

Outcome of Cortical Mastoidectomy with Tympanoplasty in Active CSOM in Kalyan Karnataka Region

Sapthami Satish¹, Renuka S. Melkundi², H M Abhijith³, Somanath⁴

¹Assistant Professor, Department of ENT, Basaweshwara Medical College and Research Institute, Chitradurga. Karnataka, India. ²Professor and HOD, Department of ENT, Gulbarga Institute of Medical Sciences, Kalaburagi. Karnataka, India. ³Senior Resident, Department of General Surgery, Basaweshwara Medical College and Research Institute, Chitradurga. Karnataka, India. ⁴Senior Resident, Department of ENT, ESIC Medical College and PGIMER, Kalaburagi, Karnataka, India

Abstract

Background: Chronic otitis media is defined as chronic infection confined to middle ear cleft, characterized by ear discharge and a permanent perforation of tympanic membrane. Maintaining ear dry for 2-3 months possesses a great hurdle for patients, due to lack of hygiene and awareness; also, the patient compliance for follow up is low. Thus, intervening an active ear becomes a necessity. Our study aims to find out the outcome of tympanoplasty with cortical mastoidectomy in active chronic suppurative otitis media with respect to 1. Post operative graft uptake, 2. Post operative audiological outcome. **Material and Methods:** A single arm, prospective control study was done in 60 patients aged 16-60 years with active chronic suppurative otitis media (CSOM) – Tubo Tympanic disease undergoing cortical mastoidectomy with tympanoplasty. Follow up of patients done at 3 months and 6 months after surgery. **Results:** Patients between the age group of 16-60 years were included in this study, mean age of 34.6 years. There were 31 females and 29 males in the study. A total of 42 patients with unilateral CSOM and 18 patients with bilateral CSOM were included. Out of 60, 8 patients had small central perforation, 14 had medium sized perforation, 31 had large central perforation, 7 had subtotal perforation. Complete graft uptake was seen in 91.7% patients. Hearing improvement, assessed by mean gain of PTA (Pure Tone Audiometry) at the end of 6 months, 11.45db gain. Graft uptake rate was 100% in the patients who were having history of <10 years of ear discharge. Higher take-up rates were seen in smaller compared to large and subtotal perforation. **Conclusion:** In our study, we conclude that outcome of cortical mastoidectomy with tympanoplasty in active CSOM, in the region of Kalyan Karnataka has good results both in terms of graft uptake and hearing improvement.

Keywords: Ear, Mastoid, Otitis Media, Audiometry, Tympanoplasty, Mastoidectomy, Hearing.

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INTRODUCTION

Hearing, a fundamental sensory function, is essential for effective communication. Moreover, it plays a pivotal role in the development of speech and language skills, making it an integral aspect of human existence. Hearing disorders can be broadly categorized as congenital or acquired. One of the most prevalent causes of acquired hearing loss is Chronic Otitis Media (COM), which is characterized by a persistent infection within middle ear complex.^[1] The World Health Organization officially defines Chronic Otitis Media as a persistent infection that affects the middle ear cleft, including structures like the mastoid air cell system and the Eustachian tube. The condition is further marked by an ongoing perforation of the tympanic membrane.^[2] In developing countries, COM's prevalence is notably high, often attributed to suboptimal living conditions, overcrowding, inadequate hygiene practices, and nutritional deficiencies.^[1,2]

Chronic otitis media Tubo-tympanic type can manifest in two primary forms: an inactive(dry) ear or an active(wet) ear with continuous discharge through a perforated tympanic membrane. When confronted with a discharging ear, surgeons often find themselves in a dilemma regarding whether to perform surgery. This dilemma arises from the

belief that surgical outcomes for wet ears tend to be less favorable compared to dry ears.^[3] This perception can significantly influence the decision-making process when considering surgical intervention for COM.

