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Improvement of Tinnitus following Tympanoplasty and Tympanomastoidectomy Surgeries in Patients with Chronic Otitis Media

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Abstract

Background: After otorrhea and hearing loss, Tinnitus is the most common symptom in patients with chronic otitis media (COM). The aim of this study was to evaluate the improvement of tinnitus in COM patients after tympanoplasty and tympanomastoidectomy surgeries. **Materials and Methods:** This cross-sectional study was conducted on COM patients suffering from Tinnitus referred to Baqiyatallah hospital, Tehran, Iran undergoing tympanoplasty or tympanomastoidectomy surgeries between March 2013 and August 2014. Tinnitus Handicap Inventory (THI) and Visual Analogue Scale (VAS) questionnaires were filled before and two months after surgery by each patient, and considered subjects were compared with each other. Audiometry test was taken from each patient before and two months after surgery. Audiometry results as well as Air-Bone gap were measured and evaluated prior and after surgery. Data were analyzed using SPSS software by ANOVA, sample t-test and Chi-square tests. **Results:** Eventually, 26 male and 24 female patients with a mean age of 38.62 ± 11.88 years were enrolled. Air conduction at all frequencies was 49.99 ± 17.37 before and 36.98 ± 22.06 after surgery ($P < 0.001$). Severity of tinnitus was 62.92 ± 30.54 before and 30.54 ± 20.08 after surgery based on THI ($P < 0.001$). Also, it was 7.46 ± 1.66 before and 3.5 ± 2.06 after surgery based on VAS evaluations ($P < 0.001$). Tinnitus severity reduction was significantly associated with the improvement of hearing loss and decrement of air-Bone gap ($P < 0.001$). Tinnitus symptoms such as loudness, annoyance, impact on life and perception of Tinnitus significantly reduced after surgery. Moreover, Tympanomastoidectomy was more effective on the improvement of Tinnitus in comparison with Tympanoplasty ($P = 0.019$). **Conclusion:** It seems that, both tympanomastoidectomy and tympanoplasty surgeries are effective on the improvement of tinnitus in patients with COM; however, Tympanomastoidectomy surgery was shown to be more effective. [GMJ.2016;5(2):63-69]

Keywords: Tinnitus; Otitis Media; Tympanoplasty; Tympanomastoidectomy



Introduction

Tinnitus is defined as the perception of a sound in the absence of an apparent acoustic stimulus [1]. Tinnitus is a relatively prevalent condition which involves approximately one fifth of the people 55 to 65 years old [2]. It is more prevalent in men in comparison with women and smokers [2]. About 50 million Americans suffer from Tinnitus [2]. Tinnitus is one of the three main symptoms of ear diseases and vestibulocochlear disorders which is sometimes so disturbing that it influences patients' hearing. Tinnitus can be triggered anywhere along the auditory pathway and is usually associated with hearing loss [3]. Tinnitus is caused by a wide spectrum of disorders from metabolic (hypo- or hyperthyroidism and hyperlipidemia), pharmacologic (NSAIDs, Aminoglycosides, heavy metals) and neurologic (Meningitis and Multiple Sclerosis) to otosclerosis, chronic otitis media and brain tumors [4-6].

Therapeutic actions are effective when tinnitus is caused by outer and middle ear disorders; while treatment is less effective when Tinnitus is a result of cochlea, vestibulocochlear nerve and CNS problems [7]. Unfortunately, most cases of tinnitus are a result of inner ear or central structure disorders [7]. Several medications have been used for tinnitus but they were not really effective [8]. Some complementary and alternative therapies such as acupuncture, transcranial magnetic stimulation (TMS), Tinnitus retaining therapy (TRT) and biofeedback are suggested for this condition [9-12].

Patients with tinnitus associated with middle ear disorders such as otosclerosis, tympanic perforation and chronic otitis media (COM) may benefit from surgery. COM is a prevalent disease of the middle ear and sometimes patients are more disturbed by Tinnitus than otorrhea and hearing loss. It has been suggested that patients may improve by tympanic repair through Tympanoplasty or Tympanomastoidectomy but it has remained a controversy [13]. Previous studies have shown improvement of tinnitus in conductive hearing loss following tympanoplasty [14].

So, in the present study we aimed to evaluate

the improvement of tinnitus in COM patients after tympanoplasty and tympanomastoidectomy surgeries.

