

AUDIOMETRIC EVALUATION OF TYMPANOPLASTY FOR HEARING IMPROVEMENTRajshekhhar Chapparbandi¹, Sutrave Mithun², Shweta Chapparbandi³**HOW TO CITE THIS ARTICLE:**

Rajshekhhar Chapparbandi, Sutrave Mithun, Shweta Chapparbandi. "Audiometric Evaluation of Tympanoplasty for Hearing Improvement". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 79, October 01; Page: 13814-13823, DOI: 10.14260/jemds/2015/1969

ABSTRACT: AIM: To determine the hearing improvement in tympanoplasty by preoperative and postoperative audiometric evaluation after 1 month and 3 months and 6 months of tympanoplasty. **MATERIALS & METHODS:** 50 Patients presenting having CSOM and presenting with complaints of deafness or ear discharge in ENT OPD at Basaveshwar Teaching and General Hospital, Gulbarga from 2012 to 2014. Pre-operative audiometry and appropriate investigation was done followed by tympanoplasty. Patient was followed up regularly with post-operative audiometry at 1 month, 3 month and 6 month. Assessment of hearing improvement was done by comparing preoperative and postoperative A-B gap at speech frequency. **RESULTS:** The number of patients who underwent Type I tympanoplasty was 26, Type II was 5, Type III was 6 and Type 4 was 1. They had a mean A-B gap closure of 10.3dB, 10.2dB, 9.33dB and 5dB respectively. When mastoidectomy was included as a part of the procedure the hearing improvement was comparatively lesser. The mean Air-Bone gap closure was 8.9dB. The mean A-B gap closure was 10.2 dB for temporalis fascia graft, 4dB for temporalis fascia with conchal cartilage and 9.2dB in case of autograft incus. The mean A-B gap closure of medium, large and subtotal perforation were 4.7, 11.7 and 6.6 respectively. The total success rate in terms of graft uptake rate was 88%. **CONCLUSION:** The study shows that A-B gap closure is greatest for Type I followed by Type II, Type III and Type IV in decreasing order. Tympanoplasty in which modified radical mastoidectomy was a part of the procedure did not give as much hearing improvement as otherwise. The grafting material also had significant bearing on the success of surgery. The Airborne gap closure is greatest for temporalis fascia graft than dura or autograft incus. Air-bone gap closure is also greater for temporalis fascia when used alone compared to when it is used along with conchal cartilage. Reperforation rates are higher when temporalis fascia is used alone compared to cases where reinforcement with cartilage is done showing greater graft stability in cartilage tympanoplasty.

KEYWORDS: A-B gap, Tympanoplasty.

INTRODUCTION: Otology is a fascinating and emerging field of surgery Initially it was the middle ear and now it is the inner ear that is emerging as a new frontier in the field of otology The number of diseases affecting the middle ear and their varied presentation has always generated curiosity among young otorhinolaryngologists Lot of research and recent advances in the surgical field has made many complications of the ear disease rare phenomena.

In early centuries, ear infection with complication was a life threatening condition. The introduction of antibiotics and use of operative microscope in surgical field were revolutionary advances in control of disease.

Tympanoplasty is procedure of eradication of disease in middle ear and reconstruction of the hearing mechanism by repairing the Tympanic membrane with. Or without ossiculoplasty. This

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operation can be combined with either an intact canal wall or a canal wall down mastoidectomy to eradicate disease from the mastoid.

In surgical repair of tympanic membrane perforations several host factors come into play such as the size of perforation, Eustachian tube function state of the middle ear mucosa, wound healing, status of the ossicles, degree of pneumatisation of the mastoid.

Surgical consideration approaches (Endaural, postaural), graft sources (Temporalis fascia, cartilage graft, dura), placement of graft, associated mastoid operation (intact canal wall, canal wall down), ossiculoplasty also have a bearing on the success of surgery. Hence there is no single technique that is best for all tympanoplasty.

The surgical success of tympanoplasties can be evaluated in terms of graft uptake rates. But to have a quantitative measurement of subjects hearing and to give scientific credibility to results of the clinical tests an audiometric evaluation of tympanoplasty can be done. Comparison of the preoperative and postoperative pure tone averages in speech frequencies and the air-bone gap gives a complete picture of the improvement in hearing after surgery and also establishes a baseline for any changes (Improvement/deterioration) which may occur as a result of treatment or due to natural progression of disease.

