

Middle Ear Findings at Exploratory Tympanotomy for Conductive Hearing Loss

Ajith K M¹, Ceethu B Raj², Shivakumar A M³

¹Associate Professor, Department of Otorhinolaryngology, S S Institute of Medical Sciences and Research Centre, Davangere, Karnataka

²Resident, Department of Otorhinolaryngology, S S Institute of Medical Sciences and Research Centre, Davangere, Karnataka

³Professor and Head of Department, Department of Otorhinolaryngology, S S Institute of Medical Sciences and Research Centre, Davangere, Karnataka

Abstract: **Background:** Exploratory tympanotomy helps in detecting the cause of conductive hearing loss with intact tympanic membrane. **Objective:** To find out any abnormalities of middle ear contributing to conductive hearing loss apart from usual middle ear causes. **Methods:** 57 patients with conductive hearing loss with intact drum were evaluated using clinical and audiometric parameters. **Intraoperatively,** 27 cases with only otosclerosis in the absence of any additional findings were excluded and 30 cases with other middle ear findings were noted. **Results:** Intraoperatively, restricted ossicular mobility was found in 21 patients and ossicular necrosis for 8. Surgery was abandoned for 2 patients with anatomical abnormalities in middle ear. **Conclusion:** The study provides an insight into different causes of conductive hearing loss behind an intact tympanic membrane and few instances where abnormal anatomy of middle ear may interfere with surgical correction of conductive hearing loss.

Keywords: exploratory tympanotomy, tympanosclerosis, ossicular necrosis, adhesive bands, anomalous facial canal

1. Introduction

Despite recent technological advances it is often difficult to establish with confidence a preoperative diagnosis in a patient with conductive hearing loss with intact tympanic membrane. Otolologists frequently resort to exploratory tympanotomy in order to establish a diagnosis & for surgical treatment. The etiology of conductive hearing loss with intact tympanic membrane includes otosclerosis, ossicular chain fixation, discontinuity, adhesions etc. Sometimes some 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.¹

2. Methodology

Objective: To find out any abnormalities in the middle ear contributing to conductive hearing loss apart from otosclerosis

Source Of Data: Patients attending Otorhinolaryngology Outpatient department in our hospital who were subjected to exploratory tympanotomy for conductive hearing loss with intact tympanic membrane, between August 2013- July 2015 (2 years)

Inclusion Criteria

- Patients with purely conductive hearing loss with intact tympanic membrane
- Patients with mixed hearing loss with Air Bone gap of >20 dB with intact tympanic membrane

Exclusion Criteria

- Acute middle ear conditions (infective, inflammatory)
- Previous history of ear surgery

Study Design: Prospective study.

57 patients in the age group of 10-50 years, attending Otorhinolaryngology outpatient department with hard of hearing were evaluated. Clinical examination, Pure tone audiometry and tympanometry were done for all patients. Intraoperatively, middle ear findings were noted like problems with ossicular anatomy, mobility, status of middle ear mucosa and evidence of any additional findings. 27 cases with intraoperative findings of only otosclerosis were excluded from the study. 30 cases with unusual findings were considered.

3. Results

Out of the total 57 patients analyzed, 27 patients (47.36%) had otosclerosis with no additional findings in the middle ear. Out of the other 30 patients included in the study, there were 19 were males and 11 were females. 6 patients were in the age group of 10-20 years, 19 patients 21-30 years, 4 patients in 31- 40 years and 1 patient was between 41-50 years. Hearing loss was the presenting complaint in all the patients. Intraoperatively, restricted ossicular mobility was found in 21 patients (70%). 8 patients had ossicular erosion (26.7%). 1 patient (3.3%) had an abnormal band of bone in middle ear.

Out of the 21 patients with restricted ossicular mobility, tympanosclerosis causing restricted ossicular mobility was found in 8 patients (38.1%). Out of these, 7 patients (87.5%) had history of ear discharge with healed membrane with persisting hearing loss. 1 patient had whitish plaque extending from posterior wall of middle ear to incus, restricting mobility of ossicular chain with no history of ear discharge. Tympanosclerotic plaques were removed and ossicles mobilized. Adhesive bands were found in the middle ear causing restricted ossicular mobility in 6 patients (28.57%). History of ear discharge was present in all the patients and a retracted tympanic membrane on examination. Intraoperatively, adhesive bands were found in the middle

