

Original Research Article

Standardizing the size of pistons in both sexes and comparing the outcome of reverse stapedotomy: our experience

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ABSTRACT

Background: Stapedotomy is one of the most fascinating surgery in otology. Stapedotomy is an effective surgical procedure for the treatment of otosclerosis which leads to improvement in patients' quality of life.

Methods: Prospective observational study conducted at Ghosh ENT foundation, Kolkata from May 2021 to May 2023 to study the outcome of reverse stapedotomy with microscope and the length of the piston used.

Results: Our study comprised of 192 ears operated for otosclerosis, 101 were males and 91 were females. 37 patients were misdiagnosed and prescribed hearing aids without being suggested stapedotomy. The most common associated complaint was tinnitus in both the sexes and only 1 patient complained of vertigo. The most common post op complication was vertigo followed by dysgeusia, Tympanomeatal flap tear was observed in a handful cases and repaired by a tympanoplasty. Our method creates minimal complication and reduces the duration of surgery. We noticed that the average length of the piston required is 4.25 mm in females while for males it is 4.5 mm. only 3 female patients were fitted with 4.5 mm piston. Patients operated by our stapedotomy technique showed that the ABG closure within 10 dB could be achieved in 87% and within 20 dB in 97% of cases without any otologic complications.

Conclusions: A good and favourable hearing outcome can be obtained by the combination of experienced hands with minimal surgical trauma and an appropriate surgical technique. This will ultimately lead to less post-operative complications and the need for revision surgery.

Keywords: Stapedotomy, Reverse stapedotomy, Piston size, Outcome

INTRODUCTION

Otosclerosis was first described by Valsalva in the early 18th century, in the course of dissecting a temporal bone of a deaf patient.¹ In 1869, von Troitsch named the final inactive sclerotic stage of the disease, "otosclerosis." Siebenmam: designated the active, hyperemic stage as "otospongiosis" in 1912.^{1,2} Toynbee surveyed 1659 temporal bones and characterized several types of stapes fixation and oval window involvement without fixation. Politzer recognized otosclerosis as a primary bone disease.^{1,2} Cytokine factors that include osteoprotegerin

(OPG), receptor activator for nuclear factor kappa B (RANK) and RANK ligand (RANK-L) play a major role in the system that directly controls bone turnover. Osteoprotegerin is a competitive inhibitor of RANK-L. High levels of OPG inhibit bone remodelling by inhibiting the differentiation, survival, and fusion of osteoclastic precursor cells, by suppressing activation and promoting apoptosis of osteoclasts.^{2,3} Stapedotomy is one of the most fascinating surgery in otology. Stapedotomy is an effective surgical procedure for the treatment of otosclerosis which leads to improvement in patients' quality of life. The stapes surgery has evolved through

different eras of beliefs, philosophy, and understanding, and the surgical technique in the current era has been fairly standardized

Aims and objectives

Aim and objective of current study was to study the outcome of reverse stapedotomy with microscope over a period of 2 years and the length of the piston used.

METHODS

Study design, location and duration

A prospective observational study was conducted at Ghosh ENT foundation, Kolkata from May 2021 to May 2023.

Inclusion criteria

Inclusion criteria for current study were; Patients with diminution of hearing with intact tympanic membrane, an audiogram showing ABG >20 dB at the frequencies of 0.5, 1, 2 and 3 kHz together with absent stapedial reflex and patient willing to give written informed consent for surgery and to be part of the study.

Exclusion criteria

Exclusion criteria for current study were; Patient with other causes of hearing loss, Patients with external ear and other middle ear pathologies and Patients with comorbidities deeming them unfit for general anaesthesia.

Procedure

Total 192 patients who presented to ENT OPD with clinical features suggestive of otosclerosis and who fulfilled inclusion and exclusion criteria were included in the study. Detailed history, complete ENT examination and audiological investigations were done. Preanesthetic evaluation was done and patients were randomly allotted into two groups. Group A consisted Male patients who underwent microscopic stapedotomy under local anaesthesia. Group B consisted of Female patients who underwent microscopic stapedotomy under local anaesthesia. Data was collected in pre-structured, pre-tested proforma

In our centre we practice endaural endomeatal approach. Using a Zeiss microscope, we raise the tympano meatal flap and drill the posterior canal wall for optimum and adequate exposure. We have simplified the next part this difficult surgery by doing 4 very simplified steps: Footplate fenestration. While the foot plate is supported by stapes, stapedial tendon and incudo stapedial joint fenestration can be easily achieved using a perforator of increasing size (0.5 mm, 0.6 mm and 0.7 mm). in a well-supported footplate chances of slipping and complications like a floating footplate can be minimised.

