

## Head injury patients having Longitudinal Fracture of Temporal Bone associated with middle ear cavity injury and its clinical importance: A Prospective study

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### Abstract:

**Introduction:** One of the most complex Head injury is involvement of the skull base fractures of different types with varying degree of severity. Vital structures in the temporal bone are bluntly ignored at the time of emergency trauma centre management. The Middle ear cavity, Facial canal & Otic capsules are the vital structure to be counted & taken care of. Missing of diagnosis of the vital structure injury may lead to future complication like deaf, facial palsy & neurological symptoms.<sup>1</sup>

**Aim and objectives:** To Study the Temporal bone fracture in Head injury patients associated with the common vital structures injuries of the Temporal bone directly or indirectly.

**Study design:** Observational study.

**Material & Method:** The Study includes 500 Head injury Patients attended in the Accident and Trauma Center, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, and Manipur. The patients were accessed properly and were given the first line management. According to their stability and fitness for further investigation, the patients were subject to CT Scan Head and Neck at the earliest.

**Conclusion:** Temporal bone fracture, especially longitudinal fracture involving mastoid, Petrous & extending to the body of sphenoid usually involves the middle ear cavity with different degree of fracture & dislocation of the ossicles. Thus a hidden fracture of middle ear cavity can be predicted by seeing the longitudinal fracture of the temporal bones involving the mastoid, petrous & body of sphenoid.

**Key words:** Temporal bone fracture, Middle ear cavity, longitudinal fracture.

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### I. Introduction:

Head injury following any type of Trauma involving skull fracture is fairly common injury in the modern age. One of the most complex Head injury is involvement of the skull base fractures of different types with varying degree of severity.<sup>2</sup> Vital structures in the temporal bone are bluntly ignored at the time of emergency trauma centre management. The Middle ear cavity, Facial canal & Otic capsules are the vital structure to be counted & taken care of. Missing of diagnosis of the vital structure injury may lead to future complication like deaf, facial palsy & neurological symptoms.<sup>3</sup>

Because of traffic congestion & fast life style in the modern world, Road traffic accident causing Head injury is increasing, so such type of study is required to evaluate the complication associated with any skull fracture.<sup>4</sup> Compression of facial canal needs immediate decompression. Similarly injury to the middle ear cavity, Otic capsule needs prompt corrective measures.

### Aim and object:

To Study the Temporal bone fracture in Head injury patients associated with the common vital structures injuries of the Temporal bone directly or indirectly.

### Study design:

Observational study

### Setting:

Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal Manipur

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## **II. Material & Method:**

The Study includes 500 Head injury Patients attended in the Accident and Trauma Center, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, Manipur. The patients were accessed properly and were given the first line management. According to their stability and fitness for further investigation, the patients were subject to CT Scan Head and Neck at the earliest .

CT Machine Allenger, 60 slices, Toshiba Company which is used for the study in the Department of Radio-diagnosis , Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal ,Manipur . CT scan of all head injury patient are examined carefully & findings are recorded in the **Excel** table for analysis.

Age of the patients is 5 to 80 years. Temporal bone fracture cases are further segregated for different parts involved in the fracture.

### **Duration:**

Study is for a period of 2 years from 1<sup>st</sup> March 2015 to 28<sup>th</sup> Feb.2017.

### **Inclusion criteria:**

All head injury patients attended in the Accident and Trauma Center, Jawaharlal Nehru Institute of Medical Sciences, Porompat, Imphal, Manipur.

### **Exclusion criteria:**

1. Skull fracture involving only the small appendage like, nasal bone, mandible & zygomatico arch.
2. Previously skull operated for other disease process or injuries.
3. Children below the age of 5 years.
4. Patients who are not fit/willing for the procedure.

