frontiers | Frontiers in Audiology and Otology

TYPE Perspective
PUBLISHED 26 January 2026
DOI 10.3389/fauot.2025.1742204

Check for updates

OPEN ACCESS

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RECEIVED 08 November 2025
ACCEPTED 11 December 2025
PUBLISHED 26 January 2026

CITATION
Gavilán J (2026) Surgical treatment of sensorineural hearing loss: an ethical dilemma in the 21st century.
Front. Audiol. Otol. 3:1742204.
doi: 10.3389/fauot.2025.1742204

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Surgical treatment of sensorineural hearing loss: an ethical dilemma in the 21st century

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Almost 70 years after Shea's first successful stapedectomy, this operation remains the gold standard for otosclerosis, providing excellent outcomes with minimal risk. In contrast, the situation is quite different for sensorineural hearing loss. The development of new middle ear active implants, such as the Vibrant Soundbridge, now provide hearing outcomes comparable to conventional hearing aids, with very low surgical risk and added acoustic benefits. However, their clinical adoption is still limited, often influenced more by economic and ethical dilemmas than by scientific evidence. In some public healthcare systems, active middle ear implants for sensorineural hearing loss are fully funded, while conventional hearing aids are not. This creates an inequity that leaves many patients unable to access non-surgical hearing solutions. This article reflects on that paradox and argues that, as technology continues to evolve, one principle must remain clear: the patient's right to hear should always take precedence over financial or bureaucratic constraints.

KEYWORDS

sensorineural hearing loss (SNHL), active middle ear implants, *vibroincudesis*, medical ethics, healthcare equity, access to hearing technology

1 Introduction

Almost 70 years after John J. Shea Jr. performed the first successful stapedectomy in Memphis (Shea, 1958), stapes surgery—encompassing both stapedectomy and stapedotomy—remains the surgical treatment of choice for the management of otosclerosis in patients with moderate-to-severe conductive hearing loss with an air–bone gap exceeding 20 dB. In experienced hands, stapes surgery is a technically straightforward procedure that achieves excellent functional outcomes in more than 90% of primary cases. The incidence of profound postoperative sensorineural hearing loss (SNHL) in primary procedures has been consistently reported at approximately 1–2% in the literature (Vincent et al., 2006).

For surgical candidates, the primary non-surgical alternative is the use of hearing aids. Although this option eliminates the risk of postoperative SNHL, it requires dependence on an external device, routine maintenance, and recurring expenses such as batteries and device replacement. Additional drawbacks include acoustic feedback, occlusion effect and, in some patients, ear canal irritation, recurrent otitis externa, or difficulty tolerating prolonged device use.

At present, most otologists offer both surgical and non-surgical options to patients with otosclerosis who wish to improve their hearing. A substantial number of patients with otosclerosis opt for surgery as their primary treatment choice.

At the other end of the hearing spectrum, SNHL traditionally had only one management option: hearing aids. In recent years, remarkable advances in hearing technology have reshaped the way we approach this problem. Implantable devices now enable surgical rehabilitation of SNHL. With the rapid evolution of cochlear implant technology, their use has expanded beyond the original indication of bilateral total deafness and is now considered the most effective treatment for patients with audiometric thresholds over 60–65 dB HL and word recognition below 60% in the best-aided condition (López-Poveda and Marrufo-Pérez, 2025). For individuals with mild to moderate hearing loss, recent advances in implantable hearing systems have expanded the possibilities for surgical auditory rehabilitation, yielding outcomes that are often comparable to those achieved with conventional hearing aids and, in some cases, even superior (Truy et al., 2008; Tysome et al., 2010).

These options encompass active middle ear implants (AMEI), and selected bone conduction systems for mild mixed hearing loss. Throughout their development, these technologies have shown varying levels of success. While most AMEIs have faded from clinical use, the Vibrant Soundbridge (VSB) has stood the test of time and remains the most widely used system worldwide (Luetje et al., 2002; Colletti et al., 2006; Baumgartner et al., 2010; Tysome et al., 2010; Bruchhage et al., 2017; Koyama et al., 2021; Lorente-Piera et al., 2024). In fact, as of this writing, the VSB is the only AMEI still commercially available in many countries. That said, the ideas presented here are broadly applicable to any implantable middle ear device designed to improve hearing in patients with sensorineural hearing loss (SNHL), provided its surgical safety and functional efficacy have been clearly demonstrated.

