

Role Of Cartilage Support In Type 1 Tympanoplasty

¹Ankit Kumar Tiwari, ²Surendra Singh Moupachi, ³Vineeth Kumar V

¹Senior Resident, ²Professor & Head, ³Post Graduate Resident, Department of ENT, Shyam Shah Medical College & Sanjay Gandhi Memorial Hospital, Rewa, MP, India

Corresponding author: Vineeth Kumar V

drankitradhasoami777@gmail.com

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Abstract

Background –Perforation of tympanic membrane is most common outcome of chronic otitis media which is by tympanoplasty. In case of large and subtotal perforation, graft material not supported by anteriorly so slice of cartilage is used to stuck the grant anteriorly.

Aim & objective–Evaluate the results of closure of subtotal perforation of tympanic membrane perforation by tympanoplasty using underlay technique with supporting the graft by single cartilage piece medially.

Method – A prospective observational study was done on 50 patients of both the sex, with large and subtotal perforation. All patients underwent type 1 tympanoplasty. In all cases a slice of cartilage was used anteriorly from medial side of graft to support it. Outcome was assessed in terms of graft uptake and hearing improvement.

Result – Out of 50 patients 32% were male and 68% were female. 96% patient uptake graft successfully with average AB Gap 13.36 ± 5.22 dB postoperatively.

Conclusion –Tympanoplasty in which graft supported by cartilage slice, achieve good anatomical and audiological results.

Key words – Chronic otitis media, Cartilage tympanoplasty, Subtotal perforation.

Introduction

Chronic suppurative otitis media (CSOM) is the most common infective condition of ear. It has two variants mainly, tubotympanic and atticofacial. Tympanoplasty is a procedure of choice to eradicate the disease from middle ear and to reconstruct the hearing mechanism with or without tympanic membrane repair.(1) Tympanoplasty has been well established procedure for chronic otitis media since decades. First tympanoplasty was done by Zollner in 1951. (2)which was enhanced by Wullstein in 1952.(3)Tympanoplasty has been modified by many authors in terms of approach, technique and materials used for grafting the tympanic membrane. Each technique had its merits and demerits.(4)(5)(6).

Subtotal perforation has always created a challenge to otologists.(7) Repair of subtotal perforations are difficult as very little support is there for the graft particularly along the anterior rim of perforation, also there are chances of recurrence of pathology due to Eustachian tube dysfunction. Chances of failure are very high in anterior–superior quadrant, since the graft may fall around the Eustachian tube orifice leading to the medialization of graft and blocking the Eustachian tube.(8)very small anterior remnant of tympanic membrane and anterior bony overhang are more prone to failure after tympanoplasty in case of subtotal perforation.(9)

The reasons of residual perforations are poor adaptation of graft, displacement of graft which may sink medially or may shift posteriorly or may shrink postoperatively especially near the anterior annular region. When the graft is supported medially only by gelfoam (abgel), failure is seen in large number of cases.(9)

Temporalis fascia and perichondrium are the most popular and commonly used graft material. They contain collagen and mucopolysaccharides. These two components give it a high tensile strength and low metabolic rate. For this reason, it does not get autolysed in the presence of infection. To overcome failure of tympanoplasty in subtotal perforation, we have introduced a technique in which a small semilunar shaped piece of tragal cartilage is placed medial to the narrow anterior rim in case of a large or subtotal perforation. Cartilage being a bradytrophic tissue so it is more resistant to infection, allows stable and functionally reliable reconstruction of the ear drum. Cartilage has low turnover rate and it is easy to work with because it is pliable, and it can resist deformation from pressure variations. The temporalis fascia graft is placed lateral to this cartilage support and medial to the thin anterior rim. This cartilage splays and stays in place and provides firm support to the fascia graft medially. It prevents sinking or shrinking of the graft.(10)(11).

The purpose of this study is to evaluate the results of closure of subtotal perforation of tympanic membrane perforation by tympanoplasty using underlay technique with supporting the graft by single cartilage piece medially. It gives support to the graft anteriorly and prevents it from falling and also residual perforation.

Material and method

A prospective study was done on 50 patients who came to ENT OPD at tertiary care centre with tympanic membrane perforation and reduced hearing (mucosal type of COM) from January 2023 to June 2023. All patients underwent detailed history and complete otorhinolaryngological examination to rule out other source of infection. Each patient was subjected to the following procedures like complete hemogram, TLC, DLC, pus culture and sensitivity, pure tone audiometry, impedance audiometry, otoendoscopy, diagnostic nasal endoscopy and plain X-ray both mastoids-Law's view.

The inclusion criteria for this study were:

1. Patients in age group of 12-50 years with mucosal type of chronic otitis media.
2. Large Central perforation
3. Subtotal perforation
4. Anterior quadrant perforation
5. Anterior tympanosclerotic patch with perforation
6. Revision myringoplasty.

