

Hearing Outcome in Stapes Surgery Using Various Biomaterial Prostheses

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Abstract

Aims: To assess the hearing outcome in patients who have undergone stapes surgery using polytetrafluoroethylene (PTFE) and Titanium prosthesis at 1 and 3 months post operatively. **Material & Methods:** Research design: Prospective study. Setting: ENT department, Pushpagiri Medical College. Study population: All age groups with clinical diagnosis of otosclerosis and air-bone gap more than 15 dB irrespective of sex difference. Patients with Meniere's disease are excluded. Method: A prospective study was conducted for a period of one and a half years from January 2014 to July 2015 to find out the hearing outcome of stapes surgery in patients with otosclerosis using polytetrafluoroethylene (PTFE) and Titanium prostheses, attending our outpatient department. **Results:** In this study, 84.21% of ears with polytetrafluoroethylene (PTFE) and 81.81% of ears with titanium were able to achieve good results in terms of Air-Bone gap (ABG) closure (ABG < 20 dB). The average post op hearing following stapes surgery at 3 months improved to near normal levels of 34.12 dB ± 8.95 with an average hearing gain of 19.19 dB with PTFE prosthesis and 30.86 dB ± 5.47 with an average hearing gain of 21.2 dB with titanium which were significant. **Conclusion:** Stapes surgery is the surgical procedure of choice for otosclerosis. In our study, a significant hearing improvement was seen in majority of cases. None of the factors considered relevant for the success of stapes surgery like age, sex, type of prosthesis appeared to affect the post-operative hearing significantly. Hence stapes surgery can be effectively used to improve hearing in otosclerosis.

Keywords

Otosclerosis, PTFE and Titanium, AC Threshold Gain, AB Gap

1. Introduction

Otosclerosis is the most common cause of progressive conductive hearing loss in

adults. It is more common in females with 2:1 female to male ratio. The age of onset is usually third decade of life. The hearing loss is bilateral in 70% of cases. Otosclerosis is transmitted in an autosomal-dominant fashion with variable penetrance.

Otosclerosis is a localized hereditary disorder affecting endochondral bone of the otic capsule that is characterized by disordered resorption and deposition of bone. It begins as spongification of the bone of the otic capsule. It may cause conductive hearing loss, a mixed hearing loss or occasionally a purely sensorineural hearing loss.

In 1860, Toynbee [1] first described the condition causing a hearing loss by fixation of the stapes. In 1893, Politzer [2] referred to the fixation of the stapes as otosclerosis. Siebenmann [3] revealed on microscopic examination that the lesion seemed to begin as spongification of the bone and termed the process otospongiosis.

The main complaint of the patient will be progressive hearing loss. If it involves stapes, hearing loss will be conductive; the commonest site of involvement being anterior crura. The disease progresses to involve the entire footplate. It may progress anteriorly to involve the cochlea leading to sensorineural hearing loss as shown in **Figure 1**.

Otosclerosis is an autosomal dominant disease with variable penetrance and expression. Women are more affected (2:1). Age of onset is late teens or early 20s, but may not occur until the 30s or early 40s. At the House Ear Clinic, the youngest patient with surgically confirmed otosclerosis was 6 years old [4]. It is aggravated in pregnancy and many present with symptoms after their first pregnancy. Clinical otosclerosis is rare in blacks, Asians, and Native Americans [5]-[11].

Occasionally, the lesion may involve only the cochlea, causing an isolated sensorineural hearing loss. Sometimes the entire cochlea is surrounded by otosclerosis, causing total deafness. In the United States, 20 of the first 57 patients to have a cochlear implant were made deaf by otosclerosis [12].

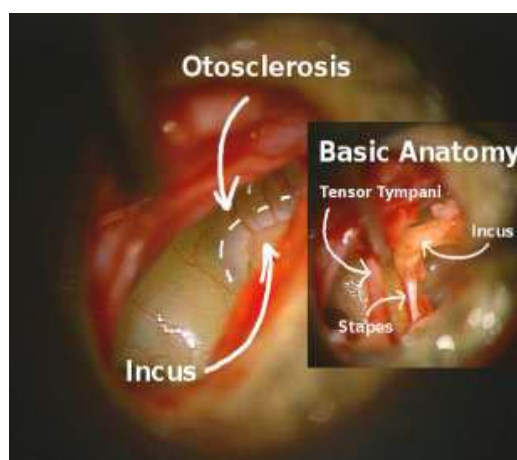


Figure 1. Otosclerosis basic anatomy [13].

