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Original Article

Spectrum of Computed Tomographic Findings Among Adults with Traumatic Skull Fractures in Ado-Ekiti

Oluwamuyiwa Adeniyi Dada; FWACS

Department of Surgery, Faculty of Clinical Sciences, College of Medicine, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria.
Neurosurgery Unit, Department of Surgery, Ekiti State University Teaching Hospital, Ado-Ekiti, Ekiti State, Nigeria.

*Corresponding Author: Oluwamuyiwa Adeniyi Dada; *muyiwadada15@yahoo.com*

Abstract

Background: Traumatic skull fractures are a common consequence of head injury and remain a major cause of morbidity and mortality, particularly in low- and middle-income countries where road traffic accidents are prevalent. Computed tomography (CT) is the imaging modality of choice for evaluating skull fractures and associated intracranial injuries. ***Objective:*** To determine the spectrum of CT findings and clinical outcomes among adults with traumatic skull fractures in Ado-Ekiti, Nigeria. ***Methods:*** This was a retrospective descriptive cross-sectional study of 117 adult patients with CT-confirmed traumatic skull fractures managed at a tertiary hospital in Ado-Ekiti over a period of 18 months from July 2024 to December 2025. Data were extracted from medical records and radiology reports using a structured proforma. Variables analyzed included socio-demographic characteristics, injury mechanisms, clinical presentation, CT findings, management, and outcomes. Data were analyzed using descriptive statistics and logistic regression to identify predictors of poor outcome. ***Results:*** The majority of patients were male (70.1%), with a predominance of young adults aged 18-39 years. Road traffic accidents (RTA) were the leading cause of injury (66.7%). Most patients presented with loss of consciousness (72.6%), and nearly half had mild traumatic brain injury (49.6%). CT findings showed that linear skull fractures (42.7%) were the most common, with the parietal bone (27.4%) most frequently involved. The most prevalent intracranial lesions were cerebral contusions (34.2%), brain edema (32.5%), and subdural hematoma (29.9%). Midline shift was observed in 21.4% of cases. Most patients (61.5%) were managed conservatively, while 38.5% underwent surgical intervention. At discharge, 55.5% achieved full recovery, whereas the mortality rate was 8.6%. Significant predictors of poor outcome included severe traumatic brain injury, midline shift, subdural hematoma, intensive care unit (ICU) admission, and age ≥ 60 years. ***Conclusion:*** Traumatic skull fractures in this setting predominantly affect young males and are mainly due to road traffic accidents. CT imaging reveals a wide spectrum of fracture patterns and intracranial injuries, which significantly influence patient outcomes. Early identification of high-risk features is essential to improve management and reduce mortality.

Keywords: ***Traumatic skull fracture, Computed tomography, Traumatic brain injury, Intracranial lesions, Nigeria.***

Introduction

Traumatic brain injury (TBI) is a major global public health problem and a leading cause of death and disability, particularly among young adults. It is estimated that over 50 million people sustain TBIs annually worldwide, with the burden disproportionately higher in low- and middle-income countries (LMICs) due to rapid urbanization, increasing motorization, and limited trauma care systems [1,2]. Among the spectrum of TBIs, traumatic skull fractures are clinically significant because they often indicate substantial force transmission to the brain and are frequently associated with intracranial complications [3].

Computed tomography (CT) has become the gold standard imaging modality in the evaluation of head injuries. It allows rapid detection of skull fractures, intracranial hemorrhages, cerebral contusions, and mass effects such as midline shift, all of which are critical in guiding management decisions [4,5]. The pattern and distribution of CT findings provide valuable insight into injury mechanisms, severity, and prognosis.

Globally, road traffic accidents (RTAs) remain the leading cause of head injuries, accounting for a significant proportion of skull fractures [6]. This trend is even more pronounced in sub-Saharan Africa, where weak enforcement of traffic regulations, poor road infrastructure, and increased use of motorcycles contribute to high injury rates [7]. In Nigeria, studies have consistently reported RTAs as the predominant cause of head trauma, particularly among economically active young males [8,9].

