



Prospective Study on Hearing Loss Following Temporal Bone Fracture in Patients Attending a Tertiary Care Centre

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ABSTRACT

Background: Temporal bone fractures are a frequent consequence of head injury and are commonly associated with hearing loss. In polytrauma settings, auditory deficits may be overlooked, leading to delayed diagnosis and management. Understanding the relationship between fracture pattern and hearing loss is essential for prognostication and early intervention.

Objectives: To evaluate the proportion, type, degree, and outcome of hearing loss following temporal bone fractures and to analyse its association with fracture type.

Methods: This prospective observational study was conducted over 18 months at a tertiary care centre and included 65 patients with radiologically confirmed temporal bone fractures. Audiological evaluation using pure tone audiometry or auditory brainstem response was performed within 72 hours of injury. Patients with hearing loss were followed up at 1, 3, and 6 months as indicated. Data were analysed using descriptive statistics.

Results: The majority of patients were aged 31–40 years, with a male predominance (83%). Road traffic accidents were the most common cause of injury (86%). Longitudinal fractures constituted 80% of cases. Conductive hearing loss was the most frequently observed type (65.4%), followed by mixed hearing loss, while some patients had normal hearing. Longitudinal fractures were predominantly associated with conductive hearing loss, whereas transverse and oblique fractures showed a higher association with mixed and sensorineural hearing loss. Conductive hearing loss showed significant improvement on follow-up, while sensorineural hearing loss demonstrated limited recovery.

Conclusion: Hearing loss is a common complication of temporal bone fractures, and fracture pattern is an important predictor of type and outcome of auditory impairment. Early audiological assessment and systematic follow-up are essential to optimise hearing outcomes in these patients.

Keywords: Temporal bone fracture; Hearing loss; Pure tone audiometry.

BACKGROUND

Temporal bones are pyramidal structures in thick bone of skull base. It encapsulates facial nerve, cranial nerves IX to XI, cochlea, labyrinth, ossicles, tympanic membrane, carotid artery and jugular vein (1). The spectrum of temporal bone trauma is extremely varied, ranging from minor concussion without functional deficits to severe blunt or penetrating injury with multifunctional deficits that involve auditory and vestibular nerves, facial nerve and cranial contents. Temporal bone fractures are frequently associated with head trauma and may lead to conductive, sensorineural or mixed hearing loss. When the head trauma is of sufficient magnitude to fracture the skull, 14% to 22% of injured patients sustain a temporal bone fracture (2). Temporal bone fracture occurs across all age groups, with more than 70% of fractures occurring during the second, third, and fourth decades of life. These fractures occur predominantly in men in a ratio of 3:1 (3). Several reasons can lead to CHL or SNHL or MHL from temporal bone fractures. These auditory losses are often overlooked in

emergency due to more serious injuries resulting in delayed diagnosis and may result in long term functional impairment. Early diagnosis and interventions can prevent the patient from functional impairment. The identification of the type, degree and cause of HL and timely intervention can improve the outcome

OBJECTIVE

To evaluate proportion, type and degree, and outcome of hearing loss following temporal bone fracture

MATERIALS AND METHODS

Study design and setting

This study was designed as hospital based prospective observational study and was conducted in Department of ENT, Government Medical College, Thiruvananthapuram.

Study population and subject

This study included all patients aged above 12 yrs with radiologically confirmed temporal bone fracture with GCS above 8 attending the department. Patients with preexisting hearing loss and those not giving consent for participation were excluded from the study.

Study period

This study was conducted over a period of 18 months after getting IEC approval.

Sample size estimation

Sample size is calculated using the formula

$$\begin{aligned} 'n' &= Z\alpha^2pq/d^2 \\ &= (1.96)^2 \times 62 \times 38 / (12.4)^2 \\ &= 58.8 + 10\% \text{ for dropouts} \\ &= 64.6 \text{ rounded off to } 65 \end{aligned}$$

Z α value when $\alpha = 0.05$ is -1.96

p = proportion of patients with hearing loss following temporal bone fracture according to a study conducted by Nagaraj Maradi, Somanath B. M titled "Hearing loss following temporal bone fractures- a study on classification of fractures and the prognosis" published in IJOHNS in 2017. q = 100-p = 38

D= Relative precision, 20% of 62% = 12.4

Sampling technique

A consecutive sampling technique was followed and all cases satisfying the inclusion criteria were recruited for the study until sample size was reached.

