

# Transcanal Endoscopic Atticotomy for Squamous Type of Chronic Otitis Media – Our Experience

Original  
Article

Meenakshi Sunderaswaran<sup>1</sup> and Sumitha Ramanathan<sup>2</sup>

<sup>1</sup>Tagore Medical College, Chennai, <sup>2</sup>Sree Balaji Medical College, Chromepet

## ABSTRACT

**Introduction:** Endoscopic ear surgery has changed the way otologists approach cholesteatoma and canal wall down surgery. This study aims to evaluate the outcomes of an endoscopic approach to patients with cholesteatoma limited to the attic and antrum.

**Objectives:** To study the outcomes in patients undergoing endoscopic atticotomy in terms of postop pain, hearing improvements, graft uptake and complications.

**Materials and Methods:** A prospective study was conducted in a tertiary care private referral hospital between December 2019 and January 2022 and included 40 consecutive patients with chronic otitis media of squamous type – with disease limited to attic & antrum. All patients underwent endoscopic atticotomy or attico-antrotomy with/ without cartilage tympanoplasty. All were evaluated at 3 months, 6 months and 12 months after surgery. The parameters evaluated were in terms of postoperative pain, hearing improvement, graft uptake, and postop complications.

**Results:** Of the 40 patients, 14 (35%) patients had cholesteatoma restricted to attic and antrum, 18 (45%) patients had posterosuperior retraction pocket and 8 (20%) patients had aural polyp on presentation. Type 3 tympanoplasty was the most common type of surgery performed. There was a significant decrease in the air bone (AB) conduction gap after tympanoplasty (43.98 vs 26.58) indicating improvement in the hearing [t-value [95% CI] >16.68 [15.29 to 19.51] ( $P < 0.05$ ).

**Conclusions:** The study showed that this approach is a very rewarding procedure to the patient, in terms of reduced hospital stay, post op complications, pain, scarring, and cavity problems but with similar hearing levels when compared to the traditional mastoidectomy.

**Key Words:** Chronic otitis media of squamous type, endoscopic atticotomy, limited mastoid disease, transcanal endoscopic ear surgery.

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**Corresponding Author:** Meenakshi Sunderaswaran, Tagore Medical College, Chennai, **Tel:** 09884843124, **E-mail:** itsmee19@gmail.com

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## INTRODUCTION

The best surgical approach for cholesteatoma has always been microscope assisted modified radical mastoidectomy - a canal wall down procedure - characterised by removal of posterosuperior canal wall - a procedure considered difficult to master and execute because of the complications that are more common – Cavity problems, facial palsy<sup>[1,2]</sup>, damage to dura and sigmoid sinus<sup>[1]</sup>, damage to the labyrinth/inner ear<sup>[3,4]</sup> - all of which can leave the patient with significant postoperative morbidity. Also the permanent cavity that is created could be difficult to maintain in many patients. With the advent of endoscopes and high resolution CT imaging - it is possible to ensure clear classification of extensive and limited mastoid disease and also identify patients who will benefit from endoscopic assisted canal wall up procedures.

The microscope assisted canal wall up procedures had the limitation of recurrence and residual disease after surgery which necessitated revision procedure. This limitation is overcome by the use of endoscope which helps in identification and removal of cholesteatoma from even the hidden areas thus allowing for an acceptable, safe and more comfortable procedure in these patients.

## OBJECTIVES

To study the outcomes of transcanal endoscopic atticotomy in patients with limited mastoid disease. Outcomes assessed were – post op pain, post op complications, hearing improvement, and graft uptake.

## MATERIALS AND METHODS

This was a descriptive longitudinal study conducted among 40 consecutive patients diagnosed with chronic otitis media of squamous type - with disease limited to attic and mastoid antrum in a tertiary care private referral hospital in Southern India between December 2019 and June 2022. Otoendoscopy was done and High resolution CT (HRCT) temporal bone was taken for all patients to evaluate the extent of the disease. Pure tone audiometry (PTA) was done for all patients to determine the extent of hearing loss. Endoscopic atticotomy with tympanoplasty was performed on all patients. Intraoperative findings were noted and depending on the ossicular chain status, tympanoplasty type 1, 3 or 4 was done. Patients were discharged on the next day of surgery, if they had no other complaints. Oral antibiotics – Amoxicillin with clavulanic acid was prescribed for 5 days for all patients. All patients were evaluated at 6 months after surgery. The outcomes measured were hearing improvement, pain and post-operative complications.

