International Journal of Medical and Health Research
ISSN: 2454-9142
Received: 07-10-2019; Accepted: 09-11-2019
www.medicalsciencejournal.com
Volume 5; Issue 12; December 2019; Page No. 24-28

Clinical assessment of endoscopic cartilage myringoplasty and endoscopic temporalis fascia myringoplasty

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Abstract
Chronic Suppurative Otitis Media (CSOM) is a worldwide prevalent disease. Despite all the scientific advancement, CSOM is still considered as an important public health problem. Tympanic membrane perforation primarily results from middle ear infections, trauma and iatrogenic causes. Up to 80% of perforations heal spontaneously. The remaining required surgical repair known as Myringoplasty, an operation performed to repair or reconstruct the tympanic membrane. It was introduced by Berthold and was further developed by Wullstein and Zollner. Hence based on above findings the present study was planned Clinical Assessment of Endoscopic Cartilage Myringoplasty and Endoscopic Temporalis Fascia Myringoplasty.
The present study was planned in Department of ENT, Patna Medical College and Hospital, Patna. Total 40 patients were enrolled in the present study. Out of that Group A consist of 20 patients were undergone the myringoplasty using temporalis fascia. The remaining 20 patients were compared in Group B in that palisade cartilage was used as a graft material to close the tympanic membrane retraction with perforation.
The data generated from the present study concludes that comparative study of using temporalis fascia graft and palisade cartilage graft in myringoplasty surgeries for perforation of tympanic membrane, yielded a better graft take up and audiologically far better results with the palisade cartilage grafting technique.

Keywords: myringoplasty, cartilage, temporalis fascia, endoscopic, etc

Introduction
Myringoplasty is the closure of the perforation of pars tensa of the tympanic membrane [1, 2, 3]. When myringoplasty is combined with ossicular reconstruction, it is called tympanoplasty. The operation is performed with the patient supine and face turned to one side. The graft material most commonly used for the surgery is temporalis fascia. The tragal cartilage [1] and tragal perichondrium are also used as the graft by some surgeons.
Myringoplasty restores hearing loss in certain cases of tinnitus. The chances of re-infection and persistent discharge is less after surgery. Myringoplasty should not be performed if there is active discharge from the middle ear, or if the patient has uncontrolled nasal allergy, or when the other ear is dead and in children less than 3 years of age. Myringoplasty is often done under general anaesthesia, but it can be done under local anaesthesia also.
The temporalis fascia is grafted. An incision is made along the edge of the perforation and a ring of epithelium is removed. A strip of mucosal layer is removed from the inner side of the perforation. The middle ear is packed with gelfoam soaked with an antibiotic [2]. The edges of the graft should extend under the margins of the perforation and a small part should also extend over the posterior canal wall. The tympanomeatal flap is then replaced.
The temporal fascia is harvested. An incision is made to raise medial meatal skin with tympanic membrane epithelium. The graft is placed on the outer surface of the tympanic membrane and a slit is made to tuck it under the handle of malleus. The ear is packed with gelfoam and antibiotics [2], and the incision is closed. Finally mastoid dressing is performed.
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 [4, 5]. 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.
Perforations are most problematic when they cause both conductive hearing loss and chronic otorrhea. Although most perforations heal spontaneously, those that persist after dry ear precautions, ototopical drops, or myringoplasty should be considered for surgical repair. Tympanic membrane perforations can arise as sequelae of acute otitis media or chronic otitis media with or without cholesteatoma, as a complication of PE tube insertion, or as a result of barotrauma to the ear. Smaller perforations of the tympanic membrane can result in low-frequency hearing loss, while larger perforations can cause high-frequency and

low-frequency hearing loss. Chronic infections and cholesteatoma can also result from perforations of the tympanic membrane [6, 7]. A perforation is a significant risk for the development of otitis when swimming in lakes, rivers, oceans, or pools.

Cholesteatoma is an epidermal inclusion cyst that contains desquamated keratin and accounts for much of the morbidity of otomastoiditis. The in-growth of squamous cells into the middle ear through a perforation can result in an acquired cholesteatoma. Chronic otitis media can occur with or without cholesteatoma, and both varieties can present challenges to the clinician and barriers to the success of a tympanoplasty.

