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HEARING LOSS IN PATIENTS WITH TRAUMATIC TEMPORAL BONE FRACTURES: A CROSS-SECTIONAL STUDY IN A TERTIARY CARE HOSPITAL IN MANDYA

Dr. Ravi D	Associate Professor & Head, Department of ENT., MIMS, Mandya
Dr. Balaji N K	Assistant Professor, Department of ENT, MIMS, Mandya
Dr.Abiramisundari M *	Resident, Department of ENT, MIMS, Mandya *Corresponding Author

ABSTRACT **Introduction:** Temporal bone and skull base fractures are frequently encountered in head trauma cases, with consequences ranging from minor, transient symptoms to severe, permanent deficits. While these injuries often present with significant neurological impairments, they can also damage auditory and vestibular systems. The temporal bone consists of four parts (squama temporalis, mastoid, petrous, and tympanic portions) and exhibits five fracture types: longitudinal (conductive hearing loss), transverse (sensorineural hearing loss), mixed, squama-mastoid, and isolated meatal fractures.**Methods:** The cross-sectional study was conducted in the department of Otorhinolaryngology and casualty, Mandya Institute of Medical Sciences, Mandya. The study was conducted from March 2025 to May 2025. Patients aged 18 years and above were included in this study. The sample size was 51. Patients who presented with ear bleed, vertigo, or hearing loss following road traffic accidents, self-falls, or assaults within the preceding week underwent HRCT (High Resolution Computed Tomography) scans of bilateral temporal bones to identify and classify any fractures (longitudinal, transverse, or mixed). Pure Tone Audiometry was performed to assess the type and degree of hearing loss. **Results:** Most common otoscopic finding was otalgia (ear pain), present in 43 (84.3%) of cases. This was followed by hemotympanum 30 (58.8%) and otorrhea (ear discharge), which was observed in 27 (52.9%) of patients (Figure 1). The hearing loss was a common finding, with conductive hearing loss being the most prevalent type, affecting 34 patients (66.7%). Sensory Neural Hearing loss was less frequent, observed in 14 patients (27.4%), while mixed hearing loss was the least common, occurring in only 3 patients (5.9%).**Conclusion:** Globally, road traffic accidents (RTAs) remain the predominant cause of head injury and are a primary mechanism for the high-energy trauma that results in temporal bone fractures with conductive hearing loss.

KEYWORDS : Temporal fractures, Hearing loss, Trauma

INTRODUCTION

The number of adults injured or killed in road traffic accidents has increased in recent years. The GBD (Global Burden of Disease) 2019 Fracture Collaborators' systematic analysis reveals a significant global burden of fractures in 2019, with an estimated 178 million new cases (95% UI: 162–196 million), 445 million prevalent cases (95% UI: 428–484 million), and 25.8 million years lived with disability (YLDs) (95% UI: 17.8–35.8 million).1

Temporal bone and skull base fractures are commonly encountered in cases of head trauma, with consequences ranging from minor, transient symptoms to severe and permanent deficits. Although these injuries often present with significant neurological impairments, they may also involve the auditory and vestibular systems. In the acute setting, associated life-threatening injuries usually require immediate attention, which can delay the evaluation and management of hearing and balance disorders.2 The temporal bone is a complex paired skull structure that houses critical components like the middle/inner ear, facial nerve (VII), vestibulocochlear nerve (VIII), carotid artery, and jugular vein. Fractures resulting from high-energy trauma may lead to hearing loss, facial paralysis, CSF leaks, or vascular injuries, though some remain asymptomatic. Its intricate anatomy renders the temporal bone particularly vulnerable to multisystem damage.3,4

The temporal bone consists of four parts (squama temporalis, mastoid, petrous, and tympanic portions) and exhibits five fracture types: longitudinal (conductive hearing loss), transverse (sensorineural hearing loss), mixed, squama-mastoid, and isolated meatal fractures. This classification aids in predicting complications and guiding treatment based on the involved structures.5,6 Sensorineural hearing loss (SNHL) can arise from various mechanisms, including central auditory pathway injury, cochlear damage due to barotrauma, shearing or avulsion of the auditory nerve, disruption of membranous labyrinth, cochlear ischemia, and peri lymphatic fistulas. Additionally, endolymphatic hydrops may develop due to obstruction of endolymphatic duct following temporal bone fractures. These diverse aetiologies highlight the complex pathophysiology underlying post-traumatic SNHL, which often results in permanent auditory dysfunction.7,8

OBJECTIVE

1. To assess the type and degree of hearing loss in patients with traumatic temporal bone fractures.
2. To determine the association between type of degree hearing loss and type of temporal bone fractures.