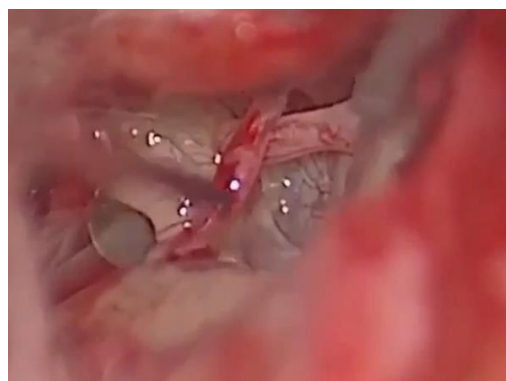


Figure 1: Footplate after exposure.



Figure 2: Fenestration done.

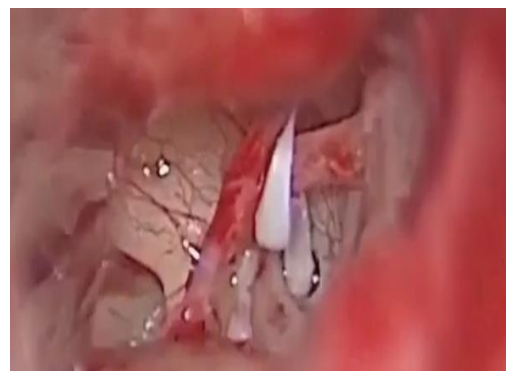


Figure 3: Piston place.



Figure 4: Posterior crurotomy being done.

Measuring the length of the piston and placing it. Posterior crurotomy. Once the prosthesis is placed and fixed with incus a posterior crurotomy is done with a skitter below the level of the stapedial tendon, trying to preserve the stapedial tendon and the stapedial reflex. In difficult cases it is sacrificed. Anterior crurotomy. It is done to remove the last attachment of foot plate from its supra structure. After anterior crurotomy the stapes supra structure can be left situ if the incudo stapedial joint is stable enough or the IS joint can be dislocated and supra structure can be removed.



Figure 5: Anterior crurotomy being done.

RESULTS

Our study comprised of 192 ears operated for otosclerosis of which 101 were males with an average age of 38.2 years and 91 were females with an average age of 41.2 years. 37 patients were misdiagnosed and prescribed hearing aids without being suggested stapedotomy.

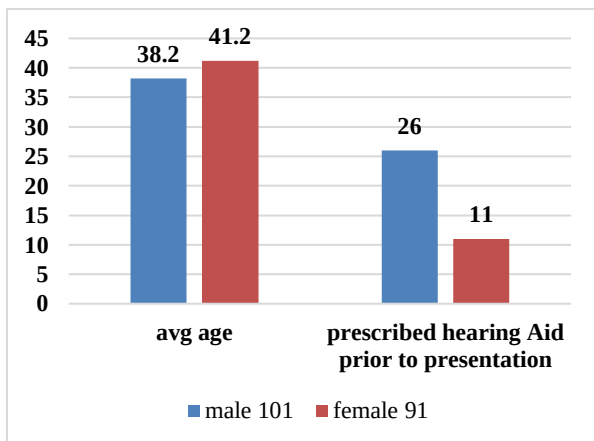


Figure 6: Age and hearing aid.

The most common associated complaint was tinnitus in both the sexes and only 1 patient complained of vertigo. The most common post op complication was vertigo followed by dysgeusia. Tympanomeatal flap tear was observed in a handful cases and a tympanoplasty was done to repair it.