Study variables

Variables included in this study were age, gender, mode of injury, radiological findings (type of fracture), hearing loss and other otological symptoms. Outcome variables included were audiology evaluation results, type of hearing loss, degree of hearing loss and type of tympanometry curve.

Data collection tool and technique

A semi-structured proforma was used to elicit the required information. All consecutive cases satisfying inclusion criteria were entered into the study after taking consent. The demographic data, mode of injury, type of temporal bone fracture and the clinical findings were entered into a proforma by the principal investigator. All patients were subjected to audiological evaluation within 72 hours. Those who gave consistent responses were subjected to PTA and for the rest, auditory brainstem response (ABR) was considered. Those with conductive hearing loss and mixed hearing loss were subjected to impedance audiometry. All patients diagnosed with hearing loss were given cause appropriate treatment and were followed up with PTA /ABR after 1 month. If hearing loss was persisting at 1 month, these were repeated at 3 months and if needed at 6 months after the first test. 10 dB improvement in 2 consecutive frequencies was taken as an improved hearing on retest (4).

Data analysis

Data was entered into Microsoft Excel sheet and data analysis was done using SPSS version 27 statistical software. Continuous variables were summarized using descriptive statistics. Categorical variables were expressed in frequencies and percentages. The proportion of hearing loss was expressed as percentages. Chi-square test was used to find association of hearing loss with type of fracture.

Ethical considerations

This study was initiated only after obtaining Institutional research committee and institutional ethics committee clearance. a detailed patient information sheet was given and Informed written consent was taken from all study participants. Confidentiality and privacy of patients information were strictly maintained. Safety and security of the data collected were maintained. No cost was borne by the patient for participating in this study.

RESULTS

A total of 65 cases were evaluated in this study. The majority of patients belonged to the age group of 31- 40, with male: female ratio of 5:1.

RTA was the main cause of injury in 56 cases (86%). 5 cases (8%) were due to fall, 2 cases (3%) resulted due to assault and the remaining 2 cases (3%) were due to hit with a cricket ball and an accidental fall of a wooden bar onto the head.

The most common complaint was bleeding from ear seen in 70% of cases and hearing loss in 37%. Other complaints were deviation of angle of mouth in 23%, vertigo in 15%, pinna injury in 12% and tinnitus in 11% of cases. 51 cases were found to have blood in external auditory canal, 10 cases had traumatic perforation, out of which 6(60%) had small-sized perforation while 4(40%) had medium-sized perforation in the pars tensa. 8 cases showed hemotympanum. In 9 cases otoscopic examination was normal. Out of 65 cases 50 cases (77%) had normal facial nerve function. 14 cases (22%) had delayed facial nerve palsy and 1 case (1%) presented with immediate facial nerve palsy.

Out of 65 cases 52 cases (80%) sustained longitudinal fracture to temporal bone, 10 cases (15%) had transverse fracture and 3 cases (5%) sustained oblique type of fracture to temporal bone. The proportion of hearing loss was 78.46%.