MATERIALS AND METHODS

Study Design: A cross-sectional study

Study Period: Three months (March 2025 to May 2025).

Study Population: Outpatient Department and casualty, Department of Otorhinolaryngology, MIMS, Mandya. Written informed consent was obtained from all participants prior to enrollment.

Sample Size:
The sample size was 51, calculated based on previous study conducted by Shankar A et al,9 by using the formula, , (Z = Standard table value at 95% Confidence interval = 1.96, p = proportion of hearing loss in cases of traumatic temporal bone fracture = 77%, d = relative precision (15% of p) = 11.55).

Sampling Method: Consecutive enrollment till the sample size was met.

Inclusion Criteria:
1. The study population was patients with head injury aged 18 years and above, both male and female genders, who sustained head injuries were diagnosed with temporal bone fractures.
2. Those who are willing to provide informed written consent was included in this study.

Exclusion Criteria:
1. Patients with preexisting hearing loss, a prior history of trauma to the temporal or facial bones, and those with severe head injuries who were bedridden or neurologically compromised were excluded from the study.
2. Those who are not willing for study

METHOD OF DATA COLLECTION (STUDY TOOLS):

After obtaining ethical clearance from the Institutional Ethical Committee, written informed consent was obtained from all study participants after explaining the purpose and procedures of the study in their preferred language. Patients presenting with ear bleed, vertigo, or hearing loss following road traffic accidents, self-falls, or assaults within the preceding week underwent HRCT (High Resolution Computed Tomography) scans of bilateral temporal bones to identify and classify any fractures (longitudinal, transverse, or mixed).

Demographic data, including age, gender, occupation, and socio-economic status, were collected and recorded. A detailed clinical history was obtained followed by thorough clinical examination. Once the patients became neurologically stable, Pure Tone Audiometry (PTA) was performed to assess the degree, type, and severity of hearing loss. Hearing loss was classified according to the American Speech-Language-Hearing Association (ASHA) guidelines.

Statistical Analysis:

All collected data were entered into an Excel sheet and statistically analysed using IBM SPSS version 29.0. Descriptive statistical tests, including frequency and percentage, were applied to categorical data such as hearing loss and temporal bone fracture types. For continuous variables quantitative mean and standard deviation were calculated. Inferential statistical tests, including the chi-square (χ^2) test, were used to examine associations between hearing loss and variables such as age group and sex. A p-value of <0.05 was considered statistically significant.

RESULTS:

The present study comprised of 51 subjects. Among the subjects 39 (76.5%) were male and 12 (23.5%) were female. The patients mean age was 37.7 + 14.3 years. The most common mode of injury was a vehicle accident, accounting for the majority of cases (60.8%), followed by assault (25.5%) and self-fall (13.7%). Regarding the side of the fracture, right-sided fractures were more prevalent (58.8%) than left-sided ones (41.1%) (Table 1).

Based on computed tomography (CT) findings, temporal bone fractures were most commonly classified using the newer system as otic capsule violating (OCV), which accounted for 36 (70.6%) of cases, while otic capsule sparing (OCS) fractures were less frequent 15 (29.4%). According to the traditional classification system, longitudinal fractures were the most prevalent type 33 (60.8%), followed by transverse fractures 19 (37.2%) (Table 2).

Table 1: Baseline characteristics (n=51)

Characteristics	n (%)
Age group (years)	
18 - 30	29 (56.9%)
31 - 40	13 (25.5%)
41 - 50	10 (19.6%)
51 - 60	10 (19.6%)
61 - 70	6 (11.8%)
Gender	
Male	39 (76.5%)
Female	12 (23.5%)
Mode of injury	
Vehicle accident	31 (60.8%)
Assault	13 (25.5%)
Self-fall	7 (13.7%)
Fracture side	
Right	30 (58.8%)
Left	21 (41.1%)

Table 2: Types of temporal bone fracture based on CT findings (n=51)