Evaluation of the surgical success of tympanoplasty an assessment of various host and surgical factors has been a subject of interest for many years and still continues to be a challenge.

OBJECTIVES: To determine the hearing improvement in tympanoplasty by pre-operative and postoperative audiometric evaluation after 1 month and 3 months and 6 months of tympanoplasty.

MATERIALS AND METHODS:

Materials and methods will be discussed under the following headings;

1. Source of data.
2. Sample size.
3. Sampling procedure.
4. Selection criteria.

Inclusion criteria:

Exclusion criteria:

5. Method of data collection.
6. Surgical technique.
 - Preparation of the part.
 - Premedication.
 - Position of the patient.
 - Anesthesia.
 - Harvesting of the graft.
 - Inspection of canal.
 - Freshening of the perforation margins.
 - Incision and flap elevation.
 - Middle ear inspection.
 - Graft placement.
 - Repositioning of the tympanomeatal flap.

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Source of Data: All Patients in ENT OPD at Basaveshwar Teaching and General Hospital, Gulbarga from 2007 to 2009.

Sample Size: 50 patients in ENT OPD at Basaveshwar hospital from 2007 — 2009.

Sampling Procedure: By simple random method.

Sampling Criteria:

Inclusion Criteria: Patients presenting with history and clinical feature of chronic suppurative otitis media with conductive deafness who undergo tympanoplasty with or without mastoidectomy using autologous temporalis fascia or cartilage graft or both.

Exclusion Criteria:

- Patients with sensorineural hearing loss.
- Those who come with active discharge are treated until the ear becomes dry for period of 1 month before taking for surgery.
- Patients with Eustachian tube occlusion.
- Biomaterials other than autografts excluded.

Method of Collection of Data: All patients with chronic otitis media presenting at Basaveshwar hospital in whom tympanoplasty was planned, who are willing to undergo surgery from 2012-2014 are selected for the study. A complete ENT examination and appropriate investigations were done to arrive at the correct diagnosis.

- Otoscopy.
- Tuning fork tests — Rinnes, Webers, Absolute bone conduction test.
- Eustachian tube function test like Valsalva maneuver, Seigels speculum test.
- Routine blood and urine examination.
- Plain X-ray — bilateral mastoid.
- Aural examination under microscope.
- Pre-operative audiometry.
- Postoperative audiometry at 1 month, 3 months and 6 months.

Preoperative Preparation:

- Preparation of the patients, shaving of hair of the post auricular region 3cm inside the hair line done.
- Xylocaine test dose -0.1 ml of 2% xylocaine intradermally given.
- Vital parameters were recorded.
- Informed consent of patients was taken.
- Preoperative dose of antibiotic given.
- If under local anesthesia, patients were premedicated half an hour prior to surgery.
- One ampule of atropine sulphate 0.6mg and pentazocine 30mg given.
- Injection calmpose may be given to allay anxiety.
- Position of the patient -supine with the face turned to one side the ear to be operated is up.
- Anesthesia- local or general. Local infiltration is done with 2% lignocaine.
- With 1:2,00,000 adrenaline. Incision may be endomeatal, endaural or postaural.

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- Harvesting of the temporalis fascia graft done. Other grafting material like tragal perichondrium or fascia lata can be used.
- Tympanic membrane is visualized. Freshening of the perforation margins done using curved pick. Curetting of the undersurface of tympanic membrane done.
- 6 O'clock and 12 O'clock incision was taken about 5mm away from the annulus.
- The tympanomeatal flap is elevated and middle ear is inspected, status of ossicles noted.
- Round window reflex is visualized and continuity of ossicular status confirmed. Graft placement is done.
- Repositioning of the tympanomeatal flap is done. Gelfoam soaked with betadine is placed in the external canal. Periosteum, subcutaneous tissue and skin are sutured and mastoid dressing is done. Patient is put on antibiotics and analgesics. Suture removal is done after 1 week. Patient is followed up postoperatively at regular interval.

