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CLINICAL RECORD

Management of cochlear implant device extrusion: case series and literature review

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Abstract

Introduction and aims: Cochlear implants have enabled an improved quality of life for many patients with deafness. Implant extrusion and skin flap necrosis are the most common complications associated with implant use. We report our management of patients presenting with complications as a result of cochlear implant insertion. The goal of surgery was to achieve a stable, healed wound for use as a cochlear device implantation site.

Methods and results: We describe a series of patients presenting with skin flap necrosis and/or extrusion of their cochlear implant. The reconstructive options employed are discussed.

Conclusion: Surgeons should be aware of the reconstructive options available in such circumstances, and should choose appropriate management depending on the clinical situation, in order to optimise the functional result for the patient.

Key words: Cochlear Implants

Introduction

The cochlear implant (CI) has revolutionised the treatment of profound sensorineural hearing loss. The most common (non-device-related) complications of cochlear implantation are skin flap necrosis, infection, dehiscence and device extrusion; one or more of these complications occurs in 1.7 to 10 per cent of cases.[1–5] The resulting defect often requires the provision of healthy, vascularised soft tissue to cover the implant.

Fashioning the pocket required for the insertion of a CI involves the creation of skin flaps, which may necrose. The pressure of the overlying magnet on the flap can also lead to skin flap necrosis. Excessive thinning of the flap or placement of the CI too close to the incision, anecdotally less than 1.5 cm, predisposes to post-operative soft tissue complications. In an effort to circumvent the effects of flap-related complications, CI manufacturers have introduced lower profile implants with a reduced maximal vertical height, thereby reducing tension on the skin flaps.

In the event of exposure of the CI, a number of options are available for soft tissue coverage. We present a series of three patients to demonstrate various options available for soft tissue coverage of CIs, including loco-regional and distant flap transfer.

Case reports

Case one

The first case was an 82-year-old woman with bilateral sensorineural hearing loss, who presented with chronic mastoiditis and a fistula in the right post-auricular region complicated by recurrent infections. Following discussion of the available options, a decision was made to insert a CI, accepting that importation of vascularised tissue would be needed to reduce the risk of implant-based complications. Concurrent medical problems included hypertension and dyslipidaemia. The overlying skin was thin, friable and tethered to the underlying periosteum, and thus unsuitable to provide soft tissue coverage for the CI. Implantation failed due to wound dehiscence. At revision, a zig-zag incision was performed extending superiorly from the root of the ear helix to the temporo-parietal region (Figure 1). A skin flap was raised in the sub-follicular plane, taking care to preserve the temporo-parietal fascia. The superior confine of the dissection was the origin of the temporalis muscle. The temporalis origin was detached in a sub-periosteal plane with the anterior and posterior attachments released. This allowed the myofascial flap to be turned down over the exposed CI (Figure 2). The patient made an uncomplicated recovery and reported good CI function.

Case two

The second case was a 74-year-old, otherwise well woman who developed an area of necrosis measuring 1 cm in diameter with surrounding cellulitis, following insertion of a CI. At the time of revision, a scalp rotation flap was fashioned via dissection in the sub-occipito-frontalis plane. The flap was advanced over the defect and sutured in a tension-free manner. Subsequently, the patient developed late failure of the skin flaps, with exposure of the CI. The CI was removed and the presence of a biofilm was noted on the pericranium (Figure 3).

A free, vascularised, fasciocutaneous, anterolateral thigh flap measuring 3×5 cm was used to provide stable soft

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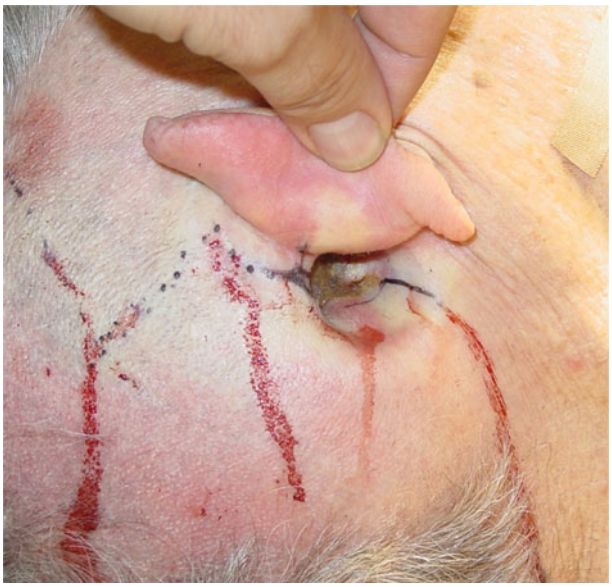

FIG. 1
Surgical photograph of case one, showing post-auricular scar with cranium on view.

tissue coverage of the CI. The anterolateral thigh flap was harvested from the left thigh. Microvascular anastomosis was performed to the facial artery, with two venous anastomoses to the common facial and external jugular vein. The flap was inserted (Figure 4), and the patient made an uncomplicated recovery.