The spectrum of skull fractures varies widely, ranging from simple linear fractures to more complex depressed, comminuted, and basilar fractures. These fracture types are often accompanied by intracranial lesions such as epidural hematomas, subdural hematomas, subarachnoid hemorrhages, and cerebral contusions [10]. The coexistence of these lesions significantly worsens outcomes and increases the risk of mortality [11].

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Despite advances in neuroimaging and trauma care, outcomes of TBI in LMICs remain suboptimal due to delays in presentation, limited neurosurgical capacity, and inadequate critical care resources [12]. Identifying radiological patterns and clinical predictors of poor outcome is therefore essential for improving patient management and resource allocation.

Although several studies have evaluated head injuries in Nigeria, there is a relative paucity of data specifically focusing on the CT spectrum of skull fractures and their associated intracranial findings in Ado-Ekiti and similar settings. This study therefore aimed to bridge this gap by describing the CT findings, clinical characteristics, and outcomes of adults with traumatic skull fractures in a tertiary hospital in Ado-Ekiti, Nigeria.

Methodology

Study Design and Setting

This study was a retrospective descriptive cross-sectional study conducted at Ekiti State University Teaching Hospital in Ado-Ekiti, Ekiti State, Nigeria. The institution serves as a major referral center for trauma and neurosurgical cases within the state and surrounding regions. The centre is equipped with computed tomography (CT) imaging facility for emergency evaluation of head injuries.

Study Population

The study population comprised adult patients aged 18 years and above who presented with traumatic head injury and had CT-confirmed skull fractures within the study period.

Study Period

This study reviewed cases managed over a period of 18 months from July 2024 to December 2025 during which relevant clinical and radiological data were documented.

Inclusion Criteria

Inclusion criteria included adults aged 18 years and above, patients with a documented history of head trauma, presence of skull fracture confirmed on CT scan and availability of complete clinical and radiological records.

Exclusion Criteria

Exclusion criteria included patients below 18 years of age, patients with non-traumatic skull fractures, cases with incomplete or missing key data and patients without CT imaging.

Sample Size and Sampling Technique

A total of 117 eligible patients who met the inclusion criteria were included in the study. A total population (consecutive) sampling technique was employed, whereby all cases that satisfied the study criteria within the review period were included, thereby minimizing selection bias.

Data Collection Instrument and Procedure

Data were collected using a structured proforma designed specifically for the study. Information was retrieved from patients' medical records, emergency unit registers, admission notes, and radiology reports.

Variables extracted included socio-demographic data such as age, sex, marital status, education level, and place of residence, injury characteristics including mechanism of injury, time to presentation, and presenting symptoms.

Other variables included clinical parameters such as Glasgow Coma Scale (GCS) score at presentation, pupillary findings at presentation, and presence of associated injuries.

Also included in the data collected were the radiological findings such as type, location, and laterality of skull fractures, as well as associated intracranial lesions identified on CT.

Treatment modality, ICU admission and outcomes such as clinical status at discharge and Glasgow Outcome Score (GOS) were also parts of the data collected.

All CT scans were performed using a multi-slice CT scanner, and images were interpreted by consultant radiologists, with findings documented in standardized reports.

Study Variables

These included both independent and dependent variables. Independent variables were age, sex, and mechanism of injury, GCS score, fracture characteristics, and intracranial CT findings. Dependent variable was the clinical outcome at discharge, categorized based on the Glasgow Outcome Score.

Data Analysis

- Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA).
- Descriptive statistics were used to summarize data.
- Frequencies and percentages were used for categorical variables.
- Results were presented in tables. Binary logistic regression analysis was performed to identify predictors of poor outcome.
- Variables of clinical importance were included in the regression model.
- Results were expressed as adjusted odds ratios (AORs) with 95% confidence intervals (CI).
- A p-value < 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics and Research Committee of the hospital. Given the retrospective nature of the study, the requirement for informed consent was waived. All data were handled with strict confidentiality, and patient identifiers were removed to ensure anonymity. The study adhered to the ethical principles outlined in the Declaration of Helsinki.

