

The Effect of Tympanoplasty on Tinnitus in Patients With Chronic Otitis Media

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Background: Tinnitus is defined as sensation of sound without any external sources, caused by defects in peripheral auditory system. Associated with hearing loss, tinnitus is produced due to changes in central nervous system in response to peripheral pathology.

Objectives: Therefore, tinnitus can be totally or partially eliminated if the peripheral lesion and the consequent hearing loss are recovered by tympanoplasty.

Patients and Methods: This clinical trial was conducted on 28 patients with chronic otitis media and tinnitus who opted for tympanoplasty. Pure tone audiometry, pitch match test, and loudness balance test were performed for the patients before and three months after the operation.

Results: Postoperation tests demonstrated tinnitus elimination in 22 cases (78.5%) along with partial improvement in tinnitus intensity in five cases (17.8%). The difference between preoperative and postoperative tests was statistically significant ($P = 0.023$). Graft success rate was 96.4% and hearing improvement was seen in 85.7%.

Conclusions: This study offered tympanoplasty as an effective procedure to control tinnitus in patients with chronic otitis media and revealed its positive effects on hearing improvement.

Keywords: Chronic Otitis Media; Hearing Loss; Tinnitus; Tympanoplasty

1. Background

Tinnitus is defined as sensation of sound without any external sources. This definition accepted by many otologist classifies tinnitus into two categories: objective and subjective. Objective tinnitus is caused by an internal sound that activates cochlea from air or bone conduction and can be heard by the observer, but subjective tinnitus is heard only by the patient and has no internal sources (1).

There are many reasons that neural plasticity plays a main role in producing chronic tinnitus. Neural plasticity can change the balance between excitation and inhibition in nervous system causing sound perception as tinnitus (2). Currently, it is believed that lesions in peripheral auditory system, such as tympanic membrane, or in the middle ear can make some changes in central auditory centers leading to tinnitus. If the peripheral lesion is resolved, the tinnitus can be totally or partially eliminated (3).

Etiologic factors of tinnitus can adversely affect the auditory input in auditory centers. Auditory pathway hyperactivity, re-routing of auditory information and reorganization of neural elements may contribute to development of tinnitus. In the patients with tinnitus, restoration of hearing and increase in external sound perception can decrease tinnitus perception and because

hearing restoration is possible through surgery, this procedure may be effective in decreasing the severity of tinnitus (4).

Tympanoplasty can help keeping a disease-free, safe, and dry ear, improve hearing levels, and reduce life-threatening complications (3).

2. Objectives

Up to now, few studies have subjectively evaluated the effect of tympanoplasty on tinnitus in the patients with chronic otitis media (COM). Nevertheless, most of these studies had a retrospective design. Thus, the present prospective study aimed to evaluate the potential changes in tinnitus severity after tympanoplasty in the patients with COM.

3. Patients and Methods

This study was performed on 28 of the 265 patients with COM and tinnitus who opted for tympanoplasty. The patients were examined preoperatively as well as one and three months after the operation. Audiometric evaluations including pure tone audiometry (PTA), and a number of tinnitus tests, including pitch match test (PMT),

and loudness balance test (LBT) were performed for all the patients before and three months after the operation.

The audiometric evaluations were based on 0.5, 1, 2, and 4 kHz frequencies and preoperative and postoperative results were compared.

All the patients underwent tympanoplasty through posterior auricular approach by the same surgeon under general anesthesia. The technique for graft placement was underlay technique and temporalis fascia was used as the graft material. The study protocol was approved by the Ethics Committee of our University Faculty of Medicine.

The inclusion criteria of the study were COM with otorrhea-free for three months (dry ear) and bone conduction of better than 20 dB in audiometry. On the other hand, the patients who presented with systemic disease, history of trauma, history of ear or brain surgery, active middle ear infection with or without cholesteatoma, and need for mastoidectomy or canaloplasty (drilling) were excluded from the study. All the patients signed written informed consents to participate in the study and completed the demographic information questionnaires.

3.1. Statistical Analysis

The statistical analyses were performed using the SPSS 18.0 (SPSS Inc, Chicago, Illinois, the United States). Paired-samples t test and Wilcoxon test were used for analysis. In addition, P values < 0.05 were considered as statistically significant.

4. Results

The present study included 28 patients, six males (21.4%) and 22 females (78.6%), with the mean age of 36.6 ± 11.5

years (range, 23 - 63 years). All these patients had COM, tinnitus, and dry ear for three months. According to the preoperative microscopic examinations, the patients were categorized into three groups in terms of site and size of perforation: central perforation, eight patients (46.4%); marginal perforation, seven patients (25%); and subtotal tympanic perforation, eight patients (28.6%). In addition, three patients (10.7%) were detected with plaques.

The patients were followed for three months. According to the results, the hearing parameters (SRT and air-bone gaps [ABG]) were improved in 24 patients (85.7%), ended up with an ABG of ≤ 10 dB, but remained unchanged in four patients (14.3%) during the third month of the operation. There was a significant ABG improvement in the postoperative at third month after the operation (15.53 dB HL (Hearing Level), $P < 0.05$) in relation to the preoperative time (28.23 dB HL).

During the first postoperative month, tinnitus was totally eliminated in nine patients (32.1%) with an ABG of ≤ 10 dB, was partially improved in 12 (42.9%) with an ABG of 11 to 20 dB, and remained unchanged in 7 (25%). Noticeably, no one presented with postoperative increase in tinnitus intensity.