TYPE OF HEARING LOSS

Table: 1

Type of Hearing Loss	Cases (n=51)	Percentage (%)
CHL	38	74
SNHL	4	8
MHL	9	18

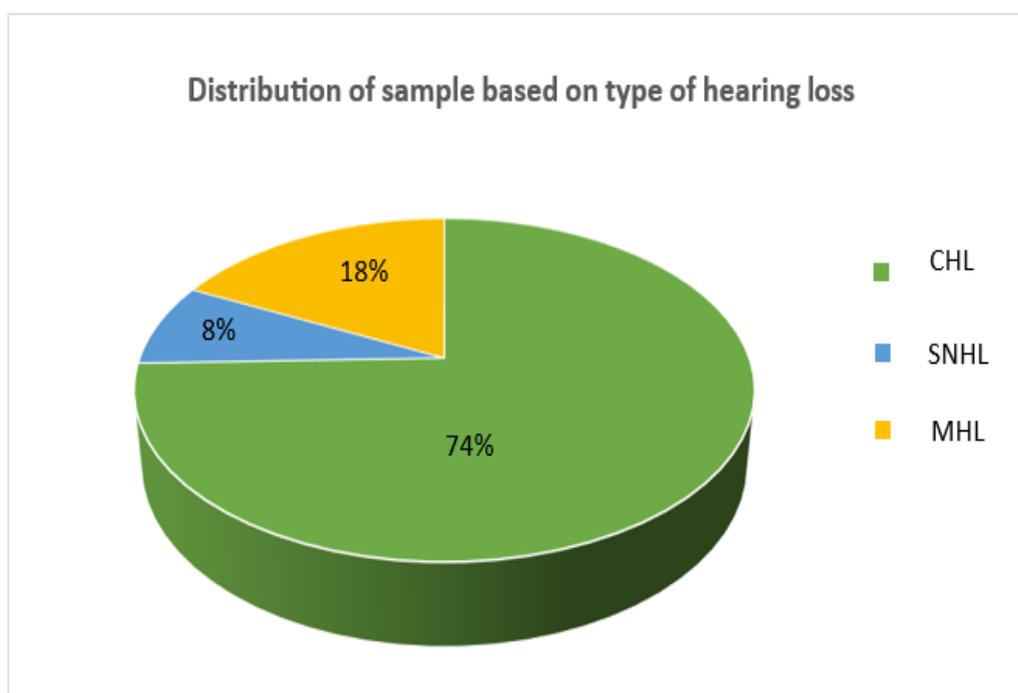


Figure 1

DEGREE OF HEARING LOSS

Table 2- Distribution of cases according to degree of hearing loss

Degree of hearing loss	Cases (n=51)	Percentage (%)
Slight	17	33
Mild	16	31
Moderate	9	18
Moderately Severe	3	6
Severe	2	4
Profound	4	8

TYPE OF FRACTURE AND TYPE OF HEARING LOSS

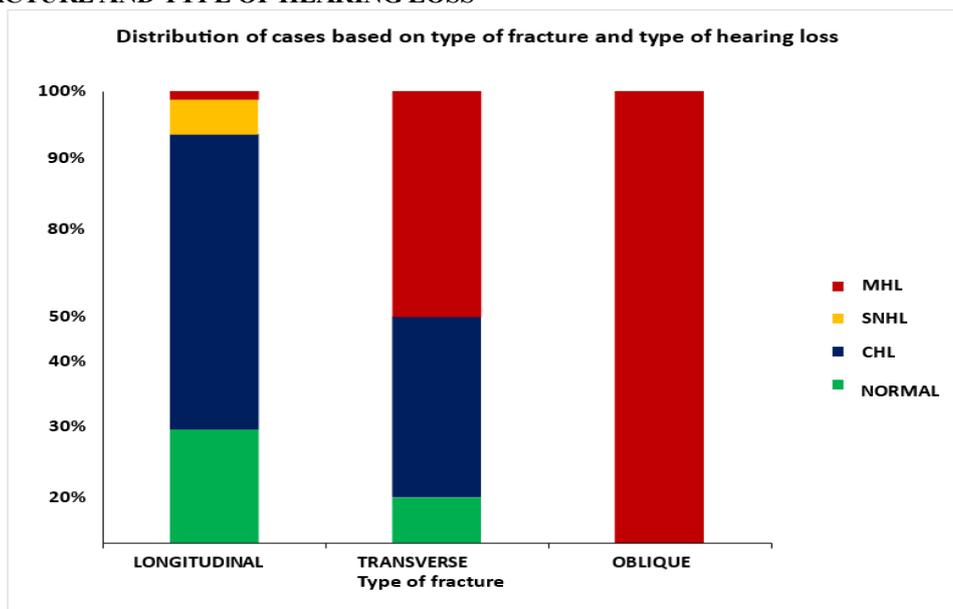


Figure 2 Distribution of cases based on type of fracture and type of hearing loss

TYPE OF FRACTURE AND DEGREE OF HEARING LOSS

Table-3 Distribution of cases according to type of fracture and degree of hearing loss

Degree of Hearing Loss	Type of fracture			Total (N=65)	P value
	Longitudinal (N=52)	Transverse (N=10)	Oblique (N=3)		
Normal	13 (25.0%)	1 (10.0%)	0 (0.0%)	14 (21.5%)	<0.001
Slight	17 (32.7%)	0 (0.0%)	0 (0.0%)	17 (26.2%)	<0.001
Mild	13 (25.0%)	3 (30.0%)	0 (0.0%)	16 (24.6%)	<0.001
Moderate	7 (13.5%)	1 (10.0%)	1 (33.3%)	9 (13.8%)	<0.001
Moderately Severe	1 (1.9%)	1 (10.0%)	1 (33.3%)	3 (4.6%)	<0.001
Severe	0 (0.0%)	1 (10.0%)	1 (33.3%)	2 (3.1%)	<0.001
Profound	1 (1.9%)	3 (30.0%)	0 (0.0%)	4 (6.2%)	<0.001