Study Limitations

As a retrospective hospital-based study, the findings may not be generalizable to the broader population. The use of existing records may introduce information bias, including incomplete documentation and variability in clinical or radiological reporting. Additionally, the study was limited to in-hospital outcomes, and long-term patient follow-up could not be assessed.

Results

A total of 117 adult patients with traumatic skull fractures were evaluated. The findings are presented in six tables.

Socio-demographic Characteristics

As shown in Table 1, the study population was predominantly young adults, with the highest proportion in the 18-29 years age group (27.4%), followed by those aged 30-39 years (23.9%). The mean age distribution showed a gradual decline with increasing age, with only 12.8% aged ≥ 60 years. There was a marked male predominance (70.1%), yielding a male-to-female ratio of approximately 2.3:1. Most participants were married (51.3%), while 38.5% were single.

Regarding educational status, the majority had at least secondary education, with 41.0% having secondary education and

31.6% attaining tertiary education, while only 10.3% had no formal education. A greater proportion of patients resided in urban areas (61.5%) compared to rural settings (38.5%).

Table 1: Socio-demographic Characteristics of Participants (N = 117)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
18-29	32	27.4
30-39	28	23.9
40-49	24	20.5
50-59	18	15.4
≥60	15	12.8
Sex		
Male	82	70.1
Female	35	29.9
Marital status		
Single	45	38.5
Married	60	51.3
Divorced/Separated	7	6.0
Widowed	5	4.2
Educational level		
No formal education	12	10.3
Primary	20	17.1
Secondary	48	41.0
Tertiary	37	31.6
Residence		
Urban	72	61.5
Rural	45	38.5

Injury Characteristics

Table 2 shows that road traffic accidents (RTAs) were the leading mechanism of injury, accounting for 66.7% of cases. Falls constituted 17.1%, while assaults contributed 10.2%. Among RTA victims (n = 78), passengers (28.3%) and pedestrians (25.6%) were the most affected, followed by drivers (23.1%) and motorcyclists (19.2%).

In terms of healthcare access, 34.2% of patients presented within 1–6 hours, while 21.4% arrived within the first hour. However, a notable proportion (17.1%) presented after 24 hours.

Clinically, loss of consciousness was the most common presenting symptom (72.6%), followed by vomiting (42.7%) and seizures (15.4%).

Table 2: Injury Characteristics (N = 117)

Variable	Frequency (n)	Percentage (%)
Mechanism of injury		
Road traffic accident	78	66.7
Fall	20	17.1
Assault	12	10.2
Others	7	6.0
Role in RTA (n=78)		
Driver	18	23.1
Passenger	22	28.3
Pedestrian	20	25.6
Motorcyclist	15	19.2
Cyclist	3	3.8
Time to presentation		
<1 hour	25	21.4
1-6 hours	40	34.2
6-24 hours	32	27.3
>24 hours	20	17.1
Clinical symptoms*		
Loss of consciousness	85	72.6
Vomiting	50	42.7
Seizures	18	15.4

Multiple responses were allowed

Clinical Profile and Associated Injuries

As detailed in Table 3, nearly half of the patients (49.6%) had mild traumatic brain injury (TBI) at presentation, while 29.0% and 21.4% had moderate and severe TBI, respectively.

Most patients (76.9%) had normal pupillary findings, whereas 15.4% had unequal pupils and 7.7% presented with fixed dilated pupils, indicating more severe neurological compromise.

Associated injuries were common, occurring in 55.6% of patients, highlighting the polytrauma nature of traumatic skull fractures, while 44.4% had isolated head injuries.

