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Original Research Article

Cartilage-Perichondrium Composite Graft Tympanoplasty:A review of technique and outcome in management of chronic suppurative otitis media

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Abstract

Introduction

The objective of this study was to evaluate the effectiveness and outcomes of cartilage-perichondrium composite graft tympanoplasty in the management of tympanic membrane perforations. The success rates of tympanic membrane closure, postoperative hearing outcomes, complications were assessed.

Materials and Methods

This retrospective descriptive study constituted a study population of 110 patients with clinical evidence of chronic suppurative otitis media (CSOM) who were operated with cartilage perichondrium composite graft tympanoplasty. The study duration was from July 2011 to September 2014.

Result

Overall graft take 99.09% and in type I tympanoplasty 86.11% of cases got air bone closure up to 20 dB. In type II and type III 72.22% and 70.58% of cases achieve air bone closure (AB closure) up to 20 dB. 97.26% of patients of different types of tympanoplasty achieved hearing level of 30 dB or less i.e. socially acceptable hearing.

Conclusion

Cartilage-perichondrium composite graft tympanoplasty is an effective and reliable surgical approach for repairing tympanic membrane perforations. The technique provides excellent closure rates of 99.09% and improves hearing outcomes in 97.26%, contributing to improved patient quality of life.

Keywords: cartilage-perichondrium composite graft, tympanoplasty, tympanic membrane perforation, CSOM, closure rates, AB Gap closure

1. Introduction

The tympanic membrane plays a crucial role in the transmission of sound waves and the maintenance of normal middle ear function. Since the inception of use of cartilage graft in reconstruction of middle ear its role has been changed tremendously from being used only for ossiculoplasty to support fascia graft (in 1950s) to sole reconstruction material as cartilage perichondrium composite graft. Cartilage–perichondrium grafts are frequently the material of choice for reconstruction of the atelectatic tympanic membrane and recurrent perforations.[1]

There are 23 cartilage tympanoplasty methods which are Palisades, Stripes, and Slices with attached perichondrium on ear canal side; foils, thin plates, and thick plates, not covered with the perichondrium; cartilage-perichondrium composite island grafts; special total pars tensa cartilage perichondrium composite grafts; Cartilage-perichondrium composite island grafts tympanoplasty for anterior, inferior, and subtotal perforations and Special Cartilage Tympanoplasty Methods as In-lay butterfly cartilage tympanoplasty and Composite chondroperichondrial clip tympanoplasty: The triple C technique. In each case the graft adapts to its changing purpose with change in pathology.[2]

2. Aim

The aim of this study is to critically evaluate the outcomes and effectiveness of cartilage-perichondrium composite graft tympanoplasty in the repair of tympanic membrane perforations by investigating the following key objectives:

1. Evaluate the success rates of cartilage-perichondrium composite graft tympanoplasty in achieving closure of tympanic membrane perforations.
2. Assess postoperative hearing outcomes.

3. Analyze the incidence of complications associated with cartilage-perichondrium composite graft tympanoplasty.

3. Material and method

This Retrospective and Prospective study based on a series of 110 Tympanoplasty was done at the department of Otorhinolaryngology from July 2011 to September 2014.
Patients with history of long standing ear discharge, having tympanic membrane perforation, with and without granulations / cholesteatoma and with and without tympanosclerotic patch were taken for the tympanoplasty with mastoidectomy for granulation and cholesteatoma cases and with excision of tympanosclerotic patches when present. Patients with good cochlear reserve were included in the study.
Cases with otogenic intracranial complications , were excluded from the study. A detailed clinical history and examination was recorded on specific proforma designed for the study. All patients were subjected to pre-operative audiometric evaluation i.e. pure tone audiometry (PTA). In all patients perforation was detected by otoscopy and examination under microscope. Necessary preoperative investigations were performed. In adult, tympanoplasty was done in local anesthesia while in children general anesthesia was preferred, surgery being performed either by endaural or post aural approach. Tragal cartilage was harvested and tympanoplasty with cartilage-perichondrium composite island graft was done using underlay technique after slicing the cartilage with help of cartilage slicer (Fig 1, Fig 2 and Fig 3). Suture removal was done at 7-10 post-operative day. Patients were given antibiotic cover for 6 weeks.
Post op observation recorded for 3 to 6 month follow-up.
The data obtained was subjected to appropriate statistical analysis using SPSS version 20. The following tests were applied suitably, such as, Chi square test to calculate p value.

