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Original Research Article

Simultaneous bilateral tympanoplasty with or without mastoidectomy

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ABSTRACT

Background: Bilateral simultaneous tympanoplasty with or without mastoidectomy scores over traditional sequential unilateral tympanoplasty with or without mastoidectomy in terms of convenience and cost-effectiveness for the patients with conservation of resources. But it is rarely performed, mainly because of the theoretical risk of iatrogenic sensorineural deafness. The outcomes of bilateral single-stage tympanoplasty with or without mastoidectomy studied are sparse in the literature. Authors intend to evaluate the risks of these procedures in the current era of advanced instrumentation and newer techniques, where the risk of complications is expected to be minimal in experienced hands, and to evaluate our results regarding hearing gain, graft uptake, and complications.
Methods: A total of 23 patients with bilateral central perforation of the tympanic membrane who underwent surgery of both ears simultaneously were retrospectively analysed (January 2017 to November 2023). The results were evaluated regarding graft uptake, hearing gain, and complications like sensorineural hearing loss (SNHL), facial nerve palsy, and chorda tympani nerve damage.
Results: Closure of perforation was successful in 89.1% of patients, and hearing improvement was observed in 95.7%. None of the patients had iatrogenic sensorineural hearing loss or facial nerve palsy. One patient had inadvertent bilateral chorda tympani nerve damage.
Conclusions: Simultaneous bilateral tympanoplasty/tympanomastoidectomy is a convenient, cost-effective procedure for patients with bilateral disease. The risk of SNHL is negligible if cases are chosen appropriately, and it has a similar success rate as a single-stage procedure.

Keywords: Single stage tympanoplasty, Chronic otitis media, Bilateral tympanoplasty, Iatrogenic sensorineural deafness, Bilateral tympanomastoidectomy

INTRODUCTION

The exact prevalence of chronic otitis media (COM) affecting both ears is uncertain; nevertheless, few studies indicate that between 25-50% of chronic otitis media are bilateral.[1] Tympanomastoid surgeries are one of the most common procedures otosurgeons perform with a high success rate. However, bilateral simultaneous tympanoplasties are not routinely performed by otologists because of the theoretical risk of iatrogenic sensorineural hearing loss (SNHL) of 1.2–4.5%.[2-4] However, it is important to emphasize that these instances of hearing loss most often occur in patients diagnosed with cholesteatoma, congenital malformations, or following ossiculoplasty procedures.[2-4]

There is also, a risk of bilateral or unilateral facial nerve palsy and chorda tympani nerve damage.

Apart from these, concerns about the extended duration of surgery, anaesthesia risk for prolonged surgery, and the surgeon's fatigue from performing microscopic surgery for extended hours were also considered. Another disagreement against a simultaneous bilateral procedure

includes the use of an ear canal pack and dressing which will affect the patient's hearing for the next 2-3 weeks.

This study aims to analyse these concerns and assess the graft uptake and hearing gain in patients undergoing bilateral ear surgery (tympanoplasty with or without mastoidectomy), and the risk of iatrogenic SNHL, facial nerve palsy, and chorda tympani.

METHODS

Retrospective analysis of 23 patients with bilateral COM mucosal (both active and inactive) disease with central perforation of the tympanic membrane (TM) who underwent simultaneous bilateral tympanoplasty with or without mastoid procedures at Bangalore Baptist Hospital, a tertiary care center in South India, between the period of January 2017 and November 2023, was included in this study.

All the collected data was analyzed with regards to history, examination, otoscopic/examination under microscopy (EUM)/otoendoscopic findings, as well as preoperative and postoperative pure tone audiograms (PTA). Additionally, whenever deemed necessary, diagnostic nasal endoscopy findings, performed to investigate sinonasal conditions potentially contributing to Eustachian tube dysfunction, were included in the analysis. The patient's middle ear mucosa and ossicular status were gauged by EUM, as required. The status of the mastoid was assessed with an X-ray mastoid. Computed tomography (CT) of the temporal bone was performed in limited cases as per requirement.

Patients with any ear having profuse active discharge were treated first with antibiotics. Patients with total or marginal perforation, attic perforation, and squamous disease were not included in the study. Patients with large bilateral air bone (AB) gaps were avoided.

