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Original Research Article

Clinicoradiological correlation of type 1 tympanoplasty in wet and dry ears

Sarthak Sachdeva[1]*, Divya Vaid[1], Lakshmi Vaid[1], Shuchi Bhatt[2]

[1]Department of Otorhinolaryngology, University College of Medical Sciences and GTB Hospital, New Delhi, India
[2]Department of Radiology, University College of Medical Sciences and GTB Hospital, New Delhi, India

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***Correspondence:**
Dr. Sarthak Sachdeva,
E-mail: sachdevasarthak68@gmail.com

ABSTRACT

Background: Chronic otitis media patients can present with a dry or wet ears (which means those ears which have a mild mucoid discharge and are negative on culture). Preoperative HRCT scans done in these patients show either a normal or an opacified mastoid cavity. This creates a dilemma in the mind of an otologist as whether doing a tympanoplasty in a patient with an active mucoid ear discharge would be beneficial or not. The goal of this study is to compare results of type 1 tympanoplasty in wet and dry mucosal COM ears and correlate between preoperative CT findings and postoperative outcomes.
Methods: A comparative study was done where a total of 30 wet and 30 dry ears respectively were included based on a preset clinical criterion. After a detailed history, otoscopic examination, pure tone audiometry (PTA) and a HRCT scan of temporal bone, all patients underwent type 1 tympanoplasty followed by PTA assessment 2 months postoperatively.
Results: The graft uptake rates and hearing outcomes after surgery were found to be similar in both wet and dry ears. Also, the graft uptake rates in patients with opaque mastoids were similar to those with normal mastoids on HRCT scans.
Conclusions: This study concludes that success of type 1 tympanoplasty surgery is not adversely affected by the presence of mucoid discharge at the time of surgery. For achieving good surgical success, meticulous graft placement is more important rather than status of the operated ear.

Keywords: Chronic suppurative otitis media, Wet ear, Tympanoplasty type 1, Mastoid opacification

INTRODUCTION

Chronic otitis media is one of the leading causes of preventable disabling hearing impairment in developing countries.[1] It is defined as chronic inflammation of middle ear and mastoid cavity, which presents with recurring ear discharge through a tympanic membrane perforation.[2] World health organization in 2004 estimated that between 65-330 million people suffer from chronic otitis media, out of which, over 90% of the burden is born by countries in South-east Asia and western pacific regions, Africa and several ethnic minorities in the pacific rim.[2] Several predisposing factors have been attributed to chronic otitis media which include poor socioeconomic status, overcrowding, poor hygiene, poor nutrition, frequent upper respiratory tract infections, inadequate antibiotic treatments, and poor and unavailable healthcare.[3] Standard therapy for chronic otitis media includes topical therapy and dry ear precautions. In those cases, that do not resolve or result in spontaneous healing of the tympanic membrane with conservative measures, surgical intervention is considered.[4] The main aim of surgery in chronic suppurative otitis media (CSOM) is to give the patient a