Materials and Methods

1. Research Design and Setting

This cross-sectional study was conducted on patients with COM suffering from Tinnitus, referring to Otorhinolaryngology clinic of Baqiyatallah hospital, Tehran, Iran between March 2013 and August 2014.

2. Selection Criteria

2.1. Inclusion Criteria

After signing an informed consent form and confirmation of COM by a single otolaryngologist, patients who had unilateral and constant Tinnitus were assigned to Tympanoplasty or Tympanomastoidectomy surgeries.

2.2. Exclusion Criteria

Patients more than 50 years of age and those with underlying neurologic or psychiatric diseases, clinical or audiological contraindications for surgery and history of surgery in the Tinnitus-affected ear were excluded from the study. Patients with no improvement in tympanic membrane after Tympanoplasty or requiring bone chain repair were excluded from analysis.

3. Data Collection

A pure-tone audiometry (PTA) was taken from each patient prior and two months after surgery. Air and bone conduction levels as well as air-bone gap at 0.5, 1, 2, 4 and 6 kHz frequencies were evaluated in audiometry assessment and results were compared.

A Persian version of Tinnitus Handicap Inventory (THI) validated by Mahmoudian *et al.* in 19 to 75-year old people [15], and Visual Analog Scale (VAS) Questionnaires for assessing Tinnitus severity, loudness, annoyance and impact on patients' life and mood were filled before and two months after surgery by each patient and considered subjects were compared with each other.

4. Research Ethics

This study was registered in ethics committee

of Baqiyatallah University of Medical Sciences (IR.BMSU.REC.1394.145). Information of all patients remained confidential and all the steps of study were conducted following Helsinki's declaration.

5. Statistical Analyses

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 16 (SPSS Inc. Chicago, IL) for Windows. Normal distribution variables (approved by one-sample Kolmogorov–Smirnov test) were compared between the groups using independent sample t-test and paired sample t-test within the groups. Chi-square test was also used to compare categorical variables in two groups. A p-value of less than 0.05 was considered statistically significant.

Results

Eventually 50 cases (26 male and 24 female) with a mean age of 38.62 ± 11.68 years underwent analysis. Mean age was 37.69 ± 12.97 in male and 39.63 ± 10.77 in female patients ($P=0.571$). In 13 males and 8 females, left ears were affected by Tinnitus; while 13 males and 16 females had right-ear involvement ($P=0.183$).

Duration of Tinnitus is summarized in Table-1 regarding gender. A total of 6 patients had Tinnitus less than one year and duration of Tinnitus was significantly higher in male patients ($P=0.004$).

The results of audiometry test at 0.5, 1, 2, 4 and 6kHz frequencies are summarized in Table-2 regarding air and bone conduction levels. According to audiometry results, air conduction level significantly decreased at 0.5, 1, 2, 4 and 6kHz frequencies after surgery; while bone conduction level did not

significantly decrease at any frequency (Table-2). In general, mean air conduction level at all frequencies was 49.99 ± 17.37 dB before and 36.98 ± 22.06 dB after surgery ($P<0.001$). Mean bone conduction level at all frequencies was 18.55 ± 16.55 dB before and 17.41 ± 12.43 dB after surgery ($P=0.243$). The mean Air/Bone gap levels (difference between air and bone conduction levels) were 31.44 ± 8.17 dB and 19.57 ± 16.34 dB before and after surgery, respectively ($P<0.001$).

The mean Tinnitus severity score, based on tinnitus handicap inventory (THI), was 62.92 ± 18.69 before and 30.54 ± 20.08 after surgery ($P<0.001$). Of 50 patients, 46 (92%) had an improvement in Tinnitus after surgery in which 12(24%) patients fully recovered and 34 (68%) mentioned a reduction in Tinnitus; while 4(8%) patients did not mention any changes in their conditions.

Mean visual analogue scale (VAS) score of patients is shown in Table-3. Mean loudness and awareness of Tinnitus scores as well as discomfort, disturbance, sleep alteration and mood change scores due to Tinnitus significantly decreased after surgery ($P<0.001$).

