

Original Research Article

Endoscopic exploratory tympanotomy in cases of conductive hearing loss with intact tympanic membrane: our experience

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ABSTRACT

Background: Determining the cause of conductive hearing loss with an intact tympanic membrane has been a challenge for the otologists for over decades. The aim of this study is to ascertain the usefulness of endoscopes to study the various middle ear pathologies on performing endoscopic exploratory tympanotomy.

Methods: A retrospective analysis of various pathologies encountered in the middle ear in 88 patients who underwent endoscopic exploratory tympanotomy done over a study period of 3.5 years (January 2015 to June 2018).

Results: In our study, age of the patients ranged from 14 to 50 years with a mean age of 32 years. Most common finding on exploration was otosclerosis in 59 patients followed by revision stapedotomy in 12 patients. 5 patients had normal middle ear findings with all ossicles intact and mobile while other pathologies encountered were tympanosclerosis (4.6%), biscuit foot plate (2.3%), mucosal bands (3.4%) and middle ear developmental anomalies (3.4%).

Conclusions: On exploring the middle ear knowing the various aetiologies helps in better preoperative counseling of the patients for the outcome of surgery. Endoscopic approach for exploratory tympanotomy has the benefit of excellent resolution with higher magnification and wider panoramic view of middle ear anatomy.

Keywords: Endoscopic exploratory tympanotomy, Conductive hearing loss, Endoscopic stapedotomy, Otosclerosis, Middle ear anomalies

INTRODUCTION

Determining the aetiology of conductive hearing loss with an intact tympanic membrane has been a challenge for the otologists for over decades. Diagnostic tools like pure tone audiometry, tympanometry and high resolution computed tomography scans have been routinely used with very less specificity and sensitivity. The otologist frequently has to resort to exploratory tympanotomy in order to establish a diagnosis and to allow for further management. When exploratory tympanotomy is undertaken in such a setting, studies reveal that the common causes of hearing loss are otosclerosis, ossicular fixation and ossicular discontinuity.¹

Middle ear exploration using microscope has been the choice of approach for many years but with the advent of endoscopes with superior optical properties, otoendoscopes are increasingly being used as a diagnostic, surgical and a teaching tool.²

The aim of this study was to ascertain the usefulness of endoscopes to study the various middle ear pathologies on performing endoscopic exploratory tympanotomy.

METHODS

A retrospective analysis of various pathologies encountered in the middle ear in 88 patients who

underwent endoscopic exploratory tympanotomy done by a single surgeon at ENT department of Sri Satya Sai Institute of Higher Medical Sciences over a study period of 3.5 years from January 2015 to June 2018.

Selection criteria for the study were patients with conductive hearing loss with an intact tympanic membrane. While exclusion criteria were acute middle ear infection and past history of ear surgery for chronic suppurative otitis media.

Patients had underwent endoscopic exploratory tympanotomy for conductive hearing loss with an intact tympanic membrane and on exploration various pathologies encountered were noted and based on the findings surgery was proceeded with either stapedotomy (Fisch or Shea technique) or ossiculoplasty.²⁻⁵ The findings noted during surgery were retrospectively collected from medical records and compiled using descriptive statistics (frequency and percentage).

RESULTS

In our study, age of the patients ranged from 14 to 50 years with a mean age of 32 years with majority of the patients (43%) within age group of 21-30 years and out of 88 patients studied 48 were female (55%) and 40 were male (45%) with a sex ratio of 0.83:1 (M:F) (Figure 1 and 2).

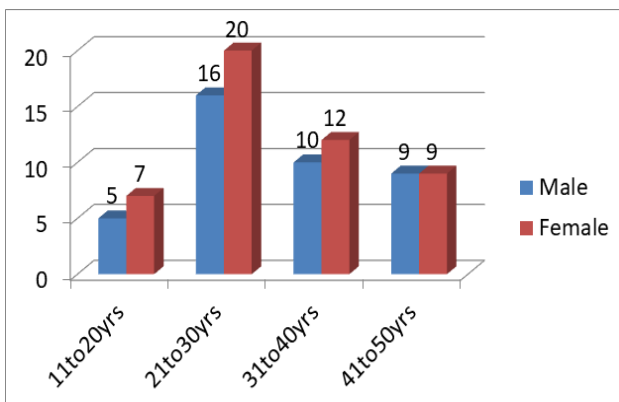


Figure 1: Age wise distribution.

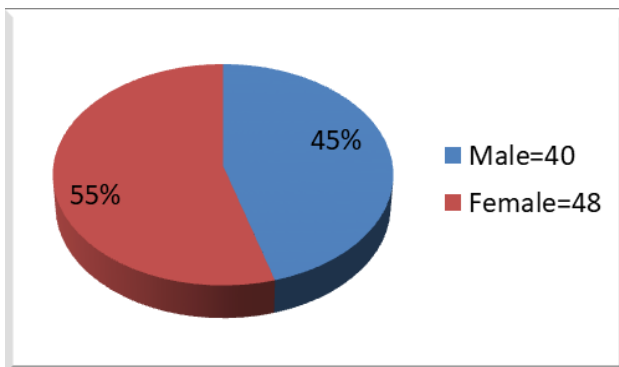


Figure 2: Sex wise distribution.

