Evaluation of Factors Affecting the Surgical Outcome in Tympanoplasty

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Abstract

Introduction:
Tympanoplasty is a standard procedure to repair tympanic membrane perforation. The aim of this study is to evaluate the results of tympanoplasty (hearing improvement and tympanic membrane closure rate) in patients suffering from chronic perforation of the tympanic membrane by considering the prognostic factors.

Materials and Methods:
In a prospective study, based on the results of tympanoplasty with temporal graft fascia in 60 patients in the ENT department of the Medical Science University of Tabriz, we evaluated prognostic factors, such as age, sex, smoking, size, and site of perforation, for the outcome of this surgery.

Results:
The rate of surgical success-integration of the graft- was 93.3%. Improvement of hearing, as demonstrated through audiometry, occurred in 93% of cases. We did not find any factors to be statistically significant to affect surgical outcome.

Conclusion:
Even by considering the influence of different factors on the results of a tympanoplasty operation, according to the statistical results of this study, there is not a significant difference in the results of the operation, neither in the health of the tympanic membrane after surgery nor in hearing development.

Keywords:
Chronic suppurative otitis media, Graft, Tympanoplasty.

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Introduction

Chronic otitis media (COM) is defined as an inflammation of the middle ear with signs of infection lasting three months or longer. Chronic suppurative otitis media (CSOM) is defined as a chronic inflammation of the middle ear and mastoid cavity, which presents with recurrent ear discharges or otorrhea through a tympanic perforation. The presence of a persistent tympanic perforation and middle ear discharge differentiates CSOM from other forms of chronic otitis media (1).

CSOM has been known since pre-historic time. Contributing factors are: low living conditions, poor personal hygiene, and diet (2). Perforation of the tympanic membrane (TM) can be caused by trauma and disease of the middle ear. Rupture of the membrane (perforation), which occurs as a result of chronic otitis media, involves at least 0.5% of the population. CSOM can cause conductive hearing loss up to 60 db, which is considered a serious disability (3).

Tympanoplasty is a procedure that is used for COM treatment. It aims to rebuild the perforated ear drum and restore the function of the middle ear. Surgical approach for tympanoplasty can be endaural or transmeatal, postauricular, and superameatal. The most common technique of grafting is underlay (medial) and overlay (lateral). Temporalis muscle fascia and targa cartilage’s perichondrium are the most popular materials as a graft (4).

Many factors have been investigated to determine their effect on the tympanic membrane closure rate and hearing improvement. Various studies on tympanoplasty have been conducted, which show that success rate and criteria for success vary from author to author. Some studies demonstrated that surgical outcome depends on several factors including size and location of the perforation, ossicular status, type of surgical technique, graft type and function of the eustachian tube. However, according to many authors, surgical outcome is independent of factors that are deemed as relevant (3-10).

It is difficult to compare these studies because of differences in age, definition of success, the method used, and the experience of the surgeon. Thus, the factors affecting tympanoplasty must be studied depend of the conditions of each study.

Materials and Methods

A total of 60 patients who underwent tympanoplasty operations between June 2013 and September 2014 were reviewed in this study. The age of the patients was between 18 to 49 years. Underlying diseases such as diabetes or immunodeficiency, cholesteatoma and erosion ossicular, presence of sensorineural hearing impairment, definitive diagnosis of tympanosclerosis, revision cases were the exclusion criteria for the study. Patient evaluation was undergone through proper history noting and thorough examination. Examination was performed radiologically if needed. For example, if there was a suspected retraction pocket, the patient was evaluated with computer tomography. Examination could also be performed audiologically and finally examined under microscope. The operation method used on all patients was the same. The post auricular approach, underlay technique, and harvesting of the temporalis fascia as the graft material was used in all the tympanoplasty procedures and the surgeon and its assistant were stable in all surgeries. One week after the operation, the status of the surgical wound was evaluated and packing was removed. Patients were followed up postoperatively up to 3 months. During the follow-up, the condition of the wound and the tympanic membrane was noted. An audiogram was performed on the 12th weeks to assess the outcome.

Data were analyzed using the chi-squared tes and t-test on a spss statistical package (version 16.0; SPSS). A P<0.05 was the level of significance.
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**Results**

For the 60 tympanoplasties, the male to female ratio was 1:2 and the age ranged between 18 to 49 years (mean 33.6 years; SD=7.32). The distribution of patients by age and sex is shown in Table 1.