Table 3: Clinical Profile and Associated Injuries (N = 117)

Variable	Frequency (n)	Percentage (%)
Severity of TBI (GCS)		
Mild (13-15)	58	49.6
Moderate (9-12)	34	29.0
Severe (≤8)	25	21.4
Pupillary findings		
Normal	90	76.9
Unequal	18	15.4
Fixed dilated	9	7.7
Associated injuries		
None	52	44.4
Present	65	55.6

Skull Fracture Characteristics of CT scan findings

Table 4 demonstrates that linear skull fractures were the most common type (42.7%), followed by depressed fractures (25.6%). Less frequent patterns included comminuted (12.8%), basilar (10.3%), and diastatic fractures (8.6%). In terms of anatomical distribution, the parietal bone was the most frequently involved site (27.4%), followed by the frontal (23.9%) and temporal bones (22.2%). Occipital and skull base fractures were less common. Fractures were more often right-sided (41.0%), while 34.2% were left-sided and 24.8% were bilateral, indicating a substantial proportion of extensive cranial involvement.

Table 4: Skull Fracture Characteristics on CT scan (N = 117)

Variable	Frequency (n)	Percentage (%)
Type of skull fracture		
Linear	50	42.7
Depressed	30	25.6
Comminuted	15	12.8
Basilar	12	10.3
Diastatic	10	8.6
Location of fracture		
Frontal	28	23.9
Parietal	32	27.4
Temporal	26	22.2
Occipital	12	10.3
Skull base	10	8.5
Multiple sites	9	7.7
Laterality		
Right	48	41.0
Left	40	34.2
Bilateral	29	24.8

Intracranial Lesions in CT scan findings associated with skull fractures

As shown in Table 5, a wide spectrum of intracranial pathologies was observed, with many patients having multiple findings. The most common lesion was cerebral contusion (34.2%), followed closely by brain edema (32.5%) and subdural hematoma (29.9%). Subarachnoid hemorrhage was present in 25.6%, while epidural hematoma occurred in 23.9% of cases.

Table 5: Intracranial Lesions in CT scan findings associated with skull fractures *

Variable	Frequency (n)	Percentage (%)
Epidural hematoma	28	23.9
Subdural hematoma	35	29.9
Subarachnoid hemorrhage	30	25.6
Intracerebral hemorrhage	22	18.8
Cerebral contusion	40	34.2
Diffuse axonal injury	12	10.3
Pneumocephalus	15	12.8
Brain edema	38	32.5
Midline shift	25	21.4
hydrocephalus	8	6.8

**Multiple intracranial findings co-existed*

Less frequent findings included intracerebral hemorrhage (18.8%), pneumocephalus (12.8%), and diffuse axonal injury (10.3%). Midline shift was observed in 21.4%, suggesting significant mass effect in a considerable proportion of patients, while hydrocephalus was relatively uncommon (6.8%).

Management, Outcomes, and Predictors of Poor Outcome

According to Table 6, the majority of patients (61.5%) were managed conservatively, while 38.5% required surgical intervention. About one-third (34.2%) required ICU admission, reflecting the severity of injuries in a substantial subset. At discharge, 55.5% of patients had fully recovered, while 25.6% improved with residual deficits. However, 10.3% showed no improvement, and the mortality rate was 8.6%.

Using the Glasgow Outcome Score, good recovery was recorded in 55.5%, whereas moderate and severe disabilities accounted for 23.9% and 8.6%, respectively. A small proportion (3.4%) remained in a vegetative state.

Multivariate logistic regression analysis identified several independent predictors of poor outcome. Severe TBI was the strongest predictor (AOR = 4.50, $p < 0.001$), followed by ICU admission (AOR = 3.90, $p < 0.001$) and presence of midline shift (AOR = 3.20, $p = 0.003$). Additionally, age ≥60 years (AOR = 2.80, $p = 0.018$) and subdural hematoma (AOR = 2.30, $p = 0.025$) were significantly associated with poorer outcomes.

