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Type 1 Tympanoplasty by Interlay Technique for Management of Tympanic Membrane Perforation

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Abstract

Tympanic membrane is the partition between the external ear and middle layer which is a vital component of the human ear. Neglected or maltreated earache, ear discharge and trauma lead to perforation of tympanic membrane. Tympanoplasty is the surgical procedure performed to repair a perforated tympanic membrane, with/without reconstruction of the ossicles, with the aim of preventing reinfection and restoring hearing ability. Type 1 tympanoplasty is the simple closure of the tympanic membrane perforation. To study the outcome of type 1 tympanoplasty operation by interlay technique, a descriptive longitudinal study was conducted among 200 patients in Community Based Medical College Hospital and in private clinics of Mymensingh from January 2012 to December 2021. Our inclusion criteria was population of age ranging from 15 to 55 yrs of both sexes having dry central perforation for at least 6 weeks and exclusion criteria was patient with active stage of chronic suppurative otitis media (CSOM), ossicular discontinuity, sensory neural hearing loss. Data was analyzed by SPSS version 20.0. Prevalence of taking graft was 96.00%. Measured by difference of preoperative air bone gap (ABG) and postoperative ABG of 15 decibel (dB) hearing improvement rate was 90%. Complication was minimal (1%). The complication was infection due to non-compliance with post-operative advice and treatment. Type 1 tympanoplasty done by interlay technique has excellent results both in terms of graft taken and hearing improvement with minimal complications.

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Introduction

We are gifted with a pair of ears essential for hearing and maintenance of balance. There is a close functional and anatomical relationship between the ear, nose and throat. The ear has also close proximity to important vital organ brain. The ear consists of the external, middle and inner ears.[1] Tympanoplasty is the surgical procedure performed to repair a perforated tympanic membrane, with/ without reconstruction of the ossicles, with the aim of preventing re-infection and restoring hearing ability.[1-4] Tympanic membrane is the partition between the external ear and middle ear which is a vital component of the human ear. It is a thin, circular layer of tissue. It is 9-10 mm tall, 8-9 mm wide and 0.1 mm thick and has a mass weight of 14 mg. Despite this diminutive size and mass, the tympanic membrane is extremely tough and flexible.

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Neglected or maltreated earache, ear discharge and trauma leads to perforation of tympanic membrane.[1-6] Hippocrates emphasized the importance of ear pain: “acute pain of the ear with continued strong fevers is to be dreaded, for there is danger that the man may become delirious and die”.[7,8] Egyptian physicians emphasized the importance of ear discharge.[8,9] Trauma is treatable and largely preventable.[1-6]

The tympanic membrane’s function is to assist in human hearing. When sound waves enter the ear, they strike the tympanic membrane. The membrane vibrates with the force of the sound wave strike and transmits the vibrations further in, to the bones of the middle ear. Patients with ruptured or absent tympanic membranes have extreme difficulty in hearing, and possibly even complete hearing loss. Tympanic membrane perforation is a major problem on social life of a person in the form of hearing disability. Long standing perforation that causes recurrent ear discharge need tympanoplasty to avoid complications like intra-temporal- otitis media with effusion, chronic suppurative otitis media (CSOM), mastoiditis, facial palsy and labyrinthitis; extratemporal extradural such as abscess, extratemporal, subdural such as meningitis, intracranial abscess and sigmoid sinus thrombosis. Timely tympanoplasty has the ability to prevent re-infection and restore hearing ability.[1-4] According to the Wullstein classification, tympanoplasty can be classified into five types. When there is no abnormality of the middle ear type I tympanoplasty is done. It is repair of the tympanic membrane alone. It is also known as myringoplasty.[2] The tympanic membrane comprises of three layers of tissue: the outer cutaneous layer, the fibrous middle layer, and a layer of mucous membrane on its innermost surface. The membrane is held in place by a thick ring of cartilage, a tough but flexible kind of tissue. Type I tympanoplasty is the simple closure of the tympanic membrane perforation. There are three techniques of type I tympanoplasty: underlay technique, overlay technique and interlay technique. In interlay technique graft is placed in between the fibrous and mucosal layers of tympanic membrane.[2] Banzer in 1640 first attempted repairing a perforated tympanic membrane.[8,10] The first true tympanoplasty is said to be performed by Berthold in 1878. He de-epithelialized the tympanic membrane remnant by applying plaster against it for 3 days. Then removing it along with the underlying epithelium, and then placing a skin graft over the defect.[8,11]

