

Original article:

Cartilage Tympanoplasty: A method for hearing reconstruction

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Abstract:

Introduction: In chronic suppurative otitis media, there occurs chronic suppurative inflammation of mucoperiosteal lining of middle ear which leads to ossicular necrosis and tympanic membrane perforation. Numerous graft materials have been used to close the tympanic membrane perforation. Temporalis fascia and perichondrium are among commonly used materials for tympanoplasty. Fascia leads to subsequent failure in postoperative period. It has been shown that tragal and conchal cartilage are well tolerated by middle ear and the hearing results appears to be good.

Aims & Objectives: The purpose of this study was to assess hearing results after cartilage tympanoplasty in cases of tympanic perforation.

Methods: Total 65 patients were included in this study, out of which in 35 patients, type I tympanoplasty was performed and in 30 patients tympanoplasty with ossicular reconstruction was performed, in patients ranging from 12 to 50 years of age.

Results: It was evident that hearing results with cartilage tympanoplasty are good despite greater thickness of cartilage graft.

Conclusion: The use of cartilage appears to offer an extremely reliable method for reconstruction of tympanic membrane in cases of advanced middle ear pathology.

Key words: CSOM, Cartilage Tympanoplasty, Graft.

1. INTRODUCTION:

Since the introduction of tympanoplasty in 1952 by Zollner⁽¹⁾ and Wullstein⁽²⁾, numerous graft materials have been used to close the tympanic membrane perforation and different prostheses have been advocated as ossicular substitute. The goal of tympanoplasty today is to control the disease, retain normal anatomy and whenever possible to restore hearing. Hearing restoration depends upon effective transmission of sound through middle ear. Temporalis fascia and perichondrium retains the most commonly used materials today for tympanic membrane reconstruction and successful closure is anticipated in

approximately 90% of primary tympanoplasties. Polyethylene or Teflon prosthesis, homologous ossicle and cartilage are commonly used as ossicular substitute. But in certain situation such as atelectatic ear, cholesteatoma and revision tympanoplasty, fascia and perichondrium used for tympanic membrane reconstruction have been shown to undergo atrophy and subsequent failure in postoperative period. These observations have led to use of more rigid and less complaint materials for tympanic membrane repair . Cartilage, because of its more rigid quality, tends to resist resorption and retraction even in the milieu of continued Eustachian tube dysfunction. It has been

shown in both clinical and experimental studies that cartilage is well tolerated by middle ear, and long term survival is the norm, and despite the thickness of graft, the hearing results appears to be good. Various criteria must be satisfied before accepting graft or prosthesis for use in tympanoplasty. The prosthesis should be inert, nontoxic, easily mould into any shape and size, inexpensive. Keeping all these factors in mind we decided to use tragal/conchal cartilage autografts for the tympanic membrane repair and ossicular chain reconstruction. Also non-availability of different synthetic prosthesis and ossicular homograft at all centers led to use cartilage for reconstruction of ossicular chain. It is a prospective, randomized and non-comparative study.

2. AIMS AND OBJECTIVES:

The aims and objectives of this study were

- To assess the hearing results after cartilage tympanoplasty

3. MATERIAL AND METHODS:

The patients included in this study were taken from the ENT Out Patient Department of the Indira Gandhi Government Medical College and Hospital, Nagpur over the duration of two and half years from June 2005 to November 2007. The study was done to present dissertation for appearing M.S. ENT examination of Rashtrasant Tukadoji Maharaj University, Nagpur. The study was done after taking permission from institutes ethical committees. All the patients were explained about the study and their written permission was taken for participation in the study. Total 65 patients were studied, out of which 37 were females and 28 were males.

Selection of Subjects:

1. **Inclusion criteria:** cases of chronic suppurative otitis media

2. **Exclusion criteria:** cases with sensorineural hearing loss and cases with complications of chronic suppurative media such as facial palsy, labyrinthitis and intracranial or extracranial complications.

Methodology:

All patients underwent routine ENT evaluation in addition to general medical. Ear finding were noted with emphasis on size, site and margin of perforation, state of drum remnants, state of middle ear mucosa, presence or absence of ear discharge and tuning fork tests. Any septic focus in the form of chronic tonsillitis, sinusitis etc was treated first. All details regarding history, examination, investigations, surgery and follow up findings were documented on proforma.

Clinical Investigations:

1. **Pure Tone Audiometry:** was conducted in all patients. It formed the baseline investigation for the level of preoperative hearing.
2. **Otomicroscopy:** with a suction clearance was performed in all cases to confirm the otoscopic findings, to clear any discharge and to rule out any epithelial migration into middle ear.
3. **X-ray mastoid Schuller's view:** of both mastoids were taken in selected cases to rule out any associated pathology.
4. **X-ray paranasal sinuses:** were taken in selected cases to rule out sinus pathology.
5. **Routine Investigations:** such as complete blood count, bleeding time, clotting time, blood grouping, routine and microscopic examination of urine was done. All patients were investigated for fitness for general anesthesia.