Case three

The last case comprised a 62-year-old man with no significant medical history, who underwent CI insertion but developed recurrent infections. Despite intravenous antibiotic treatment and a rotation advancement flap, recurrent wound healing issues and CI exposure warranted removal

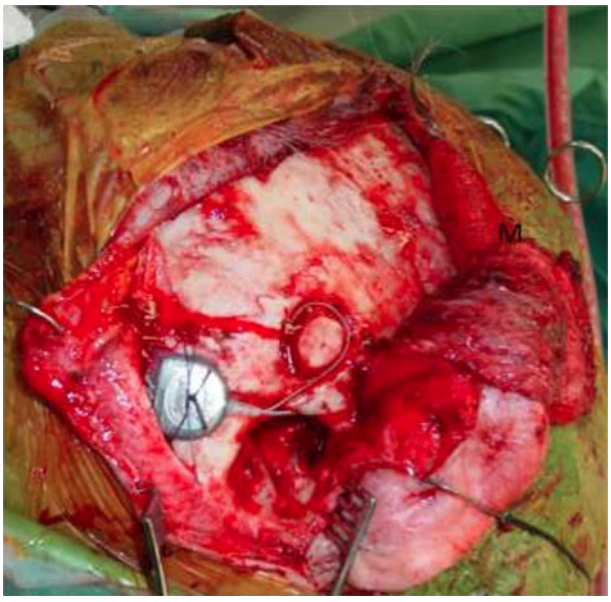

FIG. 2
Intra-operative photograph of case one, showing the detached temporalis muscle and the implant sited on the cranium.

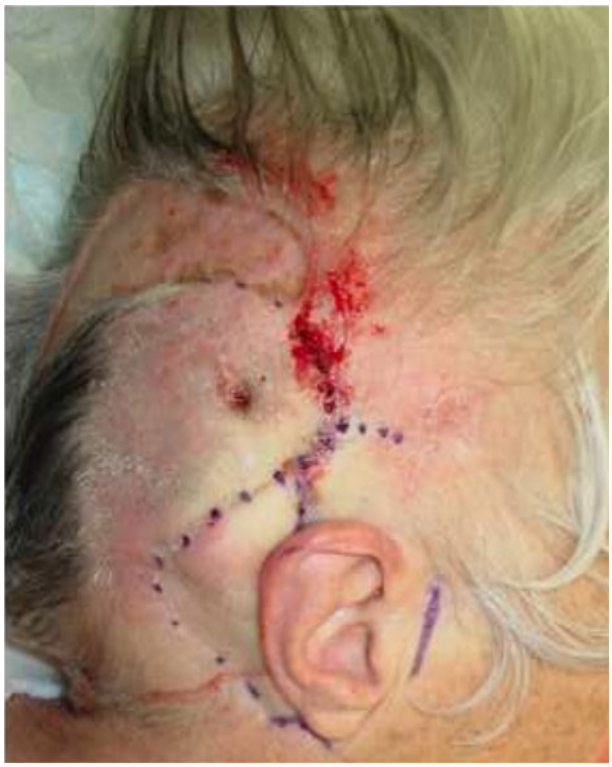

FIG. 3
Surgical photograph of case two, showing scalp wound breakdown (note the site of the previous scalp rotation flap).

of the device. At the time of CI removal, the presence of a biofilm was noted.

Subsequently, two smooth, elliptical expanders with ports were inserted in the subgaleal plane. The expanders were located in the temporo-parietal and parieto-occipital region (Figure 5). A dummy implant was inserted in the proposed site of future CI insertion. Serial instillation of expanders was undertaken in an out-patient setting. At four months, the final volume reached was 182 ml anteriorly and 162 ml posteriorly. The patient then underwent removal of the expanders and dummy implant, insertion of a new CI, and advancement of the expanded tissue to obtain coverage of the new device. There were no associated complications, and he reported good CI function. (Unfortunately, this patient failed to return for clinical photography.)