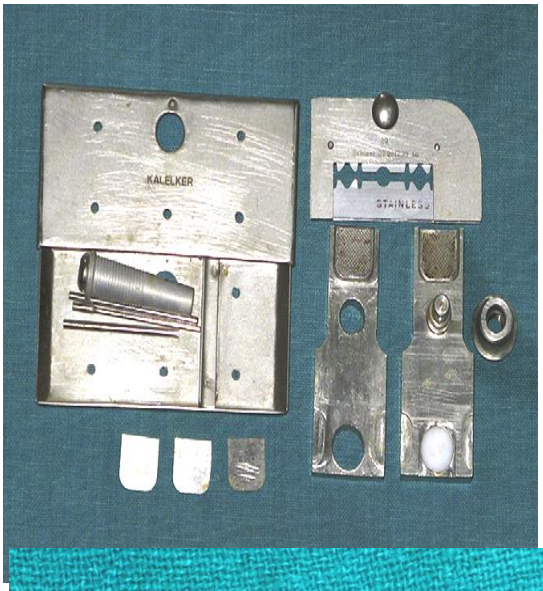

Fig 1. Cartilage slicer

Fig 2. Cartilage perichondrium island composite graft

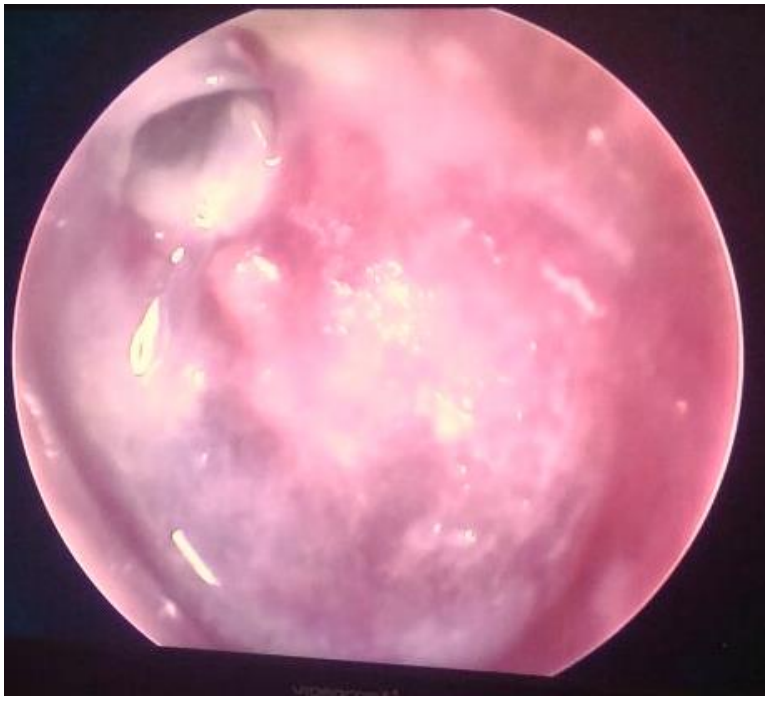

Fig 3. Type I tympanoplasty left ear

4. Results

The study comprised of 110 patients, of which 43 were male and 67 were females. The age of the patients varied from 10 to 62 years. 82 cases being central perforation and 28 patients with cholesteatoma or granulations. Deafness in 108 (98.18%) cases was the most common presenting complaint followed by otorrhea in 102 (92.72%) cases and pain in ear 47 (42.72%) cases

Any graft, which was seen to be intact for three months after operation was considered to be taken, which we found in 109 cases (99.09%).