Routine preoperative hematological investigations and cardiopulmonary assessments were done for every patient. Patients were counseled regarding the pros and cons of sequential versus simultaneous bilateral tympanomastoid surgery. In cases of simultaneous bilateral ear surgery, the chances of abandoning the second ear surgery in case of complications in the first ear were explained. The patient's choice was upheld. All were admitted the previous day of surgery and discharged the next day of the procedure, after changing the mastoid/pressure dressing. All cases were operated under general anesthesia.

Patients were put in a supine position with their heads turned to one side. The side with more severe hearing loss and larger perforation was operated on first so as to check and deal with concomitant pathology like granulation tissue, unexpected cholesteatoma, or ossicular chain defects.

The surgical steps included - post-aural approach for one ear and either a transcanal or post-aural approach for the other ear based on anatomy and the surgeon's preference were undertaken. All patients preoperatively received a single dose of amoxicillin-clavulanic acid injection (1.2 gram) intravenous, which was continued postoperatively orally for a week. The operative ear was cleaned and draped. Local infiltration with 2% pre mixed lignocaine and adrenaline solution was given post-aurally and in the four quadrants of the external auditory canal (EAC). A lazy S-shaped postural incision was made, and a very large temporalis fascia graft was harvested to divide it into two halves, where one half was used for the second ear. This saves time and avoids unnecessary harvesting of graft from the other side.

A posterior tympanomeatal incision was taken around 4 to 6 mm lateral to the annulus from the 6 to 12 O'clock position (or as required) tympanomeatal flap was elevated with the annulus and the handle of the malleus was skeletonized if needed. The middle ear was explored. The disease from the middle ear was removed and ossicular status was checked. Ossiculoplasty was done if required.

The mastoid was drilled and exposed and, in most cases, at least for a check antrotomy (unless the ear is inactive with a pneumatized mastoid on X-ray). Antrum and aditus were examined for disease and cleared if any, and complete cortical mastoidectomy was done, where required. The temporalis fascia graft was placed using the underlay technique in all cases, and whenever the handle of the malleus was skeletonized, a hole was made at the junction of 1/3 and 2/3 of the graft, 1-2 mm from its edge and this hole is fed through the handle and made to anchor on to the neck of the malleus. Authors call this as the "Hole technique" and this enhances the stability of the graft, prevents lateralization, and gives good contact with the handle of the malleus.

In all subtotal or anterior perforations, anterior tucking was done by making a small window in the anterosuperior canal wall and pulling out the pointed bit of graft through it to prevent slipping of the graft due to loss of support as the gel foam most often gets displaced into the Eustachian tube. The tympanomeatal flap was then repositioned after confirming the proper positioning of the graft in the EAC and secured with gel foam in the EAC. To prevent anterior blunting due to the anterior tucking a long compressed dry piece of gelfoam is placed anteriorly at the junction of graft and canal wall securing an acute angle. EAC pack was inserted and ear dressing was done.

The head is then turned over to the other side, exposing the second ear for surgery. Preparation of parts was done and a similar procedure was carried out. The remaining graft was used on this side and either a transcanal/ or post-aural approach was used. Most often mastoidectomy was not done on the opposite ear as cases were chosen in

such a way, as to preclude the need to do bilateral cortical mastoidectomies. If deemed required a check antrotomy was done on the other side. In this way, the second ear surgery most often took just about half the time of the first ear surgery.

Post operatively, patients were instructed not to blow their nose for 1 month after surgery, to avoid catching a cold for up to 10 days, to prevent water entry into their ears and no swimming for up to 12 weeks, till the graft uptake is assessed. They were also instructed to avoid excessive physical activity or heavy lifting for 10–15 days and avoid air travel for 4 weeks. They were routinely kept on oral antibiotics for 1 week. The mastoid bandage and ear pack were removed on the 7th day, after which antibiotic ear drops were prescribed for 2 weeks. Then, the patients were followed up on the 3rd, 6th, and 12th week of the post-operative period. On each visit, patients were evaluated for level of discomfort, success for graft uptake, SNHL, and complications if any. A repeat audiogram to check the hearing improvement was carried out at or after the 12th week post-op.

Successful closure of the perforation was defined as an intact eardrum at the 12th week postoperatively. Success in terms of hearing gain was defined as an improvement in air conduction thresholds by 10 dB (decibel) or more in comparison with the preoperative audiogram. In cases with no or minimal hearing loss in pre-operative audiogram, only the graft uptake was assessed.

Ethical approval

Study was approved as a retrospective study by the Institutional reviews Board of Bangalore Baptist Hospital and accepted for the waiver of consent (BBH/IRB/ 2024/23 on 18th April 2024).