The cases excluded from this study were:

1. Small central perforation
2. Perforation in posterior quadrant.
3. Traumatic perforation.
4. Ossiculoplasty(ossicular dehiscence)
5. Perforation with cholesteatoma
6. Mucosal type of chronic otitis media with other source of infection in ear nose & throat (URTI).

In all the cases the ear was dry at the time of surgery. Pre operative audiograms were done noting air and bone conduction thresholds.

Operative procedure

The general technique of reconstruction of subtotal perforation using perichondrium or temporalis fascia graft with single piece of cartilage begins by harvesting it. Post-auricular Wilde's incision was given. Temporalis fascia was obtained from lateral surface of temporalis muscle. To obtain tragal cartilage, incision was made slightly posterior to the free edge of the tragus to expose the cartilage. Dissection was done to free up both surface of

cartilage then cartilage is cut depending on the size of the graft required. This tragal cartilage is ideal as it is thin, flat, with some elasticity, so when it is placed medial to the anterior rim, it splays and stays in the place. (12) Subsequently, a 'T' shaped incision was made. A Farabeuf's periosteum elevator was used to mobilize the periosteum to the level of the ear canal. Horizontal incision was then made on skin of the posterior canal wall. Edges excised with sickle knife and under surface of the perforation is freshened. Under operating microscope tympanomeatal flap was elevated up to annulus. Middle ear entered by piercing the middle ear mucosa from the posterior-superior quadrant. Middle ear was examined, handle of malleus was denuded and ossicular chain was checked for continuity and mobility. First a slice of cartilage which was slightly curved, covered with perichondrium was made from tragal cartilage. Perichondrium/temporalis fascia placed as graft and this slice of cartilage was placed from hypotympanum to anterior part of attic. It is placed gently medial to the anterior rim margin in such a way that the superior tapering end goes anterior to malleus and inferior tapering end goes in hypo tympanum.

It does not obstruct Eustachian tube opening, as it is curved with concavity facing towards medial wall. The antero-posterior curvature of the cartilage fits and merges with the curvature of the anterior mesotympanum. It is ensured that the cartilage and anterior rim margin of TM are in contact with each other. Temporalis fascia graft settled in such a way that it has placed anteriorly between the rim of TM and the cartilage. Gel foam-soaked antibiotic solution is packed in middle ear. Tympanomeatal flap replaced. Canal is packed with antibiotic impregnated with gelfoam. Closure was done.

Post operatively they were given antibiotic cover for 1 week and ear drops for 3 weeks. Post operative audiograms were done. A successful anatomical outcome was considered to comprise full intact healing of graft without perforation. A successful functional outcome was good hearing improvement.

Result

During the study period, cartilage slice was used for tympanic membrane reconstruction in all 50 patients. The study comprised of 50 patients in which 16 patients (32%) were male and 34 patients (68%) were female.

Table 1: Gender distribution

	No of patients	Percentage
Male	16	32 %
Female	34	68 %
Total	50	100%

In age wise distribution most of the patients belongs to age group of 21 – 30 year (40%). 15 % of patient belong to age group of 31 – 40 years.

Table 2: Age wise distribution of patients

Age in year	No of patients	Percentage
12 – 20	8	16%
21 – 30	20	40%
31 – 40	15	30%
41 – 50	7	14%
	50	100%

Deafness was the chief complaint in almost all cases and it was mainly conductive type with that of moderate degree. Tympanoplasty was done using both post-aural (91.49 %) as well as trans canal route (8.51 %) approach.

Out of 50 patients, 48% patients (24 patients) showed large central perforation, 40% patients (20 patients) showed subtotal perforation and 12% (6 patients) showed anterior quadrant perforation. Large central perforation was a perforation occupying more than two quadrants of tympanic membrane with invariably narrow anterior rim of the membrane. In subtotal perforation a very thin rim was seen all around. In only anterior quadrant perforation, the remaining rim was very narrow.

Type of perforation	No of patients	Percentage
Large central perforation	24	48%
Subtotal perforation	20	40%
Anterior quadrant perforation	6	12%
Total	50	100%

The overall success rate in terms of closure of perforation or graft uptake in this study was 96 % (48 patients). Out of 50 only 2 patients showed had residual perforation. In most of them it was due to upper respiratory tract infection or inadequate post operative antibiotic therapy. Postoperative complications were minimal.

In this study, there was significant air-bone gap closure in postoperative audiograms as compared to preoperative audiograms. The hearing improvement was seen in all frequencies. The average AB Gap was 13.36 ± 5.22 dB. The improvement in hearing was statistically significant at all frequencies.

