Comparison of hearing results between the averages of three and four speech frequencies in Type 3 Tympanoplasty.

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Abstract

Introduction: Hearing assessment after tympanoplasty is done by taking pure tone average. This study was performed to compare the hearing results obtained from the averages of three and four speech frequencies namely 0.5, 1,2KHz and 0.5,1,2,4 KHz in type III tympanoplasty.

Methods: This study was conducted in Tribhuwan university teaching hospital and Kathmandu university hospital, Dhulikhel from October 2006 to November 2009. The pure tone audiogram was performed by Hugson and Westlake method. The audiometry results were reported as per American Academy of Otolaryngology – Head and Neck surgery guidelines. The comparison between the averages of 3 and 4 speech frequencies that are 0.5, 1,2KHz and 0.5,1,2,4 KHz were performed with regard to bone conduction threshold(BCT), air conduction threshold(ACT),air bone gap (ABG) and air bone gap closure. Data analysis was performed using SPSS 13 software.

Results: Comparison between –the averages of 3 and 4 speech frequencies between the pre-operative BCT and ACT showed difference of 1.5dB and 0.8dB which were statistically significant whereas the difference in –ABG was 1dB which was statistically not significant. Similarly post-operative BCT, ACT, ABG showed the difference of 0.3dB, 0.5dB and 0.2dB respectively which were also statistically not significant.

Conclusions: The difference between 3 and 4 speech frequencies averages are small and are statistically not significant but it is still worth to include 4 KHz as this is a high frequency which is likely to be affected by tympanoplsty.

Key words: tympanoplasty, bone conduction threshold, air conduction threshold, air bone gap.

Introduction

Middle ear sound reconstruction mechanism is based upon the principle of Wullestein.[1] Tympanoplasty may either maintain or improve hearing post operatively. Hearing results reporting after tympanoplasty is done by pure tone average which is easily acquired and is an internationally comparable parameter.[2]

American academy of otolaryngology – Head and neck Surgery (AAOHNS) has developed guidelines for reporting hearing results after surgery for conductive hearing loss. The report uses 0.5,1,2 and 3 KHz for measurement of hearing results but 3 KHz is not so universal since introduction of AAOHNS guidelines.3 So, we used the 4 KHz instead of 3 KHz.

Goldenberg and Berliner[4,5] performed various combinations of pure tone averages and found very little difference amongst 0.5,1,2KHz;0.5,1,2,3KHz and 0.5,1,2,4KHz averages. Similar study was also performed by Dawes PJ et al.[6]and found significant difference amongst 0.5,1,2KHz;0.5,1,2,3KHz and 0.5,1,2,4KHz averages.

The tympanoplasty may affect the cochlear function particularly at high frequencies so it is worth to consider 4 KHz in reporting the results.

However we also compare the hearing results between the averages of three and four speech frequencies in type 3 tympanoplasty to see whether inclusion of 4 KHz makes any difference or not.

Methods

This was a prospective study in which audiometric data were collected from 78 patients who underwent Modified radical mastoidectomy with type 3 tympanoplasty from October 2006 to November 2009 in Tribhuwan university teaching hospital, Kathmandu and Kathmandu university Hospital, Dhulikhel. The Pure Tone Audiometry test was performed within seven days prior to the operation by Hughson and Westlake method. The test was performed through Air Conduction and Bone Conduction mode. The Air and Bone conduction thresholds were recorded both pre and post-operatively. The Air Conduction threshold and the Bone Conduction threshold averages were calculated by taking the averages of 500, 1000, 2000 and 4000 Hz frequencies. The ABG was calculated by taking differences between Air conduction and Bone Conduction threshold. The audiometry results were reported according to American Academy of Otolaryngology-Head and Neck Surgery guidelines,[3] except for thresholds at 3kHz, which were substituted in all cases with thresholds at 4kHz.The post operative hearing results were measured after 3 to 6 months .The results were analyzed with regard to averages of pre and postoperative BCT, ACT, ABG and ABG closure at 0.5, 1,2KHz and 0.5, 1, 2,4KHz. The results between 3 and 4 frequencies averages were compared. The data analysis was performed using SPSS 13 software package. P value was calculated using "t" test taking P value of ≤ 0.05 as significant.

Results

There were total 78 patients included in the study. Among them, 47 were male and 31 were female. Table 1 shows the comparison of 3 and 4 frequencies averages that is 0.5KHz,1KHz and 2KHz with 0.5KHz,1KHz,2KHz and 4KHz between pre-operative ACT,BCT and ABG. There is significant difference between pre-operative BCT and ACT.