The mean Tinnitus score and air conduction level showed a decrease of 32.38 ± 21.16 and 13.02 ± 9.26 , respectively after surgery. There was a significant correlation between the improvement of Tinnitus and changes in air conduction level ($P=0.036$, $R=0.246$). The mean bone conduction level improved by 1.14 ± 6.84 after surgery ($P=0.243$). There was no significant correlation between the improvement of Tinnitus and changes in bone conduction level ($P=0.06$, $R=0.68$). The mean Air/Bone gap level improved by 11.87 ± 12.36 postoperatively. There was a significant relation between Tinnitus improvement and Air/Bone gap level ($P=0.018$, $R=0.33$).

Table 1. Duration of Tinnitus in Study Individuals

Duration of tinnitus (year)	Male (N %)	Female (N %)	Total (N %)
<1	6(21.3%)	0(0%)	6(12%)
1-3	4(15.4%)	14(58.3%)	18(36%)
3-10	11(42.3%)	6(25%)	17(34%)
>10	5(19.2%)	4(16.7%)	9(18%)
P-Value	0.004		

Mean air and bone conduction levels decreased by 11.53 ± 11.69 dB in patients (N=17) who underwent Tympanoplasty and 12.05 ± 12.86 dB in patients (N=33) who underwent Tympanoplasty and Mastoidectomy (P=0.887, Figure-1). Mean Tinnitus severity score decreased by 24 ± 13.62 in patients who underwent Tympanoplasty and by 36.69 ± 23.16 in patients who underwent Tympanoplasty and Mastoidectomy (P=0.019, Figure-2).

Discussion

In the present study, we found significant improvements in air conduction level postoperatively. Also Air/Bone gap level reduced significantly. We found that Tinnitus significantly improved following surgery and the reduction

in Tinnitus severity score had a correlation with the improvement of air conduction level and the reduction in Air/Bone gap. Our findings showed that patients who underwent Tympanomastoidectomy had a significantly higher improvement in Tinnitus than patients who had received Tympanoplasty.

Saito *et al.*, in a retrospective study, reported that Tinnitus significantly improved after surgery which is in agreement with the present study; however, improvement rate was higher in our study. As well as the retrospective evaluation, they assessed a limited number of patients which could have an influence on the results [16]. The improvement of Tinnitus was also higher in the present study than another similar one by Helms *et al.* [17].

Table 2. Audiometry Test Results in Study Individuals Before and After Surgery

Frequency(kHz)	Before Surgery (n=50)	After Surgery (n=50)	P-Value
0.5			
Air Conduction Level (dB)	47.6 ± 17.56	32.7 ± 20.53	<0.001
Bone Conduction Level (dB)	13.72 ± 13.27	12.36 ± 11.09	0.27
1			
Air Conduction (dB)	47.86 ± 14.32	33.28 ± 19.29	<0.001
Bone Conduction (dB)	14.36 ± 14.06	13.20 ± 10.77	0.11
2			
Air Conduction (dB)	48.9 ± 19.12	34.9 ± 23.11	<0.001
Bone Conduction (dB)	17.86 ± 15.19	15.98 ± 11.01	0.06
4			
Air Conduction (dB)	51.8 ± 21.18	38.9 ± 25.89	<0.001
Bone Conduction (dB)	19.98 ± 17.62	19.40 ± 12.84	0.67
6			
Air Conduction (dB)	53.80 ± 23.29	45.10 ± 28.49	<0.001
Bone Conduction (dB)	26.84 ± 26.32	26.10 ± 22.66	0.66

Table 3. Mean VAS Score of Patients Before and After Surgery

VAS Score, mean \pm SD	Preoperative (n = 50)	Postoperative (n = 50)	P-value
Loudness	7.46 ± 1.66	3.50 ± 2.06	<0.001
Discomfort	7.28 ± 1.49	3.12 ± 1.75	<0.001
Disturbance	6.82 ± 1.65	2.96 ± 1.79	<0.001
Awareness	7.0 ± 1.86	3.68 ± 2.52	<0.001
Sleep disorder	6.34 ± 2.68	2.78 ± 2.01	<0.001
Mood	6.6 ± 1.86	3.22 ± 1.96	<0.001