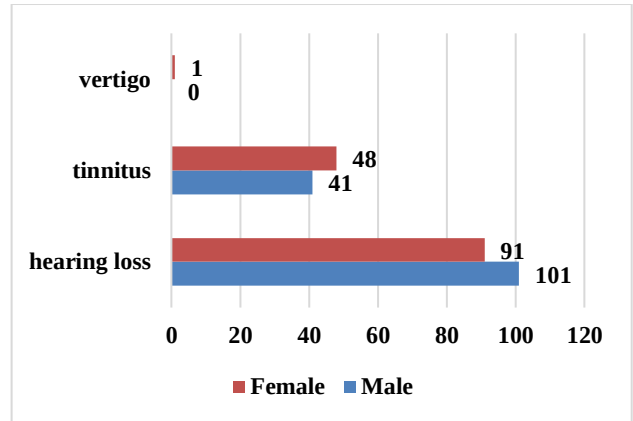


Figure 7: Presenting complaints.

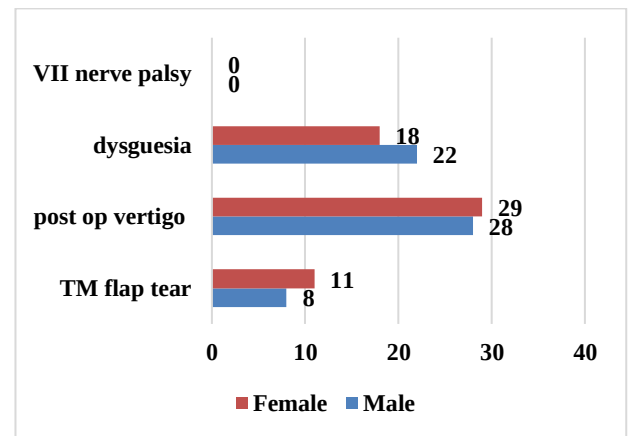


Figure 8: Complications.

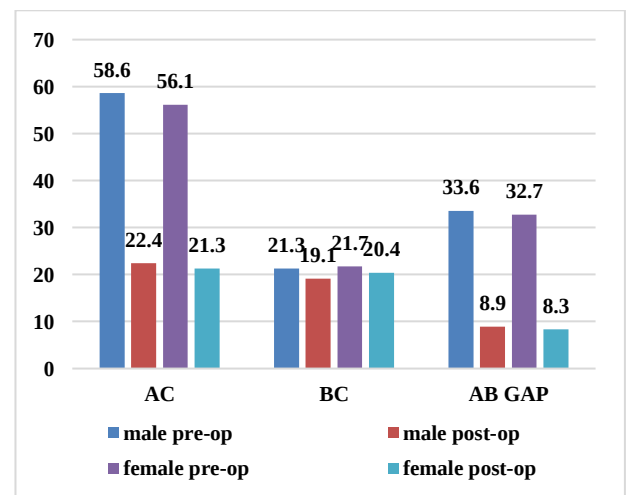


Figure 9: Outcomes.

We have observed that our method creates minimal complication and reduces the duration of surgery. We noticed that the average length of the piston required is 4.25 mm in females while for males it is 4.5 mm. only 3 female patients were fitted with 4.5 mm piston. Patients operated by our stapedotomy technique showed that the ABG closure within 10 dB could be achieved in 87% and

within 20 dB in 97% of cases without any otologic complications

DISCUSSION

The surgical approach and techniques for treating otosclerosis have evolved and been refined over time to reduce intraoperative and post-operative complications while enhancing overall effectiveness.^{4,5} There has been ongoing debate regarding the sequence of surgical steps. In early cases, the traditional method involved a classic stapedotomy, which began with the removal of the stapes superstructure, followed by perforation of the footplate, and ultimately fixing the prosthesis to the incus.^{5,6} Dr. Fisch introduced an alternative sequence of surgical steps, commencing with the perforation of the stapes footplate, followed by the removal of the stapes superstructure, and concluding with the insertion of the prosthesis. Later on, he adopted a complete reversal of the classic stapedotomy approach. In this modified technique, he initiated the procedure by perforating the stapes footplate, proceeded with the insertion of the prosthesis, and concluded by removing the stapes superstructure.⁶ An air-bone gap (ABG) of equal to or less than 10 dB post operatively has traditionally served as the established standard for successful stapes surgery. However, alternative success criteria have been proposed, with some utilizing postoperative ABG values of equal to or less than 15 dB or equal to or less than 20 dB.⁷