RESULTS

A total of 23 patients operated simultaneously on both ears, were included in the study. The age of the patients ranged from 10-59 years, with the mean age being 35.5±15 years. Among these, 18 were females and 5 were males. The mean preoperative PTA threshold was 37.7±17.6 dB (Table 1). The mean pre-operative AB (air bone) gap was 30±12.7 dB (Table 2). On preoperative assessment, 21 out of 23 patients had pre-op x-rays, among which 54.3% of x-ray mastoids were sclerotic, 39.2% were diploeic, and 2.2% were pneumatized.

Out of the 23 patients, 9 underwent bilateral tympanomastoidectomy (MM), 7 underwent unilateral tympanoplasty and contralateral tympanomastoidectomy (MT), and the remaining 7 underwent bilateral tympanoplasty (TT) simultaneously. In 3 patients (total 4 ears) ossiculoplasty was done, including 2 MM and 1 MT cases. 2 MT and 2TT cases (total 5 ears) were revision cases. The operative duration for MM was 325.56±49.082 minutes, for MT was 263.75±50.409 minutes, and for TT it was 210.0±46.476 minutes. Operative blood loss was minimal and postoperative pain was tolerable in all patients.

Table 1: Distribution of study subjects according to pre-operative audiometry (n=46).

Pre-operative audiometry	Frequency (N)	Percentage (%)
Minimal	10	21.8
Mild	23	50.0
Moderate	5	10.9
Moderately severe	6	13.0
Severe to profound	2	4.3
Mean±SD	37.726±17.611	
Range	15–91.60	

Table 2: Distribution of study subjects according to pre-operative AB gap (n=46).

Pre operative AB gap	Frequency (N)	Percentage (%)
≤25	23	50.0
26 to 40	18	39.1
41 to 70	5	10.9
Mean±SD	30.032±12.727	
Range	5.00–70.00	

None of the patients developed iatrogenic SNHL, immediate unilateral or bilateral facial nerve palsy. One patient, who underwent bilateral tympanomastoid surgery (MM), developed delayed unilateral lower motor neuron (LMN) facial nerve palsy after 2 weeks post-surgery, which was treated as Bell's palsy and recovered completely. There was 1 case of bilateral chorda tympani damage, as it was stretched and thinned out by tympanosclerosis and inadvertent injury was caused while removing the extensive tympanosclerosis. However, no taste alterations were complained of by the patient immediately post-surgery or on follow-up. It was very encouraging that patients were not annoyed by the bilateral ear canal gauze packing except one who was intolerant to the bilateral dressing in the postoperative period, as the immediate postoperative hearing was compromised. He was reassured that the hearing compromise was temporary.

Out of the 23 patients, 21 were operated on by surgeon X, and 2 were operated on by surgeon Y. So, there was no significant variation to account for the graft uptake or gain in hearing. Graft uptake was good with a rate of 89.1 % (n=41) (Figure 1). Residual perforations were seen in 10.9 % (n=5) (Figure 1). 19 out of 23 patients achieved bilateral graft uptake. During postoperative follow up no retraction pocket, no lateralization, or medial displacement of the graft was observed.

44 ears gained hearing, whereas in 2 ears no gain in hearing was observed. Post operatively PTA thresholds

improved to 22±11.7 dB (Table 3). The mean post-operative AB gap was 12.23±9.33 dB (Table 4). More than 10 dB hearing gain was observed in 26 ears and more than 20 dB gain was observed in 18 ears. 21 patients out of 23 (i.e. 91.3%) had hearing improvement in both ears and 2 patients had hearing improvement in only one ear (Figure 2).

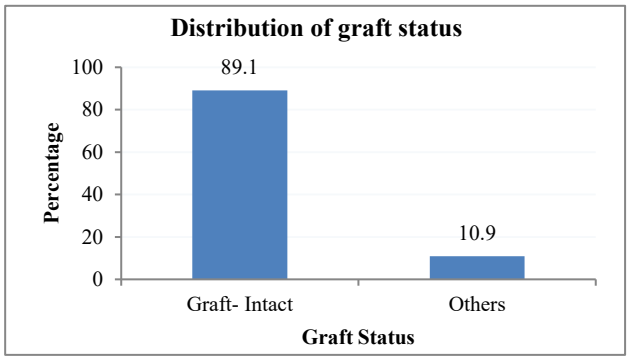

Figure 1: Post-operative graft status.

Table 3: Distribution of study subjects according to post-operative audiometry (n=46).

