

A Prospective Study on Results of Cartilage Palisade Type 1 Tympanoplasty in a Tertiary Care Hospital of Assam - A Short Term Evaluation

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ABSTRACT

BACKGROUND

Despite the invigoration of cartilage graft in the last few years, very few literatures have been found regarding the use of the cartilage palisade tympanoplasty from the North-Eastern part of India. The aim of this study is to analyse the results of cartilage palisade graft technique in type 1 tympanoplasty in terms of the graft uptake, hearing improvement and post-operative complications.

METHODS

This hospital based prospective study was done from September 2018 to September 2019 including 21 patients of tubotympanic type of chronic otitis media.

RESULTS

Hearing improved significantly ($p = 0.000$) from 31.29 ± 6.81 dB to 14.95 ± 5.36 dB in the post-operative period in terms of ABG. The mean hearing gain was found to be 6.33 ± 6.96 dB. The graft uptake rate was 95.24%, without any significant post-operative complications.

CONCLUSIONS

High graft uptake rate, and highly significant audiometric outcomes in our study emphasises upon the usage of cartilage graft after slicing and palisading in the reconstruction of tympanic membrane even in primary cases without compromising the acoustic transfer characteristics.

KEYWORDS

Cartilage Palisade Graft, CSOM, Tympanoplasty, Complication

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BACKGROUND

Chronic otitis media is one of the commonest diseases encountered by the otorhinolaryngologists all over the world. Despite the lack of awareness about the disease among the common population, the disability and morbidity caused by the disease propels them to seek medical attention.

Tympanoplasty is a procedure to eradicate disease in the middle ear and to reconstruct the hearing mechanism, with or without tympanic membrane grafting.¹ Cartilage has constant shape, firm consistency, and lack of fibrous tissue so that, its post-operative dimensions remain the same and therefore cartilage grafts are used with good results. The various cartilages used are tragal, conchal, triangular fossa and septal cartilage.²

The beginning of the cartilage palisade techniques is presumably the Heermann cartilage plate between the cartilage columella (or the stapes) and the inferior annulus. After 1962, Heermann used palisade technique with cartilage fragments for the reconstruction of the tympanic membrane. Initially cartilage was used to stabilize the fascial graft, first with small cartilage plates and later with broad plates of cartilage. The large pieces of cartilage had been found to be twisted after some years, so the cycle again shifted to small palisades.³

Very few literatures have been found regarding the use of the cartilage palisade tympanoplasty from North-East India. Hence, this study aims at evaluation of the outcomes of cartilage palisade graft technique in type1 tympanoplasty in terms of the graft uptake rate, improvement of hearing and post-operative complications among the patients attending Department of Otorhinolaryngology and Head & Neck Surgery in a Tertiary care centre, Assam.

METHODS

This hospital based prospective study was carried out for a duration of 1 year from September 2018 to September 2019 among 21 patients of tubotympanic type of chronic otitis media between the age group of 15-60 years, in the Department of Otorhinolaryngology and Head & Neck Surgery in a tertiary care centre Assam.

Ethical Considerations

Permission to conduct this study has been obtained from the Institutional Ethics Committee (Human) of Assam Medical College, Dibrugarh, before starting the study.

A written informed consent was obtained from all the individual participants included in the study.

Sample Selection

All the cases of tubo-tympanic type of chronic otitis media (COM) attending the Out Patient Dept. (OPD) & Inpatient Dept. (IPD) of Department of Otorhinolaryngology and Head

& Neck Surgery in a Tertiary care centre Assam., during the study period and fulfilling the selection criteria were included in the study.

Inclusion Criteria

1. Unilateral CSOM of safe or tubotympanic type.
2. Ear should be dry minimum for 6 weeks with intact ossicular chain.
3. Conductive hearing loss.
4. Non healed traumatic perforation.
5. Patients requiring revision surgery for failed myringoplasty or type 1 tympanoplasty.

Patients having ossicular dysfunction, safe CSOM with mixed hearing loss, or any systemic disorders like diabetes mellitus were excluded from the study. Permission has been obtained from the Institutional Ethics Committee (Human) of Assam Medical College, Dibrugarh, before starting the study. The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010. The informed written consent was taken from all the participants of the study.

Preoperative Work Up

A written informed consent has been obtained from all the patients before surgery, explaining the procedure, possible outcomes and complications. All the patients included in the study population has been pre-operatively subjected to thorough history taking, detailed clinical examination including tuning fork tests, otoscopic examination, examination under microscope, audiometric investigation in the form of pure tone audiometry & radiological investigation. Pure tone audiograms of the patients were obtained preoperatively to record the hearing threshold and the air bone gap (ABG). Radiological evaluation of the mastoid has been done by X-Ray Mastoid/HRCT Scan of temporal bone, as required. Each patient chosen for this study has been initially managed with conservative approach like aural toileting & antibiotics in an attempt to achieve dry ear for a minimum duration of 6 weeks. After the diagnosis has been made the surgical plan of management was formulated. Haematological and other systemic investigation for the purpose of anaesthetic work up has been carried out, as required.