### **Ethical Approval:**

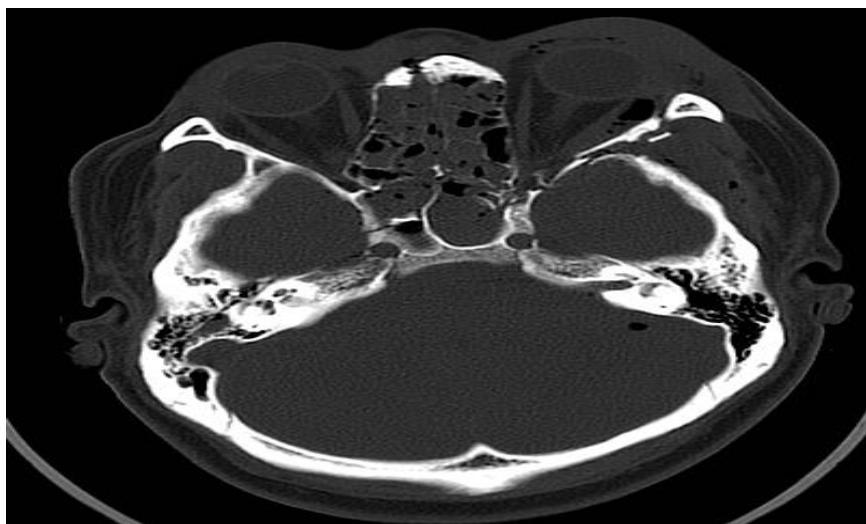
Ethical approval was taken.

### **Procedure:**

CT scan findings of all head injury patients are precisely observed. Finding data are entered in the excel sheet. Total number of temporal bone fracture were segregated, scaled the type of fracture, frequency & associated injury of vital structures in the temporal bone are also well recorded specifically. <sup>5</sup>

## **III. Results:**

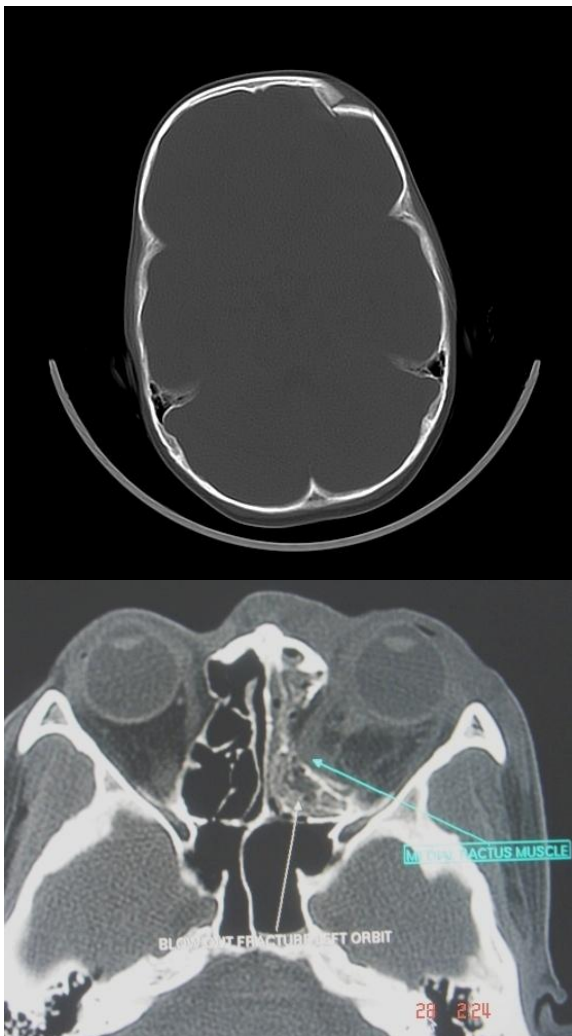
Out of 500 cases of skull fracture 119 cases of Temporal bone fracture were observed. Longitudinal temporal bone fracture is most common. These fractures are usually extends from the squamous part of temporal bone and ipsilateral to occipital bone or extended from contra lateral temporal bone fracture. Longitudinal fracture of mastoid portion of temporal bone extending to the petrous portion usually passes through the Middle Ear cavity. Those fractures with further extension to the body of sphenoid do not pass to the otic capsules.



LONGITUDINAL FRACTURE OF RIGHT TEMPORAL BONE INVOLVING MASTOID, PETROUS PORTION & EXTENDING TO THE BODY OF SPHENOID THROUGH MIDDLE EAR CAVITY

