

Endoscopic Transcanal Cartilage Strengthening Tympanoplasty for Inactive Squamous Middle Ear Disease

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Abstract

Background: *Squamous Chronic Otitis Media (COM) may present as either a passive form (retraction pocket) or an active one (cholesteatoma formation).*

Aim: *To evaluate the efficacy of transcanal endoscopic cartilage tympanoplasty for strengthening the drum in inactive squamous middle ear disease (retraction pocket) using sliced tragal cartilage.*

Patients and methods: *This was a prospective study performed on twenty five individuals with inactive chronic otitis media squamous type (RPs) at Otorhinolaryngology department Al-Azhar University from August 2023 to August 2024.*

Results: *Regarding the comparison of improvement in air bone gap postoperatively, 3 and 6 months after tympanoplasty, the results were highly significant (p value below 0.01) as the mean air bone gap significantly declined from 24.5 dB preoperatively to 17.3 dB after 3 months, and another significant decline occurred after 6 months of tympanoplasty to 11.5 dB, with a mean difference of 13 dB. Regarding the outcome and success of graft among the studied cases, it was found that the success of graft was 92% (23 cases), and the failure rate was 8% (two cases had residual perforation, and zero cases had recurrent retraction).*

Conclusion: *We concluded from our study that transcanal endoscopic cartilage tympanoplasty was found to be effective and safe method with a low complications rate also hearing was improved after 3 and 6 months.*

Keywords: Inactive squamous middle ear disease; endoscopic transcanal cartilage; outcome

1. Introduction

COM may manifest as either an active form (frank cholesteatoma formation) or a passive form (retraction pocket). A retraction pocket may involve the posterior superior portion of the pars tensa or the pars flaccida. Pars flaccida and pars tensa cholesteatomas are both initiated as retraction pockets. It is believed that tubal dysfunction is the cause of the retraction pocket, which may lead to negative pressure in the middle ear and ultimately can result in cholesteatoma.¹

One abnormal invagination of the drum into the middle ear cavity that can develop as a result of COM is the retraction pocket of the

tympanic membrane.²

It can range from a limited retraction pocket to a marked retraction that results in the drum adhering to the promontory. Up till now, the etiology that explains the pathophysiology of the condition is not clear. It is frequently considered to be the end result of chronic otitis media with effusion.³

Classification of Retraction pocket:

The retracted membrane has been classified in accordance with the otoscopic description in the majority of cases. This description involves topography, ossicular chain relationships, fundus visibility, self-cleaning, retracted membrane mobility, otorrhea, and the presence of keratin.²

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There are three primary categories into which tympanic membrane retraction pockets are classified: (1) Pars flaccida retraction, (2) localized retraction of the Pars tensa, and (3) generalized retraction of the Pars tensa or atelectasis.³

Sade classification is for pars tensa retractions.⁴ I: retracted tympanic membrane;

II: retraction with contact onto the incus;

III: middle ear atelectasis (tympanic membrane onto the promontory, but mobile); IV: adhesive otitis media (tympanic membrane onto the promontory, but fixed).

Tos's classification is for pars flaccida retractions.⁶ I: pars flaccida not in contact with malleus head; II: pars flaccida in contact with malleus head;

III: limited outer attic wall erosion; IV: severe outer attic wall erosion.

Accurate diagnosis requires a battery of tests, involving tympanometry, audiometry, an otoscopic, otomicroscopic, or otoendoscopic examination, as well as radiological examinations. When it comes to surgical planning, evaluating the condition of the ossicular chain, and ruling out the existence of cholesteatoma, temporal bone HRCT (high-resolution computed tomography) is an invaluable tool. In order to assess the orifices of the Eustachian tube, a video rhinopharyngoscopy is essential. The degree of retraction and the existence or absence of cholesteatoma might inform therapy choices. Conservative methods abound, while surgical options include less invasive procedures like transtympanic drainage or RP excision with cartilage grafting, or, in cases of cholesteatoma, tympanomastoidectomy with or without canal wall up or down.⁶

The use of an endoscope in retraction pocket management has several advantages, including improved vision of the pocket's extent, the ability to rectify ventilation faults with little bone loss, and overall efficiency. Careful, exact, and thorough retraction pocket removal is achieved with the use of angled endoscopes.

The study aimed at evaluation the efficacy of transcanal endoscopic cartilage tympanoplasty for strengthening of drum in inactive squamous middle ear disease (retraction pocket) using sliced tragal cartilage.

2. Patients and methods

This was prospective research conducted on twenty-five cases with inactive chronic otitis media squamous type (RPs) at the Otorhinolaryngology department of Al-Azhar University from August 2023 to August 2024.

Inclusion criteria: Patients with inactive

squamous middle ear disease, RP grade: 2nd, 3rd (according to Sade and Tos classification) both genders, age 12-50 years old and Preoperative ABG less than 35.

Exclusion criteria: CSOM active squamous type (atticoantral disease) (cholesteatoma), patients with perforated drum, Patients with uncontrolled systemic diseases and unfit for surgery, Previous ear surgery, grade IV consistent with Tos and Sade classifications, and Ossicular erosion

Methods

Ethical consideration

The principles of the ethical committee were taken into consideration during the study, and informed consent was obtained from the patients.