Most common finding on exploration was otosclerosis in 59 patients (67%) followed by revision stapedotomy (13.6%). 5 patients had normal middle ear findings with all ossicles intact and mobile while other pathologies encountered were tympanosclerosis (4.6%), biscuit foot plate (2.3%), mucosal bands (3.4%) and middle ear developmental anomalies (3.4%) (Table 1).

Of the 59 patients who had otosclerosis majority were females belonging to 3rd decade and 60% of them had family history of hearing loss. These patients underwent endoscopic stapedotomy by Fisch technique using teflon piston placement and patients had immediate recovery of hearing after surgery (Figure 3). Biscuit footplate (obliterative otosclerosis) was observed in 2 patients in whom Shea technique of stapedotomy was done.

Tympanosclerosis was seen in 4 patients with tympanosclerotic plaque around the stapes, which on removal improved hearing of the patient. Three patients had thick mucosal bands between the ossicles which were excised to mobilize them.

On exploration 5 patients had normal middle ear findings with mobile ossicles and hearing loss could not be explained. 3 cases with congenital middle ear abnormalities causing conductive hearing loss were stapes agenesis with absent oval window, fractured posterior cura of stapes and total absence of incus (Figure 4). Hearing mechanism was reconstructed only in patient with absent incus by using PORP (partial ossicular replacement prosthesis) (Figure 5).

Table 1: Middle ear pathologies.

Middle ear pathology	N	%
Otosclerosis	59	67
Biscuit footplate	2	2.3
Revision stapedotomy	12	13.6
Normal middle ear	5	5.7
Tympanosclerosis	4	4.6
Mucosal bands	3	3.4
Middle ear developmental anomaly	3	3.4
Total	88	100

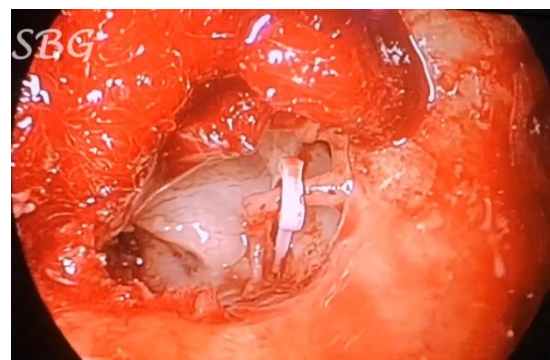


Figure 3: Stapedotomy (Fisch technique).

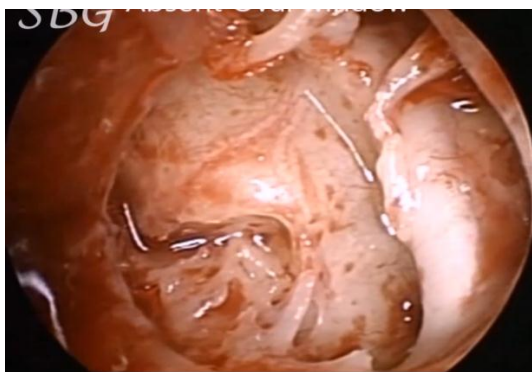


Figure 4: Stapes agenesis.



Figure 5: Absence of incus.



Figure 6: Dehiscent low lying facial nerve.

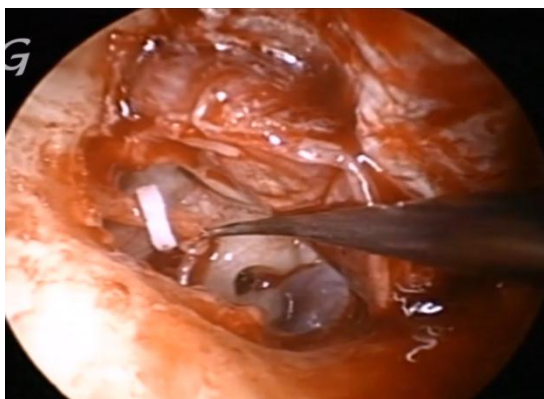


Figure 7: Stapedotomy in dehiscent high jugular bulb.

Revision stapedotomy was performed in 12 patients who had conductive hearing loss despite having undergone stapedotomy/stapedectomy. Causes for revision in these patients were displacement of prosthesis from fenestra in 6, short piston in 4 and formation of neo membrane over the fenestra in 2 patients.

Other middle ear abnormalities observed intraoperatively were low lying and dehiscent fallopian canal with exposed facial nerve and dehiscent high jugular bulb in 8 and 5 patients respectively and 1 case had both these anomalies coincidentally (Figure 6 and 7).

DISCUSSION

Conductive hearing loss in a patient with an intact tympanic membrane even after thorough audiological and radiological evaluation poses a diagnostic dilemma. Differential diagnosis should include otosclerosis and acquired traumatic or infectious disruption of the ossicular chain. Sometimes, additional findings can be encountered during exploratory tympanotomy which are of doubtful significance or which may come in the way of correction of the cause of conductive hearing loss.