Furthermore, follow-up examinations in the third postoperative month indicated total elimination of tinnitus in 22 patients (78.6%) along with partial and lack of improvement in 5 (17.9%) and 1 (3.5%) cases, respectively. Similar to the results obtained during the first month, no cases of tinnitus deterioration was observed. These data were documented with LBT (Table 1). Tinnitus improvement was statistically significant with $P < 0.05$.

Graft success was achieved in 27 cases (96.4%). The means of preoperative and postoperative PMT were respectively 3000 and 1000 Hz, and the difference was statistically significant ($P < 0.05$) (Table 2).

Table 1. Preoperative and Postoperative Intensity of Tinnitus in Loudness Balance Test ^a

	Intensity, dB				
	1	2	3	4	5
Preoperative	6 (21.4)	12 (42.8)	3 (10.7)	6 (21.4)	1 (3.5)
Postoperative	5 (17.8)	0	1 (3.5)	0	0

^a Data are presented as No. (%).

Table 2. Preoperative and Postoperative Frequency of Tinnitus in Pitch Match Test ^a

	Frequency, Hz								
	125	250	500	1000	1500	2000	4000	6000	8000
Preoperative	2 (7)	6 (21.4)	3 (10.7)	3 (10.7)	3 (10.7)	1 (3.5)	0	0	10 (35.7)
Postoperative	0	0	0	0	0	0	3 (10.7)	1 (3.5)	2 (7)

^a Data are presented as No. (%).

5. Discussion

Tinnitus develops due to defects in auditory system, mostly with peripheral origin. Tinnitus is a common problem in the patients with COM (4). Graft uptake and improvement in hearing results after tympanoplasty can determine the success of treatment (5).

Up to now, several studies have investigated postoperative patients' satisfaction for evaluation of the success of tympanoplasty. Faramarzi et al. (6) reported improved air conduction threshold and ABG in 500 to 3000 Hz frequency following the labyrinthine fistula surgery.

Erkorkmaz et al. (7) used a visual analog scale (VAS) ranging from 0 (unsatisfied) to 10 (satisfied) to determine the factors affecting patients' satisfaction following tympanoplasty. They showed that VAS score was significantly higher in the patients whose grafts were successfully healed compared to those with unhealed grafts ($P < 0.001$), in the patients whose tinnitus had decreased or disappeared ($P = 0.001$), and in the patients whose otorrhea had completely disappeared ($P = 0.008$). In other words, healing of the tympanic membrane, relief of tinnitus, hearing improvement, and relief from otorrhea were highly correlated with patients' satisfaction (7).

In the current study, the most of the patients (78.5%) showed total elimination of tinnitus at the postoperative month follow-up, while 17.8% manifested partial improvement of their tinnitus intensity ($P < 0.05$). However, in the study conducted by Lima et al. (3), only 34.8% of the cases showed total elimination of tinnitus during six-month follow-up, while the majority of the cases (47.6%) presented with partial improvement leading to total or partial improvement rate of 82.6% during the entire study. In an earlier report made by Baba et al. (8), 66.2% of the cases had tinnitus improvement, while 7.9% showed deterioration of tinnitus. This was markedly different from the results of our study as no deterioration of tinnitus was observed in our cases postoperatively. Two further reports were also made by two different research groups in 2011. In one of the reports, Kim et al. (4) observed improvement in 82% of the patients' tinnitus handicap inventory (THI), whereas the other report made by Lima et al. (3) revealed lower improvement rate of 69% (partial improvement, 43%; and total improvement, 26%) with no changes in the tinnitus level of 31% of the cases. Although our study showed a higher success rate in tinnitus improvement in comparison to the study performed by Kim et al. (4), both studies reported no worsening of tinnitus in their postoperative follow-up.

The exact mechanism of tinnitus in the patients with COM is still unknown. However, elimination of tinnitus in previous studies as well as our study developed following to improvement in middle ear conductive mechanism after tympanoplasty and graft success. Since tympanoplasty leads to hearing improvement in COM, this effect can probably help eliminate tinnitus. Furthermore, the diagnostic methods such as computed tomography are helpful in (9).

In the present study, graft success rate was 96.4%. This rate was reported as 72%, 78%, 94%, and 95% in the studies by Olusesi et al. (10), Lima et al. (3), Shetty (11), and Lima et al. (12), respectively.

In the current study, we had only one graft failure that led to no postoperative tinnitus or hearing improvement and our high rate of tinnitus improvement in a three-month follow-up (96.4%) was supposed to be due to high rate of graft success and hearing restoration. Yet, follow-up studies with longer durations may be necessary to support the long-term efficacy of tympanoplasty for tinnitus elimination.

In conclusion, our short-term follow-up study demonstrated that tympanoplasty offers good control for tinnitus in the patients with COM and it has positive effects on hearing improvement.

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Authors' Contributions

Reyhane Zaer Rezaii conducted the literature review, wrote and edited the first draft, and was involved in data acquisition and analysis. Mahmood Shishegar designed the study, was involved in data acquisition and analysis, and was supervisor and responsible for the quality assurance and control.

Financial Disclosure

We, Mahmood Shishegar, as the first author, Reyhane ZaerRezaii, as the second author and corresponding author, declared no conflict of interests. We also conformed to the Helsinki Declaration concerning human rights and informed consent of 1975, revised in 2000. It should be mentioned that all procedures were followed in accordance with the ethical standards of the Ethics Committee on human experimentation of Shiraz University of Medical Science, Shiraz, Iran.

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