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ANALYSING THE EFFICACY OF SMALL FENESTRA STAPEDOTOMY VS. LARGE FENESTRA STAPEDECTOMY FOR OTOSCLEROSIS-INDUCED HEARING LOSS- A COMPARATIVE STUDY

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Abstract

Background: The most frequent surgical procedures for treating otosclerosis-induced hearing loss are stapedectomy, or big fenestra, and stapedotomy, or tiny fenestra. Although both therapy procedures have been successful, the outcomes of comparing the two approaches are inconsistent.

Aim: The purpose of this study was to compare the effectiveness of big fenestra stapedectomy and small fenestra stapedotomy in treating hearing loss caused by otosclerosis.

Methods: 108 participants, ages 18 to 60, with conductive hearing loss, an intact tympanic membrane, and an ABG (air-bone gap) of 30 dB were evaluated for the research. Based on the clinical history of increasing hearing loss and the results of the audiometric examination, osteosclerosis was diagnosed. Additionally, the pure tone average showed a typical conductive hearing loss pattern. To evaluate hearing differences, an audiological evaluation was conducted both before and six months after surgery. All participants had the same surgical procedure, with the exception of having their foot plates removed.

Results: The average age of the research participants was 31.4±6.2 years. There were 44.4% (n=48) men and 55.5% (n=60) women. 44.4% (n=48) and 55.5% (n=60) of the participants had small fenestra stapedotomy and big fenestra stapedectomy, respectively. Both groups' ABG and PTA significantly improved after surgery, although there was no discernible difference between the two groups' ABG and PTA levels.

Conclusion: In order to improve conductive hearing loss in individuals with osteosclerosis, the current study shows that both big fenestra stapedectomy and tiny fenestra stapedotomy are safe and effective procedures.

Keywords: Air–bone gap, otosclerosis, pure tone audiometry, large fenestra stapedectomy, small fenestra stapedotomy

INTRODUCTION

Osteosclerosis is a condition that affects the middle ear's otic capsule and ossicles. It causes the production of new, thick sclerotic bone, which eventually results in hearing loss. Although the exact cause of osteosclerosis is unknown, several ideas based on hormonal, viral, genetic, and other variables have been proposed. Although autosomal inheritance is thought to be the predominant form of inheritance for osteosclerosis, alternative modes of heredity may also exist. It often affects women in their second and third decades of life and is bilateral in over 80% of instances. Affected individuals often exhibit conductive hearing loss that progresses slowly. The footplate's stapes is the most often affected area. Sensorineural hearing loss, or SNHL, is a condition that occurs when the otic capsule is affected. Dizziness and tinnitus are other symptoms associated with osteosclerosis.[1]

After an audiometric test and gradual hearing loss, osteosclerosis is detected. Pure tone audiometry, often known as PTA, shows the usual pattern of conductive hearing loss. A decrease in bone conduction, called as Carhart's notch and indicative

of osteosclerosis, is seen, especially at 2 kHz. This results from the removal of elements that aid in sound perception through bine conduction. Typical As curves that show stiffer ossicular chain and lack of stapedial reflex are observed during tympanoplasty. Surgery is required when the patient has a minimum 15-20dB hearing loss and bone conduction is superior to air conduction, a condition known as Rinne negative using a 512 Hz tuning fork.[2]

Osteosclerosis can be managed surgically, with the use of hearing aids, hormonally (with estrogen blockers), medically, or by waiting and watching. Subjects who are unwilling to undergo surgery or who also have sensorineural hearing loss are treated with hearing aids. Large or tiny fenestras are the most typical options for surgical intervention. Osteosclerosis has been successfully managed with both of these operations.[3]

ABG of 10 dB, or nearly 95% in big series, is taken into consideration when calculating the success rate for stapes surgery. Stapes surgery has a number of consequences, but the most concerning one is sensorineural hearing loss, which occurs in less than 0.5% of patients who have extensive series of operations performed by skilled surgeons. 4. The purpose of this study was to compare the effectiveness of big fenestra stapedectomy and small fenestra stapedotomy in treating hearing loss caused by otosclerosis.