2. Methods

2.1. Type of Study and Source of Data

A prospective study was conducted for a period of one and a half years from January 2014 to July 2015 to find out the hearing outcome of stapes surgery in patients with otosclerosis using PTFE and Titanium prostheses, attending ENT OPD at Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla, Kerala.

2.2. Inclusion Criteria

Patients presenting with history, clinical features and audiological findings of otosclerosis with air-bone gap of more than 15dB with conductive hearing loss and intact tympanic membrane who underwent stapes surgery with various bio-material prostheses. Patients of both sex, all age groups, patients who underwent bilateral and revision surgeries come under the study.

2.3. Exclusion Criteria

Patients with Meniere's disease are excluded from the study.

2.4. Method of Data Collection

All patients with clinical diagnosis of otosclerosis with air-bone gap of more than 15 dB across 500 Hz, 1000 Hz, and 2000 Hz in whom stapes surgery was planned and were willing to undergo surgery were selected for surgery. A total of 30 ears (28 patients where two patients underwent bilateral surgery) had undergone stapes surgery during the study period. A complete history, ENT examination and appropriate investigations [Pure Tone Audiogram, Speech Audiometry, Tympanometry] were done to arrive at the correct diagnosis.

3. Results

A total of 30 ears (28 patients where two patients underwent bilateral surgery) of otosclerosis underwent stapes surgery with either polytetrafluoroethylene (PTFE) or Titanium in Pushpagiri Medical College from January 2014 to July 2015. All the patients were available for PTA follow up at 1 month and 3 months after surgery and they were compared with pre operative PTA value. All the cases were operated by a single surgeon. The data were analyzed under the following headings:

- 1) Patient factors;
- 2) Surgical factors;
- 3) Results.

3.1. Patient Factors

3.1.1. Age Distribution (Number of Patients)

Out of the, 53.57% of the patients were between the age group of 21 to 40 years. There was only one patient above 70 years.

3.1.2. Sex Distribution (Number of Patients)

In our series of 28 patients (30 ears since two patients underwent bilateral surgery), 14 were males and 14 were females. The male to female ratio was 1:1.

3.2. Surgical Factors

Type of Prosthesis (Number of Ears Operated)

Out of 30 ears (28 patients where two patients underwent bilateral surgery), 19 ears underwent stapes surgery with PTFE biomaterial prosthesis, 11 underwent surgery with titanium prosthesis.

Table 1 shows, out of 28 patients (30 ears since two patients underwent bilateral surgery), 2 patients underwent bilateral stapes surgery and 26 patients underwent unilateral surgery. So there were 7.17% patients of bilateral and 92.86% patients of unilateral stapes surgery.

Table 2 shows, one patient had to undergo revision surgery out of 28 patients (30 ears since two patients underwent bilateral surgery). It was due to dislocation of prosthesis and was operated second time 3 months after primary surgery.

3.3. Results

TITANIUM: The average pre-op hearing loss was (AC) was $52.06 \text{ dB} \pm 7.70$. The average post op hearing (AC) at 1 month follow up was $39.33 \text{ dB} \pm 6.85$ with an average hearing gain of 12.73 dB which was significant. The average post op hearing (AC) at 3 months improved to $30.86 \text{ dB} \pm 5.47$ with an average hearing gain of 21.2 dB which was also significant as shown in **Figure 2**.

PTFE: The average pre-op hearing loss was (AC) was $53.31 \text{ dB} \pm 7.71$. The average post op hearing (AC) at 1 month follow up was $41.75 \text{ dB} \pm 7.53$ with an average hearing gain of 11.56 dB which was significant. The average post op hearing (AC) at 3 months improved to $34.12 \text{ dB} \pm 8.95$ with an average hearing gain of 19.19 dB which was also significant as shown in **Figure 2**.

TITANIUM: -In our study of 30 ears operated (28 patients where two patients underwent bilateral surgery), based on improvement of AB gap (according to Wehr's classification), 8 ears had excellent improvement at 3 months post operatively, 1 ear had good improvement, 2 ears fair improvement and no failure cases by the end of 3 months post op as shown in **Figure 3**.