Surgery:

Patients were operated either under local anesthesia or general anesthesia after xylocaine sensitivity tests. Co-operative patients were operated under local anesthesia. Patients below 15 years of age, uncooperative adults and patients who underwent mastoid exploration were operated under general anesthesia.

Local anesthesia was given by using 2% xylocaine in the subcutaneous tissue of post auricular region and external auditory canal using 26 number needle and syringe.

Either endaural or postaural approach was selected for surgery. All patients were operated by underlay technique. Underlay grafts were supported by gelfoam in the middle ear.

In the present study, we used cartilage-perichondrium island graft for tympanic membrane reconstruction and cartilage struts in different sizes and shapes for ossicular reconstruction.

There were two groups in the present study.

1. Type 1 cartilage tympanoplasty group

2. Tympanoplasty with Ossicular reconstruction (Ossiculoplasty) group

Postoperative care:

Standard mastoid dressing was given in cases operated by postaural route. Postoperative stay in the ward ranged from 3 to 7 days. In this period, all patients were on the following medications.

- Systemic antibiotics as indicated
- Anti-inflammatory, antipyretics and analgesics
- Antihistaminics and decongestants

Sutures were removed on seventh postoperative day. Patients were discharged with instructions to keep the ear dry and to continue antibiotics and antihistaminics for next 7 days. Steroid-antibiotic eardrops for local instillation were also started.

4. OBSERVATIONS:

The present study includes the cases operated by cartilage tympanoplasty method. It is a prospective study. Total 65 patients were studied, out of which 37 were females and 28 were males. Mean age of the patients 25 years with the range of 12 to 50 years.

Following observations were made in this study.

Table No. 1: Age distribution

Age (Years)	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	Total procedures	%
10-15	2	5.71	9	30	11	16.92
16-20	11	31.43	7	23.33	18	27.69
21-25	8	22.86	4	13.33	12	18.46
26-30	6	17.14	1	3.33	7	10.77
31-35	3	8.57	1	3.33	4	6.15
36-40	3	8.57	4	13.33	7	10.77
41-45	2	5.71	3	10.00	5	7.69
46-50	0	00	1	3.33	1	1.54

Table No. 2: Sex wise distribution of cases

Gender	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	Total procedures	%
Male	12	34.19	16	53.33	28	43.08
Female	23	65.71	14	46.67	37	56.92

Table No. 3: Pathological findings

Pathology	No. of cases	%
Subtotal perforation	17	26.15
Atelectasis	5	7.69
Type I Tympanoplasty failure	5	7.69
Large perforation	12	18.46
Cholesteatoma	20	30.77
Marginal perforation	3	4.62
Attic perforation/retraction	3	4.62

Table No. 4: Surgical approaches

Route of surgery	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	No. of cases	%
Postaural	29	82.86	30	100	59	90.77
Endaural	6	17.14	00	00	6	9.23

Table No. 5: Type of anesthesia

Type	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	No. of cases	%
GA	3	8.57	30	100	33	50.77
LA + sedation	32	91.43	00	00	32	49.23

GA = General anesthesia,

LA = Local anesthesia

Table No. 6: Type of graft used for tympanic membrane reconstruction

Graft	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	No. of cases	%
Tragal	14	40	25	83.33	39	60
Conchal	21	60	5	16.66	26	40

Table No. 7: Preoperative hearing loss (Air-Bone GAP)

Sr. No.	A-B gap	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	Total procedures	%
1	00-20 dB	0	00	0	00	00	00
2	20-30 dB	22	62.86	13	43.33	35	53.85
3	30-40 dB	13	37.14	12	40.00	25	38.46
4	40-60 dB	00	00	5	16.67	5	7.69

91% were having preoperative hearing loss between 20 to 40 dB.

Table No. 8: Mean preoperative hearing loss in total cases

Type of cases	No. of cases	Mean hearing loss
Type I tympanoplasty cases	35	30.14 ± 6.00 dB
Tympanoplasty with ossicular reconstruction cases	30	34.66 ± 8.99 dB

Table No. 9: Post-operative hearing level

Sr. No.	Hearing level (dB)	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	Total procedures	%
1	0-10	27	77.14	7	23.33	34	52.31
2	11-20	7	20.00	17	56.67	24	36.92
3	21-30	1	2.86	6	20.00	7	30.77
4	31-40	00	00	0	00	0	00

Table No. 10: Mean post-operative hearing level in total cases

Type of cases	No. of cases	Mean hearing loss
Type I tympanoplasty cases	35	10.42 ± 3.71 dB
Tympanoplasty with ossicular reconstruction cases	30	20.00 ± 5.97 dB

Air-Bone gap was closed within 30dB in 89.23% cases and within 10 dB in 52.31% cases.

