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Original Article

Radiology Section

Temporal Bone Fractures and its Classification: Retrospective Study of Incidence, Causes, Clinical Features, Complications and Outcome

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ABSTRACT

Introduction: Temporal bone fracture is usually associated with high energy head injury and can cause potentially severe complications. Immediate detection of temporal bone fracture and its complications helps in providing early and effective treatment, which if left untreated can have drastic consequences.

Aim: The main objective of the study is to document the frequency and most prevalent type of temporal bone fracture, co-existing complications and to establish association between them.

Materials and Methods: One year (2015-2016) retrospective study of head injured patients presented to the Emergency Department, Mysore Medical College And Research Institute was conducted. Age and gender distribution, cause of injury, radiological findings, otorhinolaryngological clinical presentations and treatment given were analyzed. The results were tabulated and were evaluated by Microsoft Excel 2013.

Results: Out of 1450 patients evaluated for head injury 154 patients were positive for temporal bone fracture. Incidence of the study was 10.6%. Majority of the patients were male (66.2%) and were between 30 to 40 years (50.1%). The major cause of injury was motor vehicle accidents (84.48%). Right side was involved (58.4%) more than the left side (41.5%). Most common clinical presentation was otorrhea 68.8%, followed by otalgia (35.04%) and otorhinorrhea (24.67%). Longitudinal type fracture was most frequent 56.25%. Otic capsule involvement was present in 35.93%. Most of the fractures were managed conservatively whereas surgery was required in 12 patients (7.7%).

Conclusion: Temporal bone fractures were frequently associated with severe traumatic brain injury leading to serious long term morbidity and sequelae. CT-scan is of utmost importance in detection of fractures and its complications.

Keywords: Facial nerve palsy, Longitudinal fracture, Otic capsule, Transverse fracture

INTRODUCTION

Temporal bone fracture accounts for 30 to 70% of skull fractures in head trauma patients [1]. The temporal bone has complex anatomy, which contains many critical structures in very close relation to it, such as cranial nerves V, VI, VII, and VIII; internal carotid and middle meningeal arteries; sigmoid sinus; jugular bulb and inner ear structures. High-energy head trauma results in temporal bone fractures. Temporal bone fracture may be asymptomatic or it can cause devastating complications such as sensorineural/conductive hearing loss, balance dysfunction, perilymphatic fistulas, cerebrospinal fluid leaks, facial nerve paralysis, and vascular injury [2]. Temporal bone fractures are easily missed on the conventional X-rays. Multidetector Computed Tomography (MDCT) is essential in identifying and classifying temporal bone fractures and in detection of important structural injuries.

MATERIALS AND METHODS

One year retrospective study was conducted from April 2015 to May 2016. The source population was from patients with head injury who presented to Emergency Department of Mysore Medical College And Research Institute, Mysuru, India, and referred to Radiology Department for CT-scan of head. Patients with old fractures and post-operative patients were excluded from the study. CT-scan images were acquired at 4mm axial cuts at skull base through the brain to the vertex, reformatting was done at 0.5 mm cuts in sagittal, coronal and axial planes to facilitate evaluation of the petrous temporal

bone and its components. Non contrast enhanced CT images were reviewed in bone and brain window settings. Medical records and treatment given to all the patients were collected and reviewed. The study was done to evaluate the incidence of temporal bone fractures in case of head injury, and to analyze these fractures by its gender distribution, cause of injury, otorhinolaryngological presentation, radiological findings and its outcome. We evaluated 1450 head CT scans, performed in the above mentioned time span, in which temporal bone fractures were present in 154 patients.

This study is approved by the institutional Ethics and Research Committee. Consent from patients was waived of as it is a retrospective study. The results were tabulated and were evaluated by Microsoft Excel 2013.