Usage of endoscopes in transtympanic middle ear examination was first reported by Nomura and Takahashi.^{6,7} While in 2006 Kakehata used transtympanic endoscopy to evaluate conductive hearing loss and since then endoscopes has widened the scope of surgeries with better optics and wide angled panoramic view.⁸ Otoendoscopes have a distinct advantage of direct, quick and easy access to areas of middle ear cavity which are difficult to view with the use of a microscope.⁹

In this study we have analysed the various middle ear pathologies on performing endoscopic exploratory tympanotomy in 88 patients with conductive hearing loss having an intact tympanic membrane. During this study exploration of middle ear has been exclusively done endoscopically with comparing results to other similar studies which are done by microscopic and endoscopic approach (Table 2).

In our study, otosclerosis was the most common finding seen in 67% of the patients and which is similar to other studies by Paperella et al (79.7%) and Sanjeev et al (66.7%).^{1,10} Majority of patients with otosclerosis belonged to 3rd decade (58.2%) with female predominance (61%) and 60% had family history of early non progressive hearing loss. Sanjeev et al had similar observation of female predominance (65.27%).

The incidence of primary obliterative otosclerosis observed by Gierek et al has been reported in 9.6% of cases getting operated while in our study we found 2 cases (3.2%) having biscuit footplate.¹¹

In our study, tympanosclerotic plaque and mucosal bands causing hearing impairment was seen in 4.6% and 3.4%

of patients respectively which on removal and mobilization of ossicles improved hearing. Similar findings were observed by Sanjeev et al

(tympanosclerosis in 2.8% and mucosal bands in 8.3%) and Robertson et al (tympanosclerosis in 8.2% and mucosal bands in 1.8%) who also concurred the same.^{10,12}

Table 2: Comparison to other similar studies.

Findings (%)	Our study	Sanjeev et al ¹⁰	Robertson et al ¹²	Paksoy et al ¹⁴
Otosclerosis	67	66.7	48.2	55.7
Revision surgery	13.6	-	0.3	4.2
Normal middle ear	5.7	4.2	4.4	
Tympanosclerosis	4.6	2.8	8.2	35.7
Mucosal band/adhesions	3.4	8.3	1.8	
ME developmental anomaly	3.4	8.3	2.9	2.9
Approach	Endoscopic	Endoscopic	Microscopic	Microscopic
Total number of cases (n)	88	72	340	95

Intraoperatively 5.7% of patients had normal middle ear status both structurally and functionally in spite of clinical and audiological conductive hearing loss. Bess et al found pathologic third windows to be a potential cause of conductive hearing loss in 20% of patients who failed to obtain hearing gain after exploratory tympanotomy and ossiculoplasty.¹³

In our study, 13.6% of patients had to undergo revision stapedotomy with main reason of failure being displacement of prosthesis (50%) followed by short piston placement (33%) and neo membrane formation over fenestra (17%). Similarly Paksoy et al on microscopic approach observed displacement of prosthesis as the commonest cause for failure post stapedotomy warranting revision.¹⁴

Of the congenital middle ear abnormalities observed, congenital stapes agenesis was seen in 1 patient and it was first reported by Mcaskile et al in two patients who had conductive hearing loss (Figure 4).¹⁵ Congenital absence of stapes and oval window have been reported in association with various syndromes including Branchio-oto-renal syndrome and Crouzon's syndrome.¹⁶ It has also been reported as an isolated inherited ossicular abnormality which was considered in our case as the patient was non syndromic. Second patient had complete absence of incus (Figure 5) which has been reported as an inherited trait either due to an autosomal dominant mutation or an X-linked dominant inheritance by Wehrs et al.¹⁷

Other middle ear abnormalities encountered were dehiscent fallopian canal exposing low lying facial nerve which was seen in 8 cases (9.1%) and has been reported in 7.9% of ears during stapedotomy by Szymański et al.¹⁸ Manipulation of the facial nerve in association with stapedectomy has to be avoided in order not to injure the nerve but all patients underwent surgery by Shea technique which exposed the footplate for placement of piston away from the facial nerve with normal facial nerve function post operatively (Figure 6).

Another middle ear abnormality encountered was a high jugular bulb which can be present in 10%–15% of individuals and can be dehiscent in 0.5%–1.7% which can also be the cause of hearing loss.¹⁹ In our study 5 cases (5.7%) had dehiscent high jugular bulb but not extending up to the oval window warning the operating surgeon to keep in mind to avoid injury during annular elevation and manipulation during surgery (Figure 7).

CONCLUSION

Conductive hearing loss in a patient with an intact tympanic membrane poses a diagnostic dilemma and warrants exploration of middle ear wherein various pathologies can be encountered with otosclerosis being the most common finding. But understanding the frequency of occurrences of various aetiologies helps in better preoperative counselling of the patients for the outcome of surgery which becomes the cornerstone of treatment protocol.

Endoscopic approach for exploratory tympanotomy has the benefit of excellent resolution with higher magnification and wider panoramic view of middle ear anatomy during surgery and serves as an excellent teaching tool as observer and the surgeon has the same focus making endoscopes a significant alternative with proven result.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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