Hearing Results Post Tympanoplasty: Our Experience with Adults at the KKR ENT Hospital, India

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Abstract Chronic suppurative otitis media is often associated with some degree of hearing loss. Tympanomastoid surgery is considered effective in controlling infection and preventing recurrence. However, opinions differ with regards the post-operative hearing results. This study aims to assess the hearing results, and also ascertain the effects of some variables on hearing in adult patients with chronic suppurative otitis media after primary tympanoplasty. This was a retrospective review of the clinical records of adult patients with chronic suppurative otitis media, who had primary tympanoplasty at the KKR ENT Hospital and Research Institute in Chennai (India), between 1st June and 30th September, 2011. A total of 26 adult patients with a mean age of 35.85 years (SD 14.775) were studied. There were 16 males (61.54 %) and 10 females (38.46 %). The commonest presenting symptoms were ear discharge (80.8 %) and hearing loss (76.9 %); and the mean duration of symptom was 8.52 years (SD 8.599). The overall mean pre-operative pure tone average was 49.58 dB (SD 18.608), while the overall mean post-operative pure tone average was 37.38 dB (SD 17.837). The difference between the overall mean pre- and post-operative pure tone average (hearing gain) was 12.192 dB (SD 12.924); and this was found to be statistically significant ($p < 0.05$). Multiple linear regression model showed that only increasing age was significantly associated with increasing mean post-operative pure tone average. This

study found primary tympanoplasty effective in improving hearing results in adults with chronic suppurative otitis media even in those with advanced ossicular lesions.

Keywords Chronic suppurative otitis media · Hearing results · Primary tympanoplasty · Nigeria

Introduction

Chronic suppurative otitis media (CSOM) is still prevalent in many countries of the world. For instance, it is reported that it affects 0.5–30 % of any community and also over 20 million people world wide are affected by the disease [1, 2].

CSOM with or without cholesteatoma is a persistent disease that can cause severe destruction of the middle ear structures and the mastoid [3]. As a result, it is frequently associated with some degree of hearing loss that can be up to 60–70 dB [2, 4]. Indeed, the issue of hearing loss is often the patient's primary concern amongst other complains.

Tympanomastoid surgery is considered the main treatment of this disease. And it is effective in controlling infection and preventing recurrence. For instance, some researchers have reported success rates in excess of 80–90 % [5, 6]. However, it is well acknowledged in the literature that the post-operative hearing results could be disappointing; especially in cases with cholesteatoma, advanced lesions of the ossicular chain or those with non-aeration of the middle ear [5, 7]. Consequently, this has lead to a diversity of surgical techniques, a wide variety of grafts and biosynthetic prosthesis in our practice today in order to address this major rehabilitative challenge.

Myringoplasty refers to the reconstruction of a perforation of the tympanic membrane, and this assumes that the

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middle ear space, its mucosa, and the ossicular chain are free of active infection; while tympanoplasty implies the reconstruction of the tympanic membrane, and also deals with pathology within the middle ear cleft [8].

This study aims to assess the hearing results, and also ascertain the effects of some variables on hearing in adult patients with CSOM after primary tympanoplasty.

Patients and Methods

This was a retrospective review of the clinical records of adult patients who had CSOM, who had tympanoplasty by one of the authors at a hospital in India, between 1st June and 30th September, 2011. The study was approved by the Institutional Review Board of the hospital.

Eligibility Criteria

Patients were recruited into the study if they had a clinical diagnosis of CSOM, pre- and post-operative records of their pure tone audiograms and those who had primary tympanoplasty. Those with incomplete relevant clinical records or without audiograms were excluded from the study.

Study Design

The case notes of all consecutive adult patients with CSOM who had tympanoplasty during the study period in our hospital were sort for and retrieved using their registration numbers from the records department. Their respective pure tone audiograms were also retrieved. Those who met the inclusion criteria above were included in the study. Subsequently, a proforma was designed to collect the following data: bio-data, symptom history, examination findings, co-morbidity, pre- and post-operative audiograms and details of their surgical procedure.