dry, safe and functioning ear by eliminating the disease process and reconstructing the middle ear.[5] Tympanoplasty refers to any operation involving reconstruction of the tympanic membrane defect along with elimination of disease, if any, from the middle ear and reconstruction of ossicular chain (hearing mechanism).[6] There have been a number of studies regarding the impact of preoperative factors on the success or failure of tympanoplasty in the past years. A number of investigations have been done regarding the impact of various factors such as age, sex, perforation size and site, the status of the opposite ear, discharge status of the ear at the time of surgery, surgical approaches and techniques, and the materials used for the graft.[7] Based on these studies, most centers mainly use the approaches and techniques preferred by their own surgeons. Among these factors, if a discharging ear presents to an otologist, there is always a dilemma of operating it or not. This is due to widespread belief that the success rate while doing tympanoplasty on wet ears (which means those ears which have a mild mucoid discharge and are negative on culture) is decidedly inferior. Therefore, surgeons usually perform tympanoplasty on ears with active discharge drainage after drying the ear, but in many cases, this is practically impossible because the discharge from the ear continues despite receiving medical treatment. This makes the decision of the date of operation quite hard. Given that no serious studies have yet examined the outcomes and outputs of tympanoplasty surgery on patients with persistent mucoid discharge, this study aims to perform tympanoplasty surgery on tympanic membrane perforations of size varying from small to large on both dry ears (no ear discharge at the time of surgery) and wet ears (mucoid ear discharge at the time of surgery) through post auricular approach and with the use of temporal fascia graft and underlay graft placement. This study aims to determine the hearing status before and after tympanoplasty surgery and compare the surgery results in terms of hearing improvement, and graft uptake rates in patients with chronic perforation of the tympanic membrane with and without active discharge. Temporal bone computed tomography (CT) plays a key role in COM diagnosis and the choice of surgical intervention. Although, tympanoplasty is a frequently performed middle ear surgery for COM, there have been not so many reports analyzing audiologic results based on preoperative CT findings in type 1 tympanoplasty. The issue whether mastoidectomy is needed for good surgical outcome in COM with active mucoid discharge and soft tissue density on preoperative CT scan is still controversial.[8,9] The literature supports the contention that the mastoid pneumatic system acts primarily as a buffer to pressure changes in the middle ear. The presence of a pneumatized mastoid greatly increases the volume of the middle ear and mastoid system (in accordance with Boyle's law). However, recent studies have suggested that Air cells of the mastoid cavity and mucosa play an important role in gas exchange, both in middle ear and mastoid cavity. It may, thus, be better to preserve rather than remove the cavity mucosa even if some amount of soft tissue opacification is seen on preoperative temporal bone CT scans.[10] The primary objective of this study was to compare the results of type 1 tympanoplasty in wet and dry ear in terms of graft uptake while the secondary objective was to correlate between preoperative CT findings and results of type 1 tympanoplasty in wet ear and dry ear.

METHODS

This study was conducted in department of otorhinolaryngology and department of radiology at university college of medical sciences and Guru Teg Bahadur hospital, Delhi during a period of November 2018 to April 2020. A total of 60 patients were enrolled in the study after taking written informed consent and approval of the institutional ethics committee. All patients who were in the age group of 18-60 years, were clinically diagnosed cases of active chronic otitis media, whose ears were not getting dry on medical management, had only conductive hearing loss and whose aural discharge culture and sensitivity yielded no pathogenic micro-organisms were included under cases (wet ears) while patients in the age group of 18-60 years and who were clinically diagnosed cases of inactive chronic otitis media on otoscopic examination were included under controls (dry ears). Patients with squamous epithelial chronic otitis media/purulent ear discharge/ previously operated patients/ patients with sensorineural hearing loss or patients with any evidence of active infection in nose, throat and paranasal sinuses were excluded from the study. A total of 30 cases and 30 controls were included in the study. A complete detailed history was taken for every patient enrolled in the study followed by routine ENT examination. Preoperative tympanic membrane perforation site and size were measured using otoscopic and microscopic examination (Figure 1).

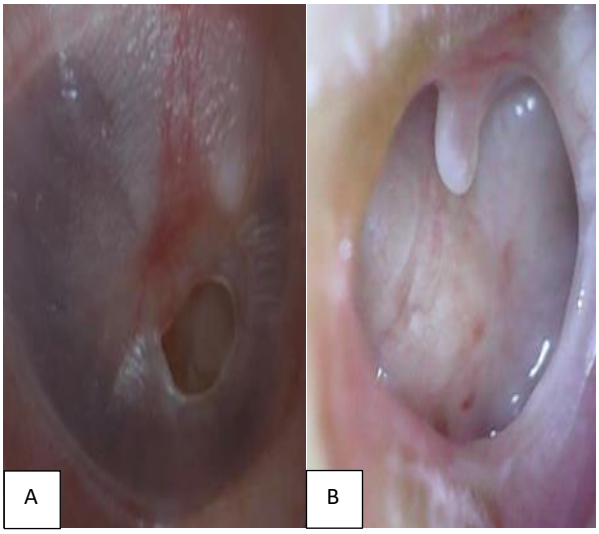

Figure 1 (A and B): Preoperative photograph of patient with inactive mucosal COM (dry ear) and active mucosal COM (wet ear).