Raj A, Vidit et al,^[4] in an experimental study conducted on 50 patients with mucoid discharge undergoing myringoplasty, to find the efficacy of graft uptake, showed that primary closure of perforation was seen in 84% cases and hearing improvement was seen in 68% of patients. It showed that the presence of ear discharge at the time of surgery did not influence the results of surgery.^[3,4]

As COM can have variable presentations, either being an actively discharging ear or dry tympanic membrane perforation,

Address for correspondence: Dr. Sapthami Satish, Assistant Professor, Department of ENT, Basaweshwara Medical College and Research Institute, Chitradurga. Karnataka, India
E-mail: drsapthami.sam@gmail.com

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prospective studies are needed to study the outcomes of tympanoplasty on ears. This would help us in managing patients more effectively, improving quality of life and proceeding without any hesitation on managing an actively discharging ear. This study is carried out to know outcome with respect to hearing improvement and graft uptake rate of active(wet) ear in patients suffering from chronic otitis media Tubo-tympanic type after microscopic assisted tympanoplasty with cortical mastoidectomy.

Objectives

To determine the outcome of tympanoplasty with cortical mastoidectomy in chronic suppurative otitis media with persistent mucosal disease with respect to:

- The post-operative graft uptake
- The post-operative audiological outcome

MATERIALS AND METHODS

Source of the data: The study included patients presenting with mucosal type of chronic otitis media, who underwent tympanoplasty and cortical mastoidectomy at Department of otorhinolaryngology, Gulbarga Institute of Medical Sciences, Kalaburagi during the study period from August 2022 to May 2024.

Sampling technique: The required sample size can be calculated using formula

$$N = \frac{Z^2 pq}{L^2}$$

N= Sample size, Z= Level of significance, (95%CI-1.96), P= prevalence/ outcome (80%), Q=(1-p) *(1-0.80), L=standard error (10%)

Therefore, the sample size for this study would be around 60 patients. We got 60 patients who met with the criteria to be included in the study.

Criteria for selection of sample:

Inclusion Criteria:

- Patients of age between 16- 60years, of both genders.
- Patient willing to give informed consent
- Patient with active small, moderate, subtotal central perforation (Tubo tympanic disease)
- CSOM with mild/ moderate conductive hearing loss with

good air bone gaps.

- Absence of infective foci e.g., nasal foci.

Exclusion criteria:

- Patients with attic perforation or cholesteatoma.
- Patient with sensory-neural hearing loss
- Patient undergoing revision tympanoplasty
- Patient with traumatic perforation of tympanic membrane.
- Chronic suppurative otitis media with intracranial complications
- HbsAg and HIV positive patients and other chronic inflammatory diseases.
- Patients that are medically certified as unfit for the anesthesia.

Methods of collection of data: Patients who satisfied the above-mentioned criteria for selection were taken as subjects for the study, after taking an informed and written consent. The selected patients are subjected to clinical, audiological and laboratory investigations. Detailed history of patient, General and systemic examination of patient done. Examination of the tympanic membrane under microscope was done and hearing evaluation using tuning fork tests. PTA (Pure Tone Audiometry) and relevant laboratory investigation including X- Ray mastoids and HRCT temporal bone are done. All patients underwent cortical mastoidectomy with tympanoplasty using temporalis fascia graft placed by underlay technique in local anesthesia. Intactness of drum and graft uptake was accessed after 1 month, 3 months and 6 months. At the end of 3rd and 6th months an audiogram was done on all the patients with intact drum. The collected information was entered into an excel spreadsheet. The data sheet was moved and analyzed using the SPSS software version after the necessary data cleaning. Descriptive statistics were used to describe the study variables of the subjects. The P-values were corrected by Bonferroni method and a P-value <0.05 was regarded as statistically significant.

RESULTS

This study comprised 60 patients aged 16 to 60 years. The most patients were seen in the 31-40 age range, with 27 in total. A total of 13 patients (45%) were in the 40-60 age range, while 20 patients (33.3%) were in the 21-30 age group. 34.5 years was the mean age [Table 1].