### Inclusion Criteria

Patients with Chronic otitis media – Squamous type – like retraction pockets/ cholesteatoma/ chronic otitis media restricted to attic and antrum were included. Both males and females of any age group and willing to attend follow up regularly were included.

### Exclusion Criteria

Extensive mastoid disease (as seen in HRCT or automastoidectomy cavity), patients with complications of chronic otitis media and patients with chronic otitis media with sensorineural hearing loss were excluded.

### Analysis

All the data were entered into Microsoft Excel and were analysed and the continuous data like age, hearing in dB, pain rating were expressed in mean or median with range depending on the skewness of the data. The categorical data like gender, diagnosis, type of tympanoplasty performed, complications were expressed in proportions. Independent – t test was used to find the difference in post-operative means of hearing in dB among types of tympanoplasty (I/II vs III/IV). Paired – t test was used to find the paired difference in means of hearing in dB before and after the tympanoplasty. The data analysis was done using SPSS version 18.0. A *P-value* of <0.05 was considered as statistically significant.

## Surgical Procedure

The method adopted was completely endoscopic ear surgery where an endomeatal Rosen incision was made and tympanomeatal flap was raised using a zero-degree Hopkins rod lens endoscope. The middle ear was entered and findings documented. The cholesteatoma was followed by curetting through the scutum and posterosuperior canal as well. The cholesteatoma matrix was de-lined en-masse and elevated completely from the underlying bone. The sac was followed into the attic and antrum by curetting out the partially eroded scutum. Ossicles were examined and if found eroded, were removed. Cholesteatoma/retraction pocket extension was followed on into the anterior epitympanic space and all disease was cleared off. Antrum was entered after delineating the tegmen tympani clearly. The turn of the lateral semicircular canal was visualised and it was confirmed that there was no disease extending into the mastoid. After confirmation, conchal cartilage grafts were harvested to reconstruct the attic (scutumplasty) and tympanoplasty was completed according to individual case.

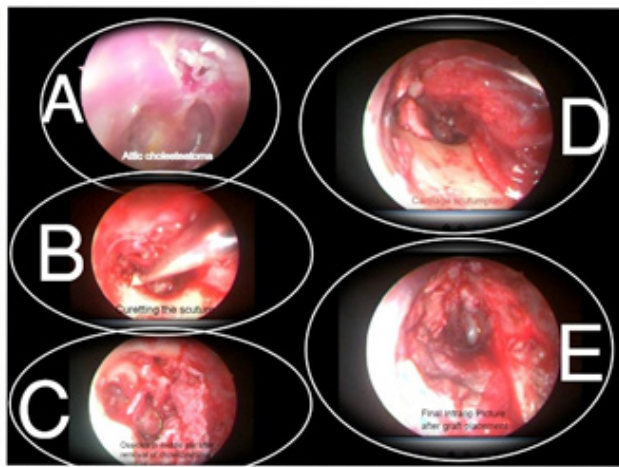
**Tympanoplasty – The Type 1** tympanoplasty was usually done with temporalis fascia but in select cases cartilage was also used to reinforce the tympanic membrane and also prevent retraction.

**Type 2** tympanoplasty was done in one case where the graft was placed on the incus and the malleus was eroded.

**Type 3** tympanoplasty was commonly done in the cases where the long process was eroded. Then the malleus was removed along with the remnants of incus in the attic and an umbrella conchal cartilage graft was placed over the head of stapes and tympanic membrane was reconstructed using temporalis fascia. In one case – PORP was used instead of the cartilage.

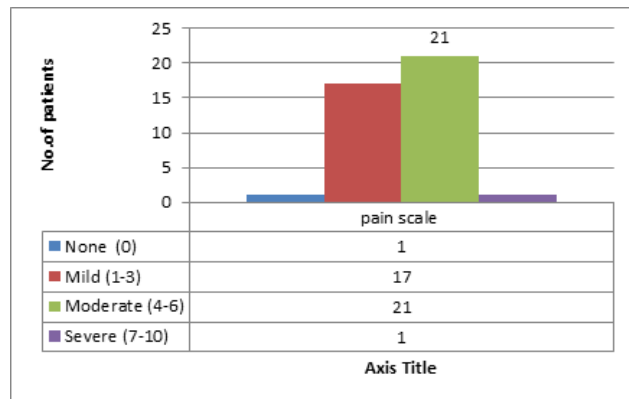
**Type 4** tympanoplasty was done in 1 case where all the ossicles were eroded and there was granulation tissue present all around the oval window. The ossicular chain was reconstructed using a single piece of thick conchal cartilage over the oval window to function as the stapes, stabilized with gelfoam and an umbrella cartilage placed over this. Temporalis fascia was used to reconstruct the tympanic membrane.