In 1961 Storrs used the temporal fascia is order to close a tympanic membrane perforation.[12] Commonly used graft materials are temporalis fascia and tragal perichondrium. The other graft material includes fascia lata, cartilage and homograft (dura, vein), cadaver tympanic membrane).[12,13]

Material and Methods

The present study is a descriptive longitudinal study conducted in Community Based Medical College Hospital and in private clinics of Mymensingh from January 2012 to December 2021. We tried to assess the efficacy of operation based on analysis of records of 200 patients prospectively. Our selected sample had no middle ear deformity, so we had chosen type 1 tympanoplasty and our opted technique was interlay technique because: (a) There is no blunting as the anterior sulcus is in lines; (b) No lateralization of graft; (c) No epithelial cyst formation; (d) No medialization; (e) Can clear the tympanosclerotic plaque; (f) No reduction for

middle are space and (g) Myringitis is avoided. Microscopic approach was used.

Our inclusion criteria was population above 15 yrs, both sexes, having dry central perforation for at least 6 weeks who underwent type 1 tympanoplasty by interlay technique. Our exclusion criteria was: patient with active stage of CSOM, ossicular discontinuity, sensory neural hearing loss. Evaluation was based on graft uptake, hearing improvement and complications. Routine laboratory investigations and ENT examinations were arranged before operation. Ear examination included examination with otoendoscope and microscope, tuning fork test, pure tone audiometry, radiological tests (x-ray mastoid town's view). Informed written consent was taken prior to operation. Operation of most of the patients were performed under local anesthesia and sedation, few were under general anesthesia or total intravenous anesthesia (TIVA). Through post-auricular approach temporalis fascia graft was taken. In all the patients after meatotomy and freshening of perforation margin, tympanomeatal flap was elevated circumferentially at the level of fibrous annulus except superiorly at the level of head of the malleus. Canalplasty was done wherever required. Fibrosquamons layer of the remnant tympanic membrane along with the annulus was elevated leaving behind the mucosal layer. After inspecting the middle ear, ossiculer mobility, Eustachian tube opening, the tip of the malleus was nibbled wherever required. Graft placed in such a fashion rests over mucosal layer and bony canal wall all around and over the handle of the malleus. The tympnomeatal flap was reposted carefully, blood soaked gel foam pledge. The external auditory canal was also filled with dry gel foam pledges, incision wad sutured with 2-0 vicryl round body, and 3-0 cutting body, mastoid bandage was given. The patients were discharged 2nd post-operative day with proper antibiotic and follow up on a regular basis i.e. 2nd wk, 3rd wk, 6th wk, 12th week. At the last visit a pure tone audiometry was undertaken for evaluation of hearing improvement. Data were recorded from history, records of clinical examination, laboratory investigations, x-ray findings and audiometry. Data was analyzed by SPSS version 20.0.

Results

The study was carried out on 200 patients at CBMCHB and private clinics of Mymensingh in the period of January 2012 to December 2021. Age distribution of patients ranged from 15 years to 55 years, mean age 32.21 years and standard deviation ± 8.634 years. Table I shows age and sex distribution of patients. Most of the patients (96%) had taken graft. Table II shows distribution of status of graft uptake.

Table I: Age and sex distribution of patients (Number in the parenthesis indicates percentage)

Age group in years	Sex		Total Frequency	Percent-age
	Male	Female		
15– 24	18 (9.00)	22 (11.00)	40	20.00
25– 34	42 (21.00)	38 (19.00)	80	40.00
35– 44	35 (17.50)	25 (17.50)	60	30.00
45– 54	8 (4.00)	6 (3.00)	14	7.00
55– 64	4 (2.00)	2 (1.00)	6	3.00
Total	107 (53.50)	93 (47.50)	200	100.00

Table II: Distribution of status of graft taken

Status of graft taken	Frequency	Percentage
Graft taken	192	96.00
Graft Rejection	8	4.00
Total	200	100.00

Complete epithelization was observed in the 3rd week visit. Factors influencing graft rejection were bilateral tympanic membrane perforation (5/8) 62.50%, retracted tympanic membrane (1/8) 12.50% and infection due to non-compliance with post-operative advice and treatment (2/8) 25%.