VSB consists of an external audio processor and an internal implant. The external processor captures and converts sound into electrical signals that are transmitted transcutaneously to the implanted part. The implant contains a Floating Mass Transducer (FMT), which may be attached to any available middle ear structure and directly converts the electrical signals into mechanical vibrations. These vibrations are transmitted to the cochlea, thereby improving hearing. VSB can be used in patients with sensorineural, conductive, or mixed hearing loss.

Compared with conventional hearing aids, the VSB offers several advantages, including preservation of an open ear canal, thereby avoiding the occlusion effect; reduced acoustic feedback; and a more natural sound quality resulting from direct mechanical stimulation of the middle ear structures. In addition, current surgical techniques for VSB implantation are standardized and safe. In patients with SNHL, the VSB includes a dedicated coupler designed for fixation to the body and short process of the incus.

The device is inserted through a simple atticotomy, which must allow a wide exposure of the incus. However, the short process of the incus must remain firmly attached to the buttress, to maintain the structural integrity of the ossicular chain. In addition, it is essential to avoid any contact between the FMT and bony structures other than the incus.

This is a straightforward procedure for any experienced otologic surgeon, associated with minimal surgical risk owing to the stability of the ossicular chain at that level (Lee et al., 2017; Schraven et al., 2018; Alzhrani et al., 2020). Because facial nerve exposure is unnecessary, the risk of iatrogenic facial paralysis is effectively eliminated. These two factors set this procedure apart from the conventional placement on the long process of the incus, in which the risk of ossicular chain disruption and facial nerve injury remains a constant concern.

2 The importance of correct nomenclature

Clear terminology facilitates accurate communication among clinicians, promotes consistency in surgical training, and allows for proper categorization of outcomes in clinical research.

Unlike the term stapedectomy, which clearly defines the surgical procedure in which the function of the stapes is replaced by a passive middle ear prosthesis, there is currently no specific term for the fixation of an active vibrating prosthesis to the body of the incus. More broadly, implantation of the VSB is commonly referred to as "*vibroplasty*". This designation, which encompasses all possible middle ear coupling sites for the FMT, is somewhat inaccurate, since the procedure does not involve any actual "*plastic*" reconstruction.

From both a practical and linguistic perspective, the procedure involving the fixation of a vibrating prosthesis to the incus could more aptly be termed *vibroincudesis* (from the Latin *vibrare*, "to vibrate"; *incus*, "anvil"; and the Greek *desis (δεσις)*, meaning "union", like in arthrodesis or pleurodesis) (Figure 1).

Establishing a precise term such as *vibroincudesis* is more than a semantic exercise—it serves a practical and scientific purpose. As AMEIs continue to evolve—allowing coupling to various structures beyond the incus—adopting a specific name for this technique will help distinguish it from the broader concept of "*vibroplasty*", enhancing clarity in both clinical practice and academic literature. In this context, *vibroincudesis* represents not just a name, but a precise and meaningful definition for a distinct surgical concept that deserves recognition within modern otologic practice.

3 The hearing care paradox

As outlined above, patients with either conductive or SNHL now have two therapeutic options: a purely prosthetic solution and another that involves surgery. The surgical approach entails the use of a middle ear prosthesis—passive in cases of conductive and active in cases of sensorineural hearing loss.

In some healthcare systems—including the Spanish public sector—surgically implanted hearing prostheses are fully funded by public health services, allowing patients to restore their hearing at no personal cost. In contrast, if the same patient opts for a traditional hearing aid, the full cost must be paid out of pocket.

Otosclerosis is commonly treated surgically with excellent long-lasting results. For otologists, recommending surgery in these cases has never raised ethical concerns—as long as the indication is clinically justified. The situation is quite different for SNHL, largely because the surgical alternative for this type of condition is relatively new and not yet widely known among specialists.

