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Post Tympanoplasty Hearing Assessment By Pure Tone Audiometry- A Case Control Study

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ABSTRACT

Background: 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.

Objectives: This study was performed to determine the hearing improvement in tympanoplasty by pre- operative and postoperative audiometric evaluation after 1 month, 3 months and 6 months of tympanoplasty.

Materials & Methods: In the present study 50 cases of age range between 15 years to 63 years, with chronic otitis media were analyzed for post-operative improvement in hearing following tympanoplasty. 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 and interpretation: 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 was10.2 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 was 4.7 dB, 11.7 dB and 6.6 dB 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.

Keywords: Words: A-B gap, Tympanoplasty, modified radical mastoidectomy, ossiculoplasty, chronic suppurative otitis media (CSOM).

INTRODUCTION

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 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 like approaches (permeatal, endaural, postaural), graft sources (temporalis fascia, cartilage graft, and 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 tympanoplasties.
The surgical success of tympanoplasties can be evaluated in terms of graft up- take 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. Comparision 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 and assessment of various host and surgical factors has been a subject of interest for many years and still continues to be a challenge.
Aim of this study was to determine the hearing improvement in tympanoplasty by pre-operative and postoperative audiometric evaluation after 1 month and 3 months and 6 months.

Materials And Methods

This study was performed on the 50 patients in ENT OPD at Durgabai Desmukh Hospital & Research Centre, Hyderabad April 2016 to April 2018 by simple random method.

Patients presented with history and clinical feature of chronic suppurative otitis media with conductive deafness who undergone tympanoplasty with or without mastoidectomy using autologous temporalis fascia or cartilage graft or both were included in the study. Patients with sensorineural hearing loss, with active ear discharge, with Eustachian tube occlusion and biomaterials other than autografts were excluded from the study.

ENT examination and appropriate investigations:

- 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% intradermal 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 diazepine may be given to allay anxiety.
- Supine position with the face turned to one side the ear to be operated was up.
- Local infiltration is done with 2% lignocaine with 1:2,00,000 adrenaline. Incision may be endomeatal, endaural or postaural.
- Harvesting of the temporalis fascia graft done. Other grafting material like tragal perichondrium or fascialata can be used.
- Tympanic membrane is visualized. Freshening of the perforation margins done using curved pick. Curetting of the undersurface of tympanic membrane done.
- 6O`clock and 12O`clock incision was taken about 5mm away from the annulus.
- The tympanomeatal flap is elevated

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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 exoneration 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

The minimum age range was 15 years to 63 years. There were 6 patients below 16 years of age. Maximum number of patients belonged to the age group of 21-25 years. (Table 1) In our study female patients outnumbered the male patients. The number of male and female patients was 23 and 27 respectively. The male to female ratio was 1:1.17. (Table 2)

Chronic otitis media (COM) is of mucosal and squamous type. In our study mucosal type far exceeded the squamous types 76% of the cases were mucosal type whereas only 24% were squamous type. (Graph 1)

Tympanic membrane perforation can be classified as small, medium, large, subtotal and total depending on the size of perforation. (Table 3) 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.

In a total of 50 patients, 26 underwent type I, 5 underwent Type II, 6 underwent Type III, and only I patient underwent Type IV Tympanoplasty. 12 patients had mastoidectomy as a part of the procedure. (Table 4)

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 was10.2 dB for temporalis fascia, 4dB for temporalis fascia with conchal cartilage and 9.2dB in case of autograft incus. (Table 5 and 6)

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 II, 13.5 dB for type III, 11 dB for Type IV, 15 dB for Type I + CM, Type II + MRM- 10 dB, Type I + MRM, there was worsening by 3 dB, Type III + MRM 9.4 dB. (Table 7)

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 Airbone 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. (Graph 2)

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[36] reported success rate of 90.2% (intact graft during follow- up).Carr MM et al.[37] reported

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79% success in pediatric cases whereas Xia R et al33 reported 89% intact graft in his series of pediatric 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[36] 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 dependent 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.[36] and Carr M et al.[37] as well.

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

According to Carr MM[37] and Uyar Y[36] size does not have a bearing on the success of surgery. The mean A-B gap closure of medium large and subtotal perforation is 4.7, 11.7 and 6.6 respectively. The closure rates is higher in small perforation (74%) than in large perforations (56%).[40, 41]

The failure of anterior perforation is higher. This can be greatly reduced by anchoring the anterior margin of the graft beneath the annulus[40].

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 was10.2 dB for temporalis fascia, 4dB for temporalis fascia with conchal cartilage and 9.2dB in case of autograft incus.

Couloigner V et al.[61] 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.

Amoros Sebastia et al.[55] 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.[54] 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[53] compared 23 cases of cartilage tympanoplasty with 28 patients of temporalis fascia tympanoplasty. Graft acceptance 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.[1]

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%.

Iurato et al.[64] 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.[65]

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Shinohara et al.[66]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[38] looked at the outcome of 281 meningoplasties in their department. The closure rate in Palva`s hands was 97%, while in hands of other members it was 74%.

Vartiainen[39] reported that the successful tympanic membrane closure rates for trainees were 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 reperforation.

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

The mean air-bone gap closure in our study was 8.9dB.

Gersdorff et al.[48] 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[49] 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 5.3 dB.