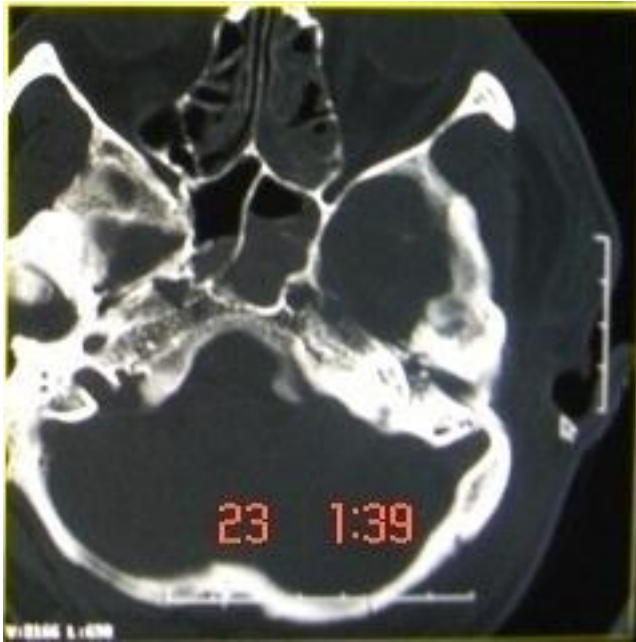


LONGITUDINAL FRACTURE OF RIGHT TEMPORAL BONE INVOLVING MASTOID, PETROUS & MIDDLE EAR CAVITY

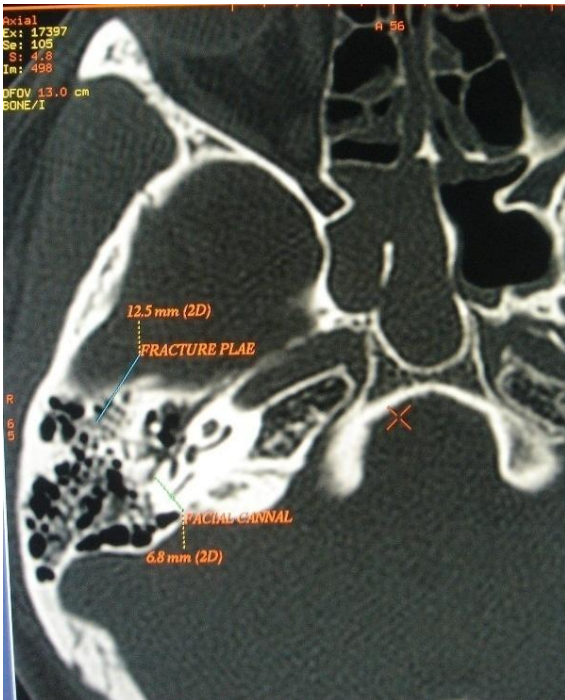


DEPRESSED COMMINUTED FRACTURE LEFT FRONTAL BONE

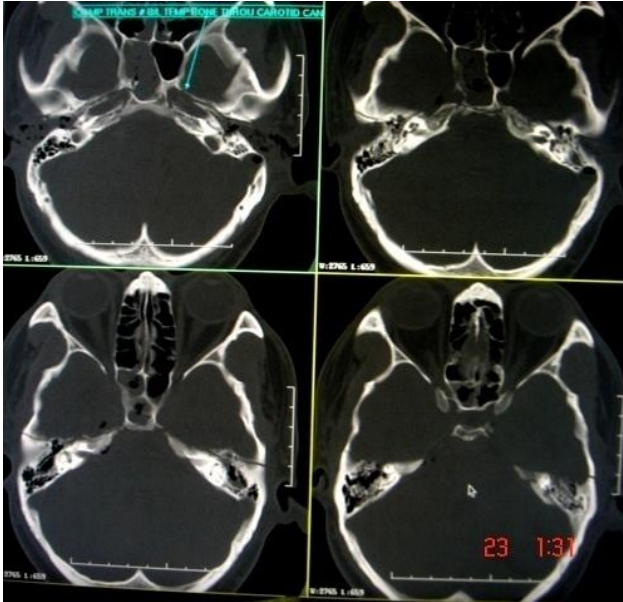
BLOW OUT FRACTURE LEFT ORBIT INVOLVING THE MEDIAL WALL WITH HERNIATION OF THE MEDIAL RECTUS MUSCLE IN THE FRACTURE



