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CLINICAL STUDY

Novel Method for Reconstruction in BAHA Revision Surgery

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Objective: In this case, we present a previously unreported operation for repair in patients with exposed bone after complications of Bone Anchored Hearing Aid (BAHA) implantation surgery.

Background: Skin necrosis is a recognised complication following BAHA surgery. Recently we encountered a case where complete loss of skin and periosteum had occurred in an elderly diabetic patient following BAHA surgery. Although a large area of bone was left exposed, osseointegration of the flange fixture had been successful.

Surgery: We describe a novel technique of two-stage, bi-lobed, bi-pedicled, muscle advancement flap with spilt-skin graft to repair the defect, thus allowing for successful replacement of the abutment.

Conclusion: Poorly vascularized tissues, including bare bone, are considered poor recipients of skin grafts. To date, no cases of BAHA revision surgery after loss of both skin and periosteal layers have been described. In this case, we present a viable option for repair in patients with exposed bone.

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Introduction

Poorly vascularized tissues, including bare bone, are considered poor recipients of skin grafts[1]. To date, no techniques have been described for the revision of soft tissues where both the skin and periosteal layers have been lost following bone anchored hearing aid (BAHA) surgery. We present a novel method of repair of the soft tissues in a patient with exposed bone after complications of BAHA implantation surgery.

Case Presentation

A 70-year-old man with bilateral conductive hearing loss and a history of recurrent Otitis Externa affecting the left ear was referred for BAHA surgery. The right ear had benefited from a BAHA 7 years earlier, without any complications. Significant past medical history included Type II (non-insulin dependent) Diabetes Mellitus.

Single-stage implantation surgery was performed using the BAHA electric dermatome technique to create a superiorly based skin flap. The surgery was uneventful. However, two weeks post-operatively the patient developed a wound infection and the skin graft failed despite antibiotic therapy. The wound was initially treated conservatively with dry dressings in order to encourage granulation tissue. However, four weeks post-operatively examination revealed bare bone with no evidence granulation tissue. Despite failure of the graft, osseo-integration of the fixture had been successful.

Surgery

Three months after initial surgery, revision BAHA surgery was performed. The intention was to remove the abutment, cover the defect with healthy tissue and then reapply an abutment once the site had healed.

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After removal of the abutment, an elliptical incision was made, debriding the wound edges to healthy skin. The fresh edges of the skin were then widely undermined (Figure 1). Next, periosteal incisions were made to develop two bipedicled periosteal flaps (Figure 2). These bipedicled flaps were brought together and secured with 4/0 vicryl rapide. Extremes of the ellipse were further approximated with 3/0 vicryl to skin, to ensure no bone remained exposed. A split-thickness skin graft was harvested from the thigh and placed over the periosteal flaps (Figure 3).

Postoperatively, the skin graft took without any problems, and an 8.5mm abutment was placed successfully. Postoperative Figures 4 and 5, show the surgical site after 11 days and 6 months, respectively.

Figure 1. Fresh skin edges widely undermined around area of exposed bone.

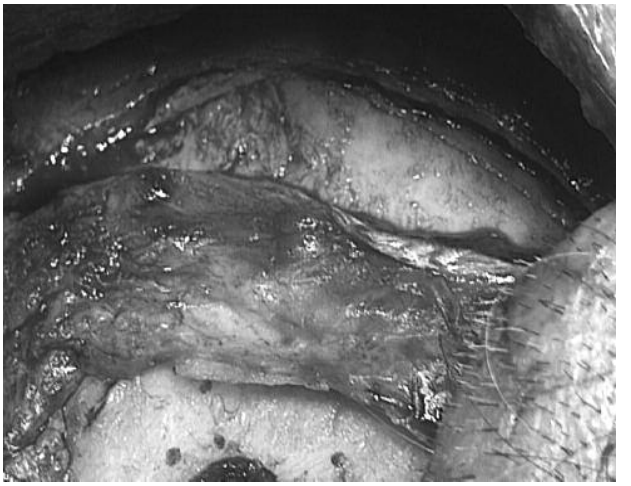

Figure 2. Bipedicled periosteal flap developed.

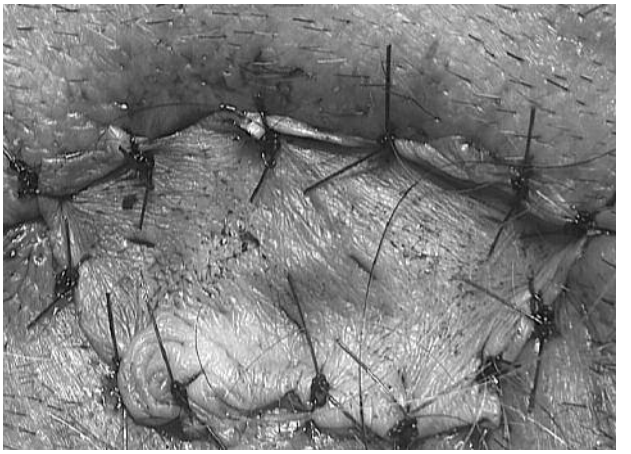

Figure 3. Split-thickness skin graft covering newly fashioned periosteal layer.

