

Percutaneous Bone-Anchored Hearing Implant Surgery Without Soft-Tissue Reduction: Up to 42 Months of Follow-up

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Objective: To report the results of bone-anchored hearing implant (BAHI) surgery without soft-tissue reduction (WoSR); in our case, a series of 30 patients with a follow-up period of up to 42 months.

Patients: The study group included 30 patients between ages 17 and 79 years, where BAHI was indicated, during a 42-month period, between February 2010 and July 2013. Initially, only patients with medical comorbidities that could compromise wound healing were offered the procedure but, subsequently, all our patients are now offered this technique.

Intervention: Unlike in traditional techniques where all dermal and subcutaneous tissue and muscle are removed to enable the thinned skin to sit directly on the periosteum, here, in our series, using the WoSR technique, the soft tissue was preserved and only longer abutments (8.5, 9, and 12 mm) were used.

Main Outcome Measure: Good early postoperative wound healing, absence of flap necrosis, absence of numbness around

the surgical site, and trouble-free follow-up period, with 25 patients encountering no complications.

Results: Of the 30 patients, 25 have had no postoperative problems and five had mild inflammation, of which three patients developed intractable pain and underwent soft-tissue reduction.

Conclusion: The technique WoSR for BAHI surgery seems to be a safe technique with consistently good results, decreasing operating time and patient morbidity and avoiding some of the complications seen in traditional techniques using soft-tissue reduction. **Key Words:** Bone-anchored hearing aids—Bone-anchored hearing implants—Long abutments—Soft-tissue preservation—Surgery without soft-tissue reduction—WoSR.

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Bone-anchored hearing implants (BAHIs) (1) have become increasingly a popular, safe, and effective modality as a form of auditory rehabilitation in specific patient groups. Since their invention by Anders Tjellström in the 1970s (2), a number of surgical techniques have evolved.

The issue of BAHI surgery without soft-tissue reduction (WoSR) was initially raised by a study with short-term outcomes in six patients (3). This idea appealed to us because we had noticed that soft-tissue inflammation with thickening resolved when the patients had the 5.5-mm abutment changed for the longer 8.5-mm abutment (avoiding revision surgery). There have been similar observations made by other groups (4–7).

Here we present our case series of 30 patients with, up to 42 months of follow-up (median of 23 mo and a mode of 31–42 mo), and discuss the results. All patients listed for BAHI surgery underwent the WoSR technique by a single surgeon.

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MATERIALS AND METHODS

Patients

We first offered the WoSR technique to a select group of patients with medical comorbidities that compromised wound healing. This comprised a small group of patients who were diabetics or cardiac patients on anticoagulants. All but one patient opted for the new technique. Only the first four patients were selected this way. With this proving to be successful, all subsequent patients were offered the WoSR technique. Our patient group consists of 30 patients, during a 42-month period (February 2010–July 2013), aged between 17 and 79 years (18 female and 12 male). All the patients had 4-mm self-tapping fixtures, diameter of 3.75 mm (except two patients with BI300 with a diameter of 4.5 mm), with one of the longer abutments (8.5, 9, or 12 mm). An informed consent was obtained from all patients.

Surgical Technique

The patient is positioned and hair is shaved, as for traditional BAHI surgery, and the outline of the desired dummy bone-anchored hearing aid is marked, along with the corresponding abutment position. The patient is then prepped and draped, and local anesthetic with adrenaline is infiltrated. A 6-mm skin

TABLE 1. *Skin reactions and follow-up*

Skin Reactions (Holgers Classification [17])	Follow-up period
Grade 0: 25 patients	31–42 mo: 11 patients
Grade 1: 5 patients	19–30 mo: 8 patients
Grade 2: 0 patients	7–18 mo: 7 patients
Grade 3: 0 patients	0–6 mo: 4 patients
Grade 4: 0 patients	Median: 23 mo
	Mode: 31–42 mo
Routinely postoperative clinic visits: Weeks 1, 2, 8 (aid fitted), 12 and 6 monthly thereafter	

