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Audiometric and Vestibular Function Following Classic and Reverse Stapedotomy

Rebel Jade*

Department of Otorhinolaryngology, University Medical Centre Maribor, Maribor, Slovenia

Introduction

The middle ear comprises three small bones: the malleus, incus, and stapes, which transmit sound vibrations from the eardrum to the inner ear. The stapes, the smallest bone, plays a critical role by acting as a piston that pushes sound waves into the cochlea through the oval window. In otosclerosis, the stapes becomes fixed due to abnormal bone growth, impairing its movement and leading to conductive hearing loss. Surgical intervention through stapedotomy aims to restore this movement. Classic stapedotomy involves several steps. First, the surgeon lifts the tympanomeatal flap to expose the stapes. After confirming the diagnosis of stapes fixation, the surgeon removes the stapes superstructure. A small hole is then drilled or perforated in the footplate of the stapes, into which prosthesis is inserted. This prosthesis bridges the gap between the incus and the oval window, allowing sound vibrations to reach the inner ear more effectively.

Reverse stapedotomy follows a slightly different approach. Instead of removing the stapes superstructure first, the surgeon creates a small hole in the stapes footplate while the superstructure is intact. Only after this hole is created is the superstructure removed, and the prosthesis is placed in the hole. This method aims to minimize trauma to the inner ear and reduce the risk of complications such as vertigo. Both classic and reverse stapedotomy aim to improve conductive hearing loss. Studies have shown significant hearing improvement in patients undergoing either procedure. Audiometric tests, particularly pure-tone audiometry, are used to measure the preoperative and postoperative hearing levels [1].

Patients typically experience substantial hearing gain, with improvements in air conduction thresholds and a reduction in the air-bone gap. The success rate for achieving postoperative air-bone gaps within 10 dB ranges from 85% to 95%. This indicates effective sound transmission through the middle ear and into the cochlea. Similar to the classic technique, reverse stapedotomy also results in significant hearing improvement. Studies comparing both techniques have found comparable outcomes in terms of air conduction thresholds and air-bone gap closure. The choice of technique often depends on the surgeon's preference and specific patient factors. Speech discrimination, the ability to understand speech, is another critical measure of auditory function. Postoperative speech discrimination scores generally improve following both classic and reverse stapedotomy. Patients often report better clarity and understanding of speech in various listening environments, which significantly enhances their quality of life [2].

Improvement in speech discrimination scores is commonly observed. Studies report that most patients achieve near-normal or significantly improved speech discrimination postoperatively. This technique also shows favourable outcomes in speech discrimination, with most patients experiencing notable improvement. Comparative studies indicate that there are no significant differences in speech discrimination scores between the two techniques. The vestibular system, responsible for balance and spatial orientation, can be affected by middle ear surgery due to the proximity of the stapes footplate to the inner ear. Postoperative vertigo and balance issues are potential complications of stapedotomy. Postoperative vertigo is a relatively common complication, occurring in approximately 15% to 30% of cases. This vertigo is usually transient, resolving within days to weeks. However, some patients may experience prolonged or severe vertigo, which can significantly impact their quality of life.

Description

Long-term audiometric and vestibular outcomes are important for evaluating the durability and overall success of stapedotomy. Both techniques generally provide stable long-term hearing outcomes, with minimal deterioration over time. Long-term studies show that the majority of patients maintain their improved hearing levels for many years postoperatively. Long-term hearing stability is also observed with this technique, with similar outcomes to the classic approach. Long-term vestibular function is typically stable, with most patients not experiencing chronic balance issues. Any transient balance disturbances usually resolve within a few weeks to months postoperatively, with long-term stability being the norm. The potential for reduced immediate postoperative vertigo and balance disturbances may contribute to a smoother recovery, with long-term vestibular function being comparable to the classic technique. Patient satisfaction and quality of life improvements are crucial indicators of the success of stapedotomy. High levels of patient satisfaction are reported, with significant improvements in hearing and speech discrimination leading to enhanced quality of life. Similar satisfaction levels are observed, with many patients experiencing a smoother postoperative course and fewer vestibular issues, contributing to high overall satisfaction [3,4].

One of the advantages of reverse stapedotomy is the potential reduction in postoperative vertigo. By creating the hole in the footplate while the superstructure is intact, the procedure may reduce trauma to the inner ear structures. Studies suggest a lower incidence of vertigo compared to classic stapedotomy, although exact figures vary. Balance and spatial orientation are assessed using vestibular function tests, such as Electronystagmography (ENG) and Videonystagmography (VNG). These tests measure eye movements in response to head movements and positional changes, providing insights into vestibular function.Some patients may experience transient balance disturbances postoperatively. These disturbances are usually mild and resolve over time. Persistent balance issues are rare but can occur in cases with significant intraoperative trauma to the inner ear. The preservation of the stapes superstructure during the initial steps of the procedure may contribute to fewer balance disturbances postoperatively. Studies comparing vestibular outcomes between the two techniques indicate that reverse stapedotomy may result in fewer and less severe balance issues. Both classic and reverse stapedotomy carry risks of complications, although they are generally safe procedures when performed by experienced surgeons. Sensorineural Hearing Loss (SNHL) is a rare but serious complication of stapedotomy. It can result from trauma to the inner ear structures during surgery. The risk of SNHL is estimated to be around 1% to 2%. This risk is associated with factors such as excessive force during prosthesis insertion or drilling, which can damage the cochlea. By potentially reducing inner ear trauma, reverse stapedotomy

***Address for Correspondence:** Rebel Jade, Department of Otorhinolaryngology, University Medical Centre Maribor, Maribor, Slovenia; E-mail: rebeljade@gmail.com*

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may lower the risk of SNHL. However, the overall risk remains low for both techniques. Prosthesis dislocation or malposition can lead to recurrent conductive hearing loss and may require revision surgery. Prosthesis dislocation rates are generally low, around 1% to 3%. Proper placement and fixation of the prosthesis are crucial for long-term stability. The technique may offer a slight advantage in prosthesis stability due to the initial preservation of the stapes superstructure, but dislocation rates are similar to the classic approach [5].

Conclusion

Both classic and reverse stapedotomy are effective surgical techniques for treating otosclerosis and improving hearing. While both methods show comparable audiometric outcomes in terms of hearing improvement and speech discrimination, reverse stapedotomy may offer advantages in reducing postoperative vertigo and balance disturbances. However, the choice of technique should be tailored to the individual patient, considering factors such as the surgeon's experience and the patient's specific anatomical and clinical characteristics. Long-term outcomes for both techniques are generally favourable, with stable hearing and vestibular function. Patient satisfaction is high, reflecting the significant positive impact on quality of life. Future research should continue to compare these techniques, focusing on refining surgical methods to further minimize complications and enhance postoperative recovery.

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Conflict of Interest

None.

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