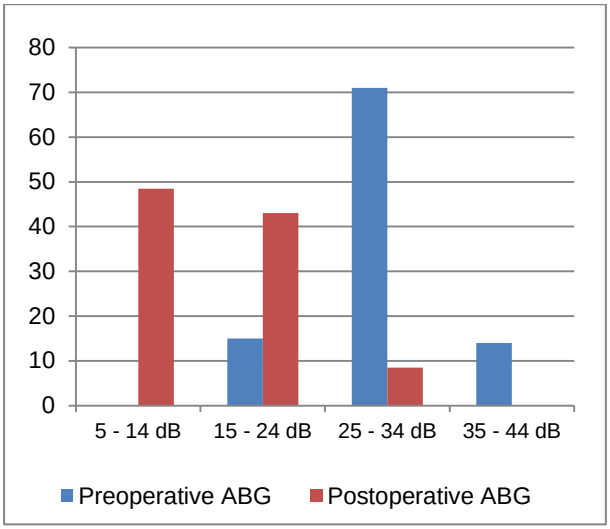
Table III shows status of hearing improvement in terms of clinical examination and investigation parameters.

Table III: Distribution of status of hearing improvement

Status of hearing improvement	Frequency	Percentage
Hearing improvement	180	90.00
No hearing improvement	20	10.00
Total	200	100.00

Pre-operative air-bone gap ranged from 20 to 35 dB. Mean preoperative ABG was 27.45 dB with SD 4.5666 dB. Post-operative air-bone gap ranged from 5 to 30 dB. Mean postoperative ABG was 13.35 dB and SD 5.933 dB. Figure 1 shows preoperative and postoperative air bone gap.

Figure 1: Preoperative and postoperative air bone gap expressed in percentage (n = 200)



Discussion

This study was carried out on 200 patients at CBMCHB and private clinics of Mymensingh in the period of January 2012 to December 2021. Age distribution of patients ranged from 15 years to 55 years, mean age 32.21 years and standard deviation ± 8.634 years. Age group 25 to 34 years (40.00%) was predominant followed by 35 to 44 years (30.00%). Males were predominant (Male: female ratio 115.05: 100). Age distribution was similar while sex distribution was different with a study conducted by Hussain *et al.* [14]

In this study, most of the patients 96.00% had taken graft. Complete epithelization was observed in the 3rd week visit. 4% had graft rejection and all of them were within 14 days. Factors influencing graft rejection were bilateral tympanic membrane perforation (5/8) 62.50%, retracted tympanic membrane (1/8) 12.50% and postoperative infection due to non-compliance with post-operative advice and treatment (2/8) 25%. This suggests that bilateral disease has a poor outcome and prognosis as compared to

unilateral disease. Compliance with postoperative advice and treatment can avoid the chance of getting infected. In different literature we reviewed, the graft uptake rate ranges from 60 – 96.60% for interlay technique.[14–23] The graft uptake rate in this study was 96.00% which was higher to the study conducted by others.[14–21] We also found some study where the graft uptake rate was more than our study.[22–23] In Hussain *et al* factor influencing graft rejection was infection.[14]

In this study, measured by clinical examination and investigation parameters the hearing improvement rate was 90.00%. Mean hearing threshold improvement was 14.10 dB which was better than several studies where mean hearing threshold improvement were 9.98 dB, 13.63 dB, 12.67 dB respectively.[16,18, 19] We also found some study where the hearing improvement was better than our study where mean hearing threshold improvement were 26.7 dB and 15.96 dB respectively.[21, 23]

Conclusion

Type 1 tympanoplasty done by interlay technique has excellent results both in terms of graft taken and hearing improvement with minimal complications. Mass people should be educated about earache, ear discharge and ear trauma and they should consult physicians as early as possible. Necessity of compliance of postoperative advice and follow up should be counseled. Limitation of the study is that it has not taken into account economic condition, educational status, personal hygiene and life style habits.

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