biopsy punch is used to cut through soft tissues, down to the bone, and a core of tissue including the periosteum is removed at the marked abutment position (Fig. 1). A linear incision is then made down to periosteum along the longitudinal axis of the perceived BAHI position (Fig. 1). With bone exposed, bone work proceeds in the traditional way. A 4-mm fixture with an 8.5- or 9-mm abutment is placed in most cases. A 12-mm abutment is used, if soft-tissue thickness dictates. In our experience, the length of the cutting end of the punch is 8 mm and provides a useful guide to the abutment needed. If the periosteum is reached with ease, then the 8.5- or 9-mm abutment is used. If, however, the periosteum could only be reached with significant pressure, then a 12-mm abutment is used. Our patient population has not needed abutments longer than 12 mm. The incision is closed with 5-0 nonabsorbable polypropylene sutures, dressed with a nanocrystalline silver dressing and a nonadhesive absorbent sponge dressing with the healing cap. This is left in situ for 1 week. A mastoid bandage is applied, which the patient removes at home in 48 hours. This reduces the risk of early displacement of the dressing and healing cap, which can lead to troublesome edema around the abutment. One week postoperatively, the dressings and sutures are removed and the patient is instructed to carry out daily wound care with alcohol wipes and mupirocin antibacterial ointment. At the second review, two weeks postoperatively, the wound is checked and local hair trimming instructions are given to keep hairs trimmed approximately 1 cm around abutment. The BAHA processor is then fitted 2 months postoperatively (although currently earlier loading is being studied and being carried out in various centers).

RESULTS

Of the 30 patients (range from 17 to 79 years old) who have undergone BAHI surgery using the WoSR technique during a 42-month period, 29 are still currently using their processors. All patients complied with the regimen of hair trimming. Five patients experienced postoperative skin reactions (Table 1); of these:

- one patient developed mild wound inflammation with dehiscence 1 week postoperatively, which resolved with conservative management (using Steri-strips).

- four patients suffered chronic inflammation. One was associated with thicker than average soft tissue. The undue thickness of the soft tissue was noted preoperatively, but the 9-mm abutment was the longest available in the market at that time and my reluctance to proceed with soft-tissue reduction because the patient has not consented for the same and was on aspirin for arrhythmia.

The 9-mm abutment was used. This, as anticipated, caused persistent mild soft-tissue inflammation, with pain starting about 4 weeks after surgery and was aggravated by the use of the aid. The 9-mm Oticon abutment (Oticon Medical, Copenhagen, Denmark), initially fitted, was subsequently replaced with a 12-mm Oticon alternative (which fortunately was launched on a controlled market release shortly afterward). The patient experienced complete resolution of symptoms (Fig. 2).

The remaining three patients had recurrent symptoms (mild recurrent inflammation with associated troublesome pain), despite meticulous wound care. Finally, after 12 to 18 months of failed conservative treatment, traditional soft-tissue reduction was performed using a linear incision, leading to resolution of their symptoms.

One patient had chronic pain, of delayed onset (12 mo), becoming intractable with no associated soft-tissue inflammation, necessitating eventual removal of fixture. A similar case series has been reported previously by van der Pouw et al. (8); however, this seems to be unrelated to the tissue preservation technique.

We started using the Cochlear 8.5-mm abutments (Cochlear baha, Gothenberg, Sweden) for WoSR technique with good results; this line has been discontinued. We now predominantly use the new Oticon abutments, the shape of which seems ideally suited for soft-tissue preservation (Table 2).

DISCUSSION

When considering the relative merits of the WoSR technique, we must first place it within the context of the alternatives. The three most common forms of soft-tissue reduction techniques currently in use are the Pedicle skin flap, Dermatome, and Linear techniques (9). The well-established principle when using these techniques is that, with skin adhering to the periosteum, there is negligible movement of the soft tissue and a good seal is formed around the abutment, with the site being free from hair growth. This is mandatory when smaller abutments are used.

Tissue preservation is now a possibility, using the longer abutments in adults and children (10,11). Hultcrantz's clinical trial in 18 adults (comparing nine patients with traditional soft-tissue reduction and nine patients without soft-tissue reduction) showed possible benefits of reduced operating time, quicker wound healing, and less numbness and pain in the group without soft-tissue reduction. Other teams have also reported good results (12–16).