MATERIALS AND METHODS

The purpose of this retrospective research was to compare the effectiveness of big fenestra stapedectomy and small fenestra stapedotomy in treating hearing loss caused by otosclerosis. The research participants came from the Institute's ENT Department. Prior to their involvement in the study, all participants gave their written and verbal informed permission.

108 osteosclerosis patients who met the research's inclusion requirements and had stapes surgery at the institution during the designated study period were evaluated. Sociodemographic information, the side of the ear afflicted, the length of the sickness, the side of the surgery, vertigo or tinnitus, and pre and postoperative pure tone audiograms for hearing result were all gathered from the Institute's records for each participant. Participants in the research had to be between the ages of 18 and 60, have conductive hearing loss, and have an undamaged tympanic membrane.

individuals with ABG >30 dB, minimum follow-up following surgery of at least 6 months, and all necessary data. Participants who had already had stapes surgery, were younger than 18 or older than 60, or had chronic otitis media were excluded from the research.

The stapedius reflex test, impedance audiometry with tympanogram, tuning fork test, otoscopic findings, and history were used to diagnose osteosclerosis in the participants. Pure tone audiometry, or PTA, was performed on each participant both before and after surgery. Air conduction thresholds (ACT) were measured between 250 and 8000 Hz, whereas bone conduction thresholds (BCT) were measured between 250 and 4000 Hz. Air and bone conduction experiments at 500 Hz, 1 kHz, and 2 kHz frequencies were used to measure ABG. ABG was calculated after surgery by deducting the postoperative ACT from the postoperative BCT.

Audiograms recorded both before and six months after surgery were used to compute the hearing outcomes. All audiologic procedures in the soundproof room were conducted using a calibrated clinical audiometer.

All of the procedures were performed under local anesthetic using a 2% lignocaine solution containing a 1:200,000 solution of adrenaline. The tympanic section of the facial canal, the footplate of the stapes, and the stapedius tendon were exposed after the tympanomeatal flap was elevated using a transcanal technique and the posterosuperior canal was curettaged. The incudostapedial joint was dislocated, the anterior and posterior crura were fractured, the stapedius tendon was severed, and the suprastructures were removed. Due to the possibility of perilymph gusher when fenestra was formed anteriorly, either a big or small fenestra was constructed in the posterior portion of the stapes footplate, and the fenestra site was maintained constant throughout all individuals.

Every patient received a Teflon piston prosthesis, and the prosthesis's length was measured from the base of the long incus process to the stapes footplate. Following measuring, the piston was positioned within an oval window, and hook crimping was carried out over an extended incus procedure. The stapes piston measured between 0.4 and 0.6 mm. In every instance, a fenestra tissue seal was created using temporalis fascia graft or ear lobule fat. Following prosthesis positioning and mobility testing, the flap was put back in place and gelfoam was used to fix it. The subjects were released two days after the procedure. With the exception of the stapes foot plate's altered dimensions, the surgical approach was the same for all individuals.

ANOVA, chi-square test, student's t-test, Fisher's exact test, Mann Whitney U test, and SPSS (Statistical Package for the Social Sciences) software (IBM Corp., Armonk, NY, USA) were used to statistically analyze the collected data. When the p-value was less than 0.05, the significance threshold was taken into account.

RESULTS

The purpose of this retrospective research was to compare the effectiveness of big fenestra stapedectomy and small fenestra stapedotomy in treating hearing loss caused by otosclerosis. 108 participants, ages 18 to 60, with conductive hearing loss, an intact tympanic membrane, and an ABG (air-bone gap) of 30 dB were evaluated for the research. In the current study, there were 55.5% (n=60) females and 44.4% (n=48) men. The research participants were 31.4±6.2 years old on average. The age group most frequently impacted was 26–35 years old (Table 1 and 2).

Small fenestra stapedotomy was performed on 44.4% (n=48) of the 108 research participants who were chosen at random, whereas big fenestra stapedectomy was performed on 55.5% (n=60) of the participants. 14.81% (n=16) of the individuals had right ear disease, 9.26% (n=10) had left ear illness, and 75.93% (n=82) had bilateral disease in both ears.