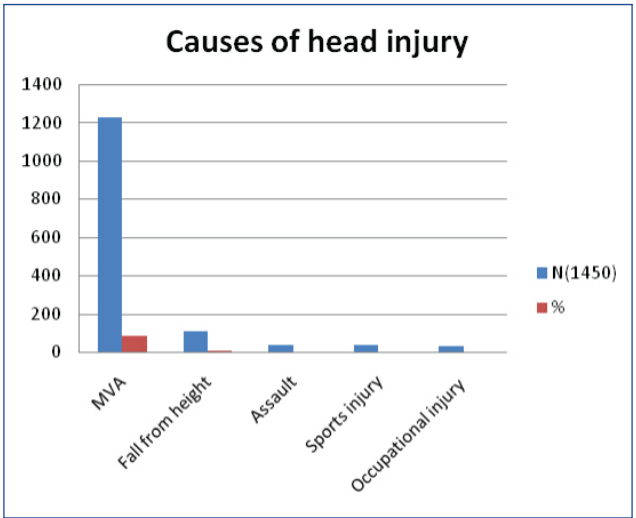
RESULTS

Out of 1450 patients evaluated for head injury 154 patients had temporal bone fracture. Incidence of the study was 10.6%. Majority of the patients were male (66.2%) and were between 30 to 40 years (50.1%) [Table/Fig-1]. The major cause of injury was found to be motor vehicle accidents (84.48%) [Table/Fig-2]. Right side was involved (58.4%) more than the left side (41.5%). Most common clinical presentation was otorrhea 68.8%, followed by otalgia (35.04%) and otorhinorrhea (24.67%) [Table/Fig-3].Out of all temporal bone fractures petrous fractures accounts for 41.5%, followed by non-petrous fractures 38.3% and mixed fractures 20.2% [Table/Fig-4].

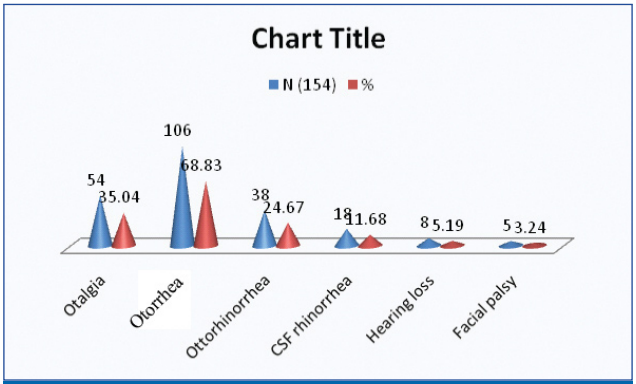
Longitudinal type fracture was most frequent 56.25% followed by oblique type 31.25% and transverse fractures 12.5% [Table/Fig-5]. In 23 cases otic capsule involvement was present (35.9%) and 41 cases of temporal bone fractures

Variables	n (154)	Percentage %
Gender		
Male	102	66.23
female	52	33.76
Side		
Right	90	58.44
Left	64	41.5
Age (in years)		
0-10	1	0.65
11-20	15	9.74
21-30	45	29.2
31-40	78	50.1
41-50	8	5.19
51-60	6	3.89
61-70	1	0.65

[Table/Fig-1]: Age, gender and side distribution of the fractures.



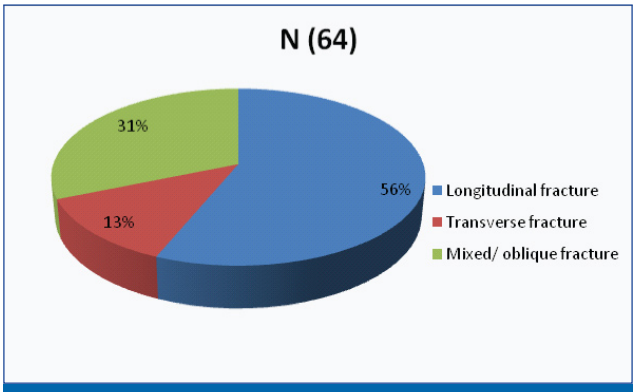
[Table/Fig-2]: Causes of head injury.
*MVA-Motor Vehicle Accidents



[Table/Fig-3]: Clinical presentations of temporal bone fracture.

Type	n (154)	Percentage (%)
Petrous fracture	64	41.5
Non petrous fracture	59	38.3
Mixed	31	20.2

[Table/Fig-4]: Types of fracture.



[Table/Fig-5]: Traditional classification of fracture.