Today, the idea of implanting a hearing device in a patient with SNHL as an alternative to a conventional hearing aid often

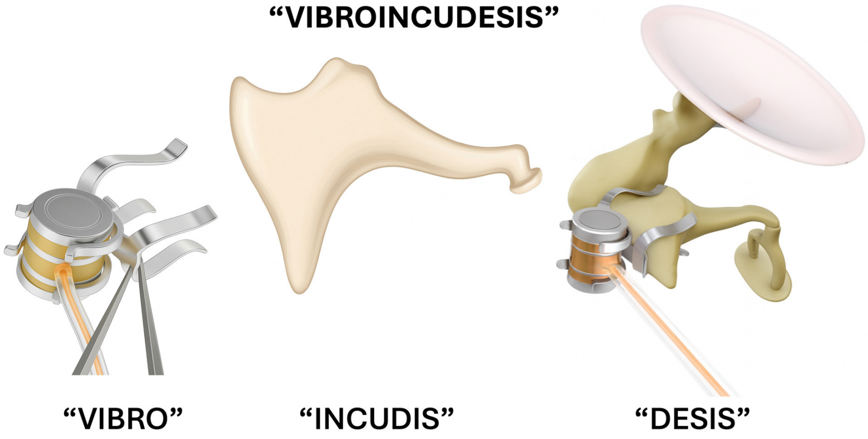

FIGURE 1
The name vibroincudesis clearly reflects the procedure where the VSB (vibrator) is fixed (desis) to the incus.

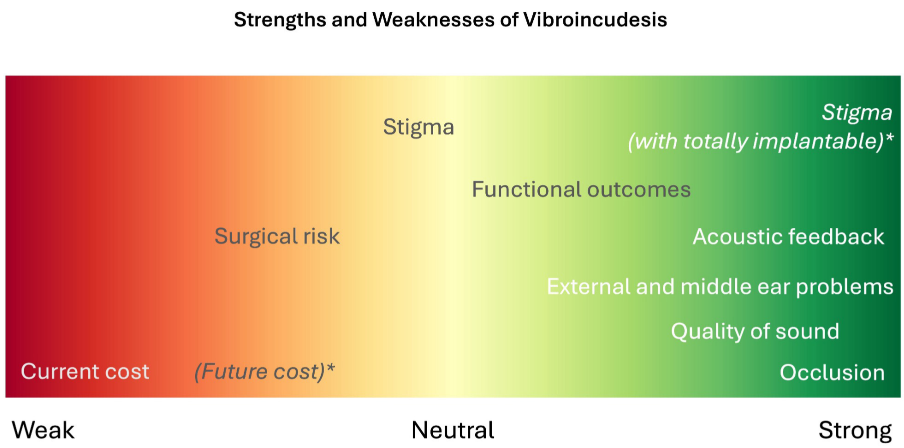

FIGURE 2
Schematic overview of the strengths and limitations of vibroincudesis. Red tones indicate disadvantages, green tones advantages, and orange tones neutral aspects. *The terms "Future cost" and "Stigma with totally implantable" refer to potential improvements in the device, as suggested by current research in the field of implantable hearing solutions.

sparks a storm of criticism questioning the morality of such an approach. Remarks such as *"It is unethical to operate on a patient to address a problem that can be managed without surgery"* or *"Surgery for SNHL—to place an active middle ear implant—is far more costly than using hearing aids"* are often fired like moral arrows the very moment this idea is brought up. The validity of these arguments deserves closer examination in the context of contemporary scientific evidence. A summary of the points discussed below is presented in Figure 2.

3.1 Surgical risk

This is what I hear whenever I propose surgery as a treatment option for these patients: *Operating on a patient with sensorineural hearing loss to place an implant undoubtedly carries a surgical risk—one that could be avoided by simply fitting a hearing aid.*

True enough. But the same could be said of otosclerosis. Or myopia. Or any number of medical conditions we treat every day. Every surgery carries risk; that is a given. Yet time and experience remind us that the benefits of surgery often far outweigh the risks that both the patient and we choose to take.

Following the same line of reasoning that has guided this reflection from the beginning, we have long accepted that patients diagnosed with otosclerosis who prefer stapedectomy over hearing aids are fully entitled to choose a treatment that time has proven to be both highly effective and safe. What, then, differentiates these patients of the past from contemporary individuals who wish to resolve their SNHL surgically?

