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COMPARATIVE STUDY OF RESULTS OF CARTILAGE-PERICHONDRIUM VS TEMPORALIS FASCIA GRAFTING IN ACTIVE TUBOTYMPANIC TYPE OF CHRONIC SUPPURATIVE OTITIS MEDIA

Rajeev Reddy¹

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ABSTRACT: Temporalis fascia has long been regarded as the ideal graft material for tympanic membrane repair. However it often does not seem to withstand negative middle ear pressure in the post-operative period. Tragal cartilage with perichondrium would appear to be a better graft material with good hearing outcome. It can be obtained easily with cosmetically acceptable incision. In the present study, we have compared the graft properties of Temporalis fascia versus Tragal cartilage perichondrium with respect to healing, hearing and rate of postoperative retraction or re-perforation. 132 patients of chronic otitis media with pure conductive hearing loss were posted for tympanoplasty. Temporalis fascia graft was used in 71 patients and cartilage perichondrium (composite graft) was used in 61 patients. Post-operative healing, hearing and rate of retraction or re-perforation were compared for both the graft materials. All the patients were followed up for 2 years. Patients where temporalis fascia graft was used, 60 (84.5%) showed a good neotympanum, 7(9.85%) had re-perforation and 5(7.04%) had retraction pockets. Patients where tragal cartilage perichondrium was used, 60(98.36%) showed a healed tympanic membrane and only 1(1.63%) had re-perforation. None of the patients showed retraction pocket or cholesteatoma. Postoperative hearing was assessed 6 months after surgery. Patients with temporalis fascia graft showed an air bone gap of less than 10 dB in 49 (82%) patients and more than 10 dB in 11(18%) patients. Air bone gap closure with tragal cartilage perichondrium was less than 10 dB in 45(78%) patients and more than 10 dB in 13 patients (122%). Tragal cartilage perichondrium (<0.5 mm) seems to be an ideal graft material for tympanic membrane in terms of postoperative healing and acoustic properties. It can easily withstand negative middle ear pressure which may have contributed to the development of otitis media and significantly affect healing outcomes in postoperative period. Tragal cartilage being composed of collagen type II is also physiologically similar to the nature of the tympanic membrane.

KEYWORDS: Tragal cartilage perichondrium - Temporalis fascia Tympanoplasty Collagen type II.

INTRODUCTION: Temporalis fascia has long been considered as the ideal graft material for tympanic perforation due to its healing and acoustic properties. The first closure was achieved by pedicled skin flap by Mortiz^[1] in 1950. Thereafter, various materials were used e.g. free skin graft, vein graft, dura etc. Heerman^[1] was first to consider temporalis fascia as a grafting material. Storrs^[1] successfully employed it thereafter. The concept of grafting tragal cartilage and perichondrium was introduced by Good hill.^[1]

The ideal grafting material used for tympanic membrane closure should meet certain criteria namely, low rejection rate, sufficient quantity, good tensile strength, conductive properties similar to that of tympanic membrane and easy availability. Membranous grafts like temporalis fascia and perichondrium meet these criteria and result in closure of tympanic membrane perforation in 95% of

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ears with normal ventilation. However, in situations such as recurrent perforation, total perforation, and chronic mucosal dysfunction or severe atelactatic tympanic membrane, fascia and perichondrium may undergo atrophy and result in graft re-perforation.^[2,3] Cartilage perichondrium would theoretically work well in these conditions, being tougher and easily neovascularised. The incorporated cartilage would give it the necessary stiffness and mechanical stability to avoid retraction. Also, it has a low metabolic rate and good acceptance in the middle ear.^[4,5] Concerns have been raised about stiff nature of cartilage, as it could reduce the vibratory properties of neotympanum. However, adequate thinning of the cartilage seems to overcome this problem. In our study, we have compared the grafting and acoustic properties of temporal fascia with cartilage - perichondrium (composite graft) especially in ears with large perforation and an unfavorable Eustachian tube function.

AIM:

1. To compare the results of healing of temporalis fascia versus cartilage perichondrium as a graft material in tympanoplasty.
2. To compare the results of post-operative hearing using temporalis fascia and cartilage perichondrium graft.
3. To compare the rate of post-operative retraction or re-perforations of neotympanum in both.

MATERIALS AND METHODS: 132 patients of chronic otitis media with pure conductive hearing loss without any complications and without any other septic foci were selected between Jan 2011 and Jan 2014. 65(49.24%) were males and 67(50.78%) were females. The age group was from 12 to 60 years. Other medical conditions like diabetes mellitus, hypertension and bronchial asthma were managed medically simultaneously. All patients were subjected to examination under microscope, pure tone audiometry, routine investigations and X-rays. Patients with pure conductive hearing loss were selected.

The pre-operative pure tone audiometry showed an Air-Bone gap of 15-20 db in 32(24.24%) patients, 30-40 db in 44(33.33%) patients and >40 db loss in 56(42.42%) patients. Patients with ossicular dysfunction, bilateral disease or external ear pathology were excluded from the study. Patients were posted for tympanoplasty, once their ear became dry for at least 6 weeks. They were divided into two groups:

Group A: Temporalis fascia graft (n = 71)

Group B: Tragal cartilage with perichondrium (n = 61).