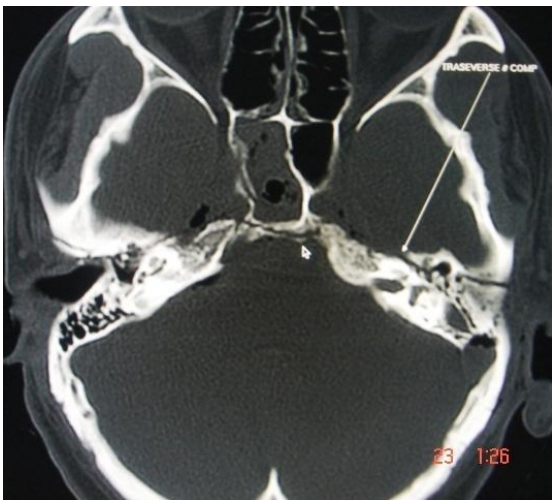
Longitudinal temporal bone fracture extending to the body of sphenoid



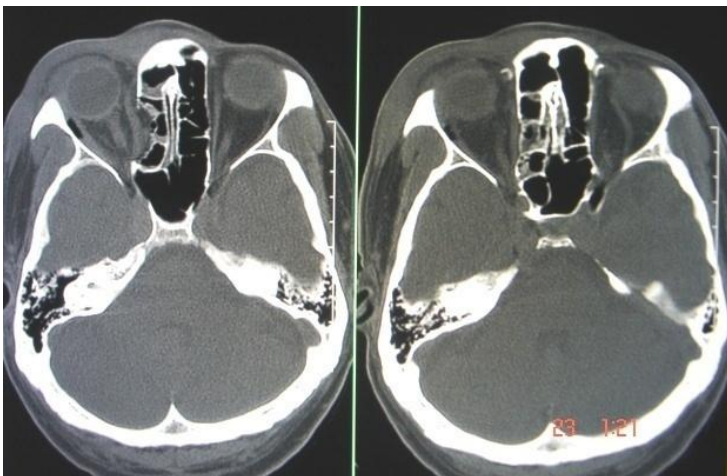
TRANVERSE SKULL FRACTURE CROSSING THE FACIAL CANNAL & INJURY OF THE NERVE



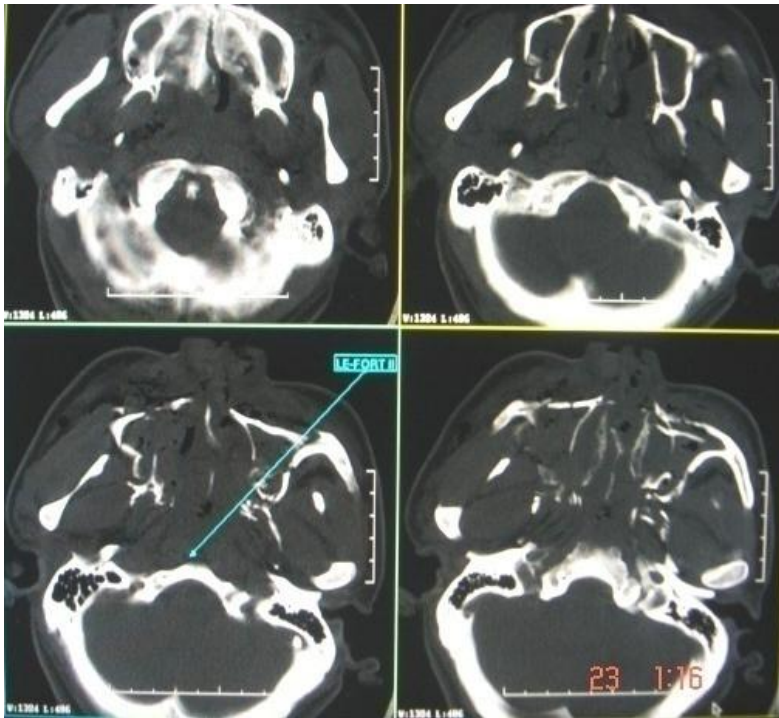
Complete transverse skull fracture involving bilateral temporal bone longitudinal fracture.



