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Assessment of anterior tucking and cartilage support tympanoplasty to Evaluate graft uptake and hearing outcome

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Abstract
Advantages of the lateral graft technique include wide exposure and versatility for larger perforations and for any needed ossicular reconstruction. Disadvantages include the requirement of a higher technical skill level, a longer operative time, slower healing rate, and the risk of blunting and lateralization of the graft. The lateral graft technique is championed by the some doctors as a technique more suited for total drum replacement. Based on the above literature findings the present study was planned to evaluate the anterior tucking and cartilage support tympanoplasty with respect to graft uptake and hearing outcome.
The present study was planned in the Department of Otorhinolaryngology (ENT), Nalanda Medical College & Hospital. Total 50 patients referred to the ENT department from March 2016 to September 2017 for chronic otitis media (COM) having tubo-tympanic type of disease were enrolled in the present study. The cases were taken up for Anterior Tucking (AT) and Cartilage Support (CS) Tympanoplasty for the treatment.
This study was aimed to compare the effect of the two methods on the graft uptake and hearing improvement. The study concludes that the Anterior Tucking type of tympanoplasty shows statistically better hearing improvement as compared to that of Tragal Cartilage Support method.

Keywords: anterior tucking, cartilage support, tympanoplasty, cortical mastoidectomy

Introduction
Tympanoplasty is a surgical technique to repair a defect in the tympanic membrane with the placement of a graft, either medial or lateral to the tympanic membrane annulus. The goal of this surgical procedure is not only to close the perforation but also to improve hearing. The success of the operation depends on the ability to eradicate disease from the middle ear (eg, inflamed granulation tissue and cholesteatoma). Various techniques have been developed and refined, and a number of grafting materials are available. Both the lateral and medial grafting techniques are detailed below. Tympanoplasty is a safe and effective outpatient procedure used to both eradicate disease from the middle ear and restore hearing and middle ear function [1, 2].
A number of surgical approaches and grafting techniques are available for use by the surgeon. Paramount to success are the preoperative assessment, good hemostasis intraoperatively, and thoughtful surgical planning with careful placement of the graft.
The outer epithelial layer is composed of stratified squamous epithelium, which is continuous with the skin of the external auditory canal. This is significant because in-growth of this outer epithelial portion through the perforation can result in an epithelial cyst called an acquired cholesteatoma. Untreated, this cyst then releases destructive enzymes that can enlarge the size of the perforation and ultimately cause ossicular erosion. The lateral grafting technique that is discussed later in this text requires that this entire epithelial layer be stripped from the drum remnant prior to placement of the graft so as to avoid iatrogenic cholesteatoma formation.
The middle fibrous layer is composed of connective tissue consisting of outer radial fibers and inner circular fibers. It provides strength to the drum. A healed perforation is also commonly deficient of this middle fibrous layer. The epithelial and endothelial layers regenerate creating a "dimeric" membrane. This miscalculation can be corrected when carefully examined under binocular microscopy. Because this middle layer is absent in the pars flaccida superiorly, the posterior-superior aspect of the drum can be drawn inward toward the middle ear as a retraction pocket.
The inner layer of the tympanic membrane consists of simple cuboidal and columnar epithelium cells. This layer is identical to the mucosal lining of the rest of the middle ear mucosal tissue and is considered to be critical to ensure healing of tympanic membrane perforations, and the surgeon often abrades or rasps the undersurface of the tympanic membrane remnant to stimulate regrowth.
Complications of the surgery include recurrence of the perforation, tympanic membrane retraction, otorrhea, cholesteatoma development, persistence or worsening of any conductive hearing loss, sensorineural hearing loss (rare), and taste disturbances. Post-auricular incisions are at risk for hematoma, and a mastoid pressure dressing is recommended for the first postoperative night. Outcomes can be optimized by a proper and detailed preoperative assessment and the careful construction of an effective surgical plan. The graft can fail because of infection, failure to pack the graft securely in place, technical error, failure to clear mastoid and middle ear disease, and because of a concurrent undetected cholesteatoma. Excising all tympanosclerosis at the edge of the perforation so as to

allow vascularized perimeters to incorporate the graft is critical.