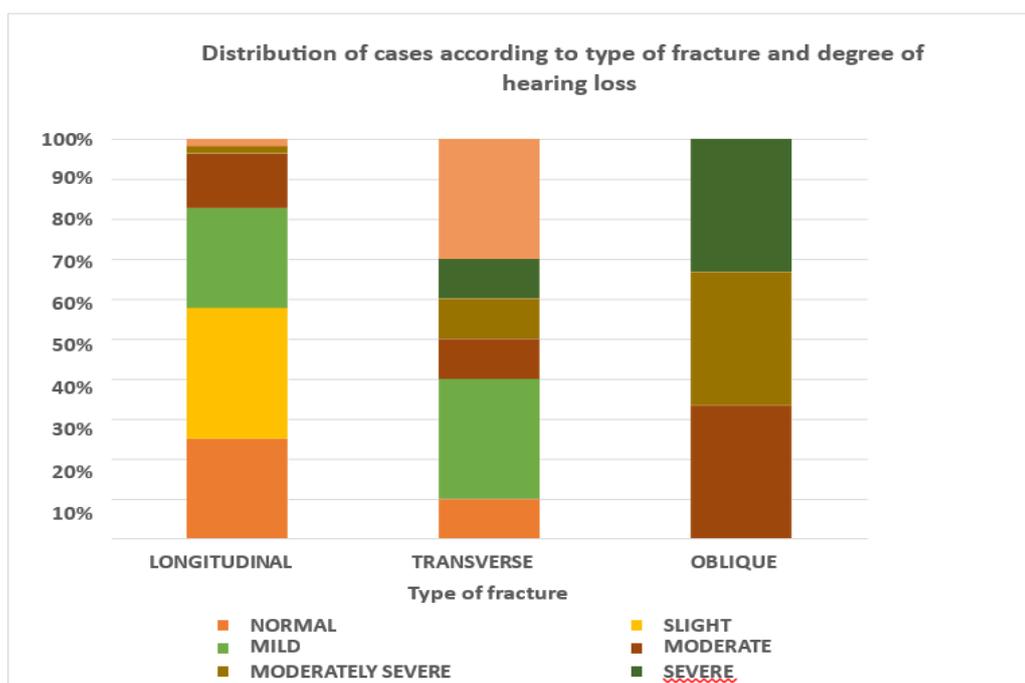


Figure-3 Distribution of cases according to type of fracture and degree of hearing loss

PROGNOSIS OF HEARING LOSS BY PTA

Table 4 Distribution of cases according to prognosis of hearing loss by PTA

Type of hearing loss	Case	Improved at 1 month	Percentage	Improved at 3 months	Percentage	Improved at 6 months	No improvement at the end of 6 months
CHL	38	34	89.4%	2	94.7%	0	2
SNHL	4	3	75%	1	100%	0	0
MHL	9	3	33.3%	2	55.5%	0	4
TOTAL	51	40	78.4%	5	88.2%	0	6