Preoperative pure tone audiometry was done for all patients to look for air-bone gap. Preoperative 64-slice, 120 Kv and 180 mas HRCT temporal bone (axial, coronal and sagittal) were done to look for soft tissue density in middle ear and mastoid cavity with a rotation time of 1 second and a slice thickness of 0.6 mm. Collimation used was 64×0.6, FOV was 206 and scanning length was from frontal bone to mastoid bone. Thin axial sections obtained combined with coronal, sagittal and oblique planes as required and reviewed for positive findings, which included soft tissue density in mastoid air cells.

Type 1 tympanoplasty surgery was performed in all patients under local anesthesia using 'inlay technique' by post-aural approach which was followed by suture removal on the 7th and pack removal on 10th post-operative day. Patients were followed up on the 1st and 3rd month and microscopic examination was performed to check for graft status to note reperforation and retraction. A PTA was done on these follow up visits to determine the postoperative hearing status. The collected data was statistically analysed using SPSS software and appropriate descriptive statistics were applied. Surgical outcomes in terms of graft uptake and Correlation of pre-operative CT findings and results of type 1 tympanoplasty in wet and dry ear were the outcome measures that were evaluated.

RESULTS

We noticed that maximum patients with wet CSOM were in the age group of 26-30 years and maximum patients with dry CSOM were in the age group of 18-25 years. The number of females were almost twice as compared to males with a M: F ratio of 0.42. There was a similar distribution of patients on the basis on the side of ear involved or bilateral ear involvement (p=0.207) in both cases and controls respectively. Ear swab for all wet ears came out to be sterile on culture and sensitivity. Distribution on the basis of size of perforation was done as per the following criteria-small perforation (less than 25% of membrane area involved), moderate perforation (25-50% of membrane area involved) and large perforation (>50% of membrane area involved). Maximum patients had a moderate sized perforation in both cases and controls and the distribution of data was similar in the two groups. The graft uptake rate was similar in both cases and controls, that is, 83.3% for cases and 86.6% for controls (Table 1).

Table 1: Distribution of patients based on graft uptake, (n=30).

Graft uptake	Cases	Percentage (%)	Controls	Percentage (%)
Yes	25	83.3	26	86.6
No	5	16.7	4	13.3
Total	30	100.0	30	100.0
P value	0.717			

Five patients (16%) in the wet ear group and 4 (13%) in the dry ear group suffered reperforation after surgery. Other complications like facial nerve paresis, sensorineural hearing loss etc were not seen in any patient after surgery. The majority of patients in cases had P.T.A values in the range of 31-40 dB (36.6%) in the preoperative period. However, this improved in the post-operative period with majority in the range of 21-30 dB at 1 and 3 months (33.3% and 36.6%) respectively. Similarly, in controls, majority of patients had P.T.A values in the range of 31-40 dB (30%) in the preoperative period. However, this improved in the post-operative period with majority in the range of 21-30 dB at 1 and 3 months (46.6%). Figure 2 demonstrates a pure tone audiogram of a 20-year-old patient with wet ear showing an improvement of hearing in the post-operative period.

