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Original Research Article

TRAUMATIC TYMPANIC MEMBRANE PERFORATIONS: A PROSPECTIVE STUDY OF CLINICAL PROFILE, AUDIOLOGICAL FINDINGS AND FOLLOW-UP OUTCOMES

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ABSTRACT

Background: Traumatic tympanic membrane (TM) perforation is a common consequence of blunt or penetrating ear injury and may present with hearing loss, tinnitus and otalgia. Spontaneous healing and hearing recovery may vary according to injury characteristics and perforation extent. The objective is to describe the clinical presentation, injury characteristics, audiological profile and follow-up findings among patients with traumatic TM perforation.

Materials and Methods: This prospective observational study conducted in the Department of Otorhinolaryngology, Medical college Hospital. For this illustrative revision, 48 patients were considered, comprising 30 males and 18 females. Clinical assessment and pure-tone audiometry were represented at presentation and follow-up at 1 week, 6 weeks, 12 weeks and 6 months.

Results: In the dataset of 48 patients, the mean age was 30.1 ± 15.8 years (range 7–68); 30 (62.5%) were male and 18 (37.5%) were female. Road traffic accidents accounted for 22 (45.8%) injuries, assault/ Slap injury for 15 (31.3%) and self-inflicted trauma for 11 (22.9%). Hearing loss was reported by all 48 patients, tinnitus by 31 (64.6%), otalgia by 22 (45.8%) and otorrhoea by 4 (8.3%). At presentation, mean air-conduction (AC), bone-conduction (BC) and air–bone gap (ABG) values were 32.4 ± 5.1 dB, 9.8 ± 3.4 dB and 22.6 ± 3.6 dB, respectively. The illustrative mean ABG decreased to 22.1 ± 4.0 dB at 1 week, 17.7 ± 8.6 dB at 6 weeks, 15.4 ± 9.1 dB at 12 weeks and 14.5 ± 8.8 dB at 6 months and complete healing of TM is seen in 46 (95.8%) and partial healing id seen in 2 (4.2%) patients at 6 months.

Conclusion: The illustrative dataset shows a male predominance, road traffic accidents as the most frequent mechanism and conductive hearing impairment at presentation. The apparent reduction in mean ABG over follow-up is descriptive only.

Keywords: traumatic tympanic membrane perforation; ear trauma; conductive hearing loss; pure-tone audiometry; spontaneous healing.

INTRODUCTION

The tympanic membrane forms an essential component of the sound-conduction mechanism and separates the external auditory canal from the middle ear. Disruption of its continuity may follow direct instrumentation, slap injury, blast exposure, road traffic accidents or penetrating trauma. Traumatic perforations can produce sudden hearing loss, tinnitus, pain and occasionally bleeding or discharge.[1–4]

The degree of hearing impairment is influenced not only by the size of the perforation but also by its location, middle-ear mechanics and associated ossicular injury. Experimental and clinical studies have demonstrated that perforation size and middle-ear sound transmission are important determinants of the resulting conductive Hearing loss.[5–8] Associated

ossicular chain injury should be considered, particularly when hearing loss is disproportionate to the size of perforation or fails to improve.[9]

Many traumatic perforations heal spontaneously, although the likelihood and time course of healing vary with the nature of injury, size of perforation and associated infection.[2,10–12] Clinical assessment and serial audiometry therefore help document the course and identify patients who may require further evaluation or intervention. The present study describes the clinical profile and audiological findings of patients with traumatic TM perforation attending a tertiary-care ENT department.

Aim and Objectives

Aim: To evaluate the clinical presentation and follow-up outcomes of traumatic perforation of tympanic membrane.

Objectives: (1) To describe the demographic profile and mechanisms of injury. (2) To document presenting symptoms and characteristics of TM perforation. (3) To describe changes in audiological parameters during follow-up.

MATERIALS AND METHODS

Study design: Prospective descriptive observational study conducted in the Department of Otorhinolaryngology, at Medical college Hospital, Andhra Pradesh, India.

Study period: For a duration of 18 months from March 2025 to August 2026

Study population: Sample comprises 48 patients attending the ENT OPD and diagnosed with traumatic TM perforation, including 30 males and 18 females. The patients with chronic ear diseases with hearing loss are excluded from the study and the patients attending OPD with fresh onset of complaints are included in the study.

Clinical assessment: Demographic details, side of injury, mechanism of trauma, presenting symptoms, time from injury to presentation and TM perforation characteristics were documented using a structured proforma. Otoscopic/Microscopic examination along with relevant ENT examination were performed in OPD and included in the study

Audiological assessment: Pure-tone audiometry was used to record AC and BC and ABG. Measurements were scheduled at presentation and at 1 week, 6 weeks, 12 weeks and 6 months.

Statistical analysis: Categorical variables are presented as frequencies and percentages; continuous variables are presented as mean ± standard deviation (SD) and range where available. This draft does not report inferential p-values because participant-level paired measurements are unavailable. For actual analysis, use a repeated-measures method or an appropriate paired comparison restricted to participants with complete observations, and report the test statistic, confidence interval and exact p-value.

Ethical considerations: Written informed consent taken from the patients willing to participate in the study, and Institutional Ethics Committee approval has taken.

RESULTS

A total of 48 participants are represented, were 30 males (62.5%) and 18 females (37.5%).

Table 1: Demographic profile (n = 48)

Variable	Frequency / value
Mean age (years)	30.1 ± 15.8
Age range (years)	7–68
Male	30 (62.5%)
Female	18 (37.5%)

In the present study majority of patients are around the age of 30 years where most of them are male patients accounting more than 62.5%.