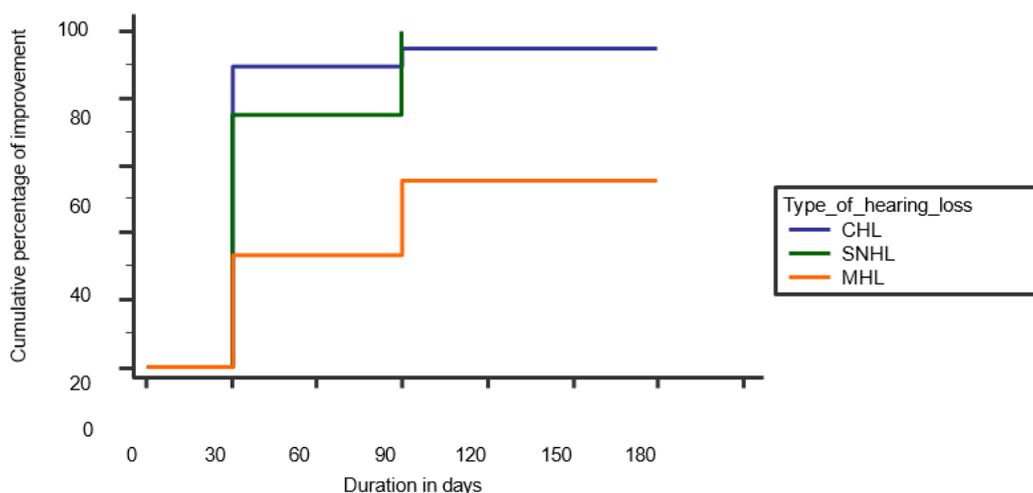


Figure 4-Distribution of cases according to prognosis of hearing loss by PTA

DISCUSSION

In this prospective study, temporal bone fractures were most commonly observed in the 31–40-year age group, with a marked male predominance (83%), reflecting greater exposure of young adult males to high-velocity trauma. Similar demographic patterns have been reported by Nagaraj Maradi et al.(5). and Vishnu Priya Padma Kumar et al.(6), both of whom documented male predominance and peak incidence in the economically productive age group.

Road traffic accidents were the leading cause of injury in this study (86%), which is consistent with findings from multiple Indian studies where RTAs accounted for 60–80% of temporal bone fractures. This highlights the continued burden of vehicular trauma as a major public health concern.

Longitudinal fractures constituted 80% of cases in the present study, followed by transverse and oblique fractures. This distribution closely parallels earlier studies by Kiran Deshmukh et al. (7)and Abhishek et al.(8), who reported longitudinal fractures in approximately 64–76% of cases. The predominance of longitudinal fractures can be attributed to lateral forces applied to the temporoparietal region during trauma.

With respect to hearing loss, conductive hearing loss was the most common type observed (65.4%), followed by mixed hearing loss, while a proportion of patients maintained normal hearing. These findings are comparable to those reported by Nagaraj Maradi et al.(5), who observed conductive hearing loss in 75.6% of patients, and by Vishnu Priya Padma Kumar et al.(6), who reported conductive loss in 53.5% of cases. The high incidence of conductive hearing loss in longitudinal fractures can be explained by hemotympanum, tympanic membrane perforation, and ossicular chain disruption, all of which were frequently noted on otoscopic examination in the present study.

Transverse and oblique fractures in this study were more commonly associated with mixed and sensorineural hearing loss, a finding that is in agreement with earlier literature demonstrating increased labyrinthine involvement and otic capsule injury in these fracture patterns. Similar observations were made by Prasad et al., who reported higher rates of sensorineural hearing loss in transverse fractures compared to longitudinal fractures. This underscores the prognostic importance of fracture orientation in predicting auditory outcomes.

Audiological follow-up in the present study showed that most cases of conductive hearing loss demonstrated significant improvement over time, correlating with resolution of middle ear pathology. In contrast, sensorineural hearing loss showed limited recovery, consistent with irreversible cochlear or neural injury. Comparable recovery trends were noted by Kiran Deshmukh et al., who reported statistically significant improvement predominantly in conductive hearing loss over a six-month follow-up period.

Facial nerve palsy was observed in a minority of patients, with delayed onset palsy being more common than immediate palsy. This pattern is similar to previously published studies, which report delayed facial nerve palsy as the more frequent presentation and often associated with better prognosis. The association of facial nerve involvement with non-longitudinal fractures in the present study further supports existing evidence that transverse and otic capsule-violating fractures are associated with more severe complications.

Overall, the findings of this study are consistent with existing literature and reinforce the importance of early otological examination and audiological assessment in patients with temporal bone fractures. Early identification of hearing loss, correlation with fracture type, and timely intervention can significantly improve auditory outcomes and reduce long-term morbidity.

CONCLUSION

Temporal bone fractures commonly result in hearing loss of varying type and degree. Longitudinal fractures were most frequent and predominantly associated with CHL, while transverse and oblique fracture showed higher association with MHL and SNHL. Early audiological assessment played a crucial role in detecting hearing impairment that may be missed in polytrauma settings. CHL generally showed a good recovery whereas SNHL had poorer prognosis. This study underscores the importance of routine otological evaluation and early audiological testing in all patients with temporal bone fracture.

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