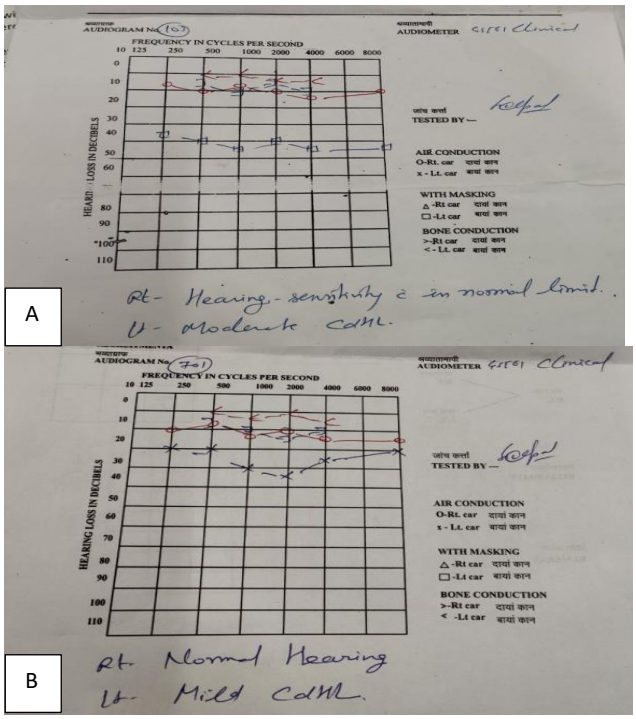

Figure 2 (A and B): PTA showing postoperative hearing improvement (after 3 months) in a 20-year-old male with left sided active mucosal COM (wet ear) after left type 1 tympanoplasty was performed for a moderate size perforation.

While considering audiological improvement in terms of P.T.A (Table 2), the mean pre op PTA (AC) in cases and control was 35.5 dB (SD-10.43) and 33.5 dB (SD-11.12), which showed improvement of 4.9 dB (SD-1.06) and 7.5 dB (SD-2.43) at 1 month post op to 30.66 dB (SD- 9.37) and 26 dB (SD-8.69) respectively. Also, there was an improvement of 5.2 dB (SD-1.04) and 8.5 dB (SD-2.43) at 3 months post op to 30.3 dB (SD-9.39) and 25 dB (SD8.69) respectively. Pre-op A-B Gap value was significantly different from postoperative 1 month and 3-month values but the postoperative 1 month and 3-month values, if compared individually, were nearly similar (Table 3).

Table 2: Distribution of patients based on audiological improvement in terms of P.T.A for A.C.

Variables	Pre-op PTA (AC)		Post-op PTA at 1 month (AC)		Post-op PTA at 3 months (AC)	
	Mean	SD	Mean	SD	Mean	SD
Cases	35.5	10.43	30.66	9.37	30.3	9.39
Control	33.5	11.12	26	8.69	25	8.69

Table 3: Distribution of patients based on hearing gain in terms of A-B gap.

Variables	Pre-op A-B GAP		Post-op A-B gap at 1 month		Post-op A-B gap at 3 months		P value	Significance (Tukey's test)
	Mean	SD	Mean	SD	Mean	SD		
Cases	26.83	6.628	21.17	4.857	21.00	4.624	<0.001	Significant
Controls	24.83	6.884	17.17	5.676	17.24	5.662		
P value	0.011							
Significance (Tukey's test)	Not significant		Significant		Significant			

Pre-operative HRCT temporal bone was done in all patients (both cases and controls) and it was found that in cases, 100% patients had an opacified mastoid cavity while in controls, 26% of patients had an opacified mastoid cavity (Table 4). A HRCT temporal bone axial cut showing right mastoid cavity opacification is shown in Figure 3.

Table 4: Distribution of patients based on HRCT temporal bone findings.