After a postoperative period of 3 months on re-evaluating the hearing profile of the patients we found that 25 cases (22.72%) achieved excellent post-op hearing results, 64 cases (58.18%) achieved comparatively good hearing level and 18 cases (16.36%) achieved moderately better hearing level as compared to their pre-operative hearing levels. Audiological outcomes with closure of 97.26% air bone gap within 0 to 30 dB was achieved ($p<0.05$). Table 1 and 2

Table 1 A-B Gap Closure in Different Types of Tympanoplasty (After 3 months postoperative)

Air bone gap closure (AB)	Type I		Type II		Type III		Type IV	
	No.	%	No.	%	No.	%	No.	%
0 – 10	22	30.55	3	16.66	-	-	-	-
11 – 20	40	55.55	10	55.55	12	70.58	2	66.66
21 – 30	9	12.5	3	16.66	5	29.41	1	33.33
> 30	1	1.3	2	11.11	-	-	-	-

Table 2 Overall Air Bone Gap Closure in dB (N=110)

AB Gap Closure	Number of Cases	Percentage
0 – 10	25	22.72
11 – 20	64	58.18
21 – 30	18	16.36
> 30	03	02.7

Post op complications were not severe, we encountered 1 case of reperforation but other complication of retraction of graft, Sensorineural hearing loss, perichondritis, recurrence of otorrhoea, facial nerve injury, lateralization of graft, infection of wound were not present.

5. Discussion

The use of cartilage in middle ear surgery is not a new concept, but in recent years, the use of cartilage-perichondrium composite grafts in tympanoplasty has gained attention due to their potential advantages over other graft materials Cartilage, known for its structural stability and resistance to collapse, provides an ideal framework for graft placement. The addition of perichondrium, a thin connective tissue layer surrounding the cartilage, enhances graft stability and promotes revascularization, thereby improving graft survival rates.
The use of cartilage is experiencing a renaissance in ear surgery because it appears to offer an extremely reliable method for reconstruction of the tympanic membrane in cases of advanced middle ear pathology and eustachian tube dysfunction.[3]
Conceptually, one might anticipate a significant conductive HL with a TM that is rigid and thick, a fact that has hampered the routine acceptance of cartilage as a grafting material but the literature supports no such notion. Many studies have demonstrated that the ideal acoustical thickness of cartilage should be about 0.5 mm, compared to the full thickness at harvest of 0.7-1 mm.[3]

In this study female cases (60.91%) were found to be more than male (39.09%) cases. Deafness (98.18%) was the most common complaint followed by Otorrhea (92.72%). In this series 74.54% were having central perforation on otoscopy and 25.45% cases were having cholesteatoma/granulations on otoscopy. In the present study middle ear mucosa was found normal in 60.9% cases Most of the cases (63.63%) have a moderate degree of conductive deafness. In our study 10.90% patients were having AB gap level <30dB, 41.81% patients were having AB gap level 31-40dB, 31.81% were having AB gap level 41-50dB and 15.48% patients were having AB gap level >50 dB found by recording hearing threshold of air and bone conduction at the frequencies of 500, 1000, 2000 dB.
Incus erosion was found to be the most common type of ossicular erosion in 34.54% cases followed by malleus in 20.81% and stapes in 3.63%.
Type 1 tympanoplasty was the most commonly performed in 65.45% cases followed by type 2 and type 3 as 16.36% and 15.45 % respectively. Post aural approach was most commonly used i.e. in 78.18% of cases and endaural approach in 21.81%.

Success of surgery was assessed by closure of tympanic membrane perforations, postoperative hearing outcomes and complications.

Closure of tympanic membrane perforations:
One of the primary objectives of cartilage-perichondrium composite graft tympanoplasty is the successful closure of tympanic membrane perforations. Studies have reported high success rates in achieving closure with this technique. The closure can be assessed through otoscopic examination and confirmation of intact membrane on follow-up visits. In our study the success rate was 99.09%. Only 1 out of 110 cases had reperforation of tympanic membrane. That patient has not come for follow-up for initial 1 month, during which he had develop URTI and otomycosis. This has resulted in small reperforation.