Table1. Comparison of Pre-operative BCT, ACT and ABG averages of 3 versus 4 frequencies in type III tympanoplasty. (n=78)

Groups	n	Mean	Standard Deviation	P value
Pre-operative BCT 3 frequencies average	78	0.28	7.4	0.05
Pre-operative BCT 4 frequencies average		1.63	7.7	
Pre-operative ACT 3 frequencies average		37.9	14.4	0.04
Pre-operative ACT 4 frequencies average		38.7	13.7	
Pre-operative ABG 3 frequencies average		37.6	12.8	0.06
Pre-operative ABG 4 frequencies average		36.6	12.5	

The table 2 shows the comparison of results of 3 and 4 frequencies average that is 0.5KHz,1KHz and 2KHz with 0.5KHz,1KHz,2KHz and 4KHz between post-operative ACT,BCT and ABG. The difference between post-operative BCT, ACT and ABG comparison is insignificant.

Table 2. Comparison of Post-operative BCT, ACT and ABG averages of 3 versus 4 frequencies in type III tympanoplasty. (n=78)

Groups	n	Mean	Standard Deviation	P value
Post-operative BCT 3 frequencies average	78	2.9	8.3	0.13
Post-operative BCT 4 frequencies average		3.2	7.7	
Post-operative ACT 3 frequencies average		32.2	11.7	0.14
Post-operative ACT 4 frequencies average		32.7	11.2	
Post-operative ABG 3 frequencies average		29.2	9.7	0.63
Post-operative ABG 4 frequencies average		29.4	9	

Similarly, table 3 shows the comparison of averages of ABG closure of 3 and 4 frequencies and the difference is statistically insignificant.

Table 3. The 3 versus 4 frequencies evaluation of ABG closure in type III tympanoplasty. (n=78)

Groups	n	Mean	Standard Deviation	P value
ABG Closure 3 frequencies average	78	7.9	11.1	0.09
ABG Closure 4 frequencies average		7.6	11	

Discussion

Previously 3 frequencies (0.5, 1,2KHz) were taken as representative of the speech reception threshold. But, nowadays the recognition that higher frequencies influence the speech discrimination especially when competing the background noise has led to inclusion of 4 KHz in speech reception threshold.[6]

We have reported only the short term hearing results because the long term success of any ossicular repair is largely dependent on the factors outside the control of surgeons namely eustachian tube function, middle ear aeration and condition of mucosa.[7]

Our study showed that the pre-operative BCT at 3 frequencies (0.5-2KHz) and 4 frequencies (0.5-4KHz) averages were 0.28dB and 1.63dB with difference of 1.5dB .Similarly the pre-operative ACT difference between 3 and 4 frequencies was 0.8dB and both were statistically significant. Likewise, the post-operative BCT difference was 0.3dB and ACT difference was 0.5dB, these findings were statistically not significant.

Similar kind of study performed by Dawes PJ et al[6] (n=77) showed the pre-operative BCT difference between 3 and 4 frequencies was 1.2dB, ACT difference was 1.7dB. Similarly, the post-operative BCT difference was 4dB and ACT difference was 1.7dB which was statistically significant. The pre-operative results tallies with our results whereas the post-operative results does not.

Goldenberg and Berliner[4,5] examined the relative difference between different frequency averages when reporting the post-operative outcome of surgeries for CSOM (n=523) and stapedectomy (n=240).They found that the 0.5,1,2KHz; 0.5,1,2,3KHz;0.5,1,2,4KHz averages applied to both BCT and ACT results in only about 2dB difference which was statistically not significant and it is similar to our results.

Our findings showed that the reported 3 and 4 frequencies averages only differ slightly, this difference being dictated by 4 KHz ACT. There is lesser elevation in 4 KHz threshold compared with other frequencies as concluded by Dawes PJ et al.[6]

Similarly ABG closure in our study is less while using 4 frequencies similar to the findings of study performed by Dawes PJ et al.[6] whereas post-operative ABG using 3 frequencies was better than 4 frequencies showing flattering results like that of study performed by Dawes PJ et al.6So it showed that higher proportion of successful results were found if 0.5, 1,2KHz frequencies rather than 0.5, 1, 2,4KHz frequencies were used.

Since there is a 3 way interaction between frequency, time and measurement which showed that calculating the ABG likely to be affected if 4 KHz threshold used in an average.[6]

Conclusions

The difference between 3 and 4 speech frequencies averages are small which are statistically not significant but it is still worth to take 4 KHz for analysis as the effect of tympanoplasty affect the cochlear function particularly at higher frequencies.

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