PTFE: -In our study, 12 ears had excellent improvement at 3 months post operatively, 4 ears had good improvement, 1 ear fair improvement and 2 failure cases by the end of 3 months post op as shown in **Figure 3**.

TITANIUM: -The average pre op ABG was $28.67 \text{ dB} \pm 4.60$. The average post op ABG at 1 month post op follow up was $17.21 \text{ dB} \pm 7.37$ with an average closure of 11.46 dB which was found to be significant. The average post op ABG at 3 months post op follow up was $12.36 \text{ dB} \pm 5.29$ with an average closure of 16.31 dB which was found to be significant as shown in **Figure 4**.

PTFE: -The average pre op ABG for PTFE prosthesis was $29.26 \text{ dB} \pm 8.73$. The average post op ABG at 1 month post op follow up was $18.26 \text{ dB} \pm 7.14$ with an average closure of 11 dB which was found to be significant. The average post op

ABG at 3 months post op follow up was $14.2 \text{ dB} \pm 8.62$ with an average closure of 15.06 dB which was found to be significant as shown in **Figure 4**.

Table 3 shows the average AC threshold post op at 1 month using PTFE was 41.75 ± 7.53 . The average AC threshold post op at 1 month using titanium was 39.33 ± 6.85 . The comparative study was not statistically significant. The average AC threshold post op at 3 months using PTFE was 34.12 ± 8.95 . The average AC threshold post op at 3 months using titanium was 30.86 ± 5.47 . The comparative study was not statistically significant.

The average ABG threshold post op at 1 month using PTFE was 18.26 ± 7.14 . The average ABG threshold post op at 1 month using titanium was 17.21 ± 7.37 . The comparable study was not statistically significant.

The average ABG threshold post op at 3 month using PTFE was 14.2 ± 8.62 . The average ABG threshold post op at 3 month using titanium was 12.36 ± 5.29 . The comparative study was not statistically significant as shown in **Table 4**.

84.21% ears with PTFE has good to excellent improvement (less than 20 dB) in ABG at 3 months post operatively. 81.81% ears with titanium has good to excellent improvement (less than 20 dB) in ABG at 3 months post operatively as described in **Table 5**.

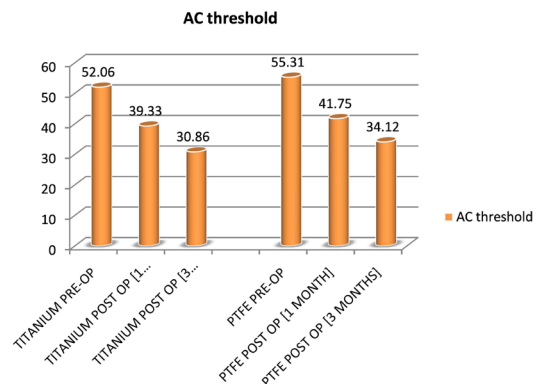


Figure 2. Improvement in terms of difference between pre and post op AC threshold with Titanium and PTFE Prosthesis.

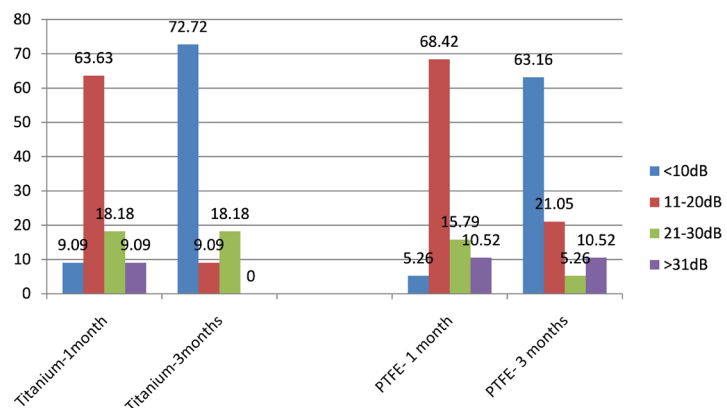


Figure 3. ABG results in number of ears operated at 1 and 3 months post op with Titanium prosthesis and PTFE prosthesis (Wehr's classification).