Post-operative audiometry	Frequency (N)	Percentage (%)
Minimal	23	50.0
Mild	6	13.0
Moderate	7	15.2
Normal	10	21.8
Mean±SD	22.252±11.757	
Range	10–50	

Table 4: Distribution of study subjects according to post-operative AB gap (n=46).

Post operative AB gap	Frequency (N)	Percentage (%)
≤25	44	95.7
>25	2	4.3
Mean±SD	12.232±9.332	
Range	3–45	

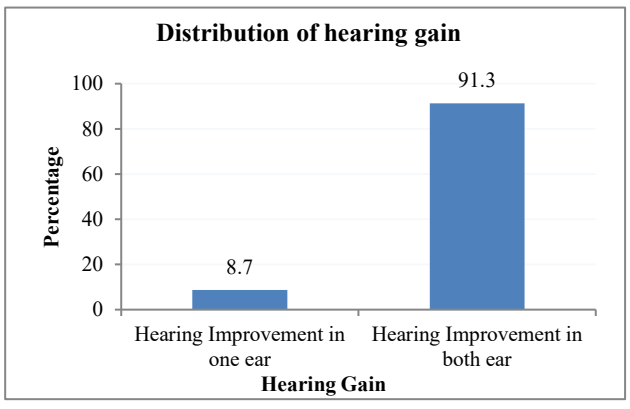

Figure 2: Distribution of post operative hearing gain.

DISCUSSION

TM is responsible for the conduction of sound waves across the middle ear and also protects the middle ear cleft and shields the round window from direct sound waves, which is referred to as the "round window baffle". This shield is necessary to create a phase differential so that the sound wave does not impact the oval and round windows simultaneously, as this would disrupt the unilateral flow of sound energy from the oval window through the perilymph. It has been found that the effect of the enhanced ratio of the surface area of the TM and that of the oval window increases the sound pressure by about 27 dB. In contrast, the lever action of ossicles contributes only about 3 dB.[5] TM perforations reduce the surface area of the membrane available for sound pressure transmission and allow sound to pass directly into the middle ear. Thus, the objectives of tympanoplasty are obtaining an intact TM, a dry middle ear, and an audiometric improvement.[6]

Perforation of TM is quite common among patients seen at the Otorhinolaryngology clinic. Bilateral perforations of the TM are not an uncommon finding, as they represent about 39.4% of perforated TM, and COM was found to be the most common cause of TM perforation in more than 90% of patients.[7]

In this study on simultaneous bilateral tympanoplasty, the graft uptake rate at 12 weeks postoperatively was 89.1%, which was within the range of typical success rates reported in the literature.

The outcome of bilateral single-stage tympanoplasty with or without mastoidectomy is sparse in the literature. Most of the reports pertain to unilateral operations with average success rates of about 60-100%.[8,9] Average reported success rate of few previous studies on bilateral ear surgeries as Rai et al, Sahu et al, and Chaaban et al are as given (Table 5).[7,10,11] The graft take-up rate was 89.1 % in our study which is in agreement with international standards of unilateral tympanoplasty type I results such as Glasscock et al with graft uptake rate of 93% in a sample of 1556 patients using autogenous and homograft temporalis fascia by underlay technique.[12] Umamaheshwaran et al compared sequential vs. simultaneous type 1 tympanoplasty, where the simultaneous group had a graft uptake of 96.7% and the sequential group had a graft uptake of 90%, whose results are similar to our study.[13] 19 out of 23 patients achieved bilateral graft uptake. 91.3% of patients had a bilateral hearing gain, and the rest had hearing gain in at least one ear. The failure rate of TM perforation repair in this study was 10.9%.

No worsening of bone conduction threshold was detected in any ear included in our study, which is concordant with the findings of Rai et al, Sahu et al, Chaaban et al, Karkanevatos et al and Caye-Thomasen et al.[7-9,14,15] Hence the suggested theoretical risk of iatrogenic sensorineural hearing loss during in simultaneous

bilateral tympanoplasty with or without mastoidectomy is negligible in experienced hands.

In this study, the hearing gain for bilateral single sitting type I tympanoplasty was more than 10 dB in 26 operated ears (56.5%) and more than 20 dB in 18 operated ears (39.2%), which is also within the average reported success rate of the previous studies.

