation of it by others until a more comprehensive evaluation which includes other surgical teams has been undertaken. Those using it should be thoroughly familiar with all its steps and any modification should be carefully considered before it is undertaken.

## Conclusions

The modified post-aural incision for placement of the 'Cochlear' multichannel implant gives excellent surgical access and healing. It appears to provide good protection from implant extrusion.

It is straight and much shorter than the other incisions used for this surgery. Interruption of the blood supply to the flaps raised is the least possible which minimizes the risk of flap necrosis. It requires less soft tissue dissection and elevation of soft tissue than other incisions so that there is less dead space and little pain. Hence the chance of haematoma formation (with associated danger of infection and flap necrosis) appears to be lessened. These features should provide maximum protection for the implant but, since the incision has been used for only a short time, some caution should be exercised in utilizing it until more experience with it is available.

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