Types of fracture	n (%)
Newer classification	
OCS	15 (29.4%)
OCV	36 (70.6%)
Traditional classification	
Longitudinal	33 (60.8%)
Transverse	19 (37.2%)
Mixed	3 (1.9%)

Most common otoscopic finding was otalgia (ear pain), present in 43 (84.3%) of cases. This was followed by hemotympanum 30 (58.8%) and otorrhea (ear discharge), which was observed in 27 (52.9%) of patients (Figure 1). The hearing loss was a common finding, with conductive hearing loss being the most prevalent type, affecting 34 patients (66.7%). Sensory neural hearing loss was less frequent, observed in 14 patients (27.4%), while mixed hearing loss was the least common, occurring in only 3 patients (5.9%) (Figure 2). Based on Clark's grading the majority exhibited some degree of hearing impairment. Mild hearing loss was the most common finding, affecting 17 patients (33.3%), followed by minimal impairment in 12 patients (23.5%) (Figure 3).

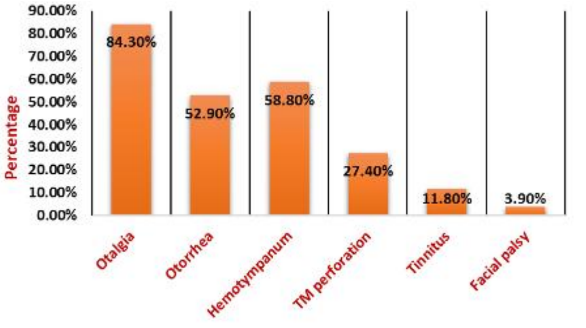

Figure 1: Distribution of Otoscopic findings

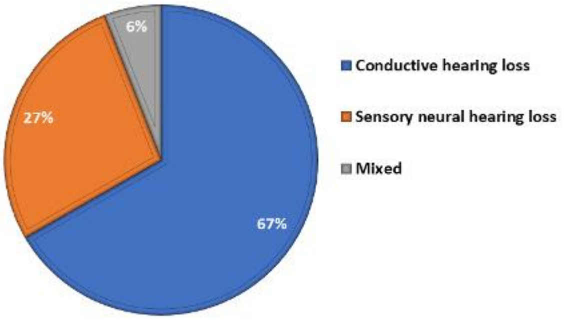

Figure 2: Distribution of type of hearing loss

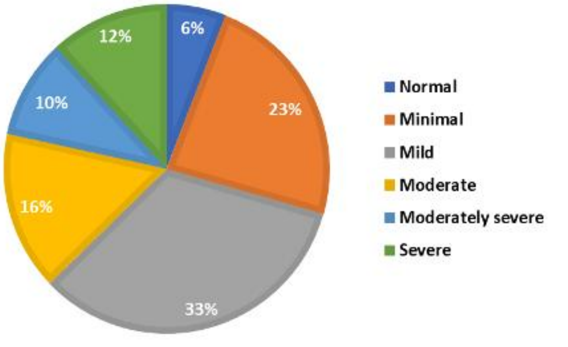

Figure 3: Clark's grading of hearing impairment

Based on the crosstabulation analysis, a statistically significant association was found between the newer fracture classification and the type of hearing loss (χ^2=8.12, p=0.017). The vast majority of OCS fractures, 93.3%, resulted in conductive hearing loss (CHL), with no associated sensorineural hearing loss (SNHL). In contrast, OCV fractures were associated with a more varied hearing loss profile; while 55.6% resulted in CHL, a substantial 38.9% led to SNHL (Table 3).

A highly statistically significant association was found between the traditional fracture classification and the type of hearing loss (χ^2=18.14, p<0.0001). Longitudinal fractures were predominantly associated with CHL, affecting 83.9% of these cases, with a low incidence of SNHL at 6.4%. In stark contrast, transverse (and mixed) fractures were strongly linked to sensorineural hearing loss, which was present in 60.0% of cases, while conductive hearing loss accounted for the remaining 40.0% (Table 4).