Type of Fracture	n (64)	Percentage (%)
Otic Capsule Involving	23	35.9%
Otic Capsule Sparing	41	64.1%

[Table/Fig-6]: Newer classification of fractures.

were otic capsule sparing (64.1%) [Table/Fig-6]. Most of the fractures were managed conservatively whereas, surgery was required in 12 patients (7.7%).

DISCUSSION

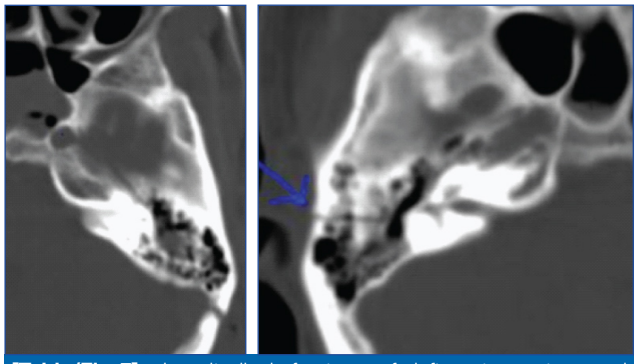
Temporal bone fractures occur from high energy trauma [3]. According to the literature, temporal bone fractures are commonly seen in male gender, younger age group, and in motor vehicle accidents [4-7]. Similarly, in our study high energy trauma like motor vehicle injury was the most frequent cause, followed by other causes like fall from height, assault, sports injury and occupational injury. A tremendous force is needed to cause temporal bone fracture, so the higher incidence of temporal bone fracture is directly proportional to severity of the force of collision in MVA cases. Our study shows similar findings to Ishman SL et al., [5] and Dahiya R et al., [8] in gender distribution and laterality of temporal bone fracture. Like our study, their study shows temporal bone fractures more commonly in male patients and on the right side. The clinical signs for temporal bone fractures include - otalgia, otorrhea, otorhinorrhea, and battle's sign (bruising of mastoid tip). Complications include-CSF rhinorrhea, hearing loss, and facial nerve paralysis [9,10]. In our study otorrhea 68.8% (n=106) was the most frequent symptom. Kerman M et al., in his study, shows that longitudinal temporal bone fractures are more often presents with blood otorrhea [11]. The radiological signs which suggest temporal bone fracture include opacification of mastoid air cells, or middle ear, air in the glenoid cavity, pneumocephalus near the temporal area. With high resolution CT temporal bone, fracture line and its extension can be better delineated.

The classification of temporal bone fractures is useful in the prediction of complications associated with the trauma, thus providing guidance for the management and treatment of the patient [12-14].

Ishman and Friedland divides the temporal bone fractures in to petrous and non-petrous types [5]. Petrous fractures involve fracture of the otic capsule or the petrous apex [15,16]. These fractures are more likely to cause vestibulo-cochlear injury, potential carotid injury, cerebrospinal fluid leak and facial nerve injury [17]. Non-petrous fractures are again divided in to middle ear category and mastoid category based on which anatomical structure is involved. Middle ear fractures have strong correlation with conductive hearing loss because of ossicular chain disruption, whereas mastoid only fractures have a much lower incidence of complications. In our study, petrous types of fractures accounts for 41.5% and non-petrous accounts for 38.3%.

Fracture of temporal bones are traditionally classified as- Longitudinal-where fracture line is parallel to long axis of petrous pyramid [Table/Fig-7]; Transverse-where fracture line is perpendicular to long axis of petrous temporal bone [Table/Fig-8]; and Mixed/oblique [Table/Fig-9].