Patients were given oral antibiotics and mastoid dressing was applied for 2 post operative days. Patients were followed up for a period of 6 months post operatively and findings documented. (Figure 1)



**Fig. 1:** Steps followed during surgery – Right ear: Attic cholesteatoma – preop picture, Curretting the scutum, Ossicles in the middle ear after removal of cholesteatoma, Cartilage scutumplasty, Final intraoperative picture after graft placement and tympanomeatal flap repositioning.

Numeric pain scale rating was used (Figure 5) where the average of 3 scores taken in the first 24hr period was calculated after filled in Mc Caffey’s questionnaire – Best case was no pain- 0 and worst pain was 10<sup>[5]</sup>.



**Fig. 5:** Pain scale

**RESULTS**

The median age of the study participants was 38 years and it ranged from a minimum of 12 years to a maximum of 68 years. Males formed the majority (57.5%) and left ear was most commonly affected. The age group between 26 to 50 years were predominantly affected (62.5%) (Table 1).

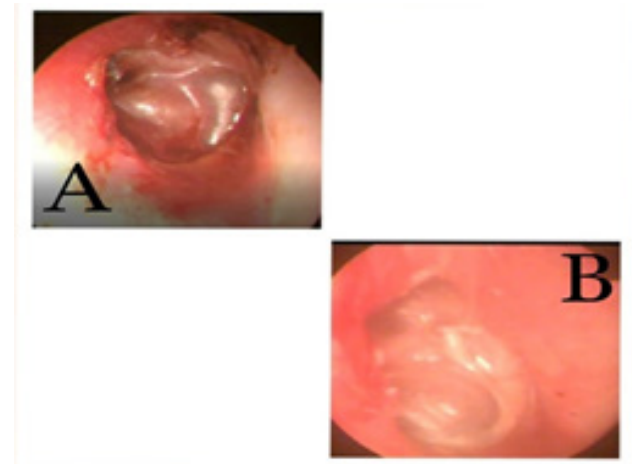
**Table 1:** Distribution of the study subjects based on socio-demographic details and side of ear affected

Socio-demographic variables	Frequency (n) (n=40)	Percentage (%) (n=100)
Age-group in years		
≤25	07	17.5
26 - 50	25	62.5
>50	08	20.0
Gender		
Male	23	57.5
Female	17	42.5
Side of the ear affected		
Left	21	52.5
Right	19	47.5

Cholesteatoma was the most common diagnosis found among the study subjects (55.0%) followed by postero-superior retraction pocket (25.0%), adhesive otitis (12.5%) and aural polyp (7.5%) (Table 2, Figure 2).

**Table 2:** Distribution of the study subjects based on the diagnosis

Diagnosis	Right (n=20) n (%)	Left (n=20) n (%)	Total N (%)
Cholesteatoma	12 (30.0)	10 (25.0)	22 (55.0)
Postero-superior retraction pocket	04 (10.0)	06 (15.0)	10 (25.0)
Adhesive otitis	02 (5.0)	03 (7.5)	05 (12.5)
Aural polyp	02 (5.0)	01 (2.5)	03 (7.5)



**Fig. 2:** Other types of chronic otitis media of squamous type – A -right ear posterosuperior retraction with plastered tympanic membrane (picture on top), B - Right ear attic retraction pocket with retracted pars tensa

Preoperative HRCT findings: Almost all patients had soft tissue shadow in the middle ear with clear or sclerosed mastoids. Ossicular necrosis was noted in 26 patients in the CT. Scutum erosion was noted in 32 patients and soft tissue shadow in antrum in 6 patients. Soft tissue shadow in external auditory canal was seen in 8 patients. Patients with extensive soft tissue shadow in mastoid and middle ear with erosion of Tegmen Tympani or other complications were excluded from the study (Figure 4).