Discussion

Hearing is one of most important and visible functions of the ear. Impairment of hearing, results in substantial disability. Perforation of tympanic membrane causes conductive hearing loss. This is a serious health problem worldwide, not only because of distress it causes to the patients and relatives, but also the associated hearing impairment imposes substantial economic burden on the patient and health care system. Permanent restoration of hearing is the goal of functional reconstruction of the perforations of tympanic membrane by tympanoplasty. Problems with Closure of Subtotal Perforation are very little support is provided by the remnant of tympanic membrane anteriorly, graft may fall around the Eustachian tube orifice, medialization of graft and blocking of Eustachian tube opening and residual perforation in anterior quadrant. Reason for failure is graft displacement, improper placement, autolysis, infection, haemorrhage, Eustachian tube dysfunction etc. The use of cartilage support is an extremely reliable method for reconstruction of tympanic membrane in cases of middle ear pathology and Eustachian dysfunction.

Heermann was the first to introduce the cartilage palisade technique, in 1962. (13) He showed in cartilage tunnel at the Eustachian Tube entrance which is very helpful in all types of tympanoplasty in maintaining the patency of the tubal entrance and in reconstructing the antero-inferior aspect of the tympanic membrane. He also used small cartilaginous chips for reconstruction of the eardrum and introduced it as Palisade Cartilage Tympanoplasty. Reconstruction of subtotal perforation counteracts the tendency of retraction of soft autologous materials like temporalis fascia or perichondrium. Cartilage is more resistant to the prolonged absence of neovascularisation from the periphery in large central and subtotal perforation making it more resistant to infection.(14)

Previously various graft materials have been used to reconstruct tympanic membrane including skin, fascia, vein, perichondrium, dura and cartilage.(15) At present the most common material used for tympanoplasty is temporalis fascia followed by tragal perichondrium.(7) The success rate of the intervention in terms of closure of perforation with fascia is estimated to be around 80–90 % for primary tympanoplasty.(16) However these results decrease in some specific cases, such as large or subtotal perforations, anterior perforations, revision tympanoplasty. Larger perforation is associated with significant low

rate of successful graft uptake. (17) Temporalis fascia has its own advantages like a common incision for approach, large amount of graft material is available and more so that its basal metabolic rate is low, its thickness is similar to normal tympanic membrane and embryologically it develops from mesoderm which is same as normal tympanic membrane. (18)(19) But temporalis fascia can suffer atrophy or vascularisation, causing posterior shrinkage or sinking in middle ear, ultimately causing failure of closure of the perforation in such cases. (20)(21) Cartilage has been used with great success to reconstruct TM. Cartilage can be used in the form of several parallel, full-thickness strips (palisade technique) or in plates of different sizes and shapes. (22) Cartilage has been shown to be well tolerated by middle ear. Long term survival is achieved since cartilage grafts are nourished largely by diffusion and not by neo vascularization. It maintains its rigid quality and resists resorption and retraction (17)(23) The cartilage is a satisfactory grafting material because it is easily accessible, easy to adapt, resistant to negative middle ear pressures, stable, elastic, well tolerated by the middle ear, resistant to resorption and various studies have demonstrated that its audiological results are good. (24)(25)(26)

In our study success rate in terms of closure of perforation or graft uptake in this study was 96 % (48 patients). Out of 50, only 2 patients showed had residual perforation due to upper respiratory tract infection or inadequate post operative antibiotic therapy. The average AB Gap was 13.36 ± 5.22 dB. This shows a satisfactory hearing improvement.

Borkowski et al, introduce a perichondrium–cartilage composite graft for closure of total perforations of the tympanic membrane. He used oval shaped piece of cartilage with perichondrium This assembly stabilizes and fixes the perichondrium and prevents the perichondrium from subsiding into the middle ear cavity. The cartilage ring reduces shrinking of the perichondrium. He found 100% graft uptake with no residual perforation. (27)

Dornhoffer found 100 % take up rate with cartilage tympanoplasty compared to 85 % with perichondrium with no difference in hearing improvement. He achieved air bone gap <20 dB by cartilage palisade technique. (26)

Indorewala reported 83 % success rate with temporalis fascia and 95 % success rate with fascia lata. (28)

Singh et al, reported a graft-take up rate of 93.3 % for large central and subtotal perforation. They reported an overall hearing gain in 92.8 % cases. (29)

Conclusion

Results of our study indicate that this tympanoplasty technique i.e., graft supported by cartilage slice, achieve good anatomical and audiological results. in spite of Cartilage slice being rigid and thick it does not hamper the routine acceptance of it and does not significantly affect post operative hearing results. With use of cartilage, space of middle ear is not reducing and structure of middle ear can be seen through semi-transparent graft in post operative period which will not be visible in cases of opaque tympanic membrane due to palisade or island cartilage perichondrium graft. Cartilage support helps in reconstruction of the tympanic membrane in cases of advance middle ear pathology and Eustachian tube dysfunction. Single slice prevents falling of graft in middle ear and prevent failure of graft as residual perforation. Cartilage slice support gives a very high success rate in cases of high-risk perforation like subtotal perforation, retraction pocket, cholesteatoma, anterior perforation of tympanic membrane. Tympanoplasty using temporalis fascia/perichondrium with graft supported by slice of cartilage anteriorly is safe and reliable procedure.

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