Studied patients were subjected to the following:

Full history taking, endoscopic Examination of the ear, the nasopharynx, and ET opening by 4 mm diameter, 0° angle, Preoperative Pure Tone Audiometry (PTA), and calculation of the mean air bone gap (ABG), CT temporal bone, and routine baseline investigations.

Surgical technique

All surgeries were done under general anesthesia. Injection of 1/200000 epinephrine into the external auditory canal, using a transcanal approach with a 0-degree rigid endoscope. A horizontal incision was made on the tragus, allowing for cosmesis. The tragus cartilage was harvested, achieving half thickness for acoustic benefit. The tympanomeatal flap was elevated to the annulus, and the fibrous annulus was elevated below the chorda tympani, leading to the middle ear. A transcanal atticotomy was performed, and the antrum was checked for pathology using an angled 30-degree endoscope. Checking of ossicular motility and continuity. The attic was reinforced with sliced tragal cartilage, followed by repositioning of the tympanomeatal flap and insertion of Gelfoam and a meatal pack.

Follow up

The stitches were removed after 7 days. The pack was removed after 14 days. Inspection of the TM for healing of the graft weekly for one month, then monthly for 6 months. Audiological assessment was also done 3 months after surgery. The data were collected in the case sheet of every patient. The graft alterations have been viewed during each follow-up visit through an endoscopic examination. An audiometric evaluation was conducted at the end of postoperative month 6 to measure the ABGs. The definition of graft success was an intact graft that was free of retraction, perforation, significant blunting, medialization, or lateralization.

Statistical analysis

The data were collected and sent for statistical analysis.

3. Results

Regarding baseline data of studied cases, mean age was 30.5 years, ranged from 12 to 50 years, 60% were females and 40% were males, for side of ear involved, 56% were in RT side and 44% were in LT side.

As regard tympanic membrane retraction pockets category, it was found that retraction of the pars flaccida was 15(60%), pars tensa localized retraction was 8(32%) and pars tensa generalized retraction or atelectasis was 2(8%).

Table 1. Classification of retraction pocket according to site of retraction

CLASSIFICATION OF RP	STUDIED CASES (N, %) (N=25)
TYMPANIC MEMBRANE RETRACTION POCKETS CATEGORY	
PARS FLACCIDA RETRACTION	15(60%)
PARS TENSA LOCALIZED RETRACTION	8(32%)
PARS TENSA OR ATELECTASIS GENERALIZED RETRACTION	2(8%)

According to Tos classification (for pars flaccida retraction), out of 15 cases with retraction of pars flaccida, 80% had retraction of grade III, 20% had retraction of grade II. According to Sade classification (for pars tensa retraction), out of 10 cases with retraction of pars tensa, 60% had retraction of grade III, 40% had retraction of grade II. (Table 3)

Table 2. Grading of retraction pocket

GRADING OF RETRACTION POCKET (RP)	STUDIED CASES (N, %) (N=25)
ACCORDING TO TOS CLASSIFICATION (FOR PARS FLACCIDA) (N=15)	
GRADE II	3(20%)
GRADE III	12(80%)
ACCORDING TO SADE CLASSIFICATION (FOR PARS TENSA) (N=10)	
GRADE II	4(40%)
GRADE III	6(60%)

Regrading preoperative endoscopic examination of studied cases, it was found that (80%) of cases had retraction pocket with adhesion to ossicle and only 20% had retraction pocket without adhesion to ossicles. (Table 4)

Table 3. Endoscopic examination of studied cases preoperatively

ENDOSCOPIC EXAMINATION	STUDIED CASES (N, %) (N=25)
ADHESION TO OSSICLE	
YES	20(80%)
NO	5(20%)

Regarding preoperative air bone gap, it was found that mean ABG was 24.5 ± 3.4 dB (ranged from 15 to 35dB) and ABG of studied cases separated into 3 categories, the first category (16%) of cases had ABG15-20 dB, second category ranged from 20 to 30 dB and represented (72%) from all cases and the remaining (12%) had ABG ranged from 30-35dB.

Table 4. Preoperative Pure Tone Audiometry (PTA) among studied cases

PREOPERATIVE EXAMINATION	STUDIED CASES (N, %) (N=25)
AIR BONE GAP	
RANGE	15-35 DB
MEAN \pm SD	24.5 ± 3.4 DB
AIR BONE GAP CLASSIFICATION	
15-20 DB	4(16%)
21-29 DB	18(72%)
30-35 DB	3(12%)

Regarding the comparison of improvement in air bone gap postoperatively, 3 and 6 months after tympanoplasty, the results were highly significant (p value under 0.01) as mean air bone gap significantly decline from 24.5 dB preoperatively to 17.3 dB after 3 month and another significant declined occurred after 6 months of tympanoplasty to 11.5 dB with mean difference of 13 dB.

Table 5. Comparison of air bone gap postoperatively at 3 and 6 months after operation.