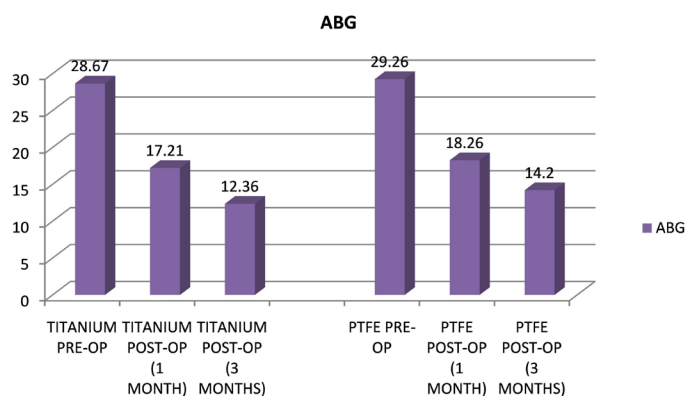


Figure 4. Improvement in terms of difference between pre-op and post op ABG and ABG closure with Titanium prosthesis and PTFE prosthesis.

Table 1. Number of unilateral and bilateral cases (number of patients).

Total no. of patients operated	Number	Percentage
Bilateral	2	7.17
Unilateral	26	92.86
Total	28	100

Table 2. Revision cases (number of ears operated).

Total No. of ears operated	No. of revision cases	Percentage of revision cases
30	1	3.33

Table 3. Comparison of AC threshold post op 1 month & 3 months between PTFE and Titanium.

	Post-Op 1 month					
	PTFE			Titanium		
	Mean (dB)	SD	P-value	Mean (dB)	SD	P-value
AC	41.75	7.53	0.603	39.33	6.85	0.595
	Post-Op 3 month					
	PTFE			Titanium		
	Mean (dB)	SD	p-value	Mean (dB)	SD	p-value
AC	34.12	8.95	0.385	30.86	5.47	0.326

Table 4. Comparison of ABG post op 1 month & 3 months between PTFE and Titanium.

	Post -op 1 month					
	PTFE			Titanium		
	Mean (dB)	SD	p-value	Mean (dB)	SD	p-value
AC	18.26	7.14	0.662	17.21	7.37	0.666
	Post-op 3 month					
	PTFE			Titanium		
	Mean (dB)	SD	p-value	Mean (dB)	SD	p-value
AC	14.2	8.62	0.652	12.36	5.29	0.609

Table 5. Comparison of percentage of ears showing ABG post op between PTFE and Titanium prosthesis.

ABG	1 month		3 months	
	PTFE (%)	Titanium (%)	PTFE (%)	Titanium (%)
<10 (excellent)	5.26	9.09	63.16	72.72
11 - 20 (good)	68.42	63.63	21.05	9.09
21 - 30 (fair)	15.79	18.18	5.26	18.18
>31 (failure)	10.52	9.09	10.52	0

4. Discussion

In the present study, 30 ears (28 patients where two patients underwent bilateral surgery) with otosclerosis underwent stapes surgery and were analyzed and followed up for post op improvement in hearing at 1 month and 3 months. Various host and surgical factors which could affect the surgical results were considered and analyzed.

The minimum age in our study group was 23 years and maximum age in the group was 73 years. The maximum number of patients was in the age group of 21 - 40 years (53.57%). Clinical otosclerosis is more frequent between the ages of 20 and 30 (Nager, 1969) [14]. Some cases become evident as early as six or seven, but the majority manifest between ages 15 and 35, with a few cases as late as 54 years old (Shambaugh, 1961). Average age of onset has been reported to be 33 (Panama, 1987), 29 (Minnesota, 1978), 24 (Chile, 1987), and 23 (Brazil, 1987).

Age does not significantly affect the success rate of stapes surgery. Kulakova *et al.* [15] found that the surgical intervention on the stirrup bone for the treatment of otosclerosis in the patients above 65 years of age is a safe and efficacious method despite marked hearing impairment in this group of patients. Massey *et al.* [16] evaluated the outcomes of stapedectomy surgery for congenital stapes fixation and found that stapedectomy remains an effective method to achieve significant hearing improvement in the majority of patients for congenital fixation. Age is not a detriment to hearing gain and instead might result in better use of hearing aids in older adults, thus facilitating social hearing recovery [17]. In our study group, there was no patient in paediatric age group and there is one patient in geriatric age group. Therefore, it is not possible to correlate age as a significant success factor for surgery.