Mastoid opacification	Cases (%)	Controls (%)
Present	30 (100)	8 (26)
Absent	0 (0%)	22 (74)
Total	30	30

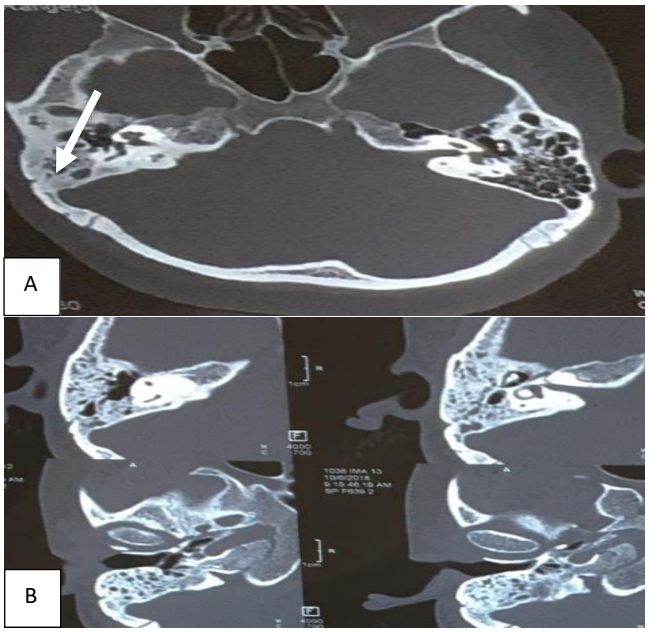

Figure 3 (A and B): An axial HRCT temporal bone with right COM showing right mastoid cavity opacification as compared to left normal mastoid cavity. (Arrow pointing to opacified mastoid cavity).

DISCUSSION

In the present study, we compared the surgical outcome of type 1 tympanoplasty in wet and dry ears in terms of graft uptake (Table 1) and audiologic improvement (Table 2 and 3). We also made a correlation between preoperative CT findings and postoperative results of type 1 tympanoplasty surgery in both groups. While comparing the 2 groups (wet and dry ears) on the basis of age distribution, we found that there was no statistically significant difference between the two groups. Also, there was a female preponderance in our study. Nagle et al observed a similar finding wherein majority of cases presented in the second decade with a female preponderance.[11] Also, maximum perforations in our study in dry ear group (67%) and wet ear group (74%) were moderate sized and involving all quadrants of the tympanic membrane. Out of the 42 patients who had a moderate sized perforation, 83% patients had successful outcomes in terms of graft uptake and almost 92% had ABG closure of ≤10 dB while 8% had an ABG closure of 11-20 dB. Out of those who had a large sized perforation, 87% patients had successful outcomes in terms of graft take and almost 33% had an ABG closure of ≤10 dB while almost 67% had an ABG closure of 11-20 dB. These results showed that there was no statistical significance of size of perforation on graft uptake ($p>0.05$), however, in terms of audiometric gains, large perforations showed a better audiological outcome postoperatively than moderate perforations ($p=0.05$). Five patients (16%) in the wet ear group and 4 patients (13%) in the dry ear group suffered reperforations. 3 patients out of 5 failures (60%) in wet ear group and 2 out of 4 failures (50%) in dry ear group had bilateral ear perforation preoperatively and a history of allergic rhinitis suggesting that these patients might be suffering from a Eustachian tube dysfunction that might by responsible for their surgical failure. Other complications like facial nerve paresis, labyrinthitis, sensorineural hearing loss etc were not seen. The surgical success rates

of various studies are described in Table 5 and these can be compared with our study.

Table 5: Comparison of our study with previous studies on the basis of surgical success rates.

Variables	Surgical success (%)	Surgical success (%)	P value
	Dry ears	Wet ears	
Nagle (2009)[11]	88	74	0.07
De lima (2011)[15]	94	100	0.3
Dhar (2014)[16]	96	84	0.09
Hosny (2014)[17]	90.4	87	0.6
Shankar (2015)[18]	88	80	0.5
Gamra (2016)[19]	87.5	88	0.9
Naderpour (2016)[20]	97	94	0.89
Our study	86.6	83.3	0.71