**Table 1:** Distribution of patients by age and sex.

| Age (years) | Total |
|-------------|-------|
| 18-28       | 6     |
| 29-39       | 10    |
| 40-49       | 4     |
| Total       | 20    |

| Sex | Male | Female | Total |
|-----|------|--------|-------|
| 18-28 | 6 | 8 | 14 |
| 29-39 | 10 | 20 | 30 |
| 40-49 | 4 | 12 | 16 |
| Total | 20 | 40 | 60 |

The perforation sites were anterior maleolar (12 patients, 20%), posterior maleolar, (14 patients, 23.3%), and central (34 patients, 56.7%). The most common perforations were small (less than 50% of the tympanic membrane). 30% of patients were smokers and 70% were non-smoker. The overall graft success rate was 93.3% (56 of 60 patients). Based on the univariate analysis, size of perforation (P=0.08), site of the perforation (P=0.26), smoking (P=0.36), age (P=0.36) and sex (P=0.143) no statistical significance was observed as prognostic factors (Fig. 1).

The average air–bone gap improvement for all 60 tympanoplasty procedures was 18.8 dB±5.62 SD. Serviceable hearing (air–bone gap<20 dB) was achieved in 93.3% of the 60 tympanoplasties postoperatively. The mean preoperative air–bone gap was 28.41 dB±5.4 SD and the mean postoperative air–bone gap was 9.56 dB ± 6.07 SD. The influence of the prognostic factors on hearing improvement in the 60 tympanoplasties is shown in Table 2. No parameters were found to be statistically significant for hearing improvement.

**Table 2:** Success rates in parameters reviewed

| Total number | Success rate | P-value | Post-op ABG ≤ 20dB | P-value |
|--------------|--------------|---------|---------------------|---------|
| Age <28 years | 14           | 85.7%   | 92.8%               | 0.49    |
| 28-39        | 30           | 96.6%   | 96.6%               |         |
| ≥40 years    | 16           | 93.7%   | 87.5%               |         |
| Sex male     | 20           | 100%    | 90%                 |         |
| female       | 40           | 90%     | 95%                 | 0.46    |
| site of perforation | | | | |
| Anterior     | 12           | 83.3%   | 83.3%               |         |
| Posterior    | 14           | 92.8%   | 100%                | 0.2     |
| Central      | 34           | 97.05%  | 94.1%               |         |
| Size of perforation (%) | | | | |
| <50          | 32           | 96.08%  | 93.5%               |         |
| 50-75        | 20           | 95%     | 95%                 | 0.82    |
| ≥75          | 8            | 95%     | 88.8%               |         |
| Smoking | | | | |
| smoker       | 18           | 88.8%   | 94.4%               | 0.82    |
| Non-smoker   | 42           | 95.2%   | 92.8%               |         |

Fig 1: Tympanic membrane closure rates
**Discussion**

Tympanoplasty is a surgical technique for the treatment of patients with chronic otitis media (COM). The goal of tympanoplasty is to eradicate disease and restore the function of the middle ear (11).

In order to repair tympanic membrane perforation, various materials including areolar connective tissue, fascia, prechondrium, periosteum, skin, fat, veins, and allogerm mucosa are used as a graft (5,11). In this study, we used a post auricular approach, underlay technique, and harvesting of the temporalis fascia as the graft material. In our study, tympanic membrane closure rates was 93.3%, which is similar to other studies (10,12-15) and even better than some studies (16,17). This difference in the levels of tympanic membrane closure rates may be due to different conditions of the middle ear throughout different studies.

The mean air-bone gap improvement in our study was 18.8 dB ± 5.62 SD and air-bone gap was significantly decreased postoperatively (P=0.002). Karela et al indicated hearing improvement in 91.5% of cases and stated that myringoplasty is a procedure that can be successful in many cases, regardless of age, gender, location, and size of the perforation (6). Some studies show age as a prognostic factor and stated that the success of the graft integration in children is slightly lower than in adults (9,18) and that this is due to the fact that children have persistent dysfunction of the Eustachian tube, recurrent infections of the respiratory tract with otorhea, and lack of development of the immune system (10,19). In our study, the mean age was of 34.07±7.3 and the tympanic membrane closure rate and hearing improvement was similar to other studies; therefore, indicating age is not a prognostic factors (4,6,20).

In our study, females were predominant over males (60% vs 40%). However, there was no statistically significant correlation between sex and success rate, which was similar in other studies (1,6,21). Emir and et al showed that being male was a good prognostic factor (9).

Based on several studies, the highest hearing loss occurs with the perforation of the large central and the lowest hearing loss occurs with the perforation of the anterior central. Larger perforations produce more pronounced losses; therefore, the size of perforation is an important factor for hearing loss. However, below 10% of the tympanic membrane, perforation size does not influence hearing (7,22). In our study, the highest hearing loss occurred with the perforation of the large anterior perforation and the lowest hearing loss occurred with a small posterior perforation.

Zhang and colleagues demonstrated that after myringoplasty for small perforation of the tympanic membrane (less than 50%) ABG is minimum (average 5.5dB) and most ABG (average 10.5 dB) was after closure of large perforations (more than 50%) (23). Lee et al report that the recovery air threshold after myringoplasty is directly associated with the preoperative size of the tympanic membrane (10).