Local anesthesia was used for 102 patients and general anesthesia was used for 30 patients during surgery. Temporalis fascia or tragal cartilage with posterior layer of perichondrium was harvested. Anterior layer of perichondrium was not included in graft. The tragal cartilage was thinned to <0.5mm and the perichondrium were spread out laterally giving it a "Fried egg appearance". After exposing the middle ear and checking the ossicular integrity and mobility, the perforation was closed using the graft material. For large perforations or anterior perforations with small anterior rim, we used the "anterior tucking technique". A small incision in the skin of anterior canal wall 2-3 mm lateral to the annulus with the help of an angled knife was made. Subsequently, a

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tunnel to the middle ear cavity was developed after limited lifting of the annulus. By using a cartilage plate with a strip of perichondrium still attached, the perichondrial part of the graft was pulled through this tunnel by using a small hook. This gives a mechanically stable reconstruction in this area. Underlay technique with perichondrium on lateral side was used in all patients. Any patient requiring ossiculoplasty were excluded from the study. Post-operatively antibiotics, anti-inflammatory, nasal decongestants and eardrops were used. Patients were followed up at 2 weeks, 6 weeks, 3 months, 6 months, 1 year and 2 years interval. Postoperative audiogram was done after 6 months of surgery.

Photo 1: Post-operative retraction pocket with Temporalis fascia grafting

RESULTS: 132 patients of chronic otitis media underwent tympanoplasty for eradication of the disease and repair of the tympanic membrane with temporalis fascia (n = 71) or tragal cartilage with perichondrium (n = 61). The patients were followed up regularly for 2 years. 6 months post operatively, in patients where temporalis fascia was used as graft material, 68(95.77%) showed formation of a neotympanum (Photo 4), whereas 3(4.22%) had re-perforation. In patients where cartilage perichondrium was used, 60(98.36%) showed a good neotympanum, while only 1(1.63%) has re-perforation. No cases of retraction were seen. 2 years post operatively, 60(84.5%) patients with temporalis fascia graft showed a good neotympanum, 7(9.85%) had re-perforation and 5(7.04%) had retraction pockets (Photo 1). Patients where tragal cartilage perichondrium was used, the results were consistent i.e. 60(98.36%) showed a healed tympanic membrane and only 1(1.63%) had re-perforation. None of the patients showed retraction pocket or cholesteatoma (Table 1).

Postoperative hearing was accessed 6 months after surgery. Patients with temporalis fascia graft showed an air bone gap of less than 10 dB in 49 (82%) patients and more than 10 dB in 11(18%) patients. Air bone gap with tragal Cartilage perichondrium was less than 10 dB in 45(78%) patients and more than 10dB in 13 patients (Table 2).

	Temporalis fascia (n = 71)		Tragal cartilage perichondrium (n= 61)	
	6 MONTHS	2 YEARS	6 MONTHS	2 YEARS
Neotympanum	68 (95.77%)	60 (84.50%)	60 (98.36%)	60 (98.36%)
Re-perforation	3 (3.422%)	7 (9.85%)	1 (1.63%)	1 (1.63%)
Retraction	0	5(7.04%)	0	0

Table 1: Graft Take Up

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Air Bone gap Closure	Temporalis Fascia (n=60)	Percentage	Tragal Cartilage Perichondrium (n=58)	Percentage
< 10dB	49	82	45	78
>10dB	11	18	13	22

Table 2: Comparative results of post-operative hearing using Temporalis fascia and tragal cartilage perichondrium on 2 years follow up

DISCUSSION: Chronic mucosal otitis media implies a permanent abnormality of the pars tensa. It is usually a result of earlier active otitis media or otitis media with effusion. Surgery is relevant in patient with active or inactive chronic otitis media. Wullstein coined the term Tympanoplasty in 1953. Tympanoplasty is "any operation where the tympanic membrane is reconstructed with or without reconstruction of the ossicular chain". In tympanoplasty, the grafting of the tympanic membrane can be done with homologous, autologous or xeno graft material. Numerous graft materials have been tried to reconstruct the tympanic membrane.

The most popular materials used are temporalis fascia and perichondrium, whereas cartilage and composite grafts have lately gain more acceptance in cases of recurrence or total perforation, severe atelectatic ears or cholesteatoma cases.^[4] The pre requisites for a successful tympanoplasty are Repair of defect so as to close the tympanic cavity. Thus, prevents recurrent middle ear infection. Neotympanum should be able to resist middle ear pressure changes in Eustachian tube dysfunction where the perforation is large.

The acoustic properties of the neotympanum should be similar to a healthy tympanic membrane⁶.

