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Vibrant Soundbridge implantation: the transmastoid/posterior tympanotomy and transcanal approaches

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Round window;
Sensorineural hearing loss

The Vibrant Soundbridge was approved in the US for moderate-to-severe sensorineural hearing loss. Initially implanted via a transmastoid/posterior tympanotomy, which is still the most commonly performed approach, the transcanal approach is growing both in interest and practice. While both share many common elements in the surgery, knowledge of the challenges and advantages of both approaches gives the surgeon greater flexibility in implanting the moderate-to-severe sensorineural hearing loss patient with the Vibrant Soundbridge.

Introduction

The Med-El Vibrant Soundbridge (Med-El, Innsubruck, Austria) is an implantable hearing device indicated for patients with a moderate to severe sensorineural hearing loss and a word recognition score of greater than 50% in the implanted ear.[1] The device consists of a magnet, receiving coil, demodulator, and conductor link attached to the Floating Mass Transducer (FMT) as well as an audio processor (Figure 1). Although both the transmastoid/posterior tympanotomy[2,3] and the transcanal[4,5] surgical techniques have many similarities to those used for cochlear implantation, there are some unique features to the surgery that are very different from that of cochlear implantation. The surgeon is well-advised to have available for the procedure the VORP template, the forming forceps, which are specifically designed for the Vibrant Soundbridge FMT clip, as well as the 7-mm skin flap gauge (Figure 2).

Once the patient has been determined to be a proper surgical candidate, CT imaging of the temporal bones can be very useful in the preparation for surgery. Imaging provides the surgeon with information regarding the aeration of the mastoid, position of the sigmoid sinus and facial nerve, and adequacy of the facial recess for placement of the device, as 3 mm is necessary to pass the FMT through the facial recess. The patient is carefully counseled on the risks of the surgery, which should include, but are not limited to, hearing loss, imbalance, alterations in taste, and the risk of facial paresis or paralysis. Only those trained and experienced at performing mastoidectomy and posterior tympanotomy should perform this surgery as it requires care and patience for successful placement of the FMT, whether via a conventional or transcanal approach.

The transmastoid/posterior tympanotomy approach

It is the author's preferred surgical technique to make a postauricular incision just posterior to the postauricular sulcus and extending that incision up into the hairline superiorly at about a 45-degree angle similar to that used for cochlear implantation (Figure 3). All patients receive antibiotics as surgical prophylaxis and continue on oral antibi-

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Figure 1 The Vibrant Soundbridge consists of an audio processor (not shown), and the Vibranting Ossiculat Prosthesis (VORP) (courtesy of Vibrant Med-El[6]). (Color version of figure is available online.)

otics for 1 week following surgery. The VORP template is placed on the skull at an approximate 45-degree angle from horizontal. The incision is designed to keep at least 2 cm from the edge of the device to reduce the likelihood of device extrusion or infection (Figure 4). The incision need only be large enough to perform a mastoidectomy and a well for the demodulator that will accommodate the VORP transition. Head shave should be commensurate with the planned incision and surgeon's preference. To mark the intended well site, it is helpful to use methylene blue (1-cc syringe with a 25-gauge Tuberculin needle filled with .01 cc of methylene blue) to mark the point where the pinna, when pressed against the skull, crosses the temporal line. This helps position the receiver of the device posterior to the pinna. The patient is prepped and draped, and the incision is performed as previously described and carried down to the temporalis fascia and pericranium. An anterior-based pericranium flap is developed, and the 7-mm skin flap thickness gauge is used to ensure that the flap will be thin enough to accommodate the auditory processor. It is this surgeon's preference to perform this dissection with the Harmonic Synergy device and bipolar electrocautery, avoiding the

Fiureg 2 From the top: The Forming Forceps, Skin Flap Guage 7, VORP template (courtesy of Vibrant Med-El[6]). (Color version of figure is available online.)