Surgical Technique

Type 1 tympanoplasty was performed with cartilage palisade technique in the selected cases via underlay technique, using the cartilage graft harvested from the tragus. Local anaesthesia was achieved by using 2% lignocaine with 1:1,00,000 adrenaline after negative skin test. Sedatives (pentazocine and promethazine injections) and analgesics (diclofenac injection) were used while doing the procedure under local anaesthesia. General anaesthesia was used in

apprehensive patients.

The graft was harvested from the tragal cartilage. For this, a 10-15 mm incision was made over the skin on the medial side of the tragus 2-3 millimeter below the dome of the tragal cartilage in one sweep through the skin and perichondrium. Then the cartilage was separated medially from the skin and soft tissue using scissors in such a way that the perichondrium remains intact on one side as shown in Figure 1(a). The wound was then closed with 3-0 nylon sutures. The harvested graft was then carefully thinned under microscope by slicing and the perichondrium was maintained on one side as shown in Figure 1 (b, c). Then, this composite graft was cut into 0.5-2 mm wide strips using a stainless surgical blade of size 15. The number and width of the strips depended on the size and shape of the perforation.

The middle ear was then gently packed with one or two small pieces of absorbable gel foam soaked in antibiotic solution. The graft placement was done by underlay technique in all the 21 cases. The first strip was placed anterior to the handle of malleus and the remaining strips were placed posterior to it in a palisade fashion. All palisade strips were placed with the perichondrium side facing laterally with the bare cartilage side facing the middle ear as shown in Figure 2(a). The tympanomeatal flap was repositioned over the cartilage palisade assembly and the canal was gently packed with absorbable gel foam impregnated with topical antibiotic ointment. Ribbon gauge soaked in antibiotic ointment was then gently packed into the external auditory canal in the form of aural packing.

Follow Up

Cases were discharged on the next day or on the 2nd post-operative day with 7 days oral antibiotic and antihistaminic course. Patients were advised to abstain from forceful nose blowing, exposure to cold & swimming. During the early post-operative period, antibiotic ear drops were prescribed & patients were asked to keep a clean cotton ball in their ear, & replace it as necessary until their next follow-up appointment. At the first follow up on 10th post-operative day, external auditory canal pack was removed and examined under microscope as shown in Figure 2(b). Second follow-up was done at 6th week and the third follow-up was done at 12th week with examination under microscope to record graft status, dryness of ear. At 12th week, PTA was done to compare the preoperative and postoperative hearing as well as to calculate the ABG closure to determine the gain in hearing. This audiological assessment was done at speech frequency of 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz.

RESULTS

An analysis of the surgical outcome of 21 patients suffering from tubotympanic type of chronic otitis media who underwent type I tympanoplasty using cartilage palisade technique, was done at Department of Otorhinolaryngology

and Head & Neck Surgery in a Tertiary care centre Assam. The results and observation of the study are as follows:

The age distribution of the patients who were operated with type 1 tympanoplasty using palisade cartilage technique is 15-20 years 19.5%, 21-30 years 42.86%, 31-40 years 14.29%, 41- 50 years 4.76%, 51-60 years 19.4%. Among all the 21 cases, most of them belong to the 21-30 years age group (42.86%). Out of all the 21 cases, 10 were male patients whereas, 11 were female patients (Male:Female = 1:1.1). Most of the patients in our study belongs to rural population.

Out of the 21 cases, 10 patients (47.62%) presented with both ear discharge and hearing loss together. 6 patients (28.57%) presented with ear discharge only. Only hearing loss was found in 5 patients (23.81%). Hence, the most common presenting feature was ear discharge in this study.

At the time of presentation to outpatient/ inpatient department out of the 21 cases, 11 patients (52.38%) presented with mucoid discharge, whereas 5 patients (23.81%) presented with mucopurulent discharge and the rest of the 5 patients (23.81%) presented with no discharge. Majority of the patients (47.62%) presented with a large perforation.

The mean preoperative air conduction (AC) threshold of the cases was found to be 44.76 ± 7.82 dB, whereas the mean bone conduction (BC) threshold was found to be 13.48 ± 3.40 dB and the mean preoperative air bone gap (ABG) was found to be 31.29 ± 6.81 dB with p value 0.00000000857548 ($p=0.000$), which is highly significant as mentioned in Table 1.