Complete transverse skull fracture involving both temporal bones



Blow out fracture right orbit involving the medial wall with herniation of the



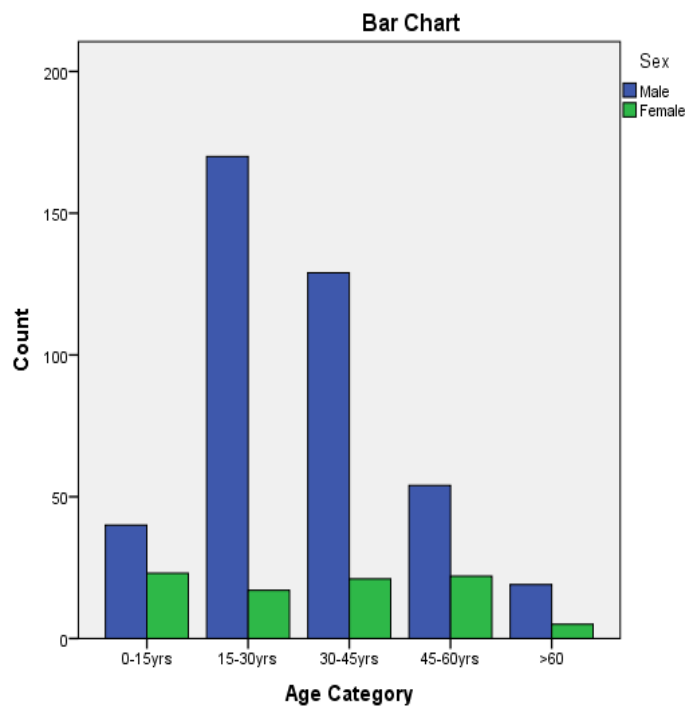
Le-fort fracture -II

Table 1: Showing distribution of head injury patients according to age and sex (n=513, either sex)

Age( in Yrs)	Sex		Total
	Male (%)	Female (%)	
0-15	40(9.7%)	23(25.6%)	63(12.6%)
15-30	170(41.3%)	17(19.3%)	187(37.4%)
30-45	129(31.3%)	21(23.9%)	150(30.0%)
45-60	54(13.1%)	22(25.0%)	76(15.2%)
>60	19(4.6%)	5(5.7%)	24(4.8%)
<b>Total</b>	<b>412</b>	<b>88</b>	<b>500</b>

$\chi^2 = 31.377$  with 4d.f & P-value=0.000<0.05; Significant

Fig 1: Shows the Bar Chart among the age and sex Categories



**Table-2: Total No. Skull Fractures**

Parietal bone	Occipital bone	Frontal Bone	Temporal Bone	Combined Vault	Combined Basal Fracture	FACIAL FRACTURE									Anterior Canal Fossa Fracture	Middle Canal Fossa Fracture	Posterior Canal Fossa Fracture	Complete Transverse & Sagittal Cranial Fracture			
						ZygomaticoMaxillary Fracture	LeFort Fracture	FRONTAL SINUS #	Nasal Bone Fracture	Orbital Fracture 17			Blow Out					Blow in with Eye-ball Rupt.	Coronal	Sagittal	
40	50	55	118	20	36	97		18										04			
						L	R		R	L	B/L		R	L	B/L						
						44	53	06	05	10	03	32	07	08	01	01	0	05	02	03	01

**PB**-Parietal bone: **OB**-Occipital bone: **TB**-Temporal bone: **ZYM**-Zygomatico maxillary fracture: **Le-Fo**- lefort fracture type: **NB**- Nasal bone: **ORB**-Orbital fracture: **ACF**-Anterior cranial fossa: **MCF**- Middle cranial fossa: **PCF**- Posterior cranial fossa: **COMPL**-Complete cranial fracture : **Sag**- sagittal: **Cor**-coronal