Univariate and multivariate analyses indicated that none of the pre-operative factors (piston type, age, sex, affected side, tinnitus, vertigo, and pre-operative hearing thresholds) affected hearing success significantly (all $p > 0.05$).

In our series of 28 patients (30 ears since two patients underwent bilateral surgery), 14 patients were males and 14 were females. The male to female ratio was 1:1. The success of stapes surgery for otosclerosis is not dependent on sex of the patients [17]. The prevalence of otosclerosis is greater in women, with a 2:1 female-to-male distribution [18]. The difference in the study arises due to random assignment.

Shabana *et al.* [19] conducted study using a 0.4-mm diameter Teflon platinumpiston and a 0.6-mm diameter PTFE piston. The postoperative air-bone gap, calculated as the difference between the postoperative air and bone conduction levels, was smaller in the 0.6 mm group for all frequencies except at 2000 Hz; the differences were statistically insignificant except at 4000 Hz. It was concluded that the 0.4 mm and the 0.6 mm PTFE prostheses produced the same hearing improvement in stapes surgery for otosclerosis. In our series of study, we used diameters of 0.4 mm PTFE prosthesis and 0.4 mm titanium prosthesis. There was no significant difference in the hearing outcome. The measurement of the piston is always described as a significant stage of the surgery, but its length is never clearly defined [20].

The measurement of the length of the piston is very significant, and in our study, the majority of the pistons were cut at 4.75 mm which indicates an incus-footplate measurement of 4.25 mm. In our series of cases, we routinely measured the length of the pistons which were 4.25 - 4.75 mm long. In our series of study, the fenestra was sealed with gel foam.

In this study, the hearing improvement at 1 month and 3 months were evaluated. We used two types of prostheses, *i.e.* PTFE and Titanium. Here we are reporting short term hearing results because long term success of stapes surgery is largely dependent on factors outside the control of surgeon like patient follow-up rate, period of study. The short-term results are a more accurate reflection of the actual surgical outcome.

In the study, the hearing outcome was analysed by comparing the pre op air conduction and post op air conduction threshold and air-bone gap at 1 month and 3 months and analysis is done for PTFE and Titanium prostheses separately and determining if there was significant improvement. The average pre-operative and post-operative AC threshold was calculated by taking the frequencies across 500 Hz, 1000 Hz and 2000 Hz. Air-bone gaps were calculated using air conduction and boneconduction thresholds at frequencies 500 Hz, 1000 Hz and 2000 Hz.

The average pre-op hearing loss in this study with titanium was (AC) was 52.06 dB \pm 7.70. The average post op hearing (AC) at 1month follow up was 39.33 dB \pm 6.85 with an average hearing gain of 12.73 dB which was significant. The average post op hearing (AC) at 3 months improved to 30.86 dB \pm 5.47 with an average hearing gain of 21.2 dB which was also significant. This was similar to results of Boleas-Aquirre *et al.* [21] who reported the overall improvement in airconduction thresholds and pure-tone average air conduction for all frequencies after 1 year of surgery. Ataide *et al.* [20] did audiometric evaluation after stapedotomy with Fisch titanium prosthesis and showed improvement post operatively. The mean hearing gain was also reported by Boleas-Aquirre *et al.* [21].

In our study of 30 ears operated, based on improvement of AB gap (according to Wehr's Classification) among titanium prosthesis, 8 ears had excellent im-

provement at 3 months post operatively, 1 ear had good improvement, 2 ears fair improvement and no failure cases by the end of 3 months post op. Singh *et al.* [21] found out that the titanium soft clip stapes piston gives good results in cases of stapedotomy for otosclerosis. The soft clip design is a new development in the evolution of stapes piston prostheses. Surgical introduction, placement, and fixation are easier than the earlier design of clip piston.

The air-bone gap with titanium in the study of Boleas-Aguirre *et al.* [21] was significantly reduced 1 year after surgery and remained so at 4 years. Preoperative air-bone gap, 34.04 dB; at 1 year, 16.40 dB; at 4 years, 17.3 dB. In our study, the average pre op ABG with titanium was 28.67 dB \pm 4.60. The average post op ABG was analysed at 1 month and post op follow up showed AB gap of 17.21 dB \pm 7.37 with an average closure of 11.46 dB which was found to be significant. The average post op ABG at 3 months post op follow up was 12.36 dB \pm 5.29 with an average closure of 16.31 dB which was found to be significant. Ataide *et al.* [22] found out that the mean low-frequency postoperative air-bone gap was 12.9 dB. Twenty-five (75.8%) patients had air-bone gaps of 10 dB and under; 32 (96.9%) patients had gaps of 20 dB and under; and all patients had gaps of 30 dB and under.