TABLE 2. *Abutments Used*

	Abutments	Number used	Soft-tissue reduction done
Cochlear	8.5 mm (old)	6	2
Cochlear	9 mm (BIA 300)	2	1
Oticon	9 mm (old)	3	Nil
Oticon	9 mm (M51137)	16	Nil
Oticon	12 mm (M51138)	3	Nil

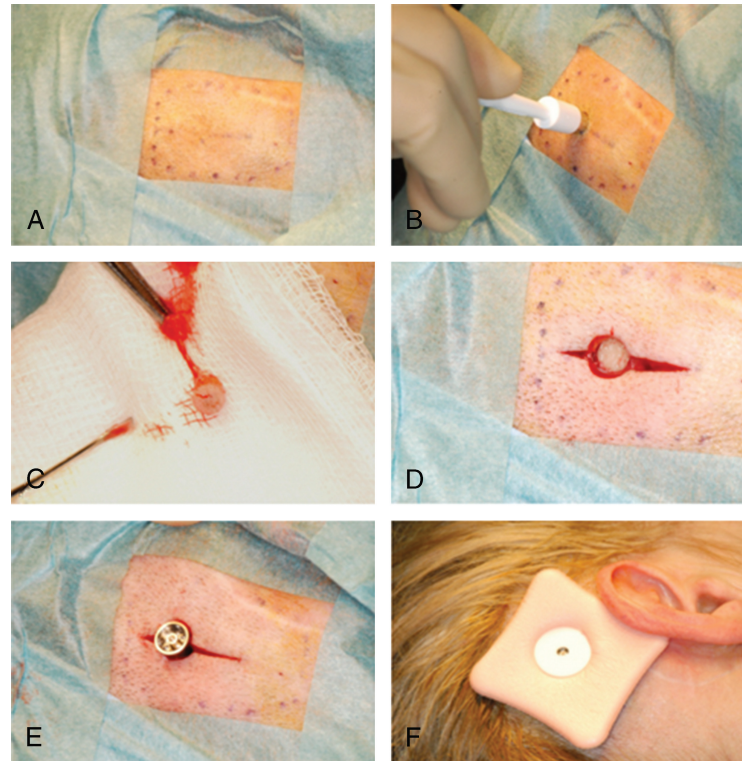


FIG. 1. WoSR technique: (A) site marked; (B) 6-mm skin punch; (C) removal of tissue core with periosteum; (D) linear incision for access; (E) the implant in position; and (F) dressing with healing cap.

The 6-mm skin biopsy punch is our preferred punch because this takes out just enough periosteum for bone work and, when soft tissue is approximated, there is no crowding or heaping of tissue against the abutment.

The inflammatory reaction observed in our patients, undergoing the WoSR technique, does not particularly fit

into the traditionally used Holgers classification (17). But, using this classification, there were no patients with grade 2, 3, or 4 reactions. Five of our patients had a grade 1 reaction. A key feature in the three patients who needed soft-tissue reduction was persistent pain (a feature absent in Holgers classification). In our series, 10% required

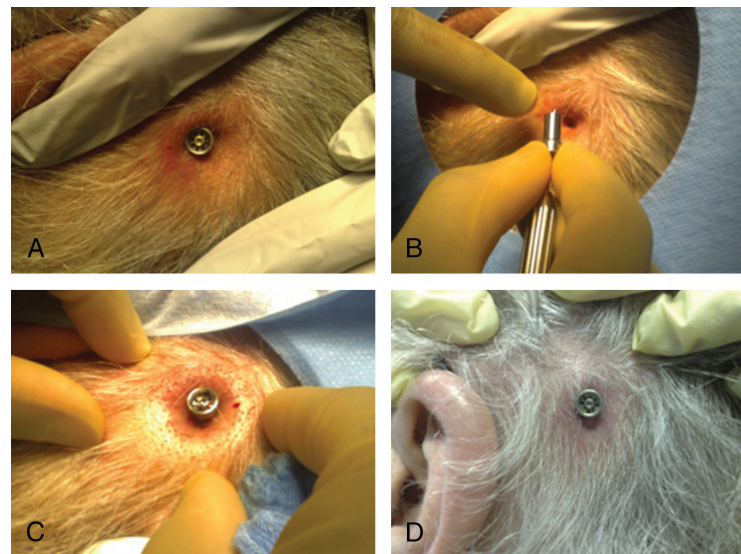


FIG. 2. Soft-tissue problems (A) with the 9-mm abutment (B) necessitating change to a 12-mm abutment in this patient with a very thick scalp; (C) 12-mm abutment sitting proud. (D) One month after the abutment change, the patient was asymptomatic.