To eradicate disease from both the mastoid and middle ear cavity tympanoplasty can be combined with mastoidectomy. Cortical mastoidectomy is exenteration of all accessible mastoid air cells preserving the posterior meatal wall. Modified radical mastoidectomy is eradication of disease of the attic and mastoid, both of which are exteriorized into the external auditory canal by removal of posterior meatal and lateral attic walls.

OBSERVATIONS:

AGE RANGE	NO.	%AGE
<15	6	12
16-20	16	32
21-25	28	56

TABLE 2

The minimum age in our study was 15 years and the maximum age was 63 years. There were 6 patients below 16 years of age.

Maximum number of patients belonged to the age group of 21-25 years.

AGE INCIDENCE:

Sex	Number of Cases	Percentage
Male	23	46
Female	27	54
Total	50	100

TABLE 3: SEX INCIDENCE OF COM

In our study female patients outnumbered the male patients. The number of male and female patients were 23 and 27 respectively. The male to female ratio was 1:1.17

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Types	Number of Cases	Percentage
Mucosal	38	76
Epithelial	12	24
Total	50	100

TABLE 4: INCIDENCE OF DIFFERENT TYPES OF COM

Chronic otitis media is of mucosal and epithelial type. In our study mucosal type only far exceeded the epithelial types 76% of the cases were mucosal type whereas 24% were epithelial type

Size	Number of Cases	Percentage
Medium	11	28.94
Large	21	51.26
Subtotal	6	15.78
Aggregate	38	100

TABLE 5: INCIDENCE OF SIZE OF PERFORATION

Tympanic membrane perforation can be classified as small, medium, large, subtotal and total depending on the size of perforation. In our study maximum number of cases had large central perforation. There was no case of total perforation. With this data we assessed the relation between size of perforation and the postoperative hearing improvement.

TYPES	Number of Cases	Percentage
TYPE 1	26	52
TYPE2	5	10
TYPE3	6	12
TYPE4	1	2
TYPE 1+CM	5	10
TYPE 1+MRM	1	2
TYPE 3+MRM	5	10
TYPE 2+MRM	1	2

TABLE 6: TYPES OF TYMPANOPLASTY

In a total of 50 patients, 26 underwent type I, 5 underwent Type II, 6 underwent Type III, and only 1 patient underwent Type IV Tympanoplasty. 12 patients had mastoidectomy as a part of the procedure.

TYPES	Number of Cases	Percentage	Number of Failure
Tf	33	66	3
3	12	24	1
Dural (Homologous)	1	2	1
Tf + Ai	4	8	1
Total	50	100	6

TABLE 7: GRAFT TYPES AND THEIR RELATION TO FAILURE RATES

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In this study temporalis fascia has been used in maximum number of cases. Other grafts used were temporalis fascia with conchal cartilage, homologous dura, and temporalis fascia with autograft incus. 66% of the grafts used were temporalis fascia out of which 3 cases went for reperforation (9.09%). In 12 cases (24%) temporalis fascia reinforcement was done with conchal cartilage. There was only 1 case (8.33%) of reperforation. Homologous dura graft proved to be a failure (anatomically). In our study the mean A-B gap closure was 0.2 dB for temporalis fascia, 4dB for temporalis fascia with conchal cartilage and 9.2dB in case of autograft incus.

	<0	0-5	6-10	11-15	16-20	21.25
TYPE1	2	5	6	7	4	2
TYPE2	0	0	2	3	0	0
TYPE3	1	1	1	1	2	0
TYPE4	0	1	0	0	0	0
TYPE1-+-CM	1	1	1	0	1	1
TYPE1+MRM	0	0	1	0	0	0
TYPE2+MRM	0	0	0	0	0	1
TYPE3-+-MRM	2	1	0	1	1	0
Total	6	9	11	12	8	14

Table 8: IMPROVEMENT IN TERMS OF A-B CLOSURE

TYPES OF TYMPANOPLASTY	Mean A-B closure
Type I	10.34
Type II	10.2
Type III	9.33
Type IV	5
Type I + CM	9.4
Type I + MRM	7
Type II + MRM	7
Type III + MRM	0.8