Table 3: Crosstabulation – Newer classification*type of hearing loss

	CHL	SNHL	Mixed	Total	^{2}, p-value
OCS	14 (93.3%)	0 (0.0%)	1 (6.7%)	15 (29.4%)	8.12, **0.017***
OCV	20 (55.6%)	14 (38.9%)	2 (5.6%)	36 (70.6%)	
Total	34 (66.7%)	14 (27.4%)	3 (5.9%)	51 (100%)	

Table 4: Crosstabulation – Traditional classification*type of hearing loss

	CHL	SNHL	Mixed	Total	^{2}, p-value
Longitudinal	26 (83.9%)	2 (6.4%)	3 (9.7%)	31 (100.0%)	18.14, **<0.0001***
Transverse + Mixed	8 (40.0%)	12 (60.0%)	0 (0.0%)	20 (100.0%)	

DISCUSSION:

Temporal bone fractures are a significant consequence of high-energy head trauma and are associated with substantial otologic, neurologic, and intracranial morbidity. They commonly result in hearing loss, facial nerve injury, vestibular dysfunction, cerebrospinal fluid (CSF) leak, and other complications. Consistent with previous studies, our study demonstrated a clear male predominance (76.5%) and primarily affected young adults, with a mean age of 37.7 years. This demographic distribution reflects the greater involvement of young males in high-risk activities and road traffic accidents (RTAs), which remain the leading cause of temporal bone fractures worldwide.

Road traffic accidents accounted for 60.8% of cases in our study, corroborating findings reported by Venugopalan et al., Basavaraju et al., and Abhishek et al. However, assault constituted the second most common cause (25.5%), a higher proportion than that reported in most published series, suggesting regional variations in trauma patterns. Such differences emphasize the importance of tailoring preventive strategies according to local epidemiological trends.

Traditional classification identified longitudinal fractures as the most frequent type, while the newer otic capsule-based classification revealed an unusually high incidence of otic capsule violating (OCV) fractures (70.6%) in our study. This finding contrasts with previous reports, where otic capsule sparing (OCS) fractures predominate. The discrepancy may reflect differences in trauma severity, referral bias, or variability in radiological interpretation. Since otic capsule involvement strongly predicts sensorineural hearing loss (SNHL), vestibular dysfunction, and facial nerve injury, standardized imaging criteria are essential for accurate diagnosis and prognostication.

Otoscopic examination demonstrated otalgia as the most common clinical finding, followed by hemotympanum and otorrhea. Previous studies have variably reported blood-stained external auditory canal or active canal bleeding as the predominant sign. These differences likely reflect variations in the timing of clinical assessment following trauma. Patients examined immediately after injury frequently present with active bleeding, whereas those evaluated later often exhibit resolving hemotympanum and persistent symptoms such as otalgia and hearing impairment. Therefore, comprehensive otologic evaluation should include repeated examinations during follow-up.

Hearing loss was the most common functional deficit, with conductive hearing loss (CHL) accounting for 66.7% of cases. This finding is comparable to reports by Abhishek et al., Maradi et al., and Bayne et al., where CHL predominated due to hemotympanum, tympanic membrane perforation, and ossicular chain disruption. Mild hearing loss was the most frequent severity grade in our study according to Clark's classification. Nevertheless, the severity and type of hearing loss varied according to fracture pattern. OCS fractures were predominantly associated with CHL, whereas OCV fractures showed a significantly higher incidence of SNHL and mixed hearing loss. This observation is consistent with existing literature and reinforces the superior prognostic value of the OCS/OCV classification over the traditional longitudinal/transverse system.

Overall, our findings highlight that temporal bone fractures exhibit predictable demographic characteristics, mechanisms of injury, and audiological outcomes. Early high-resolution computed tomography combined with detailed audiological assessment is essential for accurate fracture classification, identification of complications, and appropriate management. Furthermore, adopting standardized radiological criteria and modern fracture classification systems may improve prognostic accuracy, facilitate comparison between studies, and guide long-term rehabilitation strategies for affected patients.

CONCLUSION:

Globally, road traffic accidents (RTAs) remain the predominant cause of head injury and are a primary mechanism for the high-energy trauma that results in temporal bone fractures. The study confirms that the modern OCS/OCV classification system provides superior prognostic value for predicting hearing outcomes in temporal bone fractures, with OCV fractures carrying a significantly higher risk of permanent sensorineural loss, underscoring its critical role in guiding patient counselling and management strategies.

DECLARATIONS:

Ethics & Consent to Participate: Institutional Ethics Committee approval obtained; written informed consent from all participants was obtained.