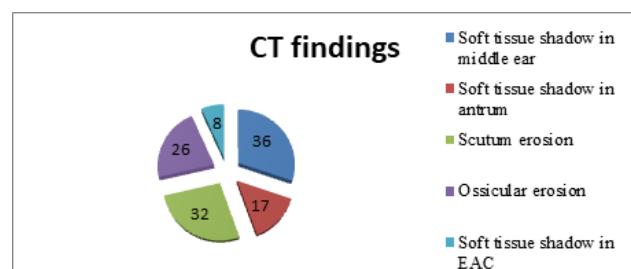


Fig. 4: Pie- chart showing CT findings

**Intraoperative findings**

The most common ossicle to be necrosed was found to be Incus which is consistent with literature. In all the cases that had cholesteatoma, the disease was restricted to the attic and the middle ear. Cholesteatoma was seen extending medial to the ossicles in five cases and cholesteatoma entered into the protympanum in three cases (Table 3).

Table 3: Intraop findings in patients

Intraop Findings	Number of patients
Number of ossicles involved – 1 (INCUS)	18
Number of ossicles involved -2 (Incus and Malleus)	11
Number of ossicles involved -3	1
Scutum erosion	8
Cholesteatoma medial to the ossicles	5
Cholesteatoma in protympanum	3

**Types of Tympanoplasty performed**

Type III tympanoplasty was the most common type of tympanoplasty performed (67.5%) among the study subjects (Table 4). The graft material used was temporalis fascia, conchal cartilage – in some patients with severe retraction and combined with tympanoplasty and scutumplasty, the temporalis fascia was used for the tympanic membrane. In selected few cases, the cartilage with perichondrium was used to reconstruct the tympanic membrane and scutum and no temporalis fascia was used.

Table 4: Distribution of the study subjects based on the Tympanoplasty performed

Types of Tympanoplasty	Frequency (n) (n=40)	Percentage (%) (n=100)
Type I	11	27.5
Type II	01	2.5
Type III	27	67.5
Type IV	01	2.5

**Hearing outcomes after tympanoplasty**

There was a significant decrease in the air bone (AB) conduction gap after tympanoplasty (43.98 vs 26.58) indicating improvement in the hearing [t-value [95% CI] >16.68 [15.29 to 19.51] (P<0.05) (Table 5). The average improvement after tympanoplasty was 17.4dB which was a significant difference (P<0.05).

Table 5: Comparison of hearing improvement among the study subjects

Pre-operative AB gap in dB	Post-operative AB gap in dB	Mean Difference	t-value [95% CI]	P-value
43.98±7.64	26.58±4.63	17.40	16.68 [15.29 to 19.51]	<0.0001*

**Pain scale**

The median pain score was found to be 3 and it ranged from a minimum rating score of 3 to a maximum rating score of 5. Most patients described their pain as around acceptable levels, “ache” type with worsening during lying down/getting up. It was also reduced after taking analgesics.

**Complications following surgery**

32.5% were found to have some complications post tympanoplasty. Wound infections (12.5%), recurrences (7.5%), nystagmus (5.0%), anterior attic retractions (2.5%) both infection and residual perforation coexisting (2.5%) and residual perforation alone (2.5%) were the common complications recorded among the study subjects (Figure6).

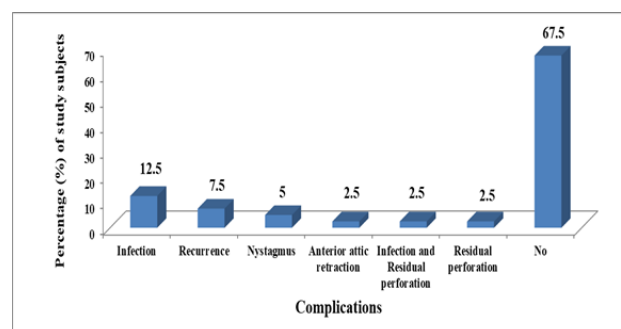


Fig. 6: Distribution of the study subjects based on the occurrences of complication

Wound infection was the most significant of the complications – in certain cases where the patient had active infection post surgery, we used prolonged antibiotic treatment for a period of 3-6 weeks to dry the ear. It led to residual perforation in two cases (2.5%) whereas it healed without perforations in the rest of the cases.

Nystagmus was seen in 5% cases due to excessive manipulation of the ossicles and subsided spontaneously. If patients reported giddiness then they were managed with labyrinthine sedatives for two days after which they improved.

Residual perforations (2.5%) were the most difficult to manage. We tried cauterization in 1 case where it had a sleeve of TM around the perforation – which was successful in closing the tiny perforation. However medium sized defects were difficult to manage – but the ear was dry, and patients had no other complaints in all of these patients.