Table 1: Age wise distribution of patients

Age group	Frequency	Percentage	P-value
21-30 yrs	20	33.33	0.086
31-40 yrs	27	45	
40-60yrs	13	21.67	
Total	60	100.00	

Table 2: Graft take-up rates in relation to age

Age group	Graft intact		Graft failure		P-value
	Frequency	Percentage	Frequency	Percentage	
21-30 yrs(n=20)	20	100	0	0	0.19
31-40 yrs(n=27)	23	85.2	4	14.8	
>40 yrs(n=13)	12	92.3	1	7.7	
Total(n=60)	55	91.7	5	8.3	

In our study, there was one graft failure in the age group above 40years of age. Maximum number of graft failures was

between 31-40 years age group i.e., 4 patients, but not statistically significant [Table 2].

Table 3: Gender wise distribution of the patients

Sex	Frequency	Percentage	P-value
Female	31	51.67	0.79
Male	29	48.33	
Total	60	100.00	

In our study, out of 60 patients, 31 were female and 29 males. Statistically insignificant [Table 3].

Table 4: Status of laterality of ear

Laterality	Frequency	Percentage
Unilateral	42	70
Bilateral	18	30
Total	60	100

Bilateral perforations were seen in 18 patients. Unilateral side operated and 29 were left side operated [Table 4]. perforations were seen in 42 patients. Of which 31 were right

Table 5: Graft uptake rates in bilateral and unilateral COM (laterality as a factor in success of cortical mastoidectomy with tympanoplasty)

Laterality	Graft intact		Graft failure		P-value
	Frequency	Percentage	Frequency	Percentage	P Value
Unilateral (n=42)	39	93	3	7	0.61
Bilateral (n=18)	16	89	2	11	
Total (n=60)	55	91.7	5	8.3	

Among 18 patients with bilateral disease, graft uptake was seen in 89% and failure was noted in 2 patients, 11%. Out of 42 patients with unilateral disease, uptake was seen in 93% and failure was noted in 3 patients, 7%. But it was not statistically significant [Table 5].

Table 6: Duration of the disease

Duration of discharge	Frequency	Percentage	P-value
Childhood	12	20	0.82
≤5 yrs	16	26.7	
6-10 yrs	17	28.3	
>10 yrs	15	25	
Total	60	100	

Maximum number of patients, i.e., 17, had duration between 6-10years. 15 patients had durations of more than 10years, and 12 patients suffered since childhood. No statistical significance in distribution of patients [Table 6].

Table 7: Duration of discharge as a factor in success of cortical mastoidectomy with tympanoplasty

Duration of discharge	Graft intact		Graft failure		P- value
	Frequency	Percentage	Frequency	Percentage	
Childhood (n=12)	11	91.7	1	8.3	0.022
≤5 yrs (n=16)	16	100	0	0	
6-10 yrs (n=17)	17	100	0	0	
>10 yrs (n=15)	11	73.3	4	26.7	
Total (n=60)	55	91.7	5	8.3	

In the present study, duration of disease had a significant role in the success of cortical mastoidectomy with tympanoplasty, as $p < 0.05$ [Table 7].

Table 8: Size of perforation

Size of perforation	Frequency	Percentage	P-value
Small Central Perforation	8	13.3	<0.0001
Medium Central Perforation	14	23.3	
Large Central Perforation	31	51.7	
Subtotal Perforation	7	11.7	
Total	60	100	

Out of 60 patients, 31 patients had large central perforation. small central perforation. And 7 cases had subtotal perforation. Statistical significance was observed [Table 8]. 14 cases had medium-sized central perforation. 8 cases had

Table 9: Graft uptake with regard to size of perforation

Size of perforation	Graft intact		Graft failure		P-value
	Frequency	Percentage	Frequency	Percentage	
Small Central Perforation (n=8)	8	100	0	11.1	0.199
Medium Central Perforation (n=14)	13	93.3	1	6.7	
Large Central Perforation (n=31)	29	93.3	2	6.7	
Subtotal Perforation (n=7)	5	66.7	2	33.3	
Total (n=60)	55	91.7	5	8.3	

Failure rates increased with perforation size; there were two failures in large central and subtotal perforations. However,

statistically insignificant [Table 9].