In our study we practice reverse stapedotomy, our method creates minimal complication and reduces the duration of surgery. In our experience we have noticed that the average length of the piston required is 4.25 mm in females while for males it is 4.5 mm. Patients operated by our stapedotomy technique showed that the ABG closure within 10 dB could be achieved in 87% and within 20 dB in 97% of cases without any dreaded otologic complications. To increase the success rate, it is also important to give the patient postoperative instructions and precautions. Patients should avoid increasing pressure in the ear by lifting heavy objects, coughing, sneezing, blowing nose, flying airplanes, swimming and exposure to loud sounds. It is also important to avoid getting the ear wet by plugging the ear with cotton ball soaked in Vaseline when taking shower. Lang et al reported closure of air-bone gap to be within 10 dB in 84.2% the reversal group compared to 80.7% of the standard group.⁸ 86% of the ABG closure within 10 dB obtained in a study by Fiorino et al.⁹ Malafronte et al compared fisch reversal technique and his modification of fisch technique and reported similar success rates (94% and 96%).¹⁰ Fisch's reversal steps stapedotomy avoids incus and footplate complications.

Sensorineural hearing loss is a relatively infrequent complication associated with stapes surgery.¹¹⁻¹⁵ It is believed to stem from inner ear damage, which may occur during either the perforation process or the insertion of the prosthesis. When technical errors have

been ruled out, other potential causes come into consideration, including reparative granuloma, labyrinthitis, and perilymph fistula.¹² During stapes surgery, small perforations of the tympanic membrane are typically sealed using a fascial graft at the conclusion of the procedure, yielding excellent outcomes. Injury to the chorda tympani nerve typically occurs during curettage or during its mobilization to expose the oval window. According to available literature, such complications have been estimated to occur in approximately 3% of cases.^{13,14} House suggested that dividing the chorda tympani, rather than stretching or manipulating it, may result in less severe symptoms.¹⁵ However, Mahendran et al. offered a contrasting viewpoint. They examined the outcomes of cutting versus manipulating the chorda tympani and recommended that, whenever possible, preserving the chorda tympani should take precedence, as cutting it was associated with significantly worse symptoms compared to manipulation.^{14,15}

A significant complication that can arise during stapes surgery is a "floating footplate." In this scenario, the footplate is unintentionally dislodged and may be displaced into the vestibule. This complication can occur when excessive force is applied during manual perforation or even when using a microdrill. To mitigate the risk of this complication, it is advisable to perform the perforation before removing the stapes superstructure, as is done in reversal stapedotomy. This approach leverages the support provided by the intact stapes superstructure to prevent footplate displacement during perforation. Another preventive measure for this complication involves the use of a CO2 laser for perforation. The CO2 laser enables the surgeon to create a hole in the footplate without exerting pressure on it. Consequently, it is not surprising to find in the literature that both reversal stapedotomy and the utilization of a CO2 laser are considered the most effective methods for preventing such complications. In our study, we did not encounter floating footplate in any of the cases of both groups. This was because alternating clockwise and counter clockwise rotatory movement without pushing will perforate rather than push the footplate. In addition, the excellent visualization provided by the microscope allowed us to see and feel the perforation making it controlled perforation. On the hand, during microscopic stapedotomy we usually feel the perforation more than we see it except after its creation, so the perforation is usually controlled with liability for pushing that may result in floating footplate.

CONCLUSION

Stapedotomy is the most effective surgical procedure for the treatment of otosclerosis significantly improving patients' quality of life. We find reversal technique to be a safe procedure, with no transmitted movement into the vestibule while crimping on a fixed chain, and the possibility of a floating footplate avoided. Our results compare well with those series reported in the literature.

We like to suggest a 4.5 mm piston for males and 4.25 mm for females can be considered rule of thumb. Most favourable hearing outcome can be obtained by the combination of experienced hands with minimal surgical trauma and an appropriate surgical technique. This will ultimately lead to less post-operative complications and the need for revision surgery.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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