The average pre-op hearing loss with PTFE was (AC) was 53.31 dB \pm 7.71. The average post op hearing (AC) at 1 month follow up was 41.75 dB \pm 7.53 with an average hearing gain of 11.56 dB which was significant. The average post op hearing (AC) at 3 months improved to 34.12 dB \pm 8.95 with an average hearing gain of 19.19 dB which was also significant. Ahmed *et al.* [23] assessed hearing improvement after stapedotomy for otosclerosis using PTFE loop prosthesis. Pre-operative audiograms showed conductive deafness. Carhart's notch was present in 33.3% cases. Tympanogram revealed loss of stapedial reflex. Post-operatively good hearing improvement was seen in 56.7%.

In our study of 30 ears operated, 12 ears had excellent improvement at 3 months post operatively, 4 ears had good improvement, 1 ear fair improvement and 2 failure cases by the end of 3 months post op. In the study conducted by Ahmed *et al.* [24], postoperatively good hearing improvement was seen in 56.7%, fair improvement in 30% and poor results in 10% cases. One patient developed dead ear.

The average pre op ABG with PTFE prosthesis was 29.26 dB \pm 8.73. The average post op ABG at 1 month post op follow up was 18.26 dB \pm 7.14 with an average closure of 11 dB which was found to be significant. The average post op ABG at 3 months post op follow up was 14.2 dB \pm 8.62 with an average closure of 15.06 dB which was found to be significant. Dall'igna *et al.* [25] in his study found out that bone-air gap reduced in an average value of 21.90 dB ($p < 0.05$) after the surgery in the group that received the PTFE prosthesis and gain in SRT was of 22.33 and the air-bone gap was below 20 dB in 80.6%

All patients in the study had better improvement at 3 months post op when compared to 1 month post op air conduction and air-bone gap closure except in

one case where there was displacement of prosthesis 3 months after stapes surgery and was operated again. Hearing improves once the swelling subsides, the slight bleeding behind the ear drum dries up and the packing is absorbed or removed, usually within two weeks. Hearing continues to get better over the next three months.

There was improvement in bone conduction in 27 out of 30 ears in the study after undergoing stapes surgery. Improvement was more in patients whose bone conduction preoperatively was equal to or more than 30 dB. This is similar to studies of Morshed *et al.* [26] where he found out there was significant improvement of AC obtained after stapedectomy. There was also significant improvement of BC at all the frequencies examined of 6 - 12 dB and it depended on BC threshold before surgery. In the group of 37 patients with BC threshold before surgery $>$ or $=$ 30 dB, a significant improvement of BC after stapedectomy developed. In the group of 14 patients with BC threshold before surgery $<$ 30 dB, the change of BC after stapedectomy was not significant. Successful stapedectomy improves bone conduction. It means that inpatients with otosclerosis, there is a reversible BC pseudo hearing loss and it is related to BC threshold before the operation.

Out of 30 ears (28 patients), 2 patients underwent bilateral surgery for otosclerosis. The typical age of onset of noticeable hearing loss is in the third decade of life, and hearing loss is bilateral in 70% of cases [18].

1 ear out of 30 ears (total of 28 patients where two patients underwent bilateral surgery) underwent revision surgery 3 months after primary surgery with PTFE prosthesis due to dislocation of prosthesis. The pre op air conduction threshold was 53.3 dB. It improved to 48.3 dB 1 month after surgery. But the hearing decreased 3 months after surgery to 60 dB. The air bone gap pre operatively was 21.7 dB. It improved to ABG of 20.3 dB 1 month after surgery. The ABG became 36.7 dB 3 months after surgery. This was due to dislocation of PTFE prosthesis. Skrivan *et al.* [27] reported the reasons of the recurrent or persisting hearing loss after previous stapes surgery indicated for otosclerosis. The main reason of the failed surgery was adhesions and dislocation of the prosthesis. The mean postoperative air-bone gap was 12.0 dB. A mean postoperative air-bone gap closure within 10 dB occurred in 24 cases (55.8%), between 11 - 20 dB occurred in 11 cases (25.6%) and above 20 dB in 8 cases (18.6%).