Table No. 11: Post-operative improvement in Air-Bone Gap (Hearing gain)

Sr. No.	Hearing level (dB)	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	Total procedures	%
1	0-10	24	68.57	11	36.67	35	53.85
2	11-20	10	28.57	13	43.33	23	35.38
3	21-30	1	2.86	5	16.67	6	9.23
4	31-40	00	00	1	3.33	1	1.54

Table No. 12: Mean post-operative hearing gain in total cases

Type of cases	No. of cases	Mean hearing loss
Type I tympanoplasty cases	35	20.00 ± 5.28 dB
Tympanoplasty with ossicular reconstruction cases	30	17.00 ± 8.36 dB

Table No. 13: Hearing results in cases of ossicular reconstruction

Sr. No.	Ossicular reconstruction	No. of cases	%	Mean preoperative hearing level (dB)	Mean post-operative hearing level (dB)	Hearing gain (dB)
1	TM-FP	12	40.00	33.75 ± 8.56	18.75 ± 5.27	15.00 ± 6.39
2	M-FP	4	13.33	38.75 ± 10.30	15.00 ± 7.07	18.75 ± 1.08
3	TM-SH	6	20.00	30.83 ± 6.64	17.50 ± 9.35	13.33 ± 8.75
4	M-SH	8	26.67	40.63 ± 9.63	19.37 ± 7.76	21.87 ± 8.42

M = Malleus

TM = Tympanic membrane

FP = Foot plate

SH = Stapes Head

It is evident from the above table that highest hearing improvement in hearing was seen in malleus to head type of reconstruction.

Table No. 14: Closure of Air-Bone Gap

Sr. No.	A-B gap	Type I Tympanoplasty cases	%	Tympanoplasty with ossicular reconstruction cases	%	Total procedures	%
1	< 10 dB	27	77.14	7	23.33	34	52.31
2	< 20 dB	35	97.14	24	80	58	89.23

It is evident from this table that A-B group closure was better in type I tympanoplasty group as compared to tympanoplasty with ossicular reconstruction group.

Table No. 15: Complications observed in the present group

Complications	No. of cases	%
Reperforation	0	00
Residual perforation	2	3.08
Graft medialization/lateralization	0	00
Retraction	0	00
Perichondritis	0	00

5. DISCUSSION:

In this study over a period of 2.5 years, 65 patients with the diagnosis of chronic suppurative otitis media were operated. Tympanoplasty with or without mastoidectomy was done on them. In this study, out of 65 patients, 37 (56.92%) were females and 28 (43.08%) were males.

In the present study, cartilage tympanoplasty was performed in 30.77% (20/35) patients of cholesteatoma. Similar findings were noted in the study of Dornhoffer⁽³⁾ et al having 35% (220/636) cholesteatoma as primary surgical indication. The cartilage graft for tympanic membrane reconstruction

was preferred over temporalis fascia in the present study because we considered these indications as high risk cases with more chances of graft failure with temporalis fascia graft. Milewski⁽⁴⁾ et al and Dornhoffer⁽³⁾ et al were also of the same opinion and they performed cartilage tympanoplasty.

In the present study, postaural approach was used in 90.77% (59/65) cases and endaural in 9.23% (96/65) cases. Postaural approach was preferred because most of the patients were having subtotal or total perforation which required manipulations around anterior annulus or cholesteatoma patients requiring mastoid exploration. In the study of

Kotecha⁽⁵⁾ et al, postaural approach was the most favored surgical approach. We used underlay technique of graft placement in all patients of present study. Similar technique of graft placement was used in the study of Gerber⁽⁶⁾ et al, Kotecha⁽⁵⁾ et al and Dornhoffer⁽³⁾ et al.

In our study, in type I tympanoplasty group, 91.43% (32) patients were operated under local anesthesia and 8.53% (3) were operated under general anesthesia. In the present study, in tympanoplasty with ossicular reconstruction, all patients were operated under general anesthesia because all patients required mastoid exploration.

In the present study, both tragal cartilage (60%) and conchal cartilage-perichondrium isografts (40%) were used for tympanic membrane reconstruction. This was in accordance with the study of Dornhoffer⁽³⁾ et al and Gerber⁽⁶⁾ et al. In the present study, for ossicular reconstruction tragal cartilage-perichondrium graft was used in all cases. This was in accordance to the study of Luetje⁽⁷⁾ et al, Desarda⁽⁸⁾ et al.