Table 10: Status of middle ear mucosa

Middle ear mucosa	Frequency	Percentage	P-value
Edematous	34	56.7	0.302
Hypertrophied	26	43.3	
Total	60	100	

Prior to the procedure, all the cases underwent examination under microscopic. Status of middle ear mucosa was assessed. 34 patients (56.7%) had edematous mucosa and 26

had hypertrophied mucosa (43.3%). We found no statistical difference in frequency [Table 10].

Table 11: Cellularity of mastoid

Mastoid air cells	Frequency	Percentage	P-value
Cellular	29	48.3	0.017
Diploic	20	33.3	
Sclerotic	11	18.4	

During the surgery, the mastoid cavity was classified into three groups: cellular, diploic, and sclerotic, depending on the cellularity of the mastoid. A total of 29 patients in our study had cellular mastoid. Diploic type mastoid was

present in 20 individuals. The remaining 11 had a sclerotic mastoid. The type of mastoid and graft take-up rates did not differ significantly [Table 11].

Table 12: Postoperative control of ear discharge

Status of ear	Frequency	Percentage	P-value
No discharge	58	96.7	<0.0001
Persistent discharge	2	3.3	
Total	60	100	

In our series, postoperative follow up showed complete control of otorrhea in 58 patients. 2 patients showed persistent ear discharge [Table 12]. On follow up at 3rd

[Figure 1] and 6th [Figure 2] month post-Surgery Tympanic membrane was found with good healing in 58 cases.

Table 13: Status of graft in patients

Status of graft	Frequency	Percentage	P-value
Graft Failure	5	8.3	<0.0001
Graft Intact	55	91.7	
Total	60	100	

In our study, postoperative follow up by otoscopic examination after 1, 3 and 6 months showed intact graft in 55 patients. 5 patients showed residual perforation [Table 13]. Patients with graft failure were excluded from follow up PTA test. Mean PTA pre-operatively was 36.4db. Mean PTA at 3rd month was 26.6db and at 6th month it was 24.8db. Hearing improvement was recorded at 3rd and 6th month

[Chart 1].

The mean A-B gap closure [Chart 2] in our study was 11.36dB. Pre-operatively maximum patients were having A-B gap of 35-40dB, 26(47%). Post-operatively the A-B gap closure was seen maximum between 25-30dB range, 26(47%) and below 25dB group, 21(38.2%).

Table 14: Distribution of patients based on Air-Bone gap pre-operatively and post-operatively (*AB Gap - Air-Bone Gap)

AB Gap*	Pre-operatively	Post-operatively	P-value
<25db	00	21	<0.0001
25-30db	05	26	
30-35db	10	07	

35-40db	26	01	
40-46db	14	00	
Total	55	55	

Table 15: Hearing gain after 3 months

Hearing gain	Frequency	Percentage	P-value
>10db gain	22	40	0.14
≤10db gain	33	60	
Total	55	100	

Patients with graft failure were excluded from the postoperative PTA test. PTA was performed on all cases during the third month of follow-up. In 22 patients, hearing

gain of more than 10 dB were noted. 33 individuals had hearing gain of less than 10 dB. 3months later, the mean gain was 9.62 [Table 15].

Table 16: Hearing gain after 6 months

Hearing gain	Frequency	Percentage	P-value
>10db gain	31	56	0.34
≤10db gain	24	43.6	
Total	55	100	

After 6 months, hearing gain of more than 10db was recorded in 37 patients. Hearing gain of less than 10db was seen in 18 patients. Mean gain after 6months was 11.45 [Table 16].