A complete discussion on the etiology and pathophysiology of cholesteatoma is beyond the scope of this article, but multiple theories exist on its etiology. One of the more common theories about how cholesteatomas form involves retraction of the pars flaccida from negative middle ear pressure, resulting in invagination of squamous epithelium into the middle ear and mastoid. Another theory suggests that cholesteatoma arises from ingrowth of epithelium through a perforation of the tympanic membrane.

The 2 other most popular theories involve hyperplasia of the basal layer of the tympanic membrane and metaplasia of middle ear mucosa. A number of complications of cholesteatoma are related to growth and bony erosion, including hearing loss (via erosion of ossicles and/or cochlea), labyrinthitis or labyrinthine fistula, facial nerve paresis, and intracranial complications.

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.

The peripheral edge of the tympanic membrane is rimmed by a dense fibrous layer called the annulus, which is essentially a thickening of the pars tensa. Successful elevation of the annulus is critical for medial grafting technique. The annulus is deficient superiorly at the "12 o'clock" location. This area is the notch of Rivinus and can guide the surgeon to a natural plane to elevate the annulus.

The ear canal has bone in the medial component (inner one-third). The lateral portion, which extends into the pinna, is composed of cartilage. The boney/cartilaginous interface is located at the medial two-thirds junction. Most incisions that are made to raise a tympanomeatal flap or perform either an endaural or transcanal approaches are made at this location as well. The superiorly placed vascular strip is another critical area within the ear canal. This region is demarcated by the tympanosquamous suture line superiorly and the tympanomastoid junction line inferiorly. Canal incisions are often made along these junctions.

The middle ear is an air-filled space bordered by the bony labyrinth of the inner ear medially, the tympanic membrane laterally, and the cranium superiorly. This space contains the ossicles, nerves (facial nerve, chorda tympani, Jacobsen nerve), small muscles (stapedius and tensor tympani), ligaments, and blood vessels. The petrous portion of the internal carotid artery and the internal jugular vein, which are both in proximity to the middle ear space, can be dehiscent and should be noted on any preoperative imaging. Rarely, middle ear pathology can involve these structures.

In order for successful grafting of the tympanic membrane to improve hearing, an intact ossicular chain must be present. The malleus transmits energy from the tympanic membrane to the incus, which itself is connected to the stapes superstructure resting on the oval window. Diarthrodial joints connect the 3 ossicles and allow the transmission of acoustic energy from the tympanic membrane to the inner ear. The incudostapedial joint is the most fragile and, hence, has the highest likelihood to require repair.

The middle ear communicates with the mastoid air cells via the mastoid antrum. The temporal bone air cells are usually pneumatized by 3 years of age. However, the air cells can remain underdeveloped and sclerotic in patients with persistent eustachian tube dysfunction. A poorly pneumatized or fluid-filled mastoid bone predisposes a patient to require a more extensive tympanomastoidectomy to improve the chances of successful graft placement.

The eustachian tube connects the middle ear with the nasopharynx and allows pressure equilibration in the middle ear. Enlarged adenoids or biofilms within this lymphoid tissue are hypothesized to predispose a patient to persistent middle ear disease. This bony-cartilaginous tube is approximately 45° from the horizontal in adults but only 10° from horizontal in infants. In addition, the infant eustachian tube is about 50% of the adult length.

The inner ear is composed of the cochlea, which is the end-organ for hearing, and the vestibular organs. The vestibular organs include the utricle, saccule, and the 3 semicircular canals and are involved in balance.

The indications and outcomes vary depending on the specific clinical problem. Success rates of tympanic membrane closure vary greatly in the literature (35-98%) but are usually greater than 80% and depend largely on the size and location of the perforation, surgical technique, and overall health of the middle ear [8, 10].

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.

Chronic Suppurative Otitis Media (CSOM) is a worldwide prevalent disease. Despite all the scientific advancement, CSOM is still considered as an important public health problem. Tympanic membrane perforation primarily results from middle ear infections, trauma and iatrogenic causes. Up to 80% of perforations heal spontaneously. The remaining required surgical repair known as Myringoplasty, an operation performed to repair or reconstruct the tympanic membrane. It was introduced by Berthold [11] and was further developed by Wullstein and Zollner. Hence based on above findings the present study was planned Clinical Assessment of Endoscopic Cartilage Myringoplasty and Endoscopic Temporalis Fascia Myringoplasty.