Consent for Publication: Not applicable.

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Conflict of Interest: The authors declare no competing interests.

REFERENCES:

1. GBD 2019 Fracture Collaborators. Global, regional, and national burden of bone fractures in 204 countries and territories, 1990–2019: a systematic analysis from the Global Burden of Disease Study 2019. Lancet Healthy Longev. 2021 Aug 20. doi:10.1016/S2666-7568(21)00172-0.
2. Maradi N, Somanath BM. Hearing loss following temporal bone fractures: a study on classification of fractures and the prognosis. Int J Otorhinolaryngol Head Neck Surg. 2017;3:390-4.
3. Patel A, Groppo E. Management of temporal bone trauma. Craniomaxillofac Trauma Reconstr. 2010;3:105-13.
4. Zayas OJ, Feliciano YZ, Hadley CR, Gomez AA, Vidal JA. Temporal bone trauma and the role of multidetector CT in the emergency department. Radiographics. 2011;31:1741-5.
5. Nosan D, Benecke J, Murr A. Current perspective on temporal bone trauma. Otolaryngol Head Neck Surg. 1997;117:67-71.
6. Probst R. Trauma to the lateral skull base. In: Probst R, Grevers G, Iro H, editors. Basic otorhinolaryngology. Stuttgart: Thieme; 2006. p. 302-5.
7. Shangkuan WC, Lin HC, Shih CP, et al. Increased long-term risk of hearing loss in patients with traumatic brain injury: a nationwide population-based study. Laryngoscope. 2017;127:2627-35.
8. Rizvi SS, Gibbin KP. Effect of transverse temporal bone fracture on the fluid compartment of the inner ear. Ann Otol Rhinol Laryngol. 1979;88:741-8.
9. Shankar A, George S, Somaraj S. Clinical and audiological evaluation of post-traumatic hearing loss. Int J Otorhinolaryngol Head Neck Surg. 2020;6(12):2258. doi:10.18203/issn.2454-5929.ijohns20205070.
10. Burgut HR, Bener A, Sidahmed H, Albuz R, Sanya R, Khan WA. Risk factors contributing to road traffic crashes in a fast developing country: the neglected health problem. Ulus Travma Acil Cerrahi Derg. 2010;16(6):497-502.
11. Gasparetto EL. Computed tomography in traumatic brain injury. Radiol Bras. 2011;44(2):vi.
12. Basavaraju U, Jayaramaiah SK, Turamari RU, Prakash V, Mankani S. Temporal bone fractures and its classification: retrospective study of incidence, causes, clinical features, complications and outcome. Int J Anat Radiol Surg. 2017;6(4):RO57-61.
13. Abhishek M, Kaleeswaran R, Srinivasan K. Assessment of hearing loss in temporal bone fractures. Indian J Otol. 2021;27(3):158-62.
14. Bayne K, Kubina M, Deshmukh A, Jeyakumar A. Temporal bone fractures and clinical hearing loss outcomes. Ann Surg Case Rep Images. 2024;1(5):1044.
15. Yalçıner G, Kutluhan A, Bozdemir K, Çetin H, Tarlak B, Bilgen AS. Temporal bone fractures: evaluation of 77 patients and a management algorithm. [Journal details incomplete—please provide].
16. Deshmukh KA, Fatima U, Siddiqui A, Tegnoor MS. Evaluation and outcomes of hearing loss in temporal bone fractures: a prospective study. Cureus. 2023;15(10).
17. Kim BJ, Song I, Choi J, Rah YC. Contralateral hearing loss in temporal bone fractures: a potential association with combined intracranial injury. J Int Adv Otol. 2024;20(3):210.
18. Honeybrook A, Patki A, Chapurin N, Woodard C. Hearing and mortality outcomes following temporal bone fractures. Craniomaxillofac Trauma Reconstr. 2017;10(4):281-5.
19. Venugopalan S, Mehta MR, Khavdu PJ, Fefar AD, Mistry SN. Temporal bone trauma management: a study of 100 cases. Indian J Otolaryngol Head Neck Surg. 2022;74(Suppl 1):299-306.
20. Stanisce L, Chryssofos S, Modi R, Raizada S, Watanabe H, Hunter K, et al. Long-term outcomes of acute temporal bone fractures. Laryngoscope. 2025;135(5):1803-8.