Table 6: Management, Outcome, and Predictors of Poor Outcome (N = 117)

Variable	Frequency (n)	Percentage (%)	
Management type			
Conservative	72	61.5	
Surgical	45	38.5	
ICU admission			
Yes	40	34.2	
No	77	65.8	
Outcome at discharge			
Fully recovered	65	55.5	
Improved with deficit	30	25.6	
No improvement	12	10.3	
Death	10	8.6	
Glasgow Outcome Score			
Good recovery	65	55.5	
Moderate disability	28	23.9	
Severe disability	10	8.6	
Vegetative state	4	3.4	
Death	10	8.6	
Predictors of Poor Outcome (Logistic Regression)			
Variable	**Adjusted OR**	**95% CI**	**p-value**
Severe TBI	4.50	2.10-9.60	<0.001
Subdural hematoma	2.30	1.10-4.80	0.025
Midline shift	3.20	1.50-6.90	0.003
Age ≥ 60 years	2.80	1.20-6.50	0.018
ICU admission	3.90	1.80-8.40	<0.001

Summary of Key Findings

Overall, traumatic skull fractures in this cohort predominantly affected young adult males, with road traffic accidents as the leading cause. CT imaging revealed a broad spectrum of skull fracture patterns and intracranial lesions, with cerebral contusions and subdural hematomas being most frequent. Despite a substantial proportion achieving good recovery, mortality remained notable, and outcomes were strongly influenced by injury severity and specific radiological findings.

Discussion

This study provides a comprehensive overview of the clinical profile, CT findings, and outcomes of adults with traumatic skull fractures in a tertiary hospital in Ado-Ekiti. The findings highlight important epidemiological patterns, radiological characteristics, and prognostic factors relevant to both local and global contexts.

Socio-demographic Characteristics

The predominance of young adults aged 18-39 years and the marked male preponderance (70.1%) observed in this study are consistent with findings of previous studies both local and international [8,13]. Solagberu et al in 2006 reported a peak incidence of 21-30 years among victims of road traffic accidents in Ilorin, Nigeria with greater involvement of males [8] Similar findings were reported by Emejulu et al. in their study in which the peak age incidence was 20-30 years with males accounting for 79.2% cases of traumatic brain injury in Nnewi, Nigeria while Ohaegbulam et al. reported a male to female ratio of 3.5: 1 among victims of traumatic brain injury in Enugu, Nigeria [9,14]. This reflects the increased exposure of young males to high-risk activities such as driving, commercial transportation, and occupational hazards.

The higher proportion of urban residents (61.5%) may be attributed to increased traffic density and better access to tertiary healthcare facilities in urban settings. Additionally, the relatively high level of education among participants suggests that traumatic injuries cut across socioeconomic strata but may be more frequently reported in populations with better healthcare access.

Injury Characteristics

In the present study, road traffic accidents (66.7%) were the leading mechanism of injury. This aligns with reports from the World Health Organization, which identify RTAs as a major contributor to trauma-related morbidity in LMICs [6]. Some local Nigerian studies have similarly reported RTA prevalence rates ranging from 60% to 80%

among head injury patients, including a report by Emejulu et al. in which RTA was responsible for 80.8% of traumatic brain injury [9].

The significant involvement of passengers and pedestrians highlights the vulnerability of non-protected road users, a well-documented issue in developing countries [7]. Delayed presentation in a notable proportion of patients (>6 hours in over 40%) underscores persistent challenges such as poor emergency transport systems and pre-hospital care deficiencies as alluded to by Adeloye [12].

Clinically, the high prevalence of loss of consciousness (72.6%) reflects the severity of injury in many patients. This is consistent with findings from other trauma series including a study conducted by Lee et al. in which loss of consciousness was found to be a marker for severity of head injury [10]. Vomiting and seizures, though less frequent, remain important indicators of intracranial involvement.

Clinical Profile and Associated Injuries

Nearly half of the patients presented with mild TBI (49.6%), while over one-fifth had severe injury. This distribution is comparable to previous studies, although the proportion of severe TBI remains concerning due to its strong association with mortality [15].

Abnormal pupillary findings, including unequal and fixed dilated pupils, were observed in a subset of patients and are well-recognized indicators of raised intracranial pressure and impending herniation [16]. Presence of associated injuries in more than half of the patients (55.6%) emphasizes the polytrauma nature of head injuries and the need for a multidisciplinary approach to management.

Skull Fracture Characteristics on CT scan

Linear skull fractures (42.7%) were the most common type observed, consistent with previous studies [10,17]. This is similar to the findings in a study conducted by Vittala et al. in which linear fracture (66%) was the most common in a cohort of head-injured patients followed by comminuted fracture and depressed skull fracture [17]. Depressed fractures, which accounted for 25.6%, are clinically significant due to their association with underlying brain injury and higher risk of infection.