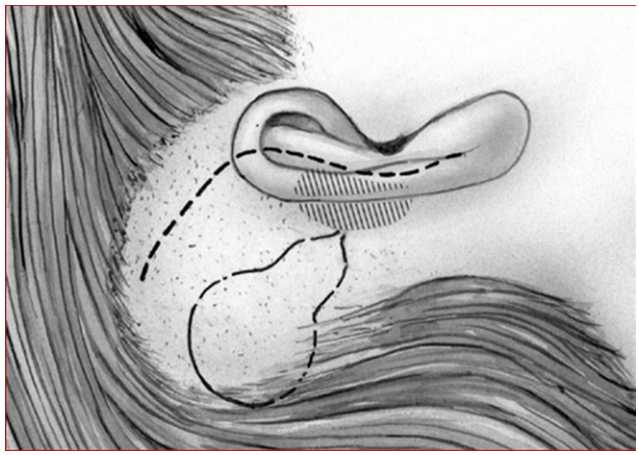

Figure 3 The incision used is similar to that used for placement of the cochlear implant processor, and the VORP template (outlined) is a useful guide for planning the incision. The incision superiorly should be at least 2 cm from the VORP. (Courtesy of Vibrant Med-El.[6])

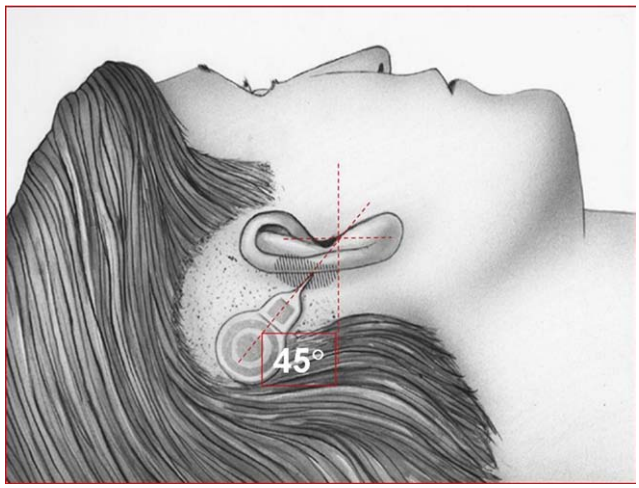

Figure 4 The VORP template is set at a 45-degree angle to the horizontal. Methylene blue can be used to mark the location of temporal line where the edge of the depressed pinna crosses, through the skin, on the pericranium to marking the approximate location for the demodulator well site.

need to remove monopolar electrocautery once the device is placed. Once the mastoid table is exposed, a simple mastoidectomy is performed, like that done for a cochlear implant with the exception that bony overhangs are often left more prominent superiorly and inferiorly, and the bone posteriorly is more completely removed (Figure 5). Sigmoid sinus exposure is avoided. Identification of incus and horizontal canals is achieved during the mastoidectomy with the aid of cutter and diamond drill bits, and drill contact with the incus is scrupulously avoided. Copious irrigation is used throughout the procedure for removal of bone dust and to ease identification of landmarks. It is the author's preference to collect bone pate as a precaution for use to cover any inadvertently exposed tegmen. The posterior tympanotomy is performed via the facial recess with care, identifying the facial nerve and preserving as much of the buttress as possible. Care is also taken to identify the chorda tymapani,

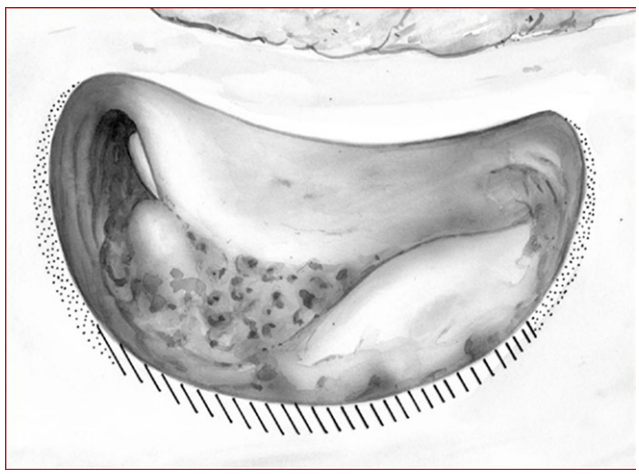

Figure 5 The stippled areas reflect bony overhands left in place, where the stripped area reflects bone that should be more completely removed.