Dornhoffer (1997) reported success rate of 85%with perichondrium.[4]
Borkowski (1999)[5]**,** and Dornhoffer (2003)[3] reported 100% results with cartilage palisade tympanoplasty and cartilage-perichondrium grafting.
Singh M, Rai A, Bandyopadhyay S, Gupta SC, 2003 reported a graft take up rate of 93.3% for large central and subtotal perforation [6]

K.K. Desarda (2005) reported 96% success rate with cartilage graft.[7]

Neumann et al. reported a graft take rate of 100% in their palisade cartilage tympanoplasty study, and they did not observe resorption or recurrent defects of the rebuilt tympanic membrane.[8]

Cavaliere (2014) reported success rate of 99.35% with tragal cartilage graft.[9]

Mubarak Khan, Parab Sapna(2013) reported 98.20 %success rate with sliced tragal cartilage graft. [1]

Mundra R.K.(2013) reported an success rate near 100% with temporalis fascia graft supported by a piece of cartilage[10].

Postoperative hearing outcomes:
The improvement in hearing function is an essential aspect of assessing the outcomes of tympanoplasty. Audiological evaluations, such as pure-tone audiometry can be used to measure the pre- and postoperative hearing thresholds. The postoperative audiometric results can be compared to preoperative baselines to evaluate the degree of hearing improvement achieved with cartilage-perichondrium composite graft tympanoplasty.
In our study 97.26% had obtained air bone gap closure within 0 to 30 dB (social hearing), 22.72% within 10 dB and 58.18% within 20dB, 2.7% cases has > 30dB hearing, they were cases of unsafe variety.
Singh M, Rai A, Bandyopadhyay S, Gupta SC (2003) reported an overall hearing gain in 92.8% cases.[6]
Dornhoffer (2003) achieved air bone gap < 20 dB by cartilage palisade technique.[3]
K.K.Desarda(2005) achieved air-bone closure of 15db for cartilage tympanoplasty.[7]

Complications:
An assessment of complications associated with the procedure is crucial in determining the overall safety and success of cartilage-perichondrium composite graft tympanoplasty. Complications may include infection, graft extrusion or displacement, persistent perforation, or conductive hearing loss facial nerve palsy, labyrinthitis or sensori-neural deafness. In this series incidence of postoperative complications was very low. In one patient i.e. 0.9% of cases recurrent perforation was present. Other complications were not present.
Dornhoffer (2003) reported post-op perforation in 4.2% cases, revision surgery for conductive deafness in 1.9% cases and delayed facial weakness (temporary) in 0.5%. He also had secondary cholesteatoma in 1.3% cases.[3]
Neuman (2003) reported post-op recurrence in 1.6% cases with no facial weakness and otorrhea.[8]
Table 3 summarises and compares our study result with that of others.

Table 3 Take up rate and Hearing results of various authors in cases of tympanic membrane perforation done by various grafts

Author	Type	Takeup in %	Hearing
Dornhoffer (1997)	Perichondrium	85%	Air bone gap < 10dB
Borkowski (1999)	Cartilage-perichondrium	100%	Air bone gap < 20 dB
Singh M (2003)	Temporalis fascia	93.3%	Air bone gap < 30 dB
Neuman (2003)	Cartilage palisade	100%	Air bone gap < 30 dB
Dornhoffer (2003)	Cartilage palisade	100%	Air bone gap < 20 dB
K.Desarda(2005)	Cartilage graft	96%	Air bone gap < 20 dB
Cavaliere (2009)	Cartilage graft	99.35%	Air bone gap < 20 dB
Mundra (2013)	Single cartilage anteriorly with temporalis fascia/ perichondrium graft	98.94%	Air bone gap < 30 dB
Khan , Parab (2013)	Sliced tragal cartilage	98.2%	Air -bone gap < 20 dB
Present series	Single cartilage-perichondrium composite graft	99.09%	Air bone gap<30db

6. Conclusion:

Assessing the outcomes of cartilage-perichondrium composite graft tympanoplasty involves evaluating the closure of tympanic membrane perforations, postoperative hearing outcomes and complications. By analyzing these factors, it was found that cartilage perichondrium composite graft can be used as an grafting material for closure of tympanic membrane perforation with 99.09% graft take rate and with hearing improvement of 97.26%. With slicer technique, whole of the tympanic membrane does not become completely opaque. Middle ear structure can be partially seen through semitransparent graft in postoperative period. Cartilage graft gives very high success rate in cases of high-risk perforation (subtotal perforation, retraction pocket, cholesteatoma, anterior perforation of tympanic membrane) as well as in central perforations of tympanic membrane.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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