Methodology

The present study was planned in Department of ENT, Patna Medical College and Hospital, Patna. Total 40 patients were enrolled in the present study. Out of that Group A consist of 20 patients were undergone the myringoplasty using temporalis fascia. The remaining 20 patients were compared in Group B in that palisade cartilage was used as a graft material to close the tympanic membrane retraction with perforation.

The indication for surgery was the presence of a unilateral retraction with perforation, an intact ossicular chain, at least a one month dry period and normal middle ear mucosa. Patients who had history of previous ear surgery were excluded from this study. In the patients who underwent palisade cartilage myringoplasty, concha cartilage was used in all cases. The perichondrium was removed from one side of the cartilage, and the cartilage was then cut into several slices with, on average, four or five palisades placed in an over-under fashion (two placed anterior to the malleus handle and two or three placed posteriorly). The remaining perichondrium was left attached to the cartilage slices on the lateral side. The perichondrium layer removed at the beginning of the procedure was then laid on the cartilage palisades, so that all the unwanted small openings between the slices were covered to improve the healing process [12].

In the patients who underwent myringoplasty where the temporalis muscle fascia was used as a grafting material, the graft was harvested from the ipsilateral deep temporal muscle fascia and placed lateral to the long process of the malleus, and medial to the drum remnant and tympanic annulus. Gelfoam was placed both medial and lateral to the graft, and the wound was closed using absorbable sutures.

Postoperatively, the patients were evaluated in a regular clinical manner and audiometrically at a six month follow up appointment. A successful myringoplasty was defined as successful acceptance of the graft, and intact healing of the TM without perforation, retraction, or lateralization within a follow up period of six months from the operation. Auditory outcomes were evaluated using pure tone audiogram. Audiological data were gathered from the preoperative and postoperative audiograms of the patients.

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.

Inclusion Criteria were- (1) The patient should be willing to undergo concomitant bilateral ear surgery; (2) The tympanic membrane has a small to medium-sized central perforation with no active discharge from the middle ear. (3) Pure tone audiometry shows a hearing threshold of 40 dB or less (to rule out ossicular problems); and (4) There should be no active disease in the nose.

Exclusion Criteria- 1) A very narrow external auditory canal, impairing transcanal visualisation of the perforation; 2) The tympanic membrane showing a marginal perforation, an attic perforation and atticoantral disease or active discharge from the middle ear; aural polypi, cholesteatoma, ossicular erosion or evidence of sensorineural hearing loss; and 3) A hearing threshold of more than 40 dB.

Results & Discussion

The use of cartilage is experiencing a renaissance in ear surgery because it appears to offer extremely reliable method for reconstruction of the tympanic membrane in cases of advanced middle ear pathology and Eustachian tube dysfunction. In this short term study, patients with retraction with perforations, an intact ossicular chain, at least an one month dry period, and normal middle ear mucosa were included.

Table 1: Descriptive Statistics

Groups	Group A	Group B
Myringoplasty using	Cartilage	Fascia
No. of Cases	20	20
Age	23 – 46	35 – 36
Sex		
Males	8	10
Females	12	10
Pre op	42.3 – 52.6	44.3 – 52.1
Post of	24.6 – 34.8	21.5 – 41.1

Table 2: Re perforation

Groups	Group A	Group B
Myringoplasty using	Cartilage	Fascia
No. of Cases	20	20
Re perforation		
Yes	1	2
No	19	18

Singh B J *et al*. conducted a study on 220 cases of unilateral chronic suppurative otitis media with dry central perforation. Age group of the patients ranged from 8 to 70 years and myringoplasty was performed using 4 types of autogenous grafts. Grafting was done by underlay technique. Temporalis fascia, tragal perichondrium, areolar tissue and fat graft were used as graft materials. It was observed that best hearing improvement occurred using temporalis fascia [13].