Karela and et al, examined the outcome of myringoplasty and hearing improvement and stated that the size and location of the perforation has no effect on the tympanic membrane closure rate and hearing improvement (6). Other studies have also demonstrated that the perforation size does not affect the surgical outcome (24-26); while some studies show that perforation size does affects the outcome (8,27). In our study, the size of the perforation had no effect on tympanic membrane closure rate and hearing improvement after surgery.

Yung et al.’s study concluded that a large central, central maleolar, and central posterior perforation show the most hearing loss and that posterior inferior perforations cause greater hearing loss than anterior inferior perforations (28). Ahmad and
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Ramani showed that the difference in hearing loss between anterior and posterior inferior perforations is only seen at low frequencies (29).

There are several studies examining the effects of the location of the perforation on the surgical outcome. Jurovitzki stated that an anterior perforation was less favorable than perforations seen in other locations (30). Gonzalez observed better success for perforations of the posterior and weaker success in perforation of the subtotal (31). Albera showed that risk of tympanic reperforation is more common in posterior perforations (32); while Onal reported that the success rate of the anterior, posterior, and central perforation showed no difference (8). In our study tympanic membrane closure rate and hearing improvement was not associated with location of perforation, similar to other studies (4,6).

Controversy exists in the results of tympanic membrane closure rate and hearing improvement in smoker and non-smoker patients. In a study of 132 patients, performed by Cantrell, success rate in non-smokers was 92.5% and 43.7% in smokers (33).

Becavarovski, in the study of 74 tympanoplasty surgeries, showed that delayed complications of surgery, such as severe atelectasis or delayed perforation after 6 months, was 20% in non-smokers and 60% in smokers (P<0.5) (34).

Onal et al reported tympanic membrane closure rate to be 78.7% and 47.4% in non-smokers and smokers, respectively (P=0.008) (8).

Other studies have not shown that smoking is a prognostic factor for graft integration, but did demonstrated that it had negative effects on the long-term results of surgery (4). In our study, smoking was not seen as an effect on tympanic membrane closure rate and hearing improvement; however, we did not follow patients for a long time.

Conclusion

Even though many different factors can influence the results of a tympanoplasty operation, according to the statistical results of the study, there is no significant difference in the outcome of the operation, neither in the health of the tympanic membrane after surgery nor in hearing development. However, more studies on more samples in various centers should be conducted in order to make an acceptable conclusion.