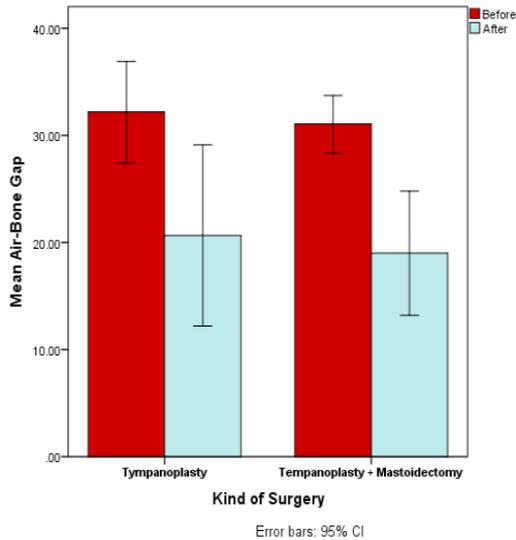


Figure 1. Mean Air-Bone Gap Level in Study Individuals Before and After Surgery

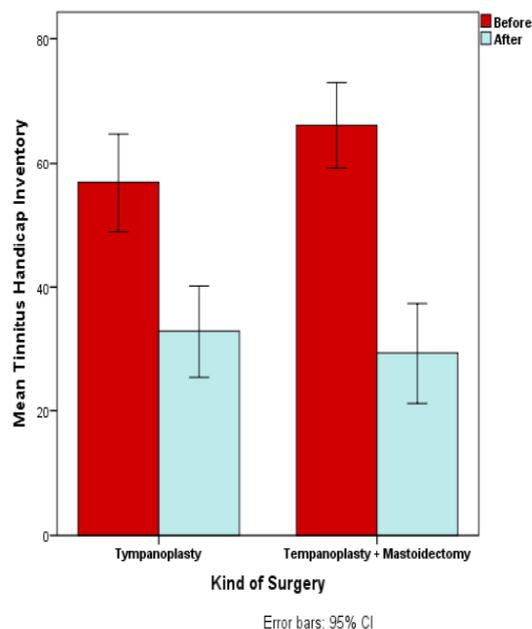


Figure 2. Mean THI scores in study individuals before and after surgery

In a retrospective study, Baba *et al.* evaluated a larger number of patients than the present study. They applied VAS questionnaire to assess Tinnitus severity and hearing improvement rather than THI that was applied in the present study. Baba *et al.* reported a lower improvement in hearing following surgery than the present study and the relation between hearing and Tinnitus improvement was not

assessed [18].

In concordance with the present study, Lima *et al.* reported the same improvement in Tinnitus postoperatively considering that they included fewer number of patients than the present study [14]. Lima *et al.* assessed Tinnitus severity only by VAS score; while we applied both VAS and THI in which it helps with a more accurate and detailed assessment. Their study did not show any significant correlation between the improvement of Tinnitus and hearing which is not in agreement with our study. Pollyanna *et al.* reported the same result as ours considering that they only applied VAS questionnaire and did not conduct audiometry and calculate Air/Bone gap postoperatively [19].

Kim *et al.* reported an improvement of Tinnitus in patients after Tympanoplasty surgery which was in accordance with our study [20]. In their study, the improvement of Tinnitus was significantly related to air conduction level improvement but showed no significant correlation with reduced Air/Bone gap.

Habeseglu *et al.* demonstrated significant improvements in Tinnitus and hearing after Tympanoplasty and also showed a significant relation between these two, confirming our results [21]. Habeseglu *et al.* evaluated fewer number of patients than the present study and also their patients had different middle ear diseases which might be confounding.

In contrast with the present study, Pichora-Fuller *et al.* [22] concluded that there was no significant relation between Tinnitus and audiometry test results. Seemingly, this finding was due to early postoperative evaluation. The present study has some limitations such as low sample volume. Moreover, the current research design may provide less options for controlling confounders.

Conclusion

In conclusion, both Tympanomastoidectomy and Tympanoplasty surgeries are effective in the improvement of Tinnitus in patients with COM; however, Tympanomastoidectomy surgery was shown to be more effective. Also, it was concluded that Tinnitus severity reduction is associated with the improvement of

hearing loss and decrement of Air-Bone gap. Future studies with a larger sample and prospective design are needed to be conducted regarding all confounding factors. It is also recommended to evaluate Tinnitus improvement rate in different types of surgeries. It is suggested that further studies use objective methods for determining Tinnitus severity

and also assess patients in whom Tinnitus gets worse following surgery.

Conflict of Interest

There are no conflicts of interest in terms of the present manuscript.

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