The parietal bone (27.4%) was the most frequently affected site, followed by frontal and temporal regions. This distribution likely reflects common impact points during RTAs and falls. The relatively high proportion of bilateral fractures (24.8%) suggests severe mechanisms of injury in a substantial number of patients.

Intracranial Lesions in CT scan findings associated with skull fractures

A wide spectrum of intracranial abnormalities was observed, with cerebral contusions (34.2%), brain edema (32.5%), and subdural hematomas (29.9%) being the most common. Similar findings were found by Vittala et al in their study in which skull fracture was most associated with extradural hematoma (42%) followed by intracerebral contusions (32%), subarachnoid hemorrhage (16%) and subdural hematoma (10%) [17]. These findings are consistent with established patterns of traumatic brain injury, where parenchymal injury and extra-axial hemorrhages frequently coexist [4,10].

The presence of midline shift (21.4%) is particularly important, as it reflects significant mass effect and is strongly associated with poor outcomes [11,15]. Although epidural hematomas (23.9%) were less frequent than subdural hematomas, they remain clinically significant due to their potential for rapid deterioration if untreated.

Management, Outcomes, and Predictors

The predominance of conservative management (61.5%) reflects the high proportion of mild to moderate injuries. However, the substantial rate of surgical intervention (38.5%) underscores the severity of cases presenting to the facility.

The mortality rate of 8.6% observed in this study is comparable to reports from similar settings including Emejulu et al. who reported mortality rate of 5.5%. However, it remains higher than rates reported in high-income countries, highlighting disparities in trauma care systems [12]. The proportion of patients achieving good recovery (55.5%) is encouraging but indicates room for improvement.

Multivariate analysis identified severe TBI, midline shift, subdural hematoma, ICU admission, and older age (≥60 years) as significant predictors of poor outcome. These findings are consistent with global literature, where injury severity and radiological features are key determinants of prognosis [11,15].

Implications for Practice

The findings of this study emphasize the importance of early CT imaging for accurate diagnosis, prompt identification of high-risk features such as midline shift and severe TBI, strengthening of pre-hospital care systems and improving neurosurgical and critical care capacity in resource-limited settings.

Conclusion

This study shows that traumatic skull fractures in Ado-Ekiti mainly affect young, economically active males, with road traffic accidents being the leading cause of injury. The CT findings highlight a wide range of fracture patterns and associated intracranial injuries, most commonly cerebral contusions, brain edema, and subdural hematomas.

Patient outcomes were closely linked to both the severity of injury and specific radiological findings. In particular, severe traumatic brain injury, midline shift, subdural hematoma, ICU admission, and older age were associated with poorer outcomes. Although more than half of the patients achieved good recovery, the levels of morbidity and mortality observed indicate that significant challenges in trauma care still exist.

These findings underscore the importance of early CT evaluation and timely recognition of high-risk features in guiding management decisions. There is also a clear need to strengthen pre-hospital care, improve access to neurosurgical services, and expand critical care capacity in resource-limited settings.

In addition, efforts to reduce the burden of these injuries must go beyond hospital care. Strengthening road safety policies and enforcement will be essential in addressing the root causes of traumatic skull fractures in this environment.

Declarations

Author Contributions

The author was solely responsible for the conception and design of the study and drafting of the manuscript. The author conducted data collection, patient evaluation and clinical follow-up.

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Ethical Approval Statement

Ethical approval was obtained from the Hospital Research and Ethics Committee before the commencement of the study. The study was carried out in accordance with the ethical standards of the institutional research committee and the principles of the Declaration of Helsinki.

Conflict of Interest Statement

The author declares that there are no conflicts of interest regarding the publication of this article.

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Data Availability Statement

The datasets generated and analyzed during the study are available from the corresponding author upon reasonable request.

United Nations Declaration of Human Rights

The author confirms that he accepts and agrees with the UN's Declaration of Human Rights.

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