AIR BONE GAP	PREOPERATIVE	3 MONTHS POST-OPERATIVE	6 MONTHS POSTOPERATIVE	P VALUE
RANGE	15-35	8-25	3-21	<0.001*
MEAN \pm SD	24.5 ± 3.4	17.3 ± 2.8	11.5 ± 4.5	
15-20	4(16%)	18(72%)	7(28%)	<0.001*
21-29	18(72%)	3(12%)	1(4%)	
30-35	3(12%)	0(0%)	0(0%)	

Regarding outcome and success of graft among studied cases, it was found that success of graft was 92% (23 case) and failure rate was 8% two cases had Residual perforation and zero cases had Recurrent Retraction.

Table 6. outcome and success of graft among studied cases

OUTCOME	STUDIED CASES (N, %) (N=25)
INTACT GRAFT TAKES	23(92%)
RESIDUAL PERFORATION	2(8%)
RECURRENT RETRACTION	0(0%)
LATERALIZATION	0(0%)

4. Discussion

Middle ear atelectasis is a consequence of chronically inadequate ventilation of the middle ear. The initial classification system that graded retractions has been proposed by Sadé.^{7,8}

Regarding baseline data of studied cases, mean age was 30.5 years, ranged from 12 to 50 years with 60% females and 40% males, for side of ear involved, 56% were RT side and 44% were LT side.

According to Tos' classification (for pars flaccida retraction), out of 15 cases with retraction of pars flaccida, 80% had retraction of grade III, and 20% had retraction of grade II. According to Sade's

classification (for pars tensa retraction), out of 10 cases with retraction of pars tensa, 60% had retraction of grade III, 40% had retraction of grade II.

Regarding outcome and success of graft among studied cases, our results revealed that success rate of the graft was 92% and failure rate was 8%. Two cases had Residual perforation (one was found in anterosuperior part of TM due to gap between graft and remnant of TM while the other case was found in central part of TM due to cartilage disintegration) and 0 case had Recurrent Retraction.

In agreement with our study, Nagar et al.,⁹ on endoscopic tympanoplasty, cartilage versus temporalis fascia in retraction pockets found that cartilage graft taken in 92% of cases and graft failure in 8% of cases.

Additionally, Tawfik et al.,¹⁰ studied thirty-eight ears in twenty-four cases with an intact ossicular chain and middle ear atelectasis. The cases had been randomly divided into two groups: group one (27 cases) had endoscopic T tube insertion, and group two (11 cases) had endoscopic cartilage tympanoplasty. The study aimed to evaluate the efficacy of endoscopic tympanoplasty in the management of atelectasis. Hearing assessments had been carried out on all patients both prior to surgery and three months following the procedure. The second group underwent tragal cartilage graft taken in 10 cases (91%), while one case (9%) had residual perforation.

Dornhoffer et al.,¹¹ who aimed to analyze the audiologic and anatomical outcomes of over 1,000 cartilage tympanoplasty cases for the management of the difficult ear (atelectasis, recurrent perforation, cholesteatoma). Of the 98 cases presented with atelectatic TM were operated on in the research. The graft was taken in 97 cases (99%), and only one case (1%) had residual perforation.

Regarding preoperative air bone gap, it was found that mean ABG was 24.5 ± 3.4 Ranged from 15 to 35 dB and all cases had ABG divided into 3 categories, the first category 16% of cases had ABG 15-20 dB, second category ranged from 20 to 30 dB and represented 72% from all cases and the remaining 12% had ABG ranged from 30-35 dB.

Regarding the comparison of improvement in air bone gap postoperatively, 3 and 6 months after tympanoplasty, the results were highly statistically significant (p value < 0.01) as mean air bone gap significantly decline from 24.5 dB preoperatively to 17.3 dB after 3 month and another significant declined occurred after 6 months of tympanoplasty to 11.5 dB with mean difference of 13 dB.

The study by Abdel Aziz et al.¹² that compares

the effectiveness of cartilage tympanoplasty with eustachian tube balloon dilatation versus cartilage tympanoplasty alone in the surgical treatment of adhesive otitis media found that the average air-bone gap before the operation was 26.5 ± 5.4 dB, and the average after the operation at six months was 19.4 ± 4.4 dB.

Also, in accordance with Parab et al.,³ who reported that the pre-operative ABG was 24.53 ± 4.326 dB, and the following surgery ABG was 13.62 ± 4.78 dB at 6 months.

In accordance with Tawfik et al.,¹⁰ who found that preoperative air bone gap was 25.25 ± 5.19 dB, and after 3 months from operation, the mean was 13.59 ± 6.28 dB. This showed that there was a highly significant result with a p -value below 0.01, as the mean air bone gap significantly declines after 3 months.

As well, agreed with Nagar et al.,⁹ who found that after three months of surgery, the patients' air-bone gaps significantly improved (p value < 0.05).

4. Conclusion

We concluded from our study that transcanal endoscopic cartilage tympanoplasty was found to be effective and safe method with a low complications rate also hearing was improved after 3 and 6 months.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

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Conflicts of interest

There are no conflicts of interest.

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