Among those who had a big fenestra stapedectomy, the ABG was 36.80±4.54 before the procedure, but it dropped dramatically to 17.74±10.30 thereafter, with a p-value of 0.001. Subjects who had a tiny fenestra stapedotomy had an ABG of 34.43±3.67 before surgery, which dropped dramatically to 16.47±7.61 after surgery, with a p-value of 0.001. Both big and small fenestra showed statistically significant improvements in ABG in the intragroup evaluation, while the intergroup ABG was statistically non-significant at 0.747.

According to the study's findings, the pure tone average (PTA) was 56.17±9.35 before surgery and dropped to 30.55±14.45 after the big fenestra, which was significant (p=0.001). PTA was 55.26±10.07 before tiny fenestra surgery and dropped to 30.32±10.85 after, indicating significant significance with $p<0.05$. Additionally, PTA had a p-value of 0.92, making it statistically non-significant when compared between groups.

DISCUSSION

108 participants, ages 18 to 60, with conductive hearing loss, an intact tympanic membrane, and an ABG (air-bone gap) of 30 dB were evaluated in this study. In the current study, there were 55.5% (n=60) females and 44.4% (n=48) men.

The research participants' average age was 31.4±6.2 years. The age group most frequently impacted was 26–35 years old. These findings were similar to those of earlier research by Lippy WH et al.6 and Balu R et al.5, where the authors evaluated participants with conductive hearing loss and included demographic information similar to those of the current study.

According to the study's findings, out of the 108 participants, 44.4% (n=48) underwent a small fenestra stapedotomy, while 55.5% (n=60) underwent a big fenestra stapedectomy. The participants were chosen at random. It was observed that 14.81% (n=16) of the participants had right ear disease, 9.26% (n=10) had left ear disease, and 75.93% (n=82) had bilateral illness.

These results were consistent with those of Vincent R et al. (2006) and Sobrinho PG et al. (2004), whose findings were similar to those of the current investigation and involved participants whose illness data were evaluated by the authors.

Before undergoing a large fenestra stapedectomy, the research participants' ABG was 36.80±4.54, but following the surgery, it reduced sharply to 17.74±10.30, with a p-value of 0.001. In subjects who had micro fenestra stapedotomy, the preoperative ABG was 34.43±3.67; the postoperative testing revealed a substantial drop to 16.47±7.61 with a p-value of 0.001. While the intergroup ABG was statistically non-significant at 0.747, the intragroup examination revealed statistically significant improvements in ABG for both big and small fenestra.

These findings were in line with those of Gristwood RE et al. (2003) and Cajade FJ et al. (2003), whose respective investigations likewise revealed ABG results for small fenestra stapedotomy and big fenestra stapedectomy that were compatible with the current study.

It was seen that on PTA (pure tone average) it was 56.17±9.35 preoperatively and decreased to 30.55±14.45 postoperatively following large fenestra which was significant with p=0.001. PTA was 55.26±10.07 before tiny fenestra surgery and dropped to 30.32±10.85 after, indicating significant significance with $p<0.05$. Additionally, PTA had a p-value of 0.92, making it statistically non-significant when compared between groups. These results were consistent with those of Redfors YD et al. (2011) and Nemat S et al. (2013), whose outcomes for PTA in small fenestra stapedotomy and big fenestra stapedectomy were comparable to those of the current investigation.

CONCLUSION

When it comes to improving conductive hearing loss in individuals with osteosclerosis, both big fenestra stapedectomy and tiny fenestra stapedotomy are safe and successful procedures. To draw a firm conclusion, further prospective longitudinal research with a bigger sample size and longer monitoring is required.

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Parameters	**Number (n)**	**Percentage (%)**
Gender		
Males	48	44.4
Females	60	55.6
Age range (years)		
15-25	22	20.4
26-35	48	44.4
36-45	26	24.1
46-55	12	11.1
Total	108	10
Face side affected		
Bilateral	82	75.93
Left	10	9.26
Right	16	14.81

Table 1: Demographic data in study subjects

Variables	**Small fenestra stapedotomy**		**Large fenestra stapedotomy**	
	n	**%**	**n**	**%**
Surgery side				
Bilateral	34	70.8	48	80
Left	6	12.50	4	6.67
Right	8	16.6	8	13.3

Table 2: Comparison of side of face treated in study subjects