Table 9

TYPES OF TYMPANOPLASTY	<0	0-5	6-10	11-15	16-20	21-25	26-30
TYPE1	1	8	2	7	3	4	1
TYPE2	0	0	1	2	2	0	0
TYPE3	1	0	0	1	4	0	0
TYPE4	0	0	0	1	0	0	0
TYPE1-+-CM	0	0	1	2	1	1	0
TYPE1+MRM	0	0	1	0	0	0	0
TYPE2+MRM	0	0	1	0	0	0	0
TYPE3-+-MRM	0	0	1	0	0	0	0
Total	1	1	0	1	1	1	0

TABLE 10: IMPROVEMENT IN TERMS OF DIFFERENCE BETWEEN PRE AND POSTOP AC THRESHOLD(IN SPEECH FREQ)

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Improvement in terms of difference between pre and postoperative air conduction threshold in speech frequency showed that mean Post of improvement of AC threshold for various types of Tympanoplasty are 11.92 for Type I, 11.6 for Type AC threshold for various types of Tympanoplasty are 11.92 for Type I, 11.6 for Type 10 dB, Type I + MRM, there was worsening by 3 dB, Type III+MRM 9.4 dB.

DISCUSSION: In the present study 50 cases of chronic otitis media were analyzed for post-operative improvement in hearing following tympanoplasty Firstly various factors were considered which could affect the surgical results

The age distribution of COM was analyzed. The minimum age in our study was 15 years and the maximum age was 63 years.

Uyar Y. et al,¹ reported success rate of 90.2% (intact graft during follow up) Carr MM et al² reported 79% success in paediatric cases whereas Tos M³ reported 89% intact graft in his series of paediatric tympanoplasties. In our study there were 6 patients below 16 years of age Reperforation was seen in 1 case (16.6%) and intact graft was seen in 83.4% of the cases.

Postoperative air-bone gap of less than 25dB were obtained in 82.9% cases by Uyar Y et al.¹ suggesting that tympanoplasty was successful in pediatric age group. In our study the mean A-B gap closure was 12.16 dB.

The success rate of tympanoplasty is not dependant on sex of the patient. The number of male and female patients in the present study was 23 and 27 respectively.

There was no significant difference in the surgical success as assessed by graft take rates and air bone closure. The A-B gap closure was 8.3dB in females and 9.6dB in males There is no gender bias in studies done by Uyar Y et al.¹ and Can M et al,² as well.

Our study included 38 cases of mucosal type and 12 cases of epithelial type of COM. 16 of the mucosal type and 3 of the epithelial were bilateral. 11 cases had medium 21 had large and 6 had subtotal perforation.

According to Carr MM² and Uyar Y² size does not have a bearing on the success of surgery The mean A-B gap closure of medium large and subtotal perforation are 4.7, 11.7 and 6.6 respectively

The closure rates is higher in small perforation (74%) than in large perforations (56%).^{4,5}

The failure of anterior perforation is higher This can be greatly reduced by anchoring the anterior margin of the graft beneath the annulus.⁴

Grafts used in the study included autologous grafts like temporalis fascia and conchal cartilage and homologous graft like dura. Autograft incus has been used in cases of ossicular necrosis to reconstruct the sound conducting apparatus. Biomaterials have been avoided.

66% of the grafts used were temporalis fascia out of which 3 cases went for reperforation (9.09%). In 12 cases (24%) temporalis fascia reinforcement was done with conchal cartilage. There was only 1 case (8.33%) of reperforation. Homologous dura graft proved to be a poor graft material as the only case in which it was used did not have success.

In our study the mean A-B gap closure was 10.2 dB for temporalis fascia, 4dB for temporalis fascia with conchal cartilage and 9.2dB in case of autograft incus. Couloigner V et al.⁶ assessed the results of cartilage tympanoplasty in 59 children and reported a 71% take rate compared to 83% take rate obtained with underlay fascia temporalis tympanoplasty. Hearing improvement was almost the same.

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Amoros Sebastia Liet al.⁷ reported a complete closing of the membrane was obtained in 86% of cases; while 14% remained re-perforated or discontinued between cartilage pieces in their study of tympanoplasty using autologous cartilage.

Martin C et al.⁸ compared patients undergoing cartilage reinforcement of the TM with those operated on with fascia or perichondrium TM reinforcement showed that retraction pocket recurrence was significantly less in cartilage reinforcement group.