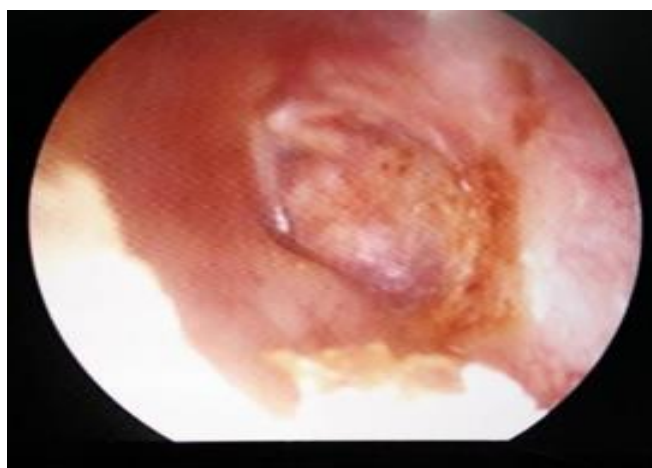


Figure 1: Healed case of perforation at 3rd month postoperatively



Figure 2: Healed case of perforation at 6th month postoperatively

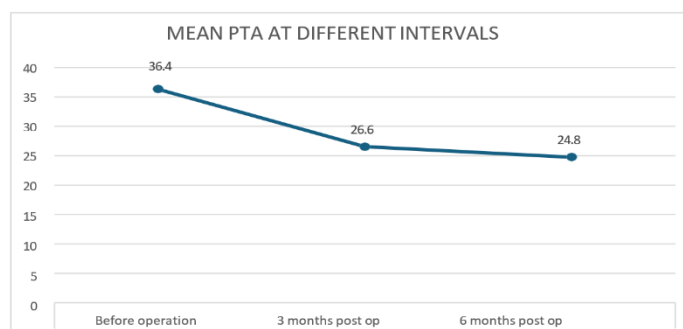


Chart 1: Mean PTA at different Intervals

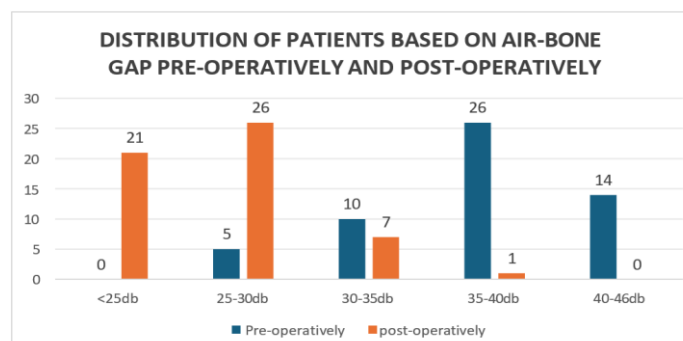


Chart 2: Air-Bone gap distribution- pre & post-operatively

DISCUSSION

One of the most frequently performed surgeries in otolaryngology is tympanoplasty. Graft success rates have increased exponentially as a result of the major improvements made to state-of-the-art facilities by sophisticated microsurgical procedures and equipment.^[5] Prior research has continuously shown that tympanoplasty results in improved hearing, graft acceptance, and the attainment of a dry ear. The literature goes into great detail on the different aspects that affect this procedure's success. One important factor to consider is the dilemma surgeons have when they are performing surgery on a patient who has active ear discharge. This situation forces them to carefully evaluate whether to proceed with the procedure. In this study, we looked at the outcomes of 60 patients with active

CSOM and underwent cortical mastoidectomy combined with tympanoplasty.

Age factor in success of cortical mastoidectomy with tympanoplasty: One significant non-mastoid factor affecting tympanoplasty outcome is age. Adenoid and Eustachian tube dysfunction is the reason behind pediatric tympanoplasty failure. Patients under the age of 16 were not included in our study. 34.6 years was the mean age. 41% of the patients were in the age bracket of 31 to 40 years.

According to J. Geetanjali et al.'s study, patients between the ages of 21 and 40 had the best results, while those over 40 and younger than 20 had poorer outcomes.^[6] Bluestone et al. published the lowest success rates in pediatric myringoplasty of 35% in 1979; their definition of success was stricter than others.^[7] Our study contradictory found no significant difference in graft uptake at 40 years of age or older; this may be because of age skewing around 40 years of age.