M S Queraishi and Jones *et al*. conducted a study among 32 patients who underwent myringoplasty through permeatal approach using tragal perichondrium graft and the results were compared with a control group, matched for age and

for the size of their perforations, in whom temporalis fascia graft was used. The success rate was 94% in the perichondrial group as compared with 84% in the control group (there was no significant difference between 2 groups P>0.05) [14].

No perforations were found in patients following palisade cartilage myringoplasty, whereas there were four perforations in the patients who underwent temporalis fascia myringoplasty. In our study, auditory function in palisade cartilage myringoplasty patients was not statistically different when compared to the gains observed in the patients who underwent temporalis fascia myringoplasty. Other studies in the literature have also reported good or acceptable hearing results with cartilage grafting. Cagdas Kazikdas and colleagues [15] demonstrated that a comparison of the gains in mean speech reception threshold, air–bone gap, and pure-tone average scores between the palisade cartilage myringoplasty and temporalis fascia technique showed no significant differences. Following cartilage perichondrial composite graft myringoplasty, Levinson reported that 65% of his patients had closure of the air bone gap to within 10 decibel and 86% to within 20 decibel. In a study by Dornhoff [16], no significant differences were demonstrated in gains in auditory function in patients who had cartilage perichondrium grafting compared with patients who had grafts of perichondrium alone. Kirazli [17] and colleagues also found no significant difference between the audiologic results after cartilage perichondrium and temporalis fascia myringoplasty. Similarly, a study by Cabra and colleagues [18] observed no relevant differences between the functional results of the two procedures (palisade cartilage myringoplasty and temporalis fascia myringoplasty). The ideal acoustic thickness of cartilage should be approximately 0.5 mm. The full thickness is 0.7 to 1 mm. However, thinning the cartilage makes the reconstruction process more difficult due to the inevitable twisting of the cartilage. We applied full thickness cartilage in our procedure. Experimental histopathologic studies have shown that cartilage is stable because of the fibrile structure of the matrix, which is independent of the survival of cellular elements. Reconstruction of the tympanic membrane using the palisade cartilage technique in myringoplasties allowed us to achieve good anatomic and audiologic results that were at least similar, if not better than traditional methods of reconstruction in high-risk cases.

While temporal fascia graft was most successful, even tragal perichondrium grafts had quite high uptake rate. TF is readily available around the ear. It is thin and strong as well as sturdy in survival. Tragal perichondrium is quite close alternative available in plenty, draws its nutrition by diffusion and can be made into shape. Hearing outcomes were good for full thickness grafting of cartilage in the reconstruction of the tympanic membrane. Negative middle ear pressure in cases of Eustachian tube dysfunction and large perforation can be better countered using cartilage in perichondrium graft [19]. Cartilage, vein, fascia, and perichondrium are mesenchymal tissues devoid of organelles as in skin. Their use as tympanic graft should not pose risk of inducing cholesteatoma. Cartilage grafts nourish through diffusion from surrounding fluids and get fast incorporated in the tympanic membrane [20, 22]. Cartilage is more robust and less prone to resorption or retraction. In the atelectatic ear reconstitution with tragal perichondrium has better anatomic outcome than fascia. Cartilage may be used to construct posterior canal wall. Post-operative gain in air conduction, ABG closure is inferior to fascia group as perichondrium is more resistant to vibration than the human tympanic membrane

Great variability exists not only in surgical technique but also in its outcome throughout the world. It is an effective and simple procedure for the closure of tympanic membrane perforations. In patients early timely myringoplasty had good chances of restoring function with the potential for reducing further complications and deterioration [23].

Myringoplasty is a simple and effective procedure that results in the successful closure of the perforation in most cases, perforation of the tympanic membrane in children can cause significant disability. The myringoplasty will reduce the complications related to chronic supportive otitis media like, loss of hearing, persistent perforation syndrome, this demands the early closure of perforation. However there seems to be no consensus among ENT surgeons regarding the benefits of myringoplasty in children in relation to the age.

Conclusion

The data generated from the present study concludes that comparative study of using temporalis fascia graft and palisade cartilage graft in myringoplasty surgeries for perforation of tympanic membrane, yielded a better graft take up and audiologically far better results with the palisade cartilage grafting technique.

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