As mentioned earlier, coupling the VSB to the body of the incus carries a low risk of hearing loss—likely even lower than that of a stapedectomy. So, in today's context, the "risk" argument holds very little real scientific ground (Lee et al., 2017; Schraven et al., 2018; Alzhrani et al., 2020).

3.2 Functional outcomes

In terms of functional performance, current evidence demonstrates that *vibroincudesis* achieves auditory results equivalent to those obtained with conventional hearing aids in both tonal thresholds and speech discrimination (Truy et al., 2008; Tysome et al., 2010). Additionally, users commonly report greater comfort and sound quality, since the device preserves an open ear canal and allows simultaneous use of residual acoustic hearing (Luetje et al., 2002).

3.3 Esthetic outcomes

From an esthetic perspective, patients with SNHL face a similar situation regardless of the chosen treatment. With both solutions, patients must wear an external device somewhere on the head, making their hearing impairment outwardly recognizable—the so-called "*hearing stigma*". This situation differs from conductive hearing loss caused by otosclerosis, in which the surgical solution provides the added advantage of being completely invisible. In any case, for patients with SNHL, the surgical and non-surgical options are nowadays essentially equivalent with respect to esthetic results. The expected evolution of fully implantable devices will likely make *hearing stigma* disappear—much as it did in the case of otosclerosis.

3.4 Cost of the procedure

Without a doubt, this is one of the most significant aspects of the entire discussion—not only because of the financial implications behind the word "*cost*"—but also due to the striking contrasts in how different healthcare systems around the world fund each treatment option. These disparities, together with the need to clearly define and properly name the surgical procedure, are what ultimately prompted me to write this reflection.

From an economic standpoint, any objective comparison between hearing aids and VSB is complicated by multiple confounding factors that go far beyond simple accounting (Krohn et al., 2025).

The previously mentioned hearing care paradox—in which, in certain countries, a patient who undergoes surgery pays nothing while one who chooses a hearing aid must bear the entire cost—completely undermines any possibility of a fair cost-effectiveness comparison. Obviously, for the national health system, the cost of the surgical–prosthetic option is higher than that of the hearing aid. This is entirely understandable: the former is publicly funded, while the latter is paid for entirely by the patient. Yet this difference in funding creates a distorted perception of value, making the surgical approach appear more expensive when, in reality, the cost is simply borne by different parties.

What is far less clear is whether this situation can truly be considered socially fair. And this is precisely where the ethical dilemma at the heart of this discussion begins to take shape. The imbalance between what is publicly funded and what is not raises uncomfortable questions about equity, access, and the true meaning of fairness in modern healthcare.

The core ethical question can be put quite simply: if a patient cannot use hearing aids because they cannot afford them, should we offer the surgical–prosthetic alternative to restore their hearing? Or, conversely, should those responsible for patients' hearing health refrain from acting to avoid imposing additional costs on the healthcare system?

In practice, this dilemma forces clinicians to balance two conflicting responsibilities: the duty to care for the individual patient and the obligation to preserve the sustainability of the healthcare system. While ethical theory often presents these principles as compatible, real-world situations like this one reveal how fragile that balance can be. When medical necessity collides with economic limitation, the physician becomes not only a healer but also an involuntary gatekeeper—deciding, in effect, who gets to hear and who remains in silence.

From my perspective, the answer is crystal clear. I studied medicine. I practiced it for more than 45 years. I am a doctor—a surgeon, in fact—not an economist, not a politician, and, fortunately, I have no ambition to be either. My answer to this moral dilemma is straightforward: my patients' health always comes first. If the choice is between living isolated in silence because of a lack of resources or regaining hearing through surgery—and the patient wants that option—then I honestly believe it's my duty to offer the surgical solution that can make it possible.

Still, I'm fully aware that this personal conviction may draw criticism from colleagues who see the role of medicine differently—those who believe that economic responsibility should weigh as heavily as clinical duty. And that's precisely what keeps this debate alive: the uneasy intersection between compassion, ethics, and cost.