Graft uptake rates in unilateral and bilateral COM: Of the 60 patients we studied, 18 had bilateral COM. 42 patients had unilateral COM. Comparable to the research of Vaidya et al., which showed that individuals with unilateral discharging ears (59%) outweighed those with bilateral discharging ears (41%).⁸ The number of individuals operated on left side was 29(48%), and right side was 31(52%). In our study, success rates were 93% and 89% for unilateral and bilateral ear disease respectively.^[8]

In the study by Dangol K et al. graft uptake with regard to condition of opposite ear was found to be significant. There was an 88.2% success rate in unilateral perforation as compared to 75% in bilateral perforations of the ear drum.^[9] Jackler and Schindler also reported the success rates of graft take up for unilateral and bilateral disease were 86% and 83.3% respectively.^[10]

Size of perforation and graft uptake rates: It was discovered that different research produced different findings regarding the size of the perforation following tympanoplasty. The study conducted by Vaidya et al. revealed that the average maximum graft intactness in single quadrant perforations was 93.22%, whereas in situations where all four quadrants were affected, the maximum residual perforations were 33.33%.⁸ Jackler and Schindler the graft take up rates were found to be 86.7% for subtotal perforations and 76.5% for small perforation.^[10]

According to a study by Patel et al., graft uptake rates were 95% for small central perforations, 94.6% for big central perforations, and 78% for subtotal perforations. Higher subtotal perforation failure rates have been attributed to both technical difficulties during surgery and the need to vascularize and epithelialize a greater area.^[11] In the study we conducted, we found that failure rates increased as perforation size increased. Two failures occurred in each of the large central and sub-total perforations. Success rate being 93% in medium and large sized perforations and 100% in small central perforations.

Duration of disease: Some studies show that duration of disease effect the outcome of the disease due to long standing, almost permanent changes with the mucosa and the membrane. Our study showed 33 patients suffering with the disease for less than 10 years and 27 patients more than

10 years. Graft uptake among those with a history of more than 10 years significantly reduced to 81%.

In Bhadesia B et al. study, the graft take up was better when the duration of discharge was less than 2 years.^[12] Verma et al stated, in cases where duration of ear discharge is less than 10 years, graft acceptance rate was 50.3% and in more than 10 years cases it was 49.1%. There was no significant association between duration of ear discharge and graft success.^[13]

Intraoperative findings: Intraoperatively, under microscope we found two different types of status of middle ear mucosa. 34(56.7%) patients had edematous mucosa and 26(43.3%) had hypertrophied mucosa. Middle ear epithelium under chronic infection conditions shows hypertrophy, hyperplasia, secretory proliferation and squamous metaplasia. Increasing of secretory elements, e.g. goblet cells and secreting glands may give rise to different clinical and pathological stages of the disease.^[14-17]

In our study, 29 patients had cellular type of mastoid, 20 had diploic type of mastoid and 11 had sclerotic type of mastoid. We found that graft take up rate in cellular mastoid was 100% compared to sclerotic mastoid which is about 63.3%.

Small mastoid volumes tend to cause greater changes in pressure. Therefore, the volume of mastoid aeration plays a significant role in middle ear compliance and the resultant forces imparted on the tympanic membrane.^[18,19] Fluctuations in middle ear pressure in the presence of a small mastoid cavity will result in greater forces applied to the tympanic membrane, when compared with the same pressure changes in a larger, more aerated mastoid.^[20]

A study by K Mallikarjuna et al,^[21] revealed that instances with large mastoids had a 100% take-up rate, while those with tiny mastoids had a 73.6% take-up rate. Holmquist et al has established a correlation between tympanic membrane repair and reduced mastoid pneumatization and persistent middle ear infections. The mastoid air cell volume has a direct correlation with the success of type I tympanoplasty. In tympanoplasty surgery, a small mastoid air cell size is a poor prognosis indication. The "air reservoir" theory underlies this, according to which the middle ear can draw on a pneumatic reservoir provided by the mastoid air cell system during a brief episode of eustachian dysfunction.^[22]