ear attached to the ossicular chain with ossicular chain erosion. Adhesive bands were released in these cases which revealed symptomatic hearing improvement. Ossicular fixation was observed in 3 patients (14.29%). 2 patients had fixation of incudomalleolar and incudostapedial joint and the other had fixation of only incudostapedial joint. Mobilization of ossicular chain was done in all 3 cases. 2 patients (9.52%) had stapes anomalies. 1 had a shield like stapes with posterior crura fixed to promontory restricting stapes mobility. Mobilisation of stapes was done in this case. 2nd patient had a very thin fixed stapes. For this patient removal of the thin stapes suprastructure and stapedotomy with teflon prosthesis placement was done. Symptomatic hearing improvement was obtained postoperatively for both patients. 2 patients (9.52%) had fixed stapes with additional finding in middle ear. Anomalous facial canal was found in both these patients. Surgery was abandoned because of risk of facial nerve palsy at attempted stapes surgery. 1 patient had a dehiscence facial canal. 2nd patient had a more anteriorly placed vertical segment of facial nerve obscuring view of doubtful fixed stapes. Postoperative counseling and hearing aid was advised for both.

Ossicular necrosis was found in 8 patients(26.7%). 4 patients (50%) had isolated incus necrosis. All these 4 patients had adhesive otitis media. One of these patients had extensive tympanosclerosis in the middle ear encasing the malleus and the incus and over the promontory. Adhesions were also found in this case between the middle ear mucosa and stapes. 2 patients(25%) had isolated malleus necrosis and 1 patient (12.5%) had malleus and incus necrosis. Both these patients had retracted tympanic membrane. One patient(12.5%) had long process of incus and stapes head necrosis. He had adhesive otitis media on the same side with retraction pockets in the attic. Intraoperatively, thick glue like material was aspirated from middle ear. Conchal cartilage was used for reconstruction of the ossicular chain in these cases. 1 patient (3.33%) had an abnormal band of bone in middle ear. He had moderate conductive hearing loss with an abnormal band of bone found along chorda tympani nerve, medial to incus. Malleus was found to be deformed. Surgery was abandoned in this case.

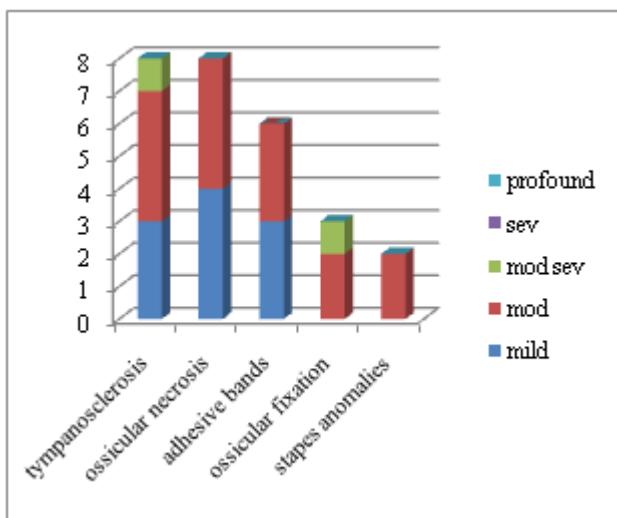


Figure 1: Degree of hearing loss in various middle ear pathologies

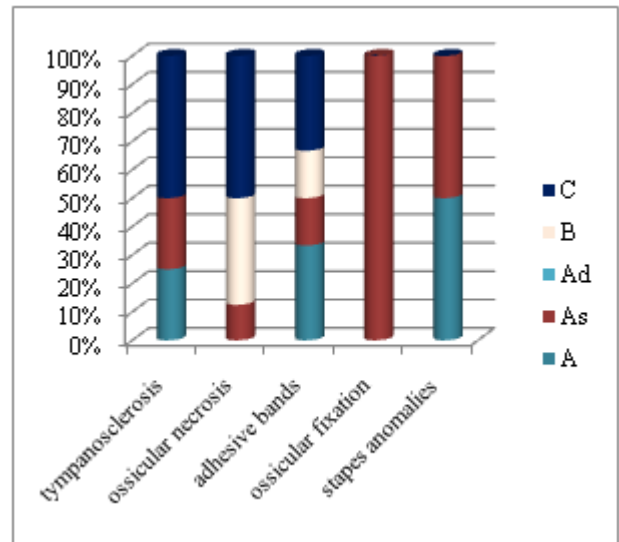


Figure 2: Tympanometry curves in different middle ear conditions

Table 1: Middle Ear Findings at Exploratory Tympanotomy

Intraoperative finding	No. of patients
A. Restricted ossicular mobility	21
1. Tympanosclerosis	8
2. Adhesive Bands	6
3. Ossicular Fixation	3
4. Stapes Anomalies	2
5. Fixed stapes + additional finding	2
B. Ossicular necrosis	8
C. Abnormal Band Of Bone	1