When planning tympanoplasty, the surgeon must consider the location of the perforation (marginal versus central), and size (total versus subtotal). Areas of myringosclerosis and tympanosclerosis should be noted. Important comorbidities worth noting include craniofacial disorders and underlying environmental allergies or chronic allergic rhinitis. Critical factors that make tympanoplasty less successful include adhesive otitis media, severe eustachian tube dysfunction with either perforation of the contralateral ear or ongoing intermittent otorrhea, cholesteatoma, and previous surgical repair [3-4]. Various techniques and grafting materials can be used, and these are covered later. Which approach is used depends on the size and location of the perforation, the presence or absence of cholesteatoma or granulation tissue, the status of the ossicles and mastoid, other anatomical considerations (eg, narrow external auditory canals), as well as the surgeon's preference and expertise [5-6]. Examining the middle ear and ossicles and removing any elements of adhesions or cholesteatoma is critical. The chosen approach should provide optimal visualization of the perforation and tympanic membrane. One should be careful not to disrupt an intact and mobile ossicular chain if the hearing loss is only low-frequency conductive, as is often the case with hearing loss secondary to a perforation [7].

Although variations exist, 2 primary grafting techniques exist: medial grafting (or underlay) and lateral grafting (or overlay). These terms refer to the position of the graft in relation to the fibrous annulus, not to the malleus or tympanic remnant. The medial grafting technique is performed as described previously. The primary advantage of the medial graft technique is that it is quicker and easier to perform than lateral grafting. It also carries a high success rate (approximately 90% in experienced hands). The biggest disadvantage is its limited exposure and poor utility for larger perforations and its difficulty with repair of near-total perforations.

Advantages of the lateral graft technique include wide exposure and versatility for larger perforations and for any needed ossicular reconstruction. Disadvantages include the requirement of a higher technical skill level, a longer operative time, slower healing rate, and the risk of blunting and lateralization of the graft. The lateral graft technique is championed by the some doctors as a technique more suited for total drum replacement. Based on the above literature findings the present study was planned to evaluate the anterior tucking and cartilage support tympanoplasty with respect to graft uptake and hearing outcome.

Methodology

The present study was planned in the Department of Otorhinolaryngology (ENT), Nalanda Medical College & Hospital. Total 50 patients referred to the ENT department from March 2016 to September 2017 for chronic otitis media (COM) having tubo-tympanic type of disease were enrolled in the present study. The cases were taken up for Anterior Tucking (AT) and Cartilage Support (CS) Tympanoplasty for the treatment.

Type I tympanoplasty was done in all the patients. All surgeries were done under microscope. After infiltration of local anaesthesia with 2% lignocaine with adrenalin and painting and draping, post auricular Wilde's incision was taken. Temporalis fascia graft was harvested in all the cases. The middle ear was examined for the status of mucosa and ossicular chain continuity.

Both the groups shared the same operative steps till elevation of the posterior tympanomeatal flap. Then onwards different steps were followed in two different methods as described below.

1. Anterior Tucking (AT) method: Incision was taken on anterior canal wall just lateral to the anterior annulus and the anterior tympanomeatal flap was elevated. The graft was placed lateral to the handle of malleus and tucked medial to the annulus anteriorly and anterior and posterior tympanomeatal flap were reposited.

2. Cartilage Support (CS) method: Here the tragal cartilage was harvested in addition to the temporalis fascia. Tragal cartilage was denuded of its perichondrium and cut into a bow or a crescentric shape. This shape helps in proper alignment of the graft in relation to the Antero-superior middle ear space. No anterior flap was elevated but the temporalis fascia graft was placed over the antero-superiorly based tragal cartilage graft. Thus the tragal cartilage graft placed medial to the annulus in the Middle ear space not only supported the temporalis fascia graft, but prevented its medialisation also. Also, Cartilage held fascia in place, preventing a residual perforation due to graft mobilisation.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion criteria: Inclusion criteria were cases of tubotympanic type COM with subtotal perforation, where discharging ears were also included; patients with age group – 15 to 60 yrs.

Exclusion criteria: Patients with or who had following conditions were excluded cholesteatoma with atticoantral disease; hearing impairment more than 50 dB which indicate ossicular chain discontinuity; already undergone tympanoplasty or any other otologic surgery; sensorineural hearing loss.