In our study we got 36 longitudinal fractures (56.25% of the case), 8 transverse (12.5%), and 20 mixed fractures (31.25%). The incidence of types of petrous temporal bone fracture seen in this study is similar to many other studies done, in which the longitudinal fracture is more common [5,8,9,11, and 18]. Longitudinal temporal bone fracture is most common

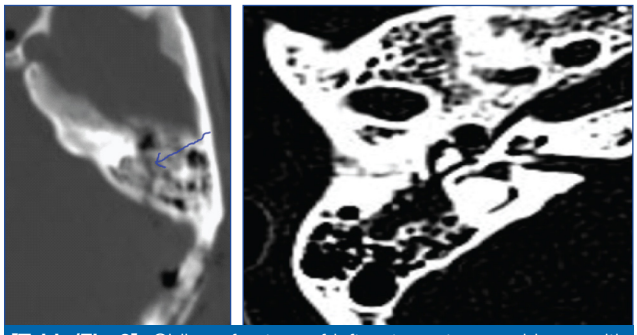


[Table/Fig-7]: Longitudinal fracture of left petrous temporal bone with otic capsule violation with hemomastoid and sphenoid hemosinus.
[Table/Fig-8]: Right sided transverse fracture of petrous temporal bone, otic capsule sparing.

type of fracture which is associated with CSF leakage [18]. This is similar to findings of our study in which all 18 cases of CSF leakage are seen in longitudinal temporal bone fracture. In our review, 5% (n=8) of the cases complained of hearing loss. Conductive type of hearing loss is commonly seen in temporal bone fractures due to hemotympanum, traumatic perforation of tympanic membrane or disruption of the ear ossicles. Profound Sensorineural Hearing Loss (SNHL) is seen in transverse fractures because the fracture often violates the otic capsule. In our study, we came across five cases of facial nerve palsy (3.25%). All of these cases occurred in transverse petrous fracture [19].

New nomenclature of "otic capsule sparing" and "otic capsule violating" has been suggested, which was thought to correlate with radiological findings, complications and surgical planning better than the traditional classification of longitudinal, transverse and oblique fractures. In case of otic capsule violating fractures [Table/Fig-7,9,10] fracture line course through the inner ear structures like cochlea, semicircular canals or vestibule, contributing to increased incidence of complications.

Dahiya R et al., [8] has proved in his study that, patients



[Table/Fig-9]: Oblique fracture of left petrous temporal bone with otic capsule violation and pneumocephalus near the temporal bone. **[Table/Fig-10]:** Right sided transverse fracture, otic capsule violating.

with otic capsule violating fracture are more likely to develop complications like facial paralysis, cerebrospinal leak, hearing loss, and intracranial complications, than those with an otic capsule sparing fracture. Similar results were obtained in our study, otic capsule violating fractures were seen in 23 cases and otic capsule sparing was seen in 41 cases. All five facial nerve injuries observed in our study was seen in otic capsule violating type of fractures.

Thus, from our study we can come to the conclusion that, complications of temporal bone fractures are seen in the form of CSF leakage in 11%, hearing loss in 5%, and facial nerve palsy in 3% of cases, and these complications are more commonly seen in otic capsule violating type of fractures according to newer classification. Coming to traditional classification, CSF leakage is common in longitudinal type, whereas hearing loss and facial nerve injury is common in transverse fractures. Thus, though longitudinal fractures are more common, transverse fracture is more dangerous.

Traditional classification of fractures like longitudinal, transverse and oblique is important to mention in the report as it gives the treating physician a conceptual idea of the fracture pattern. However, it is important to mention even the “otic capsule violating” and “otic capsule sparing” terms in the report as it gives a better idea about course of fracture line, status of inner ear structures and possibility of associated complications.

In our study, surgery was required only in 12 patients (7.7%) and others were managed conservatively. And 11.03% of patients died because of severe traumatic brain injuries like cerebral contusions, intracranial/extra axial haemorrhages, diffuse axonal injuries and meningitis. A long term survey is necessary for the proper study of morbidity outcome from temporal bone fracture.

LIMITATION

Long term follow-up for the improvement after surgical intervention could not be done since this retrospective study is done only for period of one year.

CONCLUSION

Temporal bone fractures occur as a component of severe head trauma, motor vehicle injury being the most common cause. High resolution CT is essential to delineate the fracture line, structural injury and complications. Longitudinal fractures are more frequent but transverse fractures are more commonly associated with complications like facial nerve injury. Most of the fractures are managed with conservative treatment but surgical intervention is needed in case of complications. Many studies have been done on the temporal bone fractures but however our study emphasizes the role of HRCT not only to describe the anatomy and orientation of fracture but also to predict the potential sequelae of fracture based on the types which in turn alerts the treating physician.

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