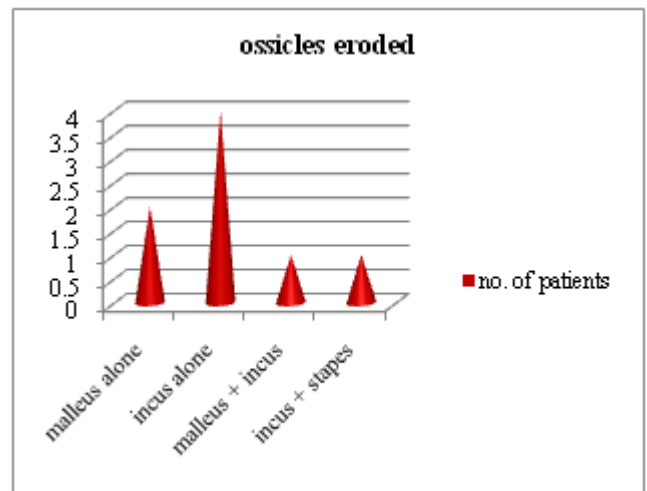


Figure 3: Ossicles eroded in adhesive otitis media



Figure 4: Abnormal band of bone in middle ear

4. Discussion

Any process that causes attenuation of sound energy that reaches the cochlea results in conductive hearing loss. The etiology of conductive hearing loss with intact tympanic membrane includes otosclerosis, ossicular chain fixation, ossicular discontinuity, congenital cholesteatoma, adhesions etc. A variety of investigations have been advocated to establish the cause of conductive hearing loss including tympanometry & CT. None of these techniques have sufficient sensitivity & specificity to allow a confident diagnosis to be made in all cases and the otologists frequently resort to exploratory tympanotomy in order to establish a diagnosis & for surgical treatment. Ossicular chain involvement is found in Chronic Suppurative Otitis Media. Ossicular chain involvement can be in the form of ossicular necrosis, tympanosclerosis and fibrosis.²

According to our study, conductive hearing loss due to middle ear pathology was found more in males with male to female ratio of 1.73. Young adults in age group of 21-30 was the most commonly affected age group (63.33%). Restricted ossicular mobility was the most common cause of hearing loss in our study followed by ossicular necrosis.

Tympanosclerosis is an abnormal condition of the middle ear cleft in which there are calcareous deposits in the tympanic membrane, tympanic cavity, ossicular chain and occasionally in the mastoid (Wielinga and Kerr, 1993). It is the irreversible end-result of any unresolved inflammatory process in the ear that has produced anatomical injury and almost always functional impairment (Ferlito, 1979).² In our study, tympanosclerosis was found to be the cause of conductive hearing loss in 26.66% of patients with conductive hearing loss. Kamaljit Kaur et al (2006) in his study of 200 patients with chronic middle ear infection, 21.1% (8 cases) had a fixed chain due to tympanosclerosis.³ The ossicles may become fixed by fibrous tissue secondary to adhesive otitis media.⁴ Suzuki.M (2008) has reported 2 cases of incudostapedial joint fixity.⁵ In our study, 3 patients with conductive hearing loss had ossicular fixity. Stapes was the most frequently involved ossicle to have congenital anomalies causing restricted ossicular mobility, according to our study. Hung K L has reported study of seventeen cases of ears that underwent exploratory tympanotomy and found that stapes was the most frequently involved ossicle to have abnormalities.⁶ Facial canal anomalies are sometimes encountered in patients operated for facial paralysis, myringoplasty, stapedotomy, middle ear exploration for sudden hearing loss etc. In a study by Sertac Yetiser, the incidence of facial canal dehiscence in patients operated for otosclerosis was found to be as high as 11.4%–19%. In the same study he reports a case of anteriorly placed facial nerve.⁷