Discussion

Wound breakdown rates of up to 10 per cent have been reported following CI insertion.[5–8] Risk factors associated with implant insertion include shape and excessive thinning of the flap (which cannot exceed 6 mm in thickness otherwise the external device will not be held in place by magnetic attraction). Cochlear implant placement in the proximity of the flap incision may also result in pressure necrosis and subsequent wound breakdown.[7–9] Cohen and Hoffman[4] reported that the majority of flap-associated complications occurred with an anteriorly based, C-shaped flap; for this reason, the use of an inferiorly based U flap has been suggested.[10–12] Schweitzer and Burtka too noted the occurrence of flap tip necrosis following use of an anteriorly based, C-shaped flap, and attributed this complication specifically to transection of the occipital artery, compromising

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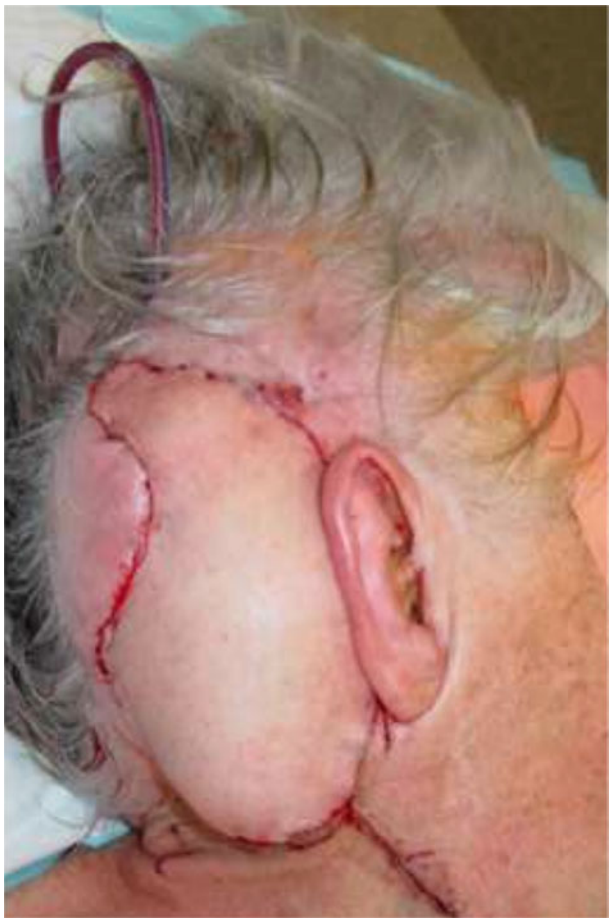

FIG. 4
Surgical photograph of case two, showing the anterolateral thigh flap in position.

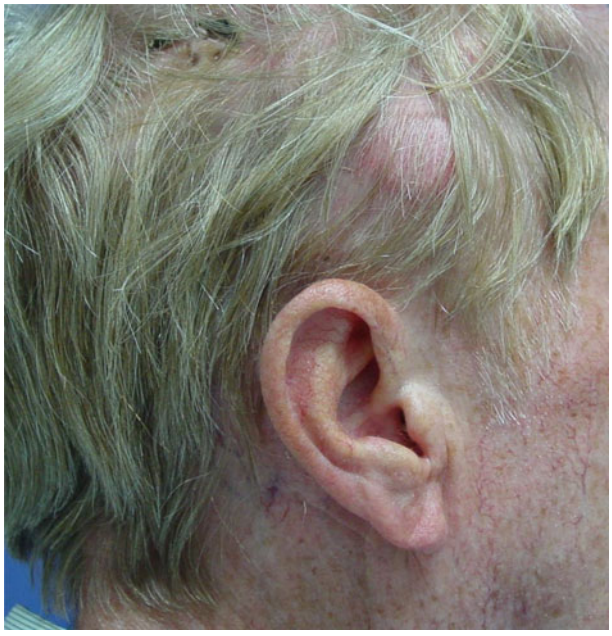

FIG. 5
Clinical photograph of case three, showing tissue expanders in the temporo-parietal region.

blood supply to the flap.[13] We believe this is one of the reasons why an inferiorly based blood supply flap is better, as it captures both the occipital and superficial temporal vessels; these vessels may be tested with Doppler ultrasonography before the flap is marked to confirm they will not be sacrificed due to flap design.

In all our cases, the CI used was the Cochlear Freedom CI24RE (CA) implant (Cochlear Ltd, Sydney, New South Wales, Australia). This CI has a maximal vertical projection of 4.7 mm. The same manufacturers have introduced a new, low profile implant, the Cochlear Nucleus 5 – CI512, with a maximal vertical diameter of 3.9 mm, reducing the tension placed on the skin flaps.