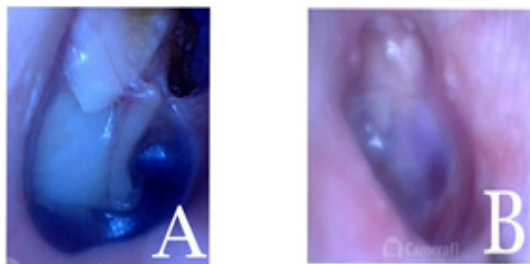
## DISCUSSION

### *Our experience -Challenges in technique*

Single handed surgical manipulation of the ossicles and the attic was a difficulty. Also in cases with aural polyps, granulations, the bleeding is a problem and it delays the surgical procedure. The curetting of the scutum and the posterior superior canal wall whilst following the cholesteatoma course is another difficulty. This can be partially overcome by the use of a drill but we preferred a House curette since the disease was usually restricted to the attic and antrum in our study cases. Surgery for a right handed surgeon was easier in the right ear – the left ear was more difficult to approach in terms of surgery. The curetting of scutum in the left ear was more difficult for the right handed surgeon because of the direction of curetting (pronation is stronger than supination).

The visualization of the protympanum and the sinus tympani was more satisfactory in our cases. We could also identify a case where the ossicular chain was intact, but the cholesteatoma extended medial to the ossicles and hence they had to be removed to ensure complete removal of the disease.

Graft material – most cases required scutumplasty with conchal cartilage. Also, tympanic membrane reconstruction was done with temporalis fascia in some patients and with perichondrium in few cases (Figure 3).



**Fig. 3:** Post-op pictures - A -Right ear cartilage scutum reconstruction with neotympanic membrane (picture on top), B - Left ear cartilage scutumplasty with neotympanic membrane

The hearing outcomes were generally good – with an average improvement of 17.4dB in our study. This was similar to the results obtained by Dr. Nair and co-workers in their study<sup>[6]</sup>. Hearing gain of around 11dB (for Type1 tympanoplasty, 9dB for Type3B and 8dB for type 3C tympanoplasty) were observed in a study conducted in Delhi<sup>[7]</sup>. The most common ossicle to be eroded was the long process of Incus in our study also as in the previous studies. Thus Type 3 tympanoplasty was the commonest procedure performed in our study.

In the study by Pradeep *et al*<sup>[7]</sup>, they had found that the most common site for cholesteatoma was the attic (13 out of 28 cases), followed by the posterosuperior mesotympanum (7 out of 28 cases) and the attic retraction pocket (fundus was not visible) in 8 cases out of 28 patients. These are very similar findings to those of the current study as well.

The classical approach of surgery for chronic otitis media of squamosal type has been microscope assisted postaural canal wall down mastoidectomy with tympanoplasty<sup>[8]</sup> (Canal wall down procedure). According to a study published by Liansheng Zhang in 2016, combining canal wall up mastoidectomy with Type I Tympanoplasty, was effective in treatment of chronic otitis media, as there was high rate dry ear canal post- operatively along with satisfactory reconstruction of hearing, and maintenance of ear morphology<sup>[8]</sup>.

Glikson *et al* published a study in 2017, which proved that transcanal endoscopic approach to cholesteatoma was a safe and acceptable technique with good hearing outcomes<sup>[9]</sup> Posterior attic was a common presentation even in their study and their overall residual and recurrent disease rate was around 18% which is a bit higher than our study. Choi *et al* describe the advantages of endoscopic approach, which include avoiding endaural and postaural incisions<sup>[10]</sup>. The endoscopic approach also provides for a better visualisation of the middle ear cavity. Endoscopic approach also minimises residual cholesteatoma and recurrence during surgeries. A study conducted by Che-Hung Kuo<sup>[11]</sup> *et al*, from 2013-2015, compared the outcomes in patients suffering from chronic otitis media with cholesteatoma, when treated endoscopically and microscopically. Out of 126 patients, 74 underwent endoscopic surgeries whereas 57 were treated microscopically. The pre-operative audiometry and the post- operative audiometry showed significant difference between the two groups. The study concluded that endoscopic middle ear surgery showed improvements in audiometry with fewer complications and lesser medical expenditure in comparison to microscopic middle ear surgery. Patients from their study however did report a residual hearing loss PTA average around 35dB<sup>[11]</sup>. Nair *et al*. conducted a study from 2017-2018, similar to our study, which included 32 patients, who underwent transcanal endoscopic ear surgery<sup>[6]</sup>. Patient outcomes were measured in terms of post-operative air bone gap, post operative pain, and quality of life after surgery. Graft