It is part of an established routine protocol in our hospital to request for a pre-operative pure tone audiogram for all patients shortly before surgery, and also at least 6 weeks post-operative. The pure tone audiometry (PTA) was preferably performed on dry ears (persistently wet ears were thoroughly dry mopped) in a sound proof booth by a trained and experienced audiologist; and with the same audiometer (calibrated Kamplex AD 229 with TDH 39P headphones). A 5 dB step procedure was employed, and a narrow band noise was used for masking. The indications for surgery included the presence of chronic persistent otorrhea resistant to medical therapy, persistent tympanic membrane perforation, retraction pockets and cholesteatoma. Tympanoplasty was all carried out under local anesthesia via a post auricular approach, tympanic membrane defects were grafted with temporalis fascia

(occasionally reinforced with conchal cartilage) and various types of ossiculoplasty were performed as required.

Data Analysis

Data obtained were entered into a computer spread sheet and analyzed using the statistical package for social sciences computer software program version 15. Quantitative variables were analyzed using descriptive statistics. Hearing results were evaluated and compared using pre- and post-operative pure tone averages at 0.5, 1, 2, and 4 kHz. Hearing gain was obtained from the difference between the pre- and post-operative pure tone averages. The paired sample *t* test was used to compare differences in means. The effects of some independent variables on hearing results were assessed using multiple linear regression model. A *p* value of <0.05 was considered statistically significant.

Results

A total of 59 clinical notes of patients with CSOM who had primary tympanoplasty were retrieved; but only 26 met the inclusion criteria and were analyzed. The clinical and demographic characteristics of these 26 patients are shown in Table 1.

The overall mean pre-operative pure tone average was 49.58 dB (SD 18.608), while the overall mean post-operative pure tone average was 37.38 dB (SD 17.837). The pre- and post-operative pure tone averages across the frequencies (0.5, 1, 2, and 4 kHz) are shown in Table 2.

The difference between the overall mean pre- and post-operative pure tone average (hearing gain) was 12.192 dB (SD 12.924); and this was found to be statistically significant (*p* < 0.05). The differences between the mean pre- and post-operative pure tone averages across the frequencies (0.5, 1, 2, and 4 kHz) are shown in Table 3.

Table 4 shows a comparison between pre- and post-operative pure tone average in patients who had and those who did not have ossiculoplasty.

Table 5 shows multivariate analysis of the effect of age, sex and disease duration on the mean post-operative pure tone average using multiple linear regression model. It showed that only increasing age was significantly associated with increasing mean post-operative pure tone average. In other words, for every year increase in age there is an increase of 0.54 dB in the mean post-operative pure tone average.

Discussion

It has been reported in the literature that despite many years of tympanoplastic surgery for chronic otitis media,

Table 1 Clinical and demographic characteristics of the study population

Characteristics	Number (<i>n</i>)	Percentage (%)
Sex		
Male	16 ^a	61.54
Female	10 ^b	38.46
Age (years)		
Range	18–65	
Mean	35.85 (SD 14.775)	
Duration of symptoms		
Range	14 months–20 years	
Mean	8.515 years (SD 8.599)	
Commonest symptoms ^c		
Ear discharge	21	80.80
Hearing loss	20	76.90
Ear pain	3	7.70
Main findings ^c		
Right ear affected	14	53.85
Left ear affected	12	46.15
Large central perforation	13	50.00
Small—moderate perforation	9	34.60
Eroded/fixed ossicles	9	34.60
Attic perforation	5	19.20
Cholesteatoma	5	19.2