In all three presented cases, there was a history of infection following CI insertion which made the importation of healthy tissue vital. The pedicled temporalis muscle flap was first described by Letz in 1895.[14] Rambo realised the potential for using the pedicled temporalis turndown flap in the mastoid region in 1958.[15] In our first case, the temporalis myofascial flap was turned down in the usual fashion and the patient recovered well with good CI function. This technique has previously been used with good effect by Ishida *et al*. These authors made use of two local muscle flaps to achieve CI coverage, namely, a temporalis turndown flap and a fascia flap based on the sternocleidomastoid muscle.[16]

In case one at the time of revision, the superficial temporal artery was not palpable, and the patient was felt to be unsuitable for a superficial temporal fascia flap for CI coverage as described by Beckenstein *et al*.[17] We agree that the superficial temporal fascia flap provides well vascularised, thin, pliable tissue which is locally accessible. Beckenstein *et al*. recognised the significance of not confusing the superficial temporal fascia with the relatively avascular deep temporal fascia.[17] This anatomy of the scalp and temporal region has previously been well described by both Stuzin *et al*.[18] and Tolhurst *et al*.[19]

Our second case had a chronically infected CI, necessitating removal. The size of this patient's defect (5×3 cm) and the chronicity of the infective process prompted our choice of a microvascular, fasciocutaneous flap. The microvascular free tissue transfer options available included a radial or lateral arm flap and an anterolateral thigh flap. The latter was chosen as this provided an appropriately sized, pliable skin paddle from an excellent donor site. Careful pre-operative planning is important. The patient with a bulky thigh will not be suitable as the resulting, thicker flap width may affect CI function; a radial forearm or lateral arm flap may be a better option. There are a multitude of recipient vessels to choose from in the ipsilateral neck, assuming that the skin flap vessels are readily accessible.

Our third case also had a chronically infected wound, with failure of a scalp rotation flap. Tissue expander insertion and removal is generally well tolerated; however, this is a two-stage procedure. Serial injection of the expander can be performed in an out-patient setting. Neumann originally described this process in the setting of an ear reconstruction, in 1957.[20] The technique was popularised by Radovan following its use in secondary breast reconstruction.[21] There are multiple situations in which scalp tissue expanders have been used for the reconstruction of scalp defects;[22] however, there are no previous descriptions of their use as reported in our third case. The result achieved was excellent: hair-bearing skin was used to cover the implant, visible scarring was minimal, and CI function was excellent.

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All three cases discussed above illustrate the versatility of the plastic surgeon and the options available to achieve a stable, healed wound. Haberkamp and Schwaber have reported a case in which the creation of consecutive local flaps was attempted in order to cover an exposed CI, without success.[23] For this reason, in our first case we decided to proceed to a temporalis myofascial flap, after consideration of a scalp rotation flap.

- **Cochlear implantation has revolutionised profound sensorineural hearing loss treatment**
- **The commonest (non-device) complications are skin flap necrosis, infection, dehiscence and extrusion**
- **Skin flap necrosis may be due to excessive tension, infection or magnet pressure**
- **Scalp rotation flaps are used to reconstruct wound breakdowns, but in this series were associated with revision failure**
- **There are several loco-regional options for wound breakdown reconstruction, yielding good results**

In our second and third cases, bacterial biofilm was discovered at the time of CI explantation. The finding of a biofilm necessitates CI removal in 37–95 per cent of cases.[1,23,24] Bacterial biofilms are three-dimensional aggregates of sessile bacteria embedded in a matrix of extracellular, polymeric substances they have produced, which adhere to foreign bodies. Their presence plays a role in chronic and implant device infections. For this reason, the use of prophylactic antibiotics at the time of CI insertion is advised.[25]

Conclusion

The key element in the prevention of flap problems is careful pre-operative planning and optimisation of patients' medical co-morbidities. As discussed above, a U-shaped, post-auricular incision should be used, the receiver should be placed at least 1.5 cm away from the wound edge, and flap thinning should cease at the level of the hair follicles. Patients should receive peri-operative antibiotics as a prophylactic measure, and long-term antibiotics should be considered where there are underlying medical co-morbidities.[25]

Biofilm is formed in association with chronic CI infection; its presence may warrant CI removal, and carries a higher risk of secondary skin flap necrosis following scalp rotation flap creation.

If a definitive procedure is required to cover the CI, the surgeon has both loco-regional and distant options, the key element being CI coverage with healthy, vascularised tissue.[26]

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