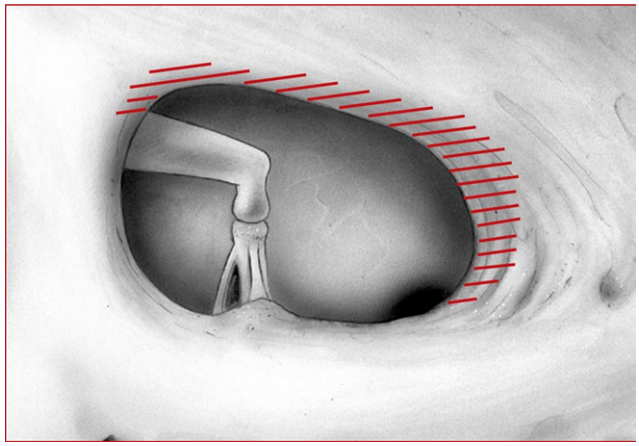

Figure 6 Because of the width of the FMT (3 mm), additional bone (as indicated by the striped area) may need to be removed. Care should be taken to preserve both the facial nerve and, if possible, the chorda tympani.

and it is preserved whenever possible. A facial recess of 3 mm is performed to achieve adequate exposure into the middle ear space for placement of the FMT, and may require more bone be removed in the area toward the chorda tympani laterally and inferiorly (Figure 6).

Once the mastoidectomy and posterior tympanotomy are completed, a large piece of saline-soaked absorbable collagen sponge is placed in the mastoid to avoid further bone dust entering the middle ear space, and the device well is then drilled. Using the mark placed with the methylene blue previously as a guide, the VORP template is seated at a 45-degree angle from horizontal; the well for the demodulator is drilled more deeply anteriorly than posteriorly to accommodate the angle between the receiver and the demodulator as well as the curvature of the VORP transition. The well is completed and the relationship with the mastoid evaluated so that there is no stress placed on the VORP or VORP transition. Cross tie holes are drilled using a 3-mm diamond drill bit in positions adjacent to each other and connected using a 1-mm cutter (Figure 7).It is the author's preference to use a permanent braided suture to secure the device.

With all the drilling complete, the entire surgical site is irrigated with copious quantities of saline. Before placement of the VORP device, the FMT clip is inspected. If the clip is somewhat closed, careful use of a straight needle through the clip can gently open it to the necessary width of approximately 0.5 mm. Cautious manipulation of the clip is necessary as it is fragile. A small curve is placed in the conductor link just back from the FMT so it will position properly in the facial recess and not be in contact with any of the bony surfaces of that space. The VORP device is placed in position with the demodulator placed into its well and the fit evaluated before being secured. It is the author's preference to place the FMT into the facial recess using a 3-French suction and to very gently push the clip onto the incus using a straight needle. Once the clip is positioned on the

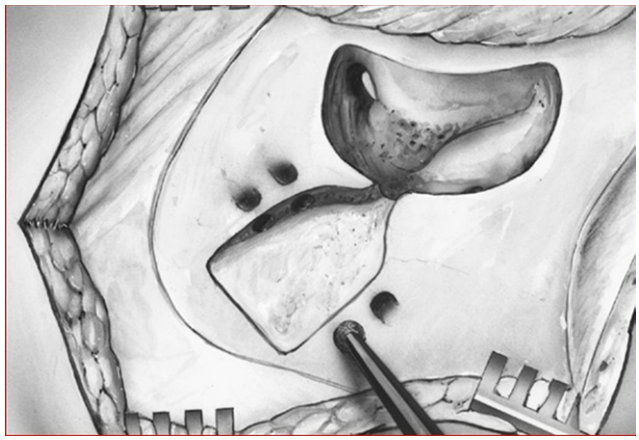

Figure 7 Following completion of the demodulator well, cross tie points are drilled with a 3-mm diamond, and those adjacent to each other are joined by connecting then using a 1-mm cutting drill bit. This forms a bony tunnel through which to pass a permanent braided suture and secure the VORP.

incus and the FMT is positioned in contact with the incudostapedial joint, the Forming Forceps are used to secure the FMT clip onto the incus (Figure 8). It is the author's experience that a single use of the Forming Forceps is sufficient for establishing adequate positioning on the incus, and further attempts to more firmly secure the FMT are not indicated. The conductor cable is inspected to insure that it is not in contact with the facial recess. As the conductor cable, which is fairly stiff, it is carefully arranged within the mastoid to insure that proper position of the FMT does not shift during closure (Figure 9).