In the present study, 91% (60/65) patients were having preoperative hearing loss (air-bone gap) between 20-40 dB. While others like Dornhoffer⁽⁶⁾ et al (45%), Gerber et al (59.9%) reported much less preoperative hearing loss between 20-40 dB. Higher preoperative hearing loss in the present study was probably due to more reluctance of patients towards their health, resulting in late referral to otologist.

Mean preoperative hearing level in the present study was 33.23 ± 7.80 dB. This was in accordance with the study of Dornhoffer⁽³⁾ et al (25.7 dB), Mayaleh⁽¹⁰⁾ et al (26.5 dB).

In the present study, mean preoperative air-bone gap for type I tympanoplasty was 30.14 ± 6 dB.

Similar findings were reported by Dornhoffer⁽⁹⁾ et al (16.1 ± 11 dB) and Aidonis⁽¹¹⁾ et al (32.4 ± 14.1 dB).

Mean postoperative air-bone gap in the present study, was 13.7 ± 6 dB while in the study of Dornhoffer⁽³⁾ et al it was 14.1 ± 9.5 dB and in study of Mayaleh et al it was 12.2 ± 7.3 dB.

In the present study, mean postoperative air-bone gap for type I tympanoplasty cases was 10.42 ± 3.71 dB. Similar findings were noted in the study of Dornhoffer⁽⁹⁾ et al wherein it was 7.7 ± 5.6 dB, Dornhoffer⁽³⁾ it was 11.3 ± 9.2 dB and in study of Aidonis et al it was 24 ± 13.7 dB. Closure of air-bone gap within 10 dB was achieved postoperatively in the present study in 52.31% (34/65) cases. Similar findings were noted in the study of Levinson⁽¹²⁾ et al (66%) and in the study of Mikaelin⁽¹³⁾ et al (72%). In the present study closure of A_B gap within 20 dB in type I tympanoplasty group was achieved in 77.14% (27/35). In the study of Melewski⁽⁴⁾ et al it was achieved in 43.6% cases, in study of Dornhoffer⁽⁹⁾ it was achieved in 77% cases. In the present study, closure of A-B gap within 30 dB is achieved in 100% (65/65) of cases. Similar findings were noted in the study of Sendra⁽¹⁴⁾ et al in which it was achieved in 92.2% and in the study of Milewski⁽⁴⁾ et al it was achieved in 85.6% cases.

In the present study, hearing improvement was seen in all cases. Mean hearing gain in the present study was 18.6 dB which was in accordance to the study of Dornhoffer⁽⁹⁾ wherein mean hearing gain was 19 dB.

Mean hearing gain for type I tympanoplasty group in present study was 20 dB. Dornhoffer⁽⁹⁾ et al achieved mean hearing gain of 6.8 dB. Gerber⁽⁶⁾ et al found hearing gain of around 5dB.

Higher hearing gain in the present study as compared to other studies was due to higher

preoperative hearing loss as compared to other studies. Present study preferred full thickness cartilage graft (with perichondrium attached on one side) rather than slicing of cartilage. From the results of the present study, it was evident that hearing result with cartilage tympanoplasty are good despite greater thickness of cartilage graft as compared to conventional fascia or perichondrium graft. The use of cartilage appears to offer an extremely reliable method for reconstruction of tympanic membrane in cases of advanced middle ear pathology and Eustachian tube dysfunction.

6. CONCLUSION:

Total 65 patients were included in this study, out of which in 35 patients, type I tympanoplasty was performed and in 30 patients tympanoplasty with ossicular reconstruction was performed, in the patients ranging from 12 to 50 years of age. The purpose of this study was to assess hearing results after cartilage tympanoplasty.

Cartilage perichondrium island graft harvested from tragus or concha was used for tympanic membrane reconstruction in all cases. Tragal cartilage with perichondrium struts were used for ossicular reconstruction in all ossiculoplasty cases.

- Postaural approach was most favored approach in this study

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- Most of the cases of type I tympanoplasty were operated under local anesthesia
- Tragal cartilage was preferred over conchal cartilage for ossicular reconstruction because of comparatively greater stiffness.
- Mean pre-operative A-B gap was 13.76 dB
- Mean post-operative A-B gap in type I tympanoplasty was 10.42 dB
- Mean post-operative A-B gap in tympanoplasty with ossicular reconstruction was 20.00 dB
- Graft take-up rate in this study was 96.92%.

Advantages of cartilage graft observed in this study were easy accessibility, availability in adequate quantity, suitable thickness and stiffness, and ability to resist retraction, resorption and reperforation.

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