In most studies considering bilateral surgery for TM perforations, only dry ears with no suspicion of additional pathology have been included because granulation tissue or a need to perform ossiculoplasty will increase the risk for an iatrogenic SNHL during the operation. However, in our study, there were ossiculoplasties performed for 4 ears, and also 5 revision ears were included, but none of them developed SNHL. However, authors would recommend avoiding revision cases and expected ossiculoplasties, especially in not very experienced hands.

None of our patients had iatrogenic facial nerve palsy. However, one patient developed unilateral delayed LMN facial nerve palsy, which was diagnosed and treated as Bell's palsy. The patient improved completely with treatment. In one case, inadvertent bilateral chorda damage occurred, but the patient reported no taste disturbance, immediate post-op, or on follow-up visits, unlike the study results of Kim et al.[16] Iatrogenic SNHL did not occur in our series.

Although these studies highlight the ease, high success rate, and patient-friendly outcome of bilateral tympanoplasty, this procedure is not without pitfalls. The patients need to be positioned for a long time if done under local anesthesia, which could be uncomfortable for some, although the bilateral procedure rarely takes more than 2-4 hours in expert hands in uncomplicated cases and if simultaneous mastoidectomy is not needed. All our patients have undergone surgery under general anesthesia. The risk of upper respiratory tract infection (URTI) in the immediate post-op leading to graft rejection is similar in unilateral and bilateral simultaneous surgeries; however, this possibility is extremely unlikely with routine post-op use of antimicrobials nowadays. Also, the surgeon's fatigue in continuously using the microscope is a concern, but it can be resolved by proper ergonomics, and maybe taking a short break between the two ears while prepping the second ear is being done. Bilateral hearing loss due to the temporary mastoid dressings causing physical occlusion is not much of a practical problem provided that the patients and their family members are thoroughly educated and warned. Above all, bilateral cases should be chosen for simultaneous intervention only by experienced surgeons, as these are microsurgeries that require higher skill and perfection, immediate and proper management of complications, and also better communicative skills in counseling the patients. The post-op pain was minimal in all cases and taken care of by routine analgesics.

Table 5: Comparison of hearing gain and graft uptake with previous similar studies.

Study	Study groups	Mean pre-operative PTA	Mean post-operative PTA	Mean pre-operative ABG	Mean post-operative ABG	Graftuptake (%)
Glasscock et al[12]	Unilateral tympanoplasty	-	-	-	-	93
Sahu et al[7]	Simultaneous bilateral tympanoplasty	32.07 dB	13.97 dB	-	-	94.6
	Unilateral tympanoplasty	30 dB	13.5 dB	-	-	93.3
Chabaan et al[11]	Simultaneous bilateral mastoidectomy	-	-	13.8 dB	9.16 dB	94.4
Rai et al[10]	Unilateral tympanoplasty	-	-	32±3.8 dB	16.33±6.6 dB	90
	Bilateral tympanoplasty			31.2±3.6 dB	17.75±4.4 dB	93
Umamahesh-waran et al[13]	Simultaneous tympanoplasty	37.2±11.3 dB	22.18±9.01 dB	21.72±7.3 dB	15.28±6.07 dB	96.7
	Sequential tympanoplasty	42.74±10.55 dB	30.8±9.98 dB	29.86±2.3 dB	24.3±10.3 dB	90
Thomasen et al[15]	Simultaneous bilateral tympanoplasty	20.1±1.2 dB	11.5±1.0 dB	14.5±1.0 dB	5.2±0.6 dB	94
Karkanevatos et al[14]	Unilateral tympanoplasty	-	-	-	-	83.3
Our study	Bilateral tympanoplasty± mastoidectomy	37.7±17.6 dB	22±11.7 dB	30±12.7 dB	12.23±9.33 dB	89.1

It is imperative to note that simultaneous bilateral ear surgeries require the same vigilance as equivalent to operating on an only hearing ear and the selection of cases is paramount in offering the patient the option of bilateral surgery.

CONCLUSION

Simultaneous bilateral tympanoplasty with or without mastoidectomy is a safe procedure with a high success rate in the hands of an experienced otologist, provided the cases are chosen well. It can be performed in most of the patients without apprehension of iatrogenic SNHL with good results comparable to unilateral ear surgery. It reduces the cost of treatment, allows single hospital admission, decreases the frequency of exposure to anesthesia, and leaves the patient satisfied. It avoids the need for a second surgery, thereby reducing the number of follow-up visits and the number of days of absence from school and work, and also reduces the burden on the healthcare system. The hearing impairment during the postoperative period with an ear canal pack is minimal and often accepted by the patients.

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