uptake after the third month of follow up showed to be 100%. Two patients had recurrence of disease after the 6<sup>th</sup> month of follow up . The air-bone conduction gap - (33.5 ± 11.1 dB vs. 16.9 ± 11.8 dB,  $p < 0.001$  ), had significantly improved similar to our study and the mean comfort score at the time of discharge was 9.3 +/- 0.6 out of 10 which was again confirmed<sup>[6]</sup>. Their residual perforation rate was 6.3% whereas in our study it was 2.5%. Similar outcomes were also observed in the graft uptake rate by Kuo and Wu in their study<sup>[11]</sup> – that is a 97% graft uptake but the difference in hearing improvement was not significant in either limb of his study. Most of these studies confirm the improved results of the endoscopic over microscopic route in experienced hands. Khalil and Windle -Taylor (2) also mention a recurrence/revision rate of 18% in their study of open mastoidectomies, which is however similar to the endoscopic technique results of Gilkson *et al*<sup>[9]</sup> which is much more than our study –we had a recurrence rate of 12.5% (if we consider both residual perforation and recurrent cholesteatoma together). Also the recurrence rate mentioned in another study by Kos *et al*<sup>[13]</sup> was only 6.1% for the open mastoidectomy which is again lower than our study. The only major advantage of canal wall down surgery over intact canal wall procedures is the lower recurrence rate in the former, which is now being eliminated by careful case selection and better endoscopes (greater clarity and angled scopes). The inner ear related effects like sensorineural hearing loss, tinnitus and giddiness which are common with canal wall down procedures are however extremely rare in endoscopic ear surgery<sup>[4]</sup>. Facial nerve injury which is also a dreaded complication after open canal wall down procedures is infrequent in this route of surgery. Cavity problems<sup>[2,13]</sup> and hence frequent followup visits are a big problem in canal wall down procedures which is not the case with endoscopic surgery. Pain, Postoperative stay, cosmetic results are much better with the endoscopic surgery<sup>[9,10,12,13]</sup> and this has been confirmed in multiple studies as it has clearly been demonstrated in our study as well. Our patients had a maximum pain score of 5 which is considered thoroughly acceptable. Post operative period was also uneventful and the patients were able to resume their normal lifestyle within a day after the procedure.

Thus, microscope assisted canal wall down mastoidectomy<sup>[2,4,13]</sup> has its own set of drawbacks which are - Postaural scar, facial nerve damage, tegmen injury, labyrinth injury, injury to sigmoid sinus and dura, residual disease in inaccessible /blind areas – protympanum, retrotympanum, facial recess, drill induced hearing loss, cavity problems postoperatively. The advances in endoscopic optics and instrumentation have made it possible to perform endoscopic transcanal surgery as a minimally invasive procedure where the best results can be ensured for the patient. The advantages of an endoscopic approach are transcanal scarless surgery, clear endoscopic visualisation of structures – ossicles, cholesteatoma sac and blind areas, minimal bone drilling because it is an inside-out technique, minimum pain and post operative stay.

The disadvantages of an endoscopic approach that we observed are - one handed surgery, limited application to selected patients and steep learning curve (especially compared to two handed microscopic canal wall down mastoidectomy techniques).

## CONCLUSION

This study has provided us great insight into the numerous advantages associated with endoscopic surgeries of the middle ear cavity. It showed that this novel endoscopic transcanal approach is a very rewarding procedure to the patient - in terms of reduced hospital stay, postoperative complications, pain, scarring, similar hearing levels and no cavity problems.

The endoscopic transcanal atticotomy/atticoantrostomy approach for management for squamosal chronic otitis media limited to attic and antrum was successful in reducing the air bone conduction gap significantly indicating improved hearing outcomes. There were minimal complications noted among just more than a quarter of them with infections being the commonest which might be addressed with broad spectrum antibiotics and ensuring the aural hygiene with reinforced instructions. Endoscopic ear surgery - atticotomy, atticoantrostomy for selected patients is an excellent choice of procedure and can be safely taken up as day -care surgery with best results for the patient.

## CONFLICT OF INTERESTS

There are no conflicts of interest.

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