Outcome of cortical mastoidectomy with tympanoplasty in active CSOM: In our study, cortical mastoidectomy with tympanoplasty was performed on 60 individuals who had active CSOM following a week-long pretreatment with antibiotics. Following surgery, three months later, 55 patients (91.7%) had graft uptake, while 5 (8.3%) still had residual perforation. Even though the treatment is common and has a typically high success rate, there is still continuous uncertainty regarding the effects of numerous contributing factors. According to some scientists, better results might result from waiting until the ear is totally dry before trying tympanic membrane restoration.^[23]

In another study, Vartiainen E studied 417 myringoplasty failure cases. He concluded that infection was the most frequent reason for re-perforation in later failures, while graft necrosis and anterior blunting were the primary causes in early failures. Greater than small perforations showed a higher frequency of re-perforation. The graft take up rates were unaffected by other preoperative parameters such as the grafting technique, site of perforation, or moist or dry ear.^[24] In our series, complete control of otorrhea was observed in 58 patients, 2 showed persistent ear

discharge. Out of 5 of residual perforation, only 2 patients had persistent ear discharge at 6 month follow up.

The source of conflict among surgeons is deciding whether to repair tympanic membrane perforation with tympanoplasty alone or in combination with cortical mastoidectomy. Infections are the primary cause of graft failure, often stemming from undetected mastoid disease. Even a well-pneumatized mastoid can be compromised by inflammation blocking the aditus and antrum, thereby disrupting communication between the middle ear and mastoid cavities. A simple mastoidectomy is an effective means of repneumatizing the mastoid air cell systems, as well as eradicating the mastoid source of infections. Thus, cortical mastoidectomy with tympanoplasty gives better results in both active and inactive ears.^[25-27]

48 patients with chronic otitis media with tympanic membrane perforations who underwent myringoplasty with cortical mastoidectomy were studied by Jackler and Schindler.^[10] Cortical mastoidectomy was found to be an effective means of repneumatizing the sclerotic mastoid and eradicating mastoid sources of infection. They found that severe Eustachian tube dysfunction to a degree not remediable by enlargement of the mastoid air reservoir is the most common cause of failure. The study concluded that cortical mastoidectomy is a safe and useful adjunct to tympanoplasty in selected cases of chronic otitis media with perforation.

Krishnan et al. examined a cohort of 120 cases of chronic suppurative otitis media (CSOM) without cholesteatoma treated surgically. They concluded that opening the mastoid antrum and air cells is advisable when the middle ear mucosa is unhealthy. Conversely, when the mucosa is healthy, performing myringoplasty alone suffices for achieving successful outcomes, regardless of whether the ear was dry or quiescent preoperatively. Thorough removal of diseased tissue from the middle ear and ensuring a stable ossicular chain assembly are crucial for achieving a dry ear with good hearing post-surgery. The study did not find significant additional benefit in terms of postoperative hearing gain from mastoidectomy.^[28]

Audiological assessment: Hearing improvement was assessed by follow-up pure tone audiometric evaluation at 3 months and 6 months. Mean pure tone value preoperatively was 36.4dB. At the end of 3 months, it showed a mean gain of 9.62, i.e., mean PTA threshold being 26.6dB. While at the end of 6 months, there was a mean gain of 11.45, i.e., mean PTA threshold of 24.8. The mean A-B gap closure was 11.6. Nearly 31 patients showed an A-B gap closure of >10dB. According to a study by Muqtadir et al, a total of 50 cases were studied, and the mean hearing gain was found to be 12.06, comparable to the hearing gain achieved in our study.^[29]

CONCLUSION

The cortical mastoidectomy with tympanoplasty resulted in graft uptake of 91.7%. Hearing improvement was determined by the mean PTA gain at the end of the sixth month postoperatively, which was 11.45dB. Even in discharging

ears, it has been found that careful pre-operative evaluation, precise surgery, and appropriate post-operative care yield major benefits. Thus, based on our findings, we may infer that cortical mastoidectomy with tympanoplasty in active CSOM patients in the Gulbarga region has favorable results in terms of graft uptake and hearing improvement.

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Conflicts of interest

There are no conflicts of interest.

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