As can be seen in the Table 5, Gamra et al in 2016 studied tympanoplasty outcomes in 108 wet and 232 dry ears and found that anatomical success rates were 88% for the wet ear group and 87.5% for the dry ear group and the differences were not statistically significant(p=0.9).[15] Similarly, Naderpour et al in 2016 conducted a similar study in 30 dry and 30 wet ears and also found no statistical difference in surgical outcomes of type 1 tympanoplasty in two groups (93.3 % in wet vs 96.7% in dry ears).[16] Similar conclusions can be drawn for other studies as well. All patients were followed up with serial P.T.A tests and on applying the repeated measure ANOVA test and finding the significance between various variables by Tukey's test, it was found that in both wet and dry ears, there was a statistically significant difference between the A-B gap measured preoperatively and that measured postoperatively at end of 1 and 3 months (p<0.001). However, there was no statistically significant difference when comparing the postoperative A-B gap at end of 1 month with that at the end of 3 months (Table 2 and 3). These findings showed that tympanoplasty improved hearing outcomes equally well in both wet and dry ears. However, on comparing hearing outcomes between the two groups we found that audiological success rate was 63% in dry ears and 56% in wet ears (p=0.59) suggesting that dry ears had a slightly better audiological outcome than wet ears. The results of our study can be compared to the previous studies in literature as shown in Table 6.

On HRCT temporal bone scans in all patients preoperatively, we found mastoid air cell opacification was present in 100% of wet and 26% of dry ears while the rest had normal mastoids on CT scan (Table 4). Of all patients who had opaque mastoids, 32 (84%) had successful graft uptake while 6 (16%) had reperforations. Also, out of all patients who had normal mastoids, 19 (86%) had successful outcomes and 3 (14%) were failures. There was no statistical significance on comparing the 2 groups (p>0.05) suggesting that opaque mastoids on preoperative CT scans had no effect on post-operative results. This was in conjunction with a study by Toros et al in 2010 where among 92 patients with COM with an opacified mastoid, 50% were subjected to tympanoplasty alone and 50% to tympanomastoidectomy, and the outcomes were similar in both groups (76.1% and 78.3% respectively).[22] This suggested that tympanoplasty alone (without mastoidectomy) was equally effective in cases with non-cholesteatomatous COM with opacification in mastoid cavity. The purpose of this study was to compare the graft uptake and hearing outcome of type 1 tympanoplasty in non-cholesteatomatous chronic otitis media between wet and dry ears focusing on factors that may have influenced the success of surgery in wet ear.

Table 6: Comparison of our study with previous studies on the basis of audiological success rates.

Variables	Audiological success (% cases)		P value
	Dry ears	Wet ears	
Claes (1990)[21]	51	48	0.01
Nagle (2009)[11]	72	60	0.85
Hosny (2014)[17]	92	91	0.88
Gamra (2016)[19]	56	62	0.29
Naderpour (2016)[20]	86	76	0.32
Our study	63	56	0.59

The major limitations of our study were that the sample size of participants in our study was 30 patients each of wet and dry ear respectively and the follow-up period was 3 months only. We recommend that a bigger sample size and a longer follow-up period should be considered if similar studies are to be carried out in future.

CONCLUSIONS

The results of type 1 tympanoplasty surgery on both dry and wet ears are quite significant and satisfying in terms of both hearing improvement and graft incorporation with no statistically significant difference additionally, it was noticed that patients with large sized perforations were more likely to have a greater A-B gap closure after myringoplasty as compared to patients with moderate sized perforation. We also concluded wet ears with mastoid cavity opacification on temporal bone CT scan had the same results as dry ears after type 1 tympanoplasty surgery suggesting that tympanoplasty alone without mastoidectomy is an effective treatment for patients with mastoid cavity opacification. This study, therefore, concludes that success of type 1 tympanoplasty surgery is not adversely affected by the presence of mucoid discharge at the time of surgery or presence of

opacification on preoperative CT scans in mastoid cavity. For achieving good surgical success, meticulous graft placement is more important rather than status of the operated ear.

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