The most common immediate postoperative complication was pain and headache affecting 7 patients (33.33%) among the 21 cases. Next common complication was nausea and vomiting affecting 3 patients (14.29%), followed by giddiness affecting 1 patient.

At 3rd follow up on 12th week the mean post-operative AC threshold was found to be 27.71 ± 6.97 dB, whereas the mean post-operative BC threshold was found to be 12.76 ± 2.96 dB. The mean post-operative ABG was found to be 14.95 ± 5.36 dB with p value of 0.00000000917707 ($p=0.000$), which is highly significant as mentioned in Table 1.

Audiological Assessment	Pre-operative	Post-operative	P- Value
Mean Air Conduction (AC)	44.76 ± 7.82	27.71 ± 6.97	0.00000000857548
Mean Bone Conduction (BC)	13.48 ± 3.40	12.76 ± 2.96	0.065184982
Mean Air-Bone Gap (ABG)	31.29 ± 6.81	14.95 ± 5.36	0.00000000917707

Table 1. Outcome of Surgery on the Basis of Audiological Assessment

Post-Operative Assessments	1 st Review (10 th Day)	2 nd Review (6 th Week)	3 rd Review (12 th Week)
Successful Graft Uptake	21*	16	20
Partial Graft Uptake	—	4	—
Graft Rejection	—	1	1
Total	—	21	21

Table 2. Distribution of Patients on the Basis of Graft Status on 2nd and 3rd Follow up (at 12th Week)

*On removal of the aural packing on 10th post-operative day, the graft and gel foam were found in-situ without any discharge or localized infection in all the 21 cases.

At 3rd follow up, most of the patients (61.90%) had an ABG closure of 11–20 dB. The mean ABG closure signifying the gain in hearing was found to be 15.75 ± 6.95 dB.

All the 21 patients had the graft and gel foam in-situ without any discharge or localized infection at the 1st follow-up on 10th post-operative day. At the 2nd follow up on 6th week, 16 patients showed successful graft uptake, while 4 patients showed partial graft uptake. Graft rejection was seen in 1 patient at the 2nd follow-up. At the 3rd follow-up on 12th week, 20 patients (95.24%) showed successful graft uptake while 1 patient (4.76%) showed graft rejection. Among those 20 patients, none of them had developed retraction of the tympanic membrane as mentioned in Table 2.



Figure 1 (a, b, c). Harvesting the Tragal Cartilage



Figure 2. (a) Graft Placement in Palisading Manner; (b) Neotympanum; (c) Post-Operative Scar on Medial Aspect of Tragus

DISCUSSION

In terms of age distribution of the patients, our study seems to be in correspond with other studies conducted by Shweta Gupta et al.², L K Yadav et al.⁴ The female preponderance in our study is also in accordance with other studies conducted by Irfan Ul Shamas et al.⁵ Nael M Shoman.⁶

Richa Gupta et al.⁷ conducted a study on clinical and epidemiological profile of chronic suppurative otitis media at a tertiary care center and found that most of the patients were from rural background (65.04%) which is also consistent with our study.

In our study, overall presentation reflects that ear discharge was more common than hearing loss among the cases. Arunabha Sengupta et al.⁸ E.S. Kolo et al.⁹ have also reported similar findings in their studies.

Each of the 21 patients chosen for our study was initially managed with conservative approach like aural toileting & antibiotics in an attempt to achieve dry ear for a minimum duration of 6 weeks prior to the surgery. While conducting a multivariate analysis of otological, surgical and patient related factors in determining success in myringoplasty K. Onal et al.¹⁰ found that, a longer dry ear for at least 1 month prior to the surgery is a relatively significant prognostic

factors positively influencing the success rate of myringoplasty.

Shweta Gupta et al.² conducted a study of anatomical and audiological outcomes of cartilage palisade type 1 tympanoplasty and found that, the mean preoperative ABG and the mean postoperative ABG in their study was 33.27 ± 4.29 dB and 12.67 ± 5.68 dB respectively, which is in accordance with our study.