Kazikdas KC,⁹ compared 23 cases of cartilage tympanoplasty with 28 patients of temporalis fascia tympanoplasty Graft take rate 95 7% in cartilage group and 75% in temporalis fascia group. Air-bone gap and pure-tone average scores comparing the gain between both techniques showed no significant changes in the threshold.

In case of an eroded lenticular process of incus in which the manubrium is in close proximity to the stapes superstructure, a sculpted incus autograft is an excellent choice. This technique was described by Penington and Austin. It affords excellent hearing results; the A-B gap closure has been reported within 20dB or less in 68% of patients.'

4 cases of autograft incus were included in our study. 2 cases showed A-B gap closure of 12dB, in 1 case it was 17dB. In 1 case there was worsening in terms of A-B closure and difference in air conduction threshold (Between pre and postop). The total success rate in terms of graft uptake rate was 88%

lurato et al,¹⁰ reviewed 290 published reports of results of ossiculoplasty when malleus and stapes superstructure were present. A postoperative air-bone gap of 0- 10dB is achieved in only 50% of patients while 80% have air-bone gap of 0-20dB. There was no significant difference in hearing outcome between different types of prosthesis.

Mills reported a mean hearing improvement after ossiculoplasty of 14dB when the stapes arch was intact and 6dB when it was eroded.¹¹

Shinohara et al¹² reported 68% success rates with PORP where only the incus needs to be replaced This compares with 46% of TORP where incus and stapes superstructure are absent. Palva and Ramsay,¹³ looked at the outcome of 281 myringoplasties in their department The closure rate in Palva s hands was 97%, while in hands of other members it was 74%.

Vartiainen,¹⁴ reported that the successful tympanic membrane closure rates for trainees was 78% compared to 95% for senior staff In our study the closure rate of tympanic membrane perforation was 88%. Out of the total of 50 cases only 6 cases (12%) had re-perforation.

In our study the mean A-B gap closure in various types of tympanoplasties are as follows

Types of tympanoplasty	Mean A-B closure
Type I	10.34
Type II	10.2
Type III	9.33
Type IV	5
Type I + CM	9.4
Type I +MRM	7
Type II+ MRM	7
Type III + MRM	0.8

Table 11

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The mean air-bone gap closure in our study was 8.9dB Gersdorff et al.¹⁵ studied 122 cases, 115 tympanoplasties (94%) were anatomically successful The mean air-bone gap improved significantly from 21.7 dB preoperatively to 8.4 dB postoperatively giving a mean gain of 13.3 dB.

Kartush JM,¹⁶ studied 120 patients who underwent over-under tympanoplasty. All 120 patients had successful grafts 12 patients had late perforations Average improvement in air-bone gap for all patients was 5.3dB.

Jung TT, Park,¹⁷ reported a hearing improvement of 0-40 dB in 70%cases (0-10 dB in 19% of ears, 11-20 dB in 44%, 21-30 dB in 7%, and 31-40 dB in 4%) even without ossiculoplasty. With ossiculoplasty using PORP- 15% TORP- 11% there were hearing improvement of 11 to 30 dB.

CONCLUSION:

1. The primary aim of middle ear surgery for chronic otitis media is eradication of disease and to achieve a dry ear.
2. Improvement in hearing is also a desirable benefit in addition to the primary aim.
3. The main objective of this study is to assess the improvement in hearing postoperatively in patients who underwent various types of tympanoplasty
4. The success of surgery is determined in terms of Air-Bone gap closure. The study shows that A-B gap closure is greatest for Type I followed by Type II, Type III and Type IV in decreasing order.
5. Tympanoplasty in which modified radical mastoidectomy was a part of the procedure did not give as much hearing improvement as otherwise
6. The grafting material also had significant bearing on the success of surgery. The Air-bone gap closure is greatest for temporalis fascia graft than dura or autograft incus. Air-bone gap closure is also greater for temporalis fascia when used alone compared to when it is used along with conchal cartilage. Reperforation rates are higher when temporalis fascia is used alone compared to cases where reinforcement with cartilage is done showing greater graft stability in cartilage tympanoplasty.
7. Tympanoplasty is a complicated surgery, the success of which depends on several host and surgical factors.

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Date of Submission: 22/05/2015.
Date of Peer Review: 25/05/2015.
Date of Acceptance: 23/09/2015.
Date of Publishing: 30/09/2015.