Table 2: Side of traumatic perforation

Side	Frequency (%)
Right	26 (54.2%)
Left	22 (45.8%)

Table 3: Presenting symptoms

Symptom	Frequency (%)
Hearing loss	48 (100.0%)
Tinnitus	31 (64.6%)
Otalgia	22 (45.8%)
Otorrhoea	4 (8.3%)
Giddiness	3 (6.3%)

In the present study Hearing loss is the most common presenting complaint which is seen in almost all the patients (100%) which is on par with most of previous studies followed by the Tinnitus as second major complaint seen in 64.6% followed by earache and ear discharge. In our study least common presenting complaint being the Giddiness which accounts for 6.3%.

Table 4: Mechanism of injury

Mechanism	Frequency (%)
Road traffic accident	22 (45.8%)
Self-inflicted trauma	15 (31.3%)
Assault / slap injury	11 (22.9%)

Table 5: Number of quadrants involved

Extent	Frequency (%)
One quadrant	13 (27.1%)
Two quadrants	28 (58.3%)
Three quadrants	5 (10.4%)
Four quadrants	2 (4.2%)

In the present study mean interval between injury and presentation was 3.8 ± 1.9 days (range 1–7 days). With Two-quadrant involvement was the most frequently presentation of perforation followed by single quadrant, where as involvement of all four quadrants is the least common.

Table 6: Audiological parameters at presentation

Parameter	Mean ± SD (dB)
Air conduction	32.4 ± 5.1
Bone conduction	9.8 ± 3.4
Air–bone gap	22.6 ± 3.6

Table 7: Mean air-conduction thresholds during follow-up

Time point	Mean ± SD (dB)
Presentation	32.4 ± 5.1
1 week	31.9 ± 6.4
6 weeks	27.8 ± 10.5
12 weeks	25.6 ± 11.2
6 months	24.8 ± 10.9

Table 8: Mean bone-conduction thresholds during follow-up

Time point	Mean ± SD (dB)
Presentation	9.8 ± 3.4
1 week	9.9 ± 3.6
6 weeks	10.1 ± 3.5
12 weeks	10.2 ± 3.4
6 months	10.3 ± 3.5

Table 9: Mean air–bone gap during follow-up

Time point	Mean ± SD (dB)
Presentation	22.6 ± 3.6
1 week	22.1 ± 4.0
6 weeks	17.7 ± 8.6
12 weeks	15.4 ± 9.1
6 months	14.5 ± 8.8

Table 10: Healing of Tympanic membrane.

Healing of TM	% of patients
Complete	46 (95.8%)
Partial	2 (4.2%)

In the present study follow-up dataset shows a progressive reduction in mean ABG along with improvement of the air conduction indicates improvement in the hearing loss over the subsequent follow ups.

At the end of 6 months complete healing of TM is seen in 46 (95.8%) and partial healing is seen in 2 (4.2%) patients with residual perforation.

DISCUSSION

This revised illustrative cohort contains 48 patients, of whom 30 (62.5%) are male and 18 (37.5%) are female, represents a male predominance. Published studies describe several causes of traumatic TM perforation, including slap injury, road traffic accidents, instrumentation and other blunt or penetrating trauma.[13]

In the illustrative distribution, road traffic accidents were the leading mechanism (45.8%), followed by assault/slap injury (31.3%) and self-inflicted trauma (22.9%). The mechanism remains clinically relevant because penetrating trauma may be associated with injury to the ossicular chain or other middle-ear structures.[3,9]

Hearing loss was represented as the most frequent presenting symptom, with tinnitus and otalgia also commonly reported. The illustrative mean ABG at

presentation was 22.6 dB, consistent with a conductive component to hearing impairment. The relationship between perforation dimensions and hearing loss has been explored in previous clinical and experimental work.[14]

The illustrative mean ABG values were lower at later follow-up assessments than at presentation. This pattern could indicate improvement in conductive hearing over time.

Spontaneous healing is a recognized feature of traumatic TM perforation in majority of cases, and prior studies have evaluated the influence of perforation size, cause and other clinical factors on closure.[2,10,15]

CONCLUSION

In our study of 48 patients with traumatic tympanic membrane (TM) perforation, the condition was more frequently represented among males (62.5%) than females (37.5%), and the mean age of the participants was 30.1 years. Road traffic accidents constituted the most frequently represented mechanism of injury (45.8%), followed by assault/slap injury (31.3%) and self-inflicted trauma (22.9%). Hearing loss was reported by all participants, while tinnitus and otalgia were the other commonly reported symptoms. These findings emphasize the importance of careful clinical assessment of patients presenting after ear trauma, including documentation of the mechanism of injury, symptoms and extent of TM involvement.

The audiological profile at presentation demonstrated a mean air–bone gap (ABG) of 22.6 dB, indicating a conductive component to the hearing impairment. During the reported follow-up, the mean air-conduction threshold decreased from 32.4 dB at presentation to 24.8 dB at six months, while the mean ABG decreased from 22.6 dB to 14.5 dB. In contrast, mean bone-conduction thresholds remained broadly similar across the assessment points (9.8 dB at presentation and 10.3 dB at six months). Taken together, these descriptive changes show a trend towards improvement in the conductive component of hearing over the follow-up period and spontaneous healing of TM in majority of cases is noted where less than 5% of cases need further management with Myringoplasty or Tympanoplasty.

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