To better frame my response to the ethical dilemma outlined above, it is worth taking a quick look at the global landscape of hearing loss and the solutions available—a snapshot that helps illustrate the true magnitude of the problem worldwide.

4 Hearing loss: the great forgotten burden in global health

In its "World Report on Hearing", the World Health Organization (World Health Organization, 2021) provides key data that illuminate the global prevalence and impact of hearing loss, as well as the persistent inequities in access to effective hearing care. Hearing loss is a major global health issue affecting children, adults, and older adults alike, with profound and far-reaching consequences (Tordrup et al., 2022; Vandenbroeke et al., 2025). Despite this, the proportion of individuals who actually receive treatment for their hearing loss remains alarmingly low. Access to hearing technology is still severely limited worldwide. Only about 17% of those who need hearing aids actually use them, leaving an estimated global coverage gap of 83%. Although this problem is most pronounced in developing countries, it remains far from acceptable even in the most developed nations (World Health Organization, 2021).

Undoubtedly, the limited uptake of hearing-care solutions is a multifactorial problem, and addressing it will require coordinated political action that goes far beyond the influence of individual hearing-health professionals. These broader issues, however, lie outside the scope of this article.

What I want to focus on here is what each of us—audiologists, physicians, and all those committed to hearing health—can do personally to help restore hearing, and with it, quality of life, for patients with SNHL who remain trapped in silence simply because they cannot afford a hearing aid. These are the patients we see every day in our clinics: older adults with moderate to severe hearing loss, disconnected from the world not because their condition is untreatable, but because the available solutions are financially out of reach. Yet many of them could meaningfully recover their hearing through a procedure like *vibroincudesis*.

I am well aware that this is not a universal problem, as the financial structure of healthcare systems varies from country to country. However, in those settings where non-surgical solutions are not publicly funded—as is the case in Spain—this becomes a daily reality for those of us who care for patients with hearing disorders.

5 Discussion: can active middle-ear implants become the "stapedectomy" of SNHL?

Many adult patients with disabling SNHL that could potentially be improved with hearing aids never pursue that option for purely economic reasons. As the guardian angels of our patients' hearing health, we hold in our hands an alternative solution—one that could restore hearing for many of these individuals, particularly those most disadvantaged from a social standpoint.

To wrap up, I would like to take a moment to compare where we stand today with stapedectomy and *vibroincudesis*. Admittedly, it's not a fair match—one is a time-tested procedure with 70 years of proven success; the other, an exciting new technique still in its early stages. But it's worth asking: what would *vibroincudesis* need to become, by the end of the century, what stapedectomy is now—a safe, effective, and universally accepted solution?

From a surgical risk perspective, the differences are not dramatic—if anything, the advantage may lean slightly toward *vibroincudesis*. In terms of functional outcomes, the upper hand still belongs to stapedectomy, thanks to its long track record of outstanding outcomes. Esthetically, stapedectomy is the clear winner, since it completely eliminates the "*hearing stigma*" by leaving no visible external components. And from a financial standpoint, again, stapedectomy takes the lead—at least for now—as the cost of an active middle-ear implant remains much higher than that of a simple stapes piston.

The day we achieve a fully implantable active middle ear device at an affordable price, the gap between the two procedures will narrow considerably. Until then, let me be perfectly clear: I am not suggesting that every patient with sensorineural hearing loss should undergo surgery. But I am saying—loud and clear—that for a meaningful number of older patients with sensorineural loss, *vibroincudesis* is an option we simply cannot, and should not, ignore.

For many, this decision represents a moral dilemma: performing surgery on these patients implies an increase in healthcare costs, while choosing not to operate risks neglecting our duty to improve our patients' health. In my view, this dilemma can only be resolved through an individualized approach—the very essence of good medicine. And within that personalized framework, *vibroincudesis*—along with any similar procedures that may emerge in the future—deserves a well-defined and legitimate place in the clinical management of SNHL.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

JG: Formal analysis, Writing – original draft, Resources, Funding acquisition, Project administration, Data curation, Visualization, Validation, Conceptualization, Writing – review & editing, Supervision, Software, Investigation, Methodology.

Funding

The author(s) declared that financial support was received for this work and/or its publication. MED-EL will cover the publication fee in case the manuscript is accepted.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

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