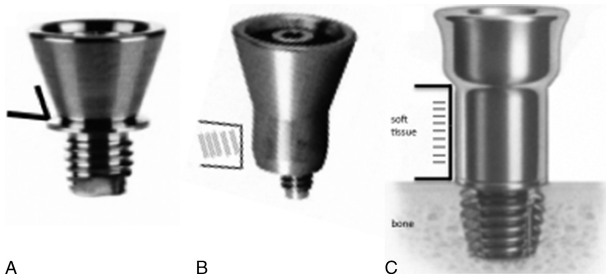


FIG. 3. Abutments series showing (A) acute soft-tissue angle with 5.5-mm abutment when there is soft-tissue thickening and the more vertical soft-tissue lie with the (B) 8.5-mm (Cochlear) and (C) 9- or 12-mm (Oticon) abutments.

conversion to traditional tissue reduction caused by troublesome persisting mild inflammation and pain. The soft-tissue reduction was done after 12 to 18 months of failed conservative treatment. Conservative treatment involved meticulous wound care, topical antibiotic, antifungal and steroid applications, and a 2- to 3-week course of systemic antibiotics with troublesome symptoms. The symptoms settled with treatment initially, but only to recur shortly after. Local excision of the inflamed tissue surrounding the abutment was then performed, but this only helped transiently. Eventual resolution of symptoms was obtained when soft-tissue reduction was performed. Two patients are now grade 0 and the third patient fluctuates between grades 0 and 1, with all three patients having complete resolution of pain.

To date, we cannot confirm any particular factor that was contributory to three patients needing soft-tissue reduction. Our suspicion lies with the shape of the abutments. The near-vertical soft tissue lie (Fig. 3) obtained, when using the previously mentioned abutments, we think decreases the propensity for inflammatory reaction. To date, we have had no problems with the new Oticon abutments, except the one patient who required a change from a 9-mm abutment to a 12-mm abutment in view of soft-tissue thickness.

The reported incidence of postoperative complications varies. In one study, significant postoperative complications requiring intervention have been reported at 12.8% using soft-tissue reduction techniques (18). This figure is

composed of 9.4% being soft-tissue reactions and 3.4% implant extrusion. Another study, comparing the U-graft technique with the Dermatome technique (both soft-tissue reduction techniques), reports adverse skin reactions at 36% and 16%, respectively, with reactions being between Holgers grades 1 and 3 (19). This study also reported the incidence of skin flap necrosis at 9.2% and 3% when using these techniques, respectively. In our series, the incidence of skin reactions was 16.6% (all Holgers grade 1), with 10% needing soft-tissue reduction. Skin flap necrosis is avoided using the WoSR technique. There have been no implant or aid issues, to date, in our patients. In our series, we have only used the 4-mm implants, regardless of skull thickness, and the longer abutments (8.5, 9, and 12 mm) and insist that all our patients keep their hair trimmed around the abutment; although some surgeons have found this unnecessary (5). The 10% incidence of soft-tissue reduction needed in our series, although it seems relatively high when one considers the benefits to the remaining 90% without soft-tissue reduction (reduced morbidity), seems justifiable. However, longer follow-up periods, to match other studies, of at least up to 74 months (19) or longer would be needed to validate these figures.

CONCLUSION

The results so far, using the WoSR technique, look very promising. There is a decrease in operative and postoperative morbidity, no associated numbness, decreased operating time, and certainly a good option in patients with medical comorbidities.

Although we present a reasonable length of follow-up for this technique (Fig. 4), longer periods of follow-up data achieved with the more established methods are needed, with close monitoring of the failures essential. The follow-up duration, along with our small numbers, in fact, is a limitation of this series.

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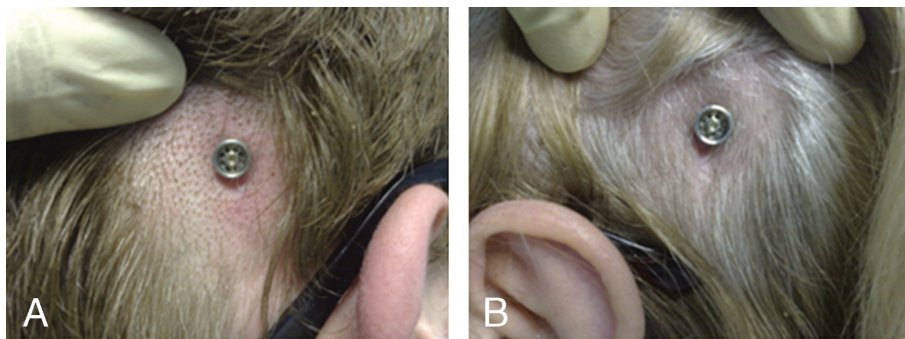


FIG. 4. Postoperative patients at (A) 30 months and (B) 42 months.

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