The nourishment of cartilage is by diffusion with the help of perichondrium. Hence for the viability of the cartilage, perichondrium on at least one side should be intact. There is alteration in shape and size of cartilage with time. It was seen that though the cartilage becomes non viable, it remains functional. There is gradual replacement of cartilage with fibrous tissue and deeper proliferation of blood vessels. Sufficient nourishment of the grafted material is ensured because cartilage and chondrocytes are bradytrophic tissues. This fact is supported by low metabolic rate of cartilage in general and the ability of receiving nutrients by diffusion. This is extremely important in the early postoperative weeks in which nourishment is absent, and fibroblasts, like in fascia, which requires fresh blood circulation for survival, would become a vital.

Many patients have undergone fascia grafting in an attempt to recreate fibrous layer and thereby strengthen the drum, but in patients with chronic Eustachian tube dysfunction, this tympanic membrane retracts and adheres again to promontory, thus increasing the rate of cholesteatoma. In these cases, cartilage perichondrium gives better results than temporalis fascia or perichondrium alone.⁽⁹⁻¹¹⁾ because of its higher mechanical stability against middle ear pressure changes. Incidence of post operative retraction pocket are seen less frequently with cartilage.^(3, 12, 13)

Cartilage can be inserted in the form of several parallel, full thickness strips (palisade technique) or as a single plate of different sizes and shapes (island technique, book cover technique, etc.). Over bosch in 1971 was first to describe a micro slice technique to improve the acoustic properties of the reconstructed tympanic membrane. He cut the cartilage by a dermatome into plates with thicknesses of 0.2-1 mm.^[18] The placement of the cartilage also determines the influence of its stiffness on the acoustic behavior of the reconstructed tympanic membrane. If the cartilage strips or plates are suspended in between the osseous annular rim, the acoustic transfer characteristics of the

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tympanic membrane are determined by the stiffness. A small cartilage plate that is placed only on the top of prosthesis, with a regular tympanic membrane surrounding it, influences the vibrational characteristics, mainly by its mass, because the stiffness of the membrane is determined by surrounding tympanic membrane remnant.

Cartilage slices <0.5 mm thick are similar to the tympanic membrane in their acoustic properties. In a normally ventilated middle ear, a cartilage plate of thickness <0.5 mm possesses sufficient mechanical stability and low acoustic transfer loss. In aerated middle ear without any risk factors, thinner cartilage plates can be used (0.1-0.3 mm). However, in cases of tubal dysfunction, the stiffer cartilage plates of >0.5 mm layer thickness may be more advantageous from a mechanical point of view. Temporalis fascia and perichondrium alone often fails as graft material for tympanic membrane reconstructions because of their low mechanical stability and tendency to atrophy over the years.^[7,8] The "Take" rate for these materials ranges between 86 and 97%.

The advantages of cartilage are high mechanical stability and long lasting vitality ever years after surgery. The success rate of "take up" by using cartilage grafts is reported up to 100% [24-30]. In our study, all the patients were followed up for 2 years. Patients where temporalis fascia graft was used, 60(84.5%) showed a good neotympanum, 7(9.85%) had re-perforation and 5(7.04%) had retraction pockets. Patients where tragal cartilage perichondrium was used, 60(98.36%) showed a healed tympanic membrane and only 1(1.63%) had re-perforation. None of the patients showed retraction pocket or cholesteatoma.

Fascia and perichondrium display acoustic properties similar to those of tympanic membrane. This might be a reason for the good hearing results after myringoplasty with airborne gaps <30 dB in 90% of the cases, when these materials are used.^[18] But they may not withstand negative middle ear pressure in the postoperative period causing retraction and re-perforation. For optimal acoustic transfer behavior, the cartilage should be cut as thin as Springer possible. The cartilage plates with the thickness of 0.5mm show stiffness similar to that of healthy tympanic membrane and might be considered an acceptable compromise between satisfactory acoustic properties and sufficient mechanical stability. In our study, Postoperative hearing was accessed 6 months after surgery. Patients with temporalis fascia graft showed an air bone gap of less than 10 dB in 49(82%) patients and more than 10 dB in 11(18%) patients. Air bone gap closure with tragal cartilage perichondrium was less than 10 dB in 45(78%) patients and more than 10 dB in 13 patients (22%).

CONCLUSION: It would be worthwhile therefore to consider tragal perichondrium cartilage as suitable alternative to temporalis fascia. The key seems to be the use of cartilage of appropriate thickness. This would not hamper conduction of sound while protect from retraction or re-perforation of the neo tympanum. Perichondrium is a tough graft material showing good revascularization. The incorporation of cartilage in perichondrium as a composite would counter-act negative middle ear pressure. This is of paramount importance in poor Eustachian tube function and in ears with a large perforation.

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AUTHORS:

1. Rajeev Reddy

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of ENT,
K.B. N. Institute of Medical Sciences.

**NAME ADDRESS EMAIL ID OF THE
CORRESPONDING AUTHOR:**

Rajeev Reddy,
Ruby ENT Center,
Opp. Catholic Church, Anand Nagar,
Gulbarga – 585103, Karnataka, India.
E-mail: drrajeev_ruby@yahoo.com

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