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Reference

1. Acuin J. Chronic suppurative otitis media: burden of illness and management. 1st ed. Switzerland: World Health Organization, Geneva; 2004: 9-10.
2. Malik S, Ashrifi K, Sohail Z, Afaq S, Nawaz A. Determinants of variable hearing loss in patients with chronic suppurative otitis media. Pak J Otolaryngol 2012; 28: 45-7.
3. Bhusal CL, Guragain RP, Shrivastav RP. Frequency dependence of hearing loss with perforations. Nepal Med Assoc 2007; 46(168):180-4.
4. Lima JCB, Marone SAM, Martucci O, González F, Silva Neto JD, Ramos ACM. Evaluation of the organic and functional results of tympanoplasties through a retro-auricular approach at a medical residency unit. Brazilian journal of otorhinolaryngology 2011; 77(2): 229-36.
5. Pfammatter A, Novoa E, Linder T. Can myringoplasty close the air-bone gap? Otology & Neurotology 2013; 34(4):705-10.
6. Karela M, Berry S, Watkins A, Phillipps JJ. Myringoplasty: surgical outcomes and hearing improvement: is it worth performing to improve hearing? European Archives of Oto-Rhino-Laryngology 2008; 265(9): 1039-42.
7. Shetty S. Pre-operative and post-operative assessment of hearing following tympanoplasty. Indian Journal of Otolaryngology and Head & Neck Surgery 2012; 64(4): 377-81.
8. Onal K, Uguz MZ, Kazikdas KC, Gursoy ST, Gokce H. A multivariate analysis of otologial, surgical and patient-related factors in determining success in myringoplasty. Clinical Otolaryngology 2005; 30(2): 115-20.
9. Emir H, Ceylan K, Kizilkaya Z, Gocmen H, Uzunkuluoglu H, Sanim E. Success is a matter of experience: type I tympanoplasty. European archives of otorhinolaryngology 2007; 264(6): 595-9.
10. Lee P, Kelly G, Mills RP. Myringoplasty: does the size of the perforation matter? Clinical Otolaryngology Allied Sciences 2002; 27(5): 331-4.
11. Flint PW, Cummings CW, Haughey BH, Lund VJ, Niparko JK, Richardson MA. Cummings otorhinolaryngology head and neck surgery. 5th ed. Mosby; 2010:1999.
12. Angeli SI, Kulak JL, Guzmán J. Lateral Tympanoplasty for Total or Near-Total Perforation: Prognostic Factors. The Laryngoscope 2006; 116(9): 1594-9.
13. Bastos Freitas E. Estudo comparativo entre as técnicas medial e lateral de timpanoplastia tipo I quanto ao fechamento da perfuração timpânica, resultado funcional e complicações empregando-se enxerto autólogo de fáscia temporal. São Paulo, 2000 (Doctoral dissertation, Tese (doutorado). Faculdade de medicina da USP.[Links]).
14. Mane R, Patil B, Molite A, Varute VV. Bilateral type I tympanoplasty in chronic otitis media. Indian Journal of Otolaryngology and Head & Neck Surgery 2013; 65(4): 293-7.
15. Raghuvanshi SK, Asati DP. Outcome of Single-Sitting Bilateral Type I Tympanoplasty in Indian Patients. Indian Journal of Otolaryngology and Head & Neck Surgery 2013; 65(3): 622-6.
16. Mohamad SH, Khan I, Hussain SM. Is cartilage tympanoplasty more effective than fascia tympanoplasty? A systematic review. Otology & Neurotology 2012; 33(5): 699-705.
17. Iacovou E, Vlastarakos PV, Papacharalampous G, Kyrodimos E, Nikolopoulos TP. Is cartilage better than temporalsis muscle fascia in type I tympanoplasty? Implications for current surgical practice. European Archives of Oto-Rhino-Laryngology 2013; 270(11): 2803-13.
18. Koch WM, Friedman EM, McGill TJ, Healy GB. Tympanoplasty in children: the Boston Children's Hospital experience. Archives of Otolaryngology–Head & Neck Surgery 1990; 116(1): 35-40.
19. Black JH, Wormald PJ. Myringoplasty-effects on hearing and contributing factors. South African Medical Journal 1995; 85(1):41.
20. Pinar E, Sadullahaoglu K, Calli C, Oncel S. Evaluation of prognostic factors and middle ear risk index in tympanoplasty. Otolaryngology-Head and Neck Surgery 2008; 139(3): 386-90.
21. Kageyama-Escobar AM, Rivera-Moreno MA, Rivera-Mendez A. Risk Factors Associated with Failure in Myringoplasty. Gaceta medica de Mexico 2001; 137(3): 209-20.
22. Niculescu B, Vesa D, Tomescu E. Variations of Pre-And Post-Operative Hearing Loss Depending On The Size Of Tympanic Membrane Perforation. Medical interventions 2011; 1(3):236-41.
23. Zhang ZG, Huang QH, Zheng YQ, Sun W, Chen YB, Si Y. Three autologous substitutes for myringoplasty: a comparative study. Otology & Neurotology 2011; 32(8):1234-8.
24. Yung MW. Myringoplasty for subtotal perforation. Clinical Otolaryngology and Allied Sciences 1995; 20(3): 241-5.
25. Kotecha B, Fowler S, Topham J. Myringoplasty: a prospective audit study. Clinical otolaryngology and allied sciences 1999; 24(2):126-9.
26. Perkins R, Bui HT. Tympanic membrane reconstruction using formaldehyde-formed autogenous temporalis fascia: twenty years' experience. Otolaryngology-Head and Neck Surgery 1996; 114(3):366-79.
27. Sarker MZ, Ahmed M, Patwary K, Islam R, Joarder AH. Factors affecting surgical outcome of myringoplasty. Bangladesh Journal of Otorhinolaryngology 2011; 17(2): 82-7.
28. Yung MW. Myringoplasty: Hearing gain in relation to perforation site. The Journal of Laryngology & Otology 1983; 97(01): 11-17.
29. Ahmad SW, Ramani GV. Hearing loss in perforations of the tympanic membrane. The Journal of Laryngology & Otology 1979; 93(11): 1091-8.
30. Jurovitzki I, Sade J. Myringoplasty: long-term followup. Otology & Neurotology 1988; 9(1):52-5.
31. Frade GC, Castro VC, Cabanas RE, Elhendi W, Vaamonde LP, Labella CT. Prognostic factors influencing anatomic and functional outcome in myringoplasty. Acta otorrinolaringologica Espanola 2002; 53(10): 729-35.
32. Albera R, Ferrero V, Lacilla M, Canale A. Tympanic reperforation in myringoplasty: evaluation of prognostic factors. Annals of Otology, Rhinology & Laryngology 2006; 115(12): 875-9.
33. Cantrell RW. Myringoplasty failure related to smoking: a preliminary report. Otolaryngologic clinics of North America 1970; 3(1): 141.
34. Becvarovski Z, Kartush JM. Smoking and tympanoplasty: implications for prognosis and the Middle Ear Risk Index (MERI). The Laryngoscope 2001; 111(10):1806-11.