On comparing hearing outcome with PTFE and titanium, 72.72% of ears (8 out of 11) with titanium prosthesis had excellent improvement in ABG at 3 months after surgery. There were zero cases with ABG more than 31 dB whereas 63.16% of ears (12 out of 19) with PTFE prosthesis had excellent improvement in ABG at 3 months after surgery whereas ABG more than 31 dB was seen in 10.52% cases (2 out of 19). So, 84.21% ears with PTFE attained ABG less than 20 dB; it was 81.81% ears with titanium who attained ABG less than 20 dB. Thus it can be concluded that the result with respect to ABG between the two prosthesis were comparable and produced similar results. Similar results were seen with

studies conducted by Massey *et al.* [28] where the study group was comprised of 35 titanium and 183 PTFE prostheses. Closure of the air-bone gap to less than 20 dB was achieved in 86% of the ears with PTFE prosthesis compared with 71% of those with titanium prostheses. Other studies included were by Rajesh *et al.* [29] where postoperative ABG of 20 dB or less was seen in 96% in both groups.

The average AC threshold post op at 1 month using PTFE was 41.75 ± 7.53 . The average AC threshold post op at 1 month using titanium was 39.33 ± 6.85 . The comparative study was not statistically significant. The average AC threshold post op at 3 month using PTFE was 34.12 ± 8.95 . The average AC threshold post op at 3 month using titanium was 30.86 ± 5.47 . The comparative study was also not statistically significant.

The average ABG threshold post op at 1 month using PTFE was 18.26 ± 17.14 . The average ABG threshold post op at 1 month using titanium was 17.21 ± 7.37 . The comparative study was not statistically significant. The average ABG threshold post op at 3 month using PTFE was 14.2 ± 8.62 which was not statistically significant. The average ABG threshold post op at 3 month using titanium was 12.36 ± 5.29 which was also not statistically significant. This was similar to studies of Rajesh *et al.* [29] where the mean postoperative ABG was 8.2 dB and 11.5 dB for PTFE and Titanium group respectively.

4.1. Alternative Treatment

4.1.1. Hearing Aids

All patients with conductive hearing loss caused by otosclerosis may use hearing aids as an alternative to surgery. If the patient has a significant sensorineural component to the hearing loss, a hearing aid may be required even after successful stapedectomy. A patient with far advanced otosclerosis requires a hearing aid at all times. It may take 4 months before these patients can tolerate and benefit from the hearing aid.

4.1.2. Fluoride Therapy

Injury to the inner ear is believed to occur as a result of the spread of proteolytic enzymes to the inner ear fluids from an active otospongiotic focus, with resultant injury to the organ of Corti and spiral ligament [30]. In patients with evidence of progressive sensorineural hearing loss, fluoride therapy has been shown to reduce the progression of hearing loss due to the conversion of the active otospongiotic lesion to a more stable otosclerotic lesion [30]. Patients are typically treated with Florical 8 mg three times per day until hearing loss stabilizes.

5. Conclusions

The main objective of this study is to assess the hearing outcome in stapes surgery using PTFE and titanium prostheses at 1 month and 3-month post operatively. The post operative AC threshold gain and ABG were taken as the two variables used to determine the hearing outcomes. The AC threshold improved post operatively in 95% ears with PTFE and 100% ears with titanium. The main

cause for failure is dislocation of prosthesis which was encountered in one of the ears in the study with PTFE. The ABG attained post operatively at 3 months to less than 20 dB was in 84.21% ears of PTFE and 81.81% ears of titanium.

The bone conduction improved post operatively in 90% of ears which was more with ears with pre-op bone conduction threshold more than or equal to 30 dB. The comparison of hearing outcome in stapes surgery using PTFE and titanium were not significant statistically. Both prostheses produced similar and comparable results and it cannot be concluded one prosthesis is better than the other since ours is a small case series and the study is for shorter duration of time. It may require a larger case series and longer duration of time to find out if there is significant difference between the two prostheses. So PTFE and titanium can be equally suggested for patients in stapes surgery. In our study, we have analysed the hearing outcomes in stapes surgery using PTFE and titanium prostheses. Hence it is concluded that stapes surgery can be effectively used to improve hearing in otosclerosis irrespective of the prosthesis used.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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