The superscripts (a, b) have no significant difference

SD standard deviation

^c A patient may have more than one feature

Table 2 Comparison of mean pre- and post-operative pure tone averages

Frequency (kHz)	Pre-operative (dB)	Post-operative (dB)
0.5	44.42 (18.885) ^a	30.77 (16.834)
1	50.00 (19.391)	35.96 (19.236)
2	50.00 (20.736)	38.46 (18.749)
4	52.00 (19.579)	43.20 (21.645)

dB decibel

^a Standard deviation

the goal of achieving and maintaining good post-operative hearing results has remained elusive [9]. Possible reasons for these include the pathological changes that can occur within the middle ear as a result of healing response to surgical trauma such as: fibrosis, adhesion, tympanosclerosis and non-aeration of the middle ear. Consequently, these can compromise the sound transmitting mechanics of the reconstructed tympanic membrane and ossicles [10].

Table 3 Mean difference between pre- and post-operative pure tone average

Frequency (kHz)	Mean difference (dB)	Z score	<i>p</i> Value
0.5	13.654 (15.399) ^a	−3.567	<0.05
1	14.038 (16.372)	−3.656	<0.05
2	11.538 (11.981)	−3.605	<0.05
4	8.800 (13.172)	−2.847	<0.05

dB decibel

^a Standard deviation

Table 4 Comparison of mean pre- and post-operative pure tone averages in patients with or without ossiculoplasty

	Pre-operative (dB)	Post-operative (dB)	Mean difference	<i>p</i> Value
Ossiculoplasty	55.44 (13.794) ^a	42.56 (19.692)	12.88	<0.05
No ossiculoplasty	46.47 (20.403)	34.65 (16.740)	11.82	<0.05

dB decibel

^a Standard deviation

Table 5 Multiple regression model for the effect of age, sex and disease duration on post-operative pure tone average

Variable	Coefficient	Standard error	<i>p</i> Value
Age	0.544	0.209	<0.05
Disease duration	−0.098	0.370	NS
Sex	−0.235	6.261	NS

NS not significant

In this study, we found a remarkable improvement in the post-operative hearing results after primary tympanoplasty. In other words, we found significant hearing gain (least was 8.8 dB; maximum was 13.7 dB) within and across the frequencies 0.5, 1, 2, and 4 kHz. Although our findings corroborates that of other researchers who also reported good post-operative hearing levels [3, 4, 11], our study did not investigate the possible effects of the type of surgery (canal wall down or canal wall up) and the status of the middle ear at time of surgery (wet or dry) on the post-operative hearing outcome. Some researchers are of the opinion that they are important variables in determining the post tympanoplasty hearing results [12–14]. On the other hand, some investigators have repeatedly emphasized that these variables do not in any way significantly influence the post-operative hearing results [4, 15–17].

Furthermore, this study found good post-operative hearing results in patients who had, and those who did not

have ossiculoplasty. In fact, the mean hearing gain in these sub-groups were substantial and comparable (ossiculoplasty, the mean hearing gain was 12.88 dB; no ossiculoplasty, the mean hearing gain was 11.82 dB). On the contrary, other workers had reported that post-operative hearing results are often unsatisfactory in patients with advanced ossicular lesions who had ossiculoplasty. They concluded that the more the extent of ossiculoplasty, the poorer the post-operative hearing outcome [5, 7].

Again, this study found that increasing age was an unfavorable prognostic factor in determining the post-operative hearing results after primary tympanoplasty. The reason for this was not very apparent. Perhaps, this could possibly be ascribed to the phenomenon of delayed wound healing in the older age group [18]. As a result, this might have affected the sound transmitting dynamics of the middle ear.

In conclusion, this study found tympanoplasty effective in improving hearing results in adults with chronic suppurative otitis media. Notwithstanding, the authors acknowledge that functional success is determined not just by the surgeon's technical skill, but by other anatomical, physiological and pathological events that occur post-operatively in the middle ear. In addition, this study being retrospective had limitations, not to mention our relatively small sample population that could possibly have introduced bias in our findings. A multi-center prospective study with a large sample size and under standardized settings will probably yield more valid results.

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Conflict of interest None.

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