**Table-3: Total No. Of Temporal Bone Fractures**

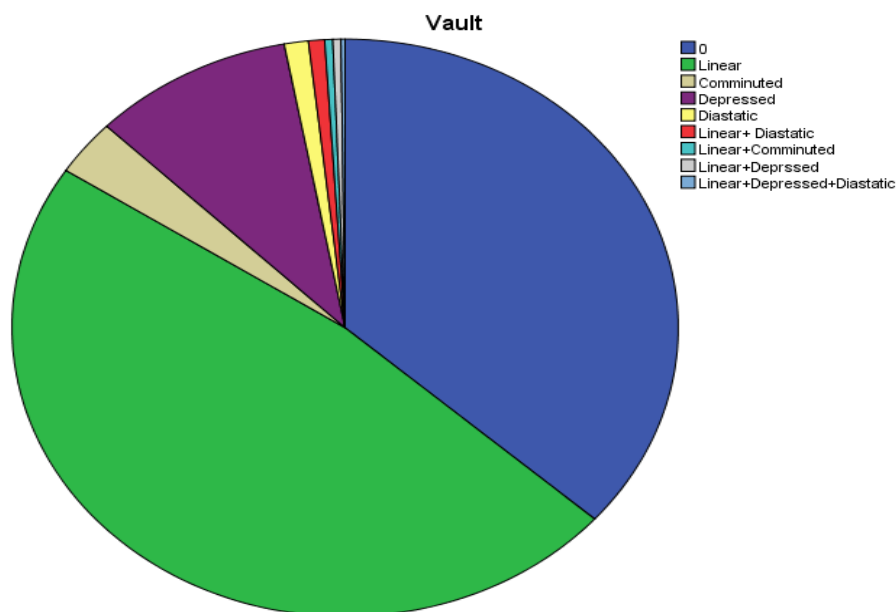
Different type of Skull Fracture	Total No. of Temporal Bone Fracture	Total No. of Squamous Part Fracture only	TOTAL LONGITUDINAL TEMPORAL BONE FRACTURE					TOTAL NO. BILATERAL LONGITUDINAL TEMPORAL BONE FRACTURE		TOTAL NO. OF TRANSVERSE TEMPORAL FRACTURE		p-value of Involvement of Middle Ear Cavity	
			Mastoid only	Mastoid + Petrous without (Middle Ear Cavity)	Mastoid+ Petrous through (Middle Ear Cavity)	Mastoid +Petrous+Sphenoid through (Middle Ear Cavity)	Mastoid + Petrous + Otic Caps.	Mastoid + Petrous + Facial Canal	Bilateral Mastoid+ Petrous through body of Sphenoid & middle ear cavities	Unilateral Mastoid + Bilateral Petrous & Middle Air cavities through the body of Sphenoid	Mastoid only		Petrous portion only, passing through the Facial Canal
	119	07	10	02	65	21	03	01	02	02	03	03	
Total	119	07	102					04		06			

**Table No. 4: Longitudinal Temporal Bone Fracture**

Name and type of the Bone #	Unilateral						Bilateral	
	Mastoid only	Mastoid + Petrous without (Middle Ear Cavity)	Mastoid+ Petrous through (Middle Ear Cavity)	Mastoid +Petrous+Sphenoid through (Middle Ear Cavity)	Mastoid + Petrous + Otic Caps.	Mastoid + Petrous + Facial Canal	Bilateral Mastoid+ Petrous through body of Sphenoid & middle ear cavities	Unilateral Mastoid + Bilateral Petrous & Middle Air cavities through the body of Sphenoid
LONGITUDINAL TEMPORAL BONE FRACTURE	10	02	65	21	03	01	02	02
Total:	102						04	

**Table 5: Pattern of skull Fracture (Vault) (Multiple Variable Counted):**

Vault	No. Of Cases	Percentages (%)
Linear	244	75.1%
Comminuted	16	4.9%
Depressed	50	15.4%
Diastatic	6	1.8%
Linear+ Diastatic	4	1.2%
Linear+ Comminuted	2	0.6%
Linear+Depressed	2	0.6%
Linear +Depressed+Diastatic	1	0.3%
Total	325	100%



**Table 6:**

S L. N O.	TOTAL NO OF TEMP. BONE #	TOTAL NO. OF SQ.PA RT # Only	TOTAL LONG.TEMP BONE#						TOTAL NO OF TRANSVERSE #		TOTAL NO. COMPL. B/L TEMP.BON E #	p- value of MEC
			Mastoi d only	Mastoid + Petreous without (Middle Ear Cavity)	Mastoid + Petreous through (Middle Ear Cavity)	Mastoid +Petrous+S phenoid through (Middle Ear Cavity)	Ot ic Ca ps.	Faci al Can al	Mast oid	Petreous passing through the Facial Canal		
			103						04			
1.	118	11	08	02	78	09	01	01	02	02	04	.000<.05

$\chi^2 = 14.510$  with 1d.f ; P-Value= 0.000<0.05 Which is Significant by Linear by Linear Association.

Body of Sphenoid which is not affecting the Middle Ear Cavity is **04** cases, **3** cases involves Otic capsule & **1** involves facial canal. **2** cases of longitudinal fracture were minor which do not pass through middle ear cavity.

**4** cases of transverse temporal bone fractures are recorded, three were passing through mastoid portion & other three cross petrous portion through the facial canal. Another **4** cases of complete transverse fracture of temporal bone were seen, involving both the temporal bones through their longitudinal axis, treated as longitudinal fracture.