Closure is performed in layers and a pressure dressing is then applied. The patient wears the dressing for 2 days, at which point the dressing may be removed, and an additional day of topical antibiotic ointment used. This author had never used a drain for this surgery, but defers to the surgeon's judgment and preference on its use. The patient is seen 10-14 days following surgery, at which

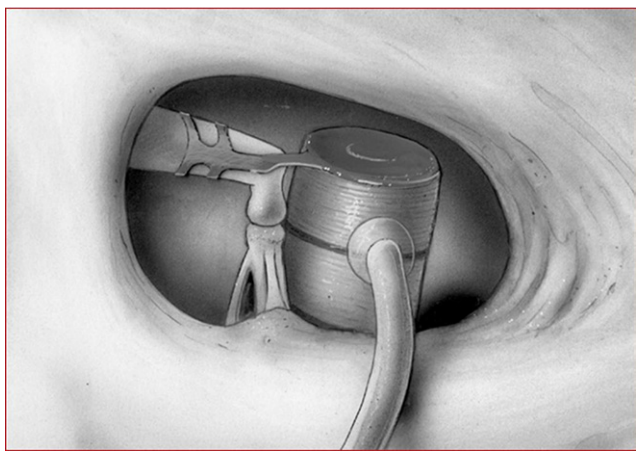

Figure 8 Successful surgery requires proper placement of the FMT adjacent to the incudostapedial joint, and the conductor cable not being in contact with the bony surfaces of the facial recess.

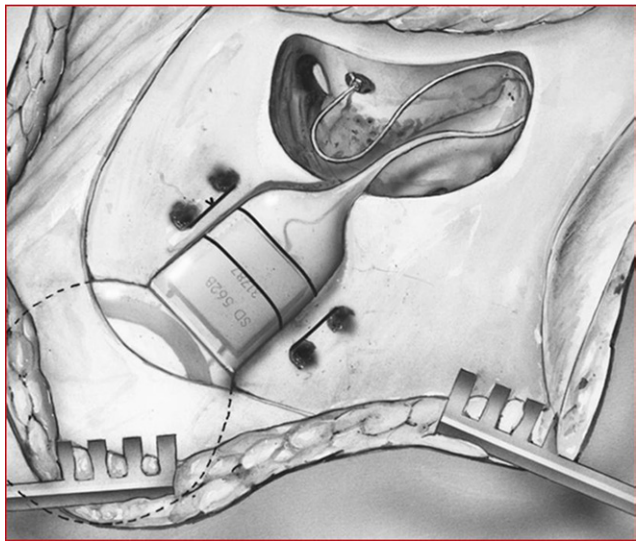

Figure 9 The position of the conductor cable should be such that on closure displacement of either the FMT or the conductor cable is prevented or minimized.

time healing is evaluated. The device is typically activated 8 weeks following surgery.

The transcanal surgical approach

The transcanal placement of the Vibrant Soundbridge for the traditional indication of sensorineural hearing loss is an exciting development. This approach has the attraction of being easier to perform, is less risky to facial nerve and chorda tympani, and allows implantation in those patients where mastoid or facial recess anatomy may not be favorable.[4,5] The surgery is carried out in much the same manner as the transmastoid/posterior tympanotomy approach, except as described below. The device is secured as previously described.

Once the demodulator well site has been identified, and the soft tissue elevation completed, a shallow mastoidectomy is performed sufficient for placement of the demodulator, VORP transition, and the coiling of excess conductor cable. The surgeon carefully elevates the external auditory canal skin off the underlying posterior bony canal from the 12 o'clock to the 6 o'clock position. The fibrous annulus is then elevated from the bony annulus, and the scutum removed as necessary to visualize the chorda tympani, incus, incudostapedial joint, and stapes. Starting approximately at or just posterior to the 6 o'clock position, a 1.5-mm-deep groove is created, gently curving laterally and posterior, terminating at the junction of the lateral inferior aspect of the external bony canal and the mastoid defect. The clip of the FMT is carefully rotated 45 degrees to permit use of the Forming Forceps prior to placement on the incus adjacent to the incudostapedial joint. The conductor cable is then covered in the external bony canal groove with bone pate, and fascia positioned over this area before repositioning the annulus and external auditory canal skin. Postoperative care is as previously described.

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