Results & Discussion

A group of 25 patients was undergone for anterior tucking method and in remaining 25 patients (second group) tympanoplasty was performed using temporalis fascia as the primary graft, along with tragal cartilage graft used for providing support to it anteriorly. These patients were followed up for a period of 6 months and were evaluated for graft uptake and hearing improvement.

In the past, many techniques of grafting have been used. There have been many modifications and variations of the technique of tympanoplasty. Primrose and Kerr [8] described their techniques of closing the anterior marginal perforation, wherein a small tag was fashioned anteriorly and later pulled through a small tunnel under the anterior-superior annulus.

Palva described the surgical treatment of chronic suppurative otitis media (CSOM) using myringoplasty and tympanoplasty. His underlay "swinging door" technique was successful in 97% of the ears. Palva's "swinging door"

tympanoplasty was modified and reported by several surgeons including Glasscock, Fisch, Smyth, and Pennington. The basic technique involves the elevation of superiorly based and inferiorly based canal skin flaps, or "swinging doors."

A retrospective study of 200 cases was conducted by Moras *et al.* [9]. data were sourced from 200 patients who underwent tympanoplasty for CSOM, tubotympanic disease by 360° technique. The study showed an overall success rate of 96% for graft uptake. Eight patients (4%) were found to have a residual perforation.

In a study conducted by Burse *et al.* 2009 [10]. 50 clinically diagnosed cases were randomly divided into two groups of 25 each to be operated by anterior tucking method and cartilage support method of tympanoplasty. Successful graft uptake was observed in 96% of patients in both the groups but it was not statistically significant.

Table 1: Age & Sex of Study Groups

Groups	Group I	Group II
Method	C.S. method	A.T method
Total Cases	25	25
Age		
20 – 30 years	4	3
31 – 40 years	12	15
41 – 50 years	7	5
51 – 60 years	2	2
Gender		
Male	15	20
Female	10	5
Total	25	25

Table 2: Graft uptake

Groups	Group I	Group II
Method	C.S. method	A.T method
Total Cases	25	25
Graft uptake	25	23
Not taken	0	2
Total	25	25

Table 3: Complications Observed

Groups	Group I	Group II
Method	C.S. method	A.T method
Total Cases	25	25
Complications		
Yes	0	5
No	25	20
Total	25	25

Table 4: Patient's Hearing Improvement in Decibels

Groups	Group I	Group II
Method	C.S. method	A.T method
Total Cases	25	25
1 - 10 db	5	2
11 – 20 db	16	11
21 – 30 db	4	11
31 – 40 db	0	1
Total	25	25

Aarnisalo *et al.* [11]. have concluded that the placement of cartilage on the medial surface of TM reduces the motion of the TM that opposes the cartilage. These obvious local changes occur even though the cartilage had little effect on the sound-induced motion of the stapes. Mohamad *et al.* [12]. have concluded that tympanoplasty using cartilage with or without perichondrium has better morphological outcome than tympanoplasty using temporalis fascia. However, there was no statistically significant difference in hearing outcomes between the 2 grafts. Khan and Parab [13] have shown good anatomical and functional results using sliced cartilage for tympanoplasty technique. Chhapola and Matta [14] have mentioned that cartilage thickness of <0.5 mm is seen to have similar acoustic properties as the tympanic membrane.

This study was designed to evaluate results of tympanoplasty and to see if there is significant difference in hearing when cartilage shield tympanoplasty is used for reconstruction of tympanic membrane and also to note the graft uptake rates. Many patients of chronic otitis media in India have unhealthy middle ear mucosa and large, subtotal, or total perforations of the ear drum. This requires additional support for the graft material to increase chances of graft uptake. The current study was done in cases of mucosal disease to objectively evaluate results of tympanoplasty and to study if there is any difference in hearing improvement as cartilage is a thicker grafting material.

Conclusion

This study was aimed to compare the effect of the two methods on the graft uptake and hearing improvement. The study concludes that the Anterior Tucking type of tympanoplasty shows statistically better hearing improvement as compared to that of Tragal Cartilage Support method.

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