Discussion

The Bone-anchored hearing aid (BAHA) system is used to treat deafness through direct bone conduction. It is used in children and adults with unilateral or bilateral conductive, or mixed hearing loss, or in cases of unilateral profound sensorineural hearing loss. In addition, because the BAHA is not worn in the ear canal, problems encountered by air-conduction devices, such as chronic otitis media, chronic otitis externa, and congenital aural atresia, are avoided.

The BAHA consists of three components: a titanium implant, percutaneous abutment, and a sound processor. A skin flap is raised behind the affected ear and the titanium fixture implanted into the skull. The skin flap is then restored over the surgical site and a percutaneous abutment attached to the implant. The sounds processor is fitted onto the abutment after osseointegration of the implant has occurred.

Most complications after primary BAHA implantation surgery are relatively minor and can be managed without further surgery[2]. However, indications for revision surgery include failure of osseointegration, bone overgrowth, skin reaction or skin loss[3]. As in the case presented above, soft tissue complications are the most common[4,2], and are discussed in more detail.

The overall rate of severe local skin reactions around the implant site after BAHA surgery has been reported at 21% to 38%[5,6]. Skin reactions can be divided into two types: local wound inflammation or infection, and skin overgrowth. Mild to moderate wound inflammation or infection may be managed conservatively with oral and

Figure 4. Result 11 days post-operatively.

Figure 5. Result 6 months post-operatively.

local antibiotics. However, severe reactions will necessitate removal of the skin surrounding the abutment, the abutment itself, and also the titanium implant. A skin graft is then applied, and a new implant can be considered if the area heals properly. The other form of skin reaction is skin overgrowth, which may engulf the abutment to varying degrees. This is a frequent reason for revision BAHA surgery and usually occurs as a late complication[2]. The early stages of excessive skin growth may be arrested with the use of topical steroid creams. In severe cases local injection of steroid, in conjunction with topical application may be required. If these conservative measures are unsuccessful, surgical revision of the skin flap in theatre is performed.

Skin graft loss after BAHA implantation may be partial or complete and most often occurs in the first few months after surgery. Post-operative complications leading to loss of skin graft include haematoma, seroma, infection, excessive graft pressure, and inappropriate removal of periosteum under the skin graft. Graft loss may also be associated with other factors that impair wound healing, such as smoking, diabetes mellitus, steroid medications, and local radiation[7]. These factors are important to consider when selecting patients for primary BAHA surgery.

Skin loss can occur with or without bone exposure. If the underlying periosteum is not exposed, it is possible for healing to take place by secondary intention. Revision surgery in these cases can be avoided. Alternatively, a split-thickness skin graft (STSG) or local skin advancement flap may be used to hasten recovery and prevent delay in use of the hearing device[3].

Exposed bone is vulnerable to osteomyelitis. Therefore, coverage of this layer is essential. However, as previously mentioned a skin graft is unlikely to survive without a vascular bed. The management of skin loss with exposed bone is still controversial. Revision surgery due to graft necrosis is necessary in 1% of cases[5]. The two methods previously employed involve creation of local rotation flaps with a split-thickness skin graft (STSG)[3]. These methods, namely the superficial temporal parietal (STPF) flap and Galeal flap are described below.

The STPF lies superficial to the deep temporal fascia

covering the temporalis muscle and is typically supplied by the superficial temporal artery. A flap is created by making a vertical incision, starting at the zygomatic arch a few centimeters anterior to the root of the pinna. The incision is extended superiorly to obtain a graft of sufficient length. The flap is then elevated with its pedicle hinged in the zygomatic area, from where it is rotated over the exposed bone[8].

The galea aponeurotica is contiguous with the STPF beyond the superior temporal line, but is supplied by the occipital artery. The Galeal flap is created by making a linear incision carried posteriorly from the defect. A posteriorly based flap is then developed and rotated over the defect[9].

Both the STPF and Galeal flaps are extremely thin, and must be covered with a STSG. In comparison to the novel periosteal flap described above, they also involve larger incisions and more complicated dissection of the scalp. Additionally, the STPF flap involves in a preauricular incision, which is aesthetically less pleasing. Smaller incisions and less aggressive dissection, is likely to reduce the incidence of post-operative complications and result in faster graft healing.

Conclusion

To date, our flap is the only periosteum advancement flap that has been described for use as a bipedicled vascular flap in the head. The flap is highly vascular and resistant to infection, and it readily accepts a skin graft. The simplicity of this flap is sure to make it a reliable method for consideration in the setting of BAHA revision surgery, and other instances of devascularised tissue beds.

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