Out of the **119** cases of Temporal bone fractures, the total no. of longitudinal fracture of Temporal bone is **99** cases. Out of **102** cases of longitudinal temporal bone fracture total number of fracture passing through Mastoid, Petrous portion through Middle Ear Cavity only were **65** cases. Total no. of longitudinal fracture of Temporal bone involving Mastoid, Petrous portion and body of Sphenoid bone through middle ear cavity are **21** cases., Mastoid only is 10 cases, No. of longitudinal fracture of Temporal bone involving Mastoid, Petrous, & Otic Capsule is 3 cases , Mastoid, Petrous without middle ear cavity is 2 cases & Mastoid, Petrous & Facial canal is 1.

Bilateral Mastoid, Petrous through body of Sphenoid & middle ear cavities is 2 cases and Unilateral Mastoid , Bilateral Petrous & Middle Air cavities through the body of Sphenoid is 2 cases.

#### IV. Discussion:

CT scan findings of all 500 (five hundred) head injury patients are precisely observed. Finding data are entered in the excel sheet. Total number of skull fractures are recorded in the three categories viz. **Cranial vault**



*fracture; Base of the skull fracture & Facial fracture etc.* Cranial vault fracture are further categorized as linear, comminuted & depress fracture with involvement of one, more than one bones.<sup>6</sup>

**The code name of the bones is specified as follows.** **PB**-Parietal bone: **OB**-Occipital bone: **TB**-Temporal bone: **ZYM**-Zygomatico maxillary fracture: **Le-Fo**- lefort fracture type I, II, III: **NB**- Nasal bone: **ORB**-Orbital fracture: **ACF**-Anterior cranial fossa: **MCF**- Middle cranial fossa: **PCF**- Posterior cranial fossa: **COMPL**-Complete cranial fracture : **Sag**- sagittal: **Cor**-coronal fractures. **IMEC**: involvement of middle ear cavity in the longitudinal fracture of temporal bone.

Only mandible fracture cases are not counted

In facial fracture most common fracture is the Zygomatico maxillary fracture followed by frontal & nasal bone fracture.

Similarly fracture base of the skull is also recorded as anterior cranial, Middle cranial fossa & Posterior cranial fossa fracture with further categorization in the type of the individual bone fracture. Bone fracture were further segregated, scaled the type of fracture, frequency & associated injury of vital structures in the temporal bone are well recorded specifically. In the middle cranial fossa fracture most important bone is Temporal bone.<sup>7</sup>

Out of the 119 cases of Temporal bone fractures, the total no. of longitudinal fracture of Temporal bone is **99** cases. Out of **99** cases of longitudinal temporal bone fracture total number of fracture passing through Mastoid, Petrous portion through Middle Ear Cavity only were **65**cases.<sup>8</sup> Total no. of longitudinal fracture of Temporal bone involving Mastoid, Petrous portion and body of Sphenoid bone through middle ear cavity are **21** cases. No. of longitudinal fracture of Temporal bone involving Mastoid, Petrous, Body of Sphenoid which is not affecting the Middle Ear Cavity is 04 cases, three (3) cases involves Otic capsule & one (1) involves facial canal. Two (2) cases of longitudinal fracture were minor which do not pass through middle ear cavity.

Besides, six (6) cases of transverse fracture temporal bone were seen. Out of these six (6) cases 3 (Three) fracture passing through the petrous portion crosses facial canal with facial palsy.<sup>9</sup>

Complete transverse bilateral temporal bone fracture cases are also found with involvement of the Middle ear cavity. *The longitudinal fracture line passing through the mastoid, petrous portion & body of sphenoid does not involve the otic capsule.*<sup>10</sup>

## V. Conclusion:

1. Temporal bone fracture, especially longitudinal fracture involving mastoid, Petrous & extending to the body of sphenoid usually involves the middle ear cavity with different degree of fracture & dislocation of the ossicles. Thus a hidden fracture of middle ear cavity can be predicted by seeing the longitudinal fracture of the temporal bones involving the mastoid, petrous & body of sphenoid.
2. Fracture extending to the body of sphenoid usually does not involve otic capsule
3. Longitudinal fracture of temporal bone usually does not cross the facial canal.
4. Transverse fracture of temporal passing through the petrous portion usually passes through the facial canal.

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