Ossicular necrosis is often associated with chronic adhesive otitis media and chronic suppurative otitis media.^{8,9} Long process of incus is the most common ossicle to undergo necrosis and this can be attributed to its poor blood supply. Incus necrosis was found in about 60-80 % according to literature.¹⁰ This is similar to our study where 50% of ossicular erosion was confined to incus alone. The ossicles may become fixed by fibrous tissue secondary to adhesive

otitis media. The stapes (more specifically, its crural arches) is the second most commonly involved ossicle.⁴ In our study 12.5% patients had stapes erosion whereas stapes erosion is seen in 25% of cases according to literature.¹⁰ Malleus is reported to be the most resistant ossicle. But in our study 25% of patients were found to have isolated malleus erosion. The proposed mechanism for ossicular erosion is chronic middle ear inflammation as a result of overproduction of cytokines-TNF alpha, interleukin-2, fibroblast growth factor, and platelet derived growth factor, which promote hypervascularisation, osteoclast activation and bone resorption causing ossicular damage.¹¹

The significance of the abnormal band of bone found in middle ear as a contributive factor for conductive hearing loss is not known. This anomaly has not been reported in literatures.

5. Conclusion

Exploratory tympanotomy can be done in patients with conductive hearing loss with intact tympanic membrane for a definitive diagnosis and treatment. The different middle ear pathologies causing conductive hearing loss with intact drum include otosclerosis, tympanosclerosis, middle ear adhesions, ossicular necrosis, ossicular immobility etc. Correction of these pathologies can result in significant symptomatic hearing improvement. Tympanosclerosis is found to be a sequelae of middle ear inflammatory conditions. Ossicular erosion cases are most often associated with adhesive otitis media. Incus is the most commonly eroded ossicle due to middle ear pathologies. Facial canal anomalies can cause technical problems in correction of conductive hearing loss. An abnormal bony band of doubtful significance was found in middle ear.

The purpose of this study is to provide an insight into the different causes of conductive hearing loss behind an intact tympanic membrane which may mimic otosclerosis on clinical presentation and to provide few instances where abnormal anatomy of middle ear may interfere with surgical correction of conductive hearing loss.

References

- [1] Se-Hyung Kim, Yang-Sun Cho., Hye Jeong Kim, Hyung-Jin Kim. Operative findings of conductive hearing loss with intact tympanic membrane and normal temporal bone computed tomography. *Eur Arch Otorhinolaryngol.* 2014; 271: 1409-14
- [2] Rout M R et al. Ossicular chain defects in safe type of chronic suppurative otitis media. *Indian J Otol.* 2014; 20:102-105
- [3] Kamaljit Kaur, Nishi Sonkhya, A.S. Bapna. Tympanosclerosis revisited. *Indian J Otolaryngol Head Neck Surg.* 2006; 58: 128-32
- [4] Bluestone and Klein. Complications and sequelae: intratemporal. In Charles.D. Bluestone, Jerome.O. Klein Eds. *Otitis media in infants and children.* 4th ed. B.C. Decker Inc; 2007: 410-11.
- [5] Suzuki M, Kanabayashi H, Kawano A, Hagiwara A, Furuse H, Yamaguchi T, Shimizu M. Involvement of

- the incudostapedial joint anomaly in conductive deafness. *Acta Otolaryngol.* 2008; 128(5):515-9.
- [6] Hung KL, Tu TY, Tsai TL, Shiao AS. Congenital ossicular anomalies. *J Chin Med Assoc.* 2003 ;66(8):474-9.
- [7] Sertac Yetiser .The Dehiscent Facial Nerve Canal. *Int J Otolaryngol.* 2012;10:1-5
- [8] Watson C. Necrosis of the incus by the chorda tympani nerve. *J Laryngol Otol.* 1992; 106(3): 252-3.
- [9] Saurabh Varshney, Ashutosh Nangia, S. S. Bist, R. K. Singh, N. Gupta, S. Bhagat. Ossicular Chain Status in Chronic Suppurative Otitis Media in Adults. *Indian J Otolaryngol Head Neck Surg.* 2010 ; 62(4): 421- 26.
- [10] Salah Mansour, Jacques Magnan, Hassan Haidar, Karen Nicolas. Atelectasis and adhesive otitis media. In Salah Mansour, Jacques Magnan, Hassan Haidar, Karen Nicolas Eds. *Tympanic membrane retraction pocket. Overview and advances in diagnosis and management.* 1st ed. Springer International Publishing; 2015:74-75
- [11] Kansu L, Yilmaz I, Akdogan V, Avci S, Ozluoglu . Idiopathic incus necrosis: Analysis of 4 cases. *Ear Nose Throat J.* 2013;92(2):10-13