In a study conducted on the post-operative outcomes of type 1 tympanoplasty using cartilage palisades as graft, Ashish Vashishth et al.¹¹ reported that, the mean ABG pre- and post-operatively in the cartilage palisade group was 29.00 ± 6.21 dB and 7.33 ± 3.88 dB respectively with an improvement in ABG of 21.67 ± 6.73 dB and a highly significant results of $p = 0.000$. C. Uzun et al.¹² in a study on cartilage palisade tympanoplasty found a statistically significant results of $p=0.0001$ on comparing the pre-operative ABG of 31 dB with post-operative ABG of 20 dB. In our study also, while comparing the mean pre-operative and post-operative ABG a highly significant result was found with $p = 0.000$. Andreas Neumann et al.¹³ evaluated the morphologic and functional long-term results of palisade cartilage tympanoplasty in a retrospective study design. In their study the average PTA-ABG decreased from 28 dB to 13 dB after surgery with a closure of 15 dB. This finding is also consistent with our study. Similar results were reported from other studies on the same subject done by, Poonam KC¹⁴, Cem Ozbek et al.¹⁵ showing effective outcome without hampering the hearing gain post operatively.

Ronald G Amedee et al.¹⁶ used cartilage palisades to perform type 1 tympanoplasty and found 100% graft take up rate. Kazikdas et al.¹⁷ conducted a study on palisade cartilage tympanoplasty for management of subtotal perforations and they achieved 95.7% graft take rate, which also corresponds with our study. A high graft uptake rate of 95.24% in our study is also in accordance with other studies conducted by Shweta Gupta et al.² Poonam KC¹⁴, Cem Ozbek et al.¹⁵

Nael M Shoman attributed the high success rate of palisade cartilage myringoplasty to a number of factors. Firstly, the preservation of perichondrium intact on the cartilage adds flexibility as it allows for contouring to the perforation margin, and overlap between adjacent grafts. Juxtaposing the cartilage grafts provides union between adjacent perichondrium via tissue fluid. Perichondrium also helps with cartilage nourishment via diffusion, potentially improving the long-term graft survival. Finally, maintaining perichondrium only on the lateral aspect of the graft helps minimize the risk of adhesions in the middle ear.⁶

Cartilage grafting is considered to alter the acoustic transfer characteristics due to its stiff nature and increased mass. However, Dirk Mürbe et al.¹⁸ proved in their experiment that, slicing 1-mm-thick cartilage into palisades or thin plates reduce the stiffness, leads to decreased first resonance frequencies and increased amplitudes which only slightly affect the transfer characteristics.

H. Bhattarai¹⁹ stated that, vibration characteristics of cartilage, especially if thinned or used in the form of

palisades, are close to normal tympanic membrane with comparable hearing results. Palisade reconstruction of TM facilitates its mobility and decreases the acoustic impedance in comparison with larger pieces of cartilage.

While A. Neumann et al.²⁰ found that, using the cartilage of thickness value of 0.5 mm is suitable for good sound transmission characteristics, Shweta Gupta et al,² Irfan Ul Shamas et al.⁵ used full thickness cartilage in their study.

Only one patient (4.76%) in our study failed to uptake the graft. She was a 60-year-old female hailing from a rural background with a poor socioeconomic status presented with a subtotal perforation. Nael M. Shoman⁶ reported upon analysing his case series on palisade cartilage myringoplasty that, only subtotal perforations showed a statistically significant relationship with unsuccessful outcome ($p=0.04$). This finding seems to be relevant with our study. B. J. Singh et al.²¹ proposed that, causes of graft failure may be older age group, infection despite antibiotic coverage, poor hygiene, respiratory tract infection producing cough and sneezing leading to graft displacement apart from the poorer blood supply and less attachment with the rim in cases of larger perforations. In our study, the patient with graft failure also reported to have developed an upper respiratory tract infection (URTI) 2 weeks after the surgery.

Nael M Shoman⁶ reported in his case series on clinical and audiometric outcomes of palisade cartilage myringoplasty that, the most common complication noted was post-operative nausea and vomiting followed by vertigo. Temporary facial nerve weakness was noted in two patients in their study. Perichondritis was noted in few cases by Nikhil Arora et al.²² while doing the procedure. None of the patients in our study developed any other complications like, donor site hematoma, giddiness, ear discharge, facial palsy and perichondritis of tragus. It is worth mentioning the cosmetic supremacy of this technique as the scar formation at graft harvesting site is behind the tragus as shown in Figure 2(c). Limitations

A smaller sample size and a shorter duration of follow up are some of the limitations of this study.

CONCLUSIONS

High graft uptake rate and highly significant audiometric outcomes in our study emphasises upon the usage of cartilage graft after slicing and palisading, in the reconstruction of tympanic membrane without compromising the acoustic transfer characteristics. Hence, palisade grafting can be used as a first choice in type 1 tympanoplasty even in primary cases without any significant complications.

The limited number of cases and consequently a shorter duration of follow up period are some of the limitations associated with this present study. Hence, drawing a definite conclusion from this study would not be doing justice to the concerned procedure in terms of other available techniques. However, studies with larger sample sizes with a longer follow up period in the subject could draw adequate conclusions in the near future.

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