Jung TT, Park SK[51] 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

The main objective of this study was to assess the improvement in hearing postoperatively in patients who underwent various types of tympanoplasty

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. Tympanoplasty in which modified radical mastoidectomy was a part of the procedure did not give as much hearing improvement as other. 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. Tympanoplasty is a complicated surgery, the success of which depends on several host and surgical factors. More number of data required for getting a significant result.

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TABLES AND GRAPHS

Table 1: age incidence.

AGE RANGE	NO.	%
<15	3	6
16 – 20	14	28
21-25	17	34
26-30	4	8
31-35	4	8
36-40	0	0
41-45	3	6
46-50	0	0
51-55	2	4
56-60	1	2
>60	1	2
Total	50	100

Table 2: Gender incidence of cortical mastoidectomy

Sex	No. of cases	%
Male	23	46
Female	27	54
Total	50	100

Table 3: incidence of size of perforation

Size	No. of Cases	%
MEDIUM	11	28.94
LARGE	21	51.26
SUBTOTAL	6	15.78
AGGREGATE	38	100

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Table 4: types of tympanoplasty

TYPES	NO. OF CASES	%
TYPE 1	26	52
TYPE 2	5	10
TYPE 3	6	12
TYPE 4	1	2
TYPE 1+CM	5	10
TYPE 1+MRM	1	2
TYPE 3+MRM	5	10
TYPE 2+MRM	1	2

Table 5: types of graft and their relation to failure rates.

Types	No. of Cases	%	Number of failure
Ft.	33	66	3
Tf + Cc	12	24	1
Dura (Homologous)	1	2	1
Tf +Ai	4	8	1
Total	50	100	6

Table 6: Improvement in terms of A-B closure with mean.

TYPES OF TYMPANOPLASTY	<0	0-5	6.- 10	11.-15	16-20	21-25	Mean A-B closure
TYPE1	2	5	6	7	4	2	10.34
TYPE2	0	0	2	3	0	0	10.2
TYPE3	1	1	1	1	2	0	9.33
TYPE4	0	1	0	0	0	0	5
TYPE1+CM	1	1	1	0	1	1	9.4
TYPE1+MRM	0	0	1	0	0	0	7
TYPE2+MRM	0	0	0	0	0	1	7
TYPE3 +MRM	2	1	0	1	1	0	0.8
Total	6	9	11	12	8	4	-

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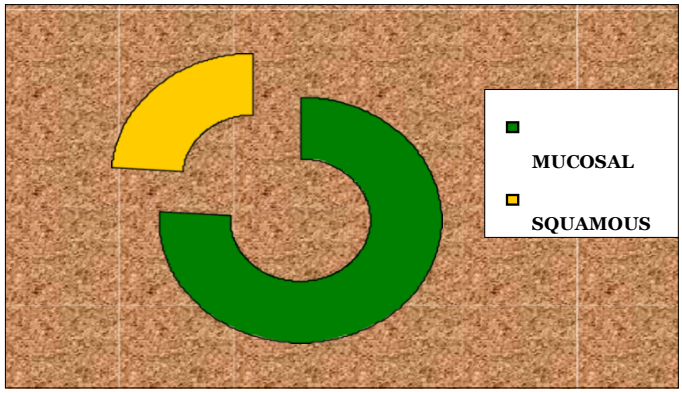
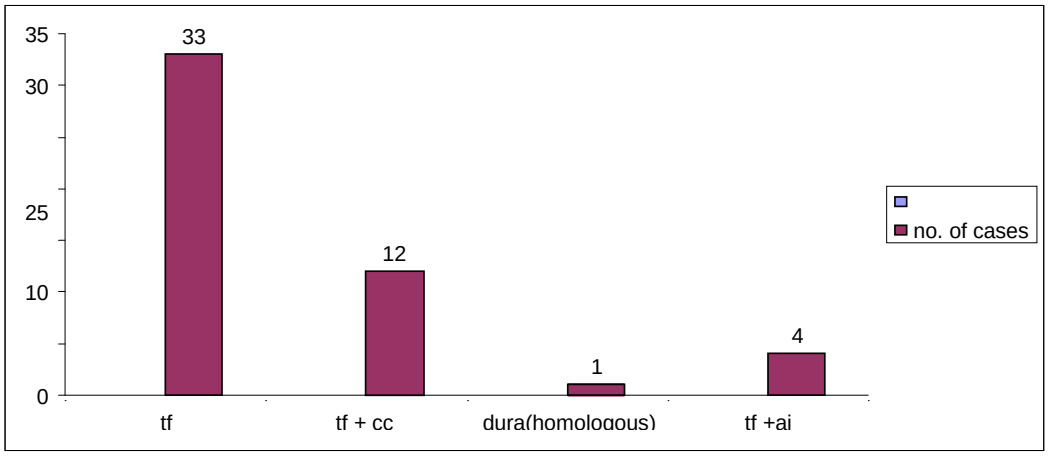
Improvement In Terms Of Difference between Pre and Postop Ac Threshold (In Speech Freq)

TYPES OF TYMPANOPLASTY	< 0	0-5	6.-10	11.-15	16-20	21-25	26-30
TYPE 1	1	8	2	7	3	4	1
TYPE 2	0	0	1	2	2	0	0
TYPE 3	1	0	0	1	4	0	0
TYPE 4	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	1	1	0	1	1	1	0

Graph 1: Types of CSOM

Graph 2: **types of graft and their relation to failure rates**





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