Prospective Evaluation of the Subperiosteal Technique for Receiver-Stimulator Fixation in Cochlear Implant Surgery

Emily Z. Stucken, MD; Michelle K. Kraskin, AuD, CCC-A; Hannah E. Shonfield, AuD, CCC-A; Joseph J Montano, EdD; Samuel H. Selesnick, MD; Kevin D. Brown, MD, PhD

Weill Cornell Medical College and New York Presbyterian Hospital, New York, NY.

Abstract

Recent refinements in cochlear implant surgery now permit placement of the receiver-stimulator in a subperiosteal pocket in the standard implant position without direct bone fixation. Two major concerns have been raised with this technique: migration of the receiver-stimulator and damage to a non-recessed electrode lead. We wished to determine the incidence of these potential complications by prospectively evaluating a cohort of patients receiving cochlear implants at our institution using the subperiosteal technique.

All patients undergoing cochlear implantation using this technique were included. The type of implant, patient age, months of follow-up, evidence of migration of the receiver-stimulator, and evidence of soft or hard implant failures were recorded.

The total number of ears implanted utilizing this technique was 31 (18 adult ears, 13 pediatric ears). There were 19 Cochlear Nucleus 5™ devices placed, 5 Cochlear Freedom™ devices and 7 Med-El Sonata™ devices. Average patient age was 22 months for children and 58 years for adults (10-51 months, 19-85 years). Average follow-up length was 10 months (range 2 weeks-2 years). There were no episodes of migration of the receiver-stimulator. There were no intracranial complications. There were no cases of soft failures. There was one episode of possible hard failure that is awaiting diagnostic evaluation of the explanted device.

The subperiosteal technique is a safe and effective method for restraining the receiver-stimulator. No episodes of migration were seen and there were no intracranial complications.

Introduction

Since the introduction of cochlear implantation, surgical technique has evolved considerably with the aim of producing safer and more effective results. Adjustments to operative technique have included different surgical approaches, an array of surgical incisions, new techniques to seat the internal receiver-stimulator, techniques to secure the receiver-stimulator in its seat, and techniques to maintain electrode placement. Traditionally, the receiver-stimulator component has been seated in its place by drilling a well in the calvarium that houses the receiver-stimulator unit, which is then secured using fixation via bony tie-down sutures. This technique carries with it a small but veritable risk of intracranial complications such as CSF leak, subdural hematoma, and epidural hematoma. This technique has also been associated with instances of receiver-stimulator migration. Migration of the internal receiver-stimulator can lead to uncomfortable or dysfunctional interaction with the external speech processor, and requires revision surgery. Technological and engineering advances have lead to new implant designs featuring a lower profile receiver-stimulator with a larger footprint. This has led to the development of new surgical techniques aimed at eliminating intracranial complications while maintaining traditional results for efficacy. With these goals in mind, a subperiosteal pocket technique has been developed to house the internal receiver-stimulator. This technique requires no bony drilling of the calvarium and no exposure of the dura.

Two major concerns have been raised with this technique: migration of the receiver-stimulator and damage to a non-recessed electrode lead. We wished to determine the incidence of these potential complications by prospectively evaluating a cohort of patients receiving cochlear implants at our institution using the subperiosteal technique.

Methods and Materials

All patients undergoing cochlear implantation at our institution by a subperiosteal technique were identified prospectively for inclusion in this study. Patients were excluded if they underwent a cochlear implantation technique that included calvarial drilling to seat or fix the implant to bone. Patients undergoing revision implantation were also excluded. Demographic and clinical information was collected for each patient including age, sex, indication for implantation, side of implantation, type of implant, operative time, complications, and length of follow-up. The study protocol was approved by the Institutional Review Board at Weill Cornell Medical College.

SURGICAL TECHNIQUE. An incision is designed 1cm posterior to the postauricular sulcus. The postauricular region is infiltrated with local analgesic containing epinephrine. The skin and soft tissues are incised to the level of the temporalis fascia, and anterior and posterior skin flaps are elevated. An anteriorly based Palva flap is created approximately 3cm in length, and is elevated up to the external auditory canal. A posterosuperior subperiosteal pocket is then created with a subperiosteal elevator until the pocket is just large enough to house the receiver-stimulator. A mastoidectomy is performed with a facial recess approach to the round window. The implant receiver-stimulator is placed into the subperiosteal pocket. A cochleostomy is performed anterior and inferior to the round window. The implant electrode is inserted into the cochleostomy site, and the cochleostomy is sealed with harvested muscle fragments. The ground electrode is placed under the temporalis muscle. The pericranial and skin layers are closed. The surgical technique is depicted in Figure 1.

Results

To date, there have been 27 patients enrolled in the study representing 31 ears implanted utilizing this technique. This includes 13 pediatric implants and 18 adult implants. 15 patients were male, and 12 patients were female. The average age of pediatric patients was 1 year 10 months (range 10 months-4 years). The average age of adult patients was 58 years (range 19-85 years). 15 implants were placed on the left side, 16 were placed on the right side. 19 Cochlear Nucleus 5™ devices were placed, 5 Cochlear Freedom™ devices were placed, and 7 Med-El Sonata™ devices were placed. The average operative time was 2 hours, 32 minutes.

There were no cases of receiver-stimulator migration or intracranial complications. There was one case of possible hard failure that is awaiting diagnostic evaluation of the explanted device. There have been no cases of soft failure. One patient was noted to have a skin protrusion external to the site of the receiver-stimulator approximately one month after implantation. It was found on imaging and re-exploration that though the receiver-stimulator had not migrated from its position in the subperiosteal pocket, the patient had formed dense scar tissue that had caused bending of the posterior aspect of the receiver-stimulator unit. One pediatric patient had a wound dehiscence one week after implantation requiring operative closure. There was one seroma treated conservatively with antibiotics. Average follow up time was 10 months (range 2 weeks-2 years).

Discussion

A myriad of surgical techniques have been proposed to contain the cochlear implant receiver-stimulator unit. A recent survey of 62 respondents showed that the majority of surgeons regularly drill out a bony well to seat the receiver-stimulator. In the case of adult implants, 83.3% of respondents always and 6.7% usually drill out a well. In pediatric cases, 78.6% of respondents always and 8.9% usually drill a well. There have been numerous techniques developed to secure the receiver-stimulator in place, including the drilling of bony holes for tie-down sutures, the drilling of titanium screws on the side of the bony well for suture fixation of the implant, the application of polypropylene mesh to house the receiver-stimulator, the use of bone cement, and the use of peristaltic sutures. The currently described technique of developing a subperiosteal pocket to accommodate the receiver-stimulator was described by Balkany et al in 2009 in an anatomic and clinical study that delineated the boundaries of the temporalis pocket: pericranial condensations at surrounding suture lines that would prevent migration of the receiver-stimulator. The clinical arm to the study demonstrated safety and efficacy of the technique, with no cases or migration or intracranial complications. A later study by Guldiken et al demonstrated similar safety and efficacy, and also noted a reduction in mean operative time by up to 30% using this technique. Our results support the safety and efficacy of the subperiosteal technique, with no cases of migration or intracranial complications were seen.

Conclusions

The subperiosteal technique is a safe and effective method for restraining the receiver-stimulator. No episodes of migration or intracranial complications were seen.

References


Contact

Emily Z. Stucken, MD
Resident, Department of Otolaryngology – Head & Neck Surgery
New York Presbyterian Hospital, Columbia & Cornell
crzc9004@nyup.org
(646) 469-0079