Clinical profile of skull fractures at The University Teaching Hospital of Kigali (CHUK)

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ABSTRACT

Background: Head injury is a common reason of emergency admission. Skull fractures are among common patterns of head injury and they require immediate clinical assessment and management. This represents an economic burden on health system in settings with limited financial resources, infrastructure, and equipment number of qualified personnel. The main objective of this study was to evaluate the clinical profile of skull fractures at the University Teaching Hospital of Kigali (CHUK).

Method: This is a retrospective descriptive study of patients with head injury who sustained skull fractures at CHUK from 1 January 2014 to 31 December 2015.

Results: 635 patients presented at CHUK Emergency Department with head injury. The medical records for 241 patients presenting with heady injury was consulted. Of these 241 patients, 62 (25.72%) were diagnosed with skull fractures. Hospital records of these 62 patients were analyzed in accordance with the objectives to describe demographics, clinical presentation, injury mechanisms, management, and outcomes

Conclusion: Our research describes the most common mechanisms of injury that result in skull fractures that were treated at a major teaching university in East Africa. This paper offers insight on public health issues such as road traffic safety, occupational hazards such as those in farming, as well as sequalae of interpersonal conflicts. Attention and strong prevention measures in Rwanda and similar settings are thus warranted.

Keywords: Head injuries, Skull fractures, CHUK, Farming, Traffic accidents, Rwanda

ABBREVIATION
CHUK: Centre Hospitalier Universitaire de Kigali;
GCS: Glasgow Coma Scale; **RTI:** Road Traffic Injury; **CNS:** Central Nervous System; **CT:** Computed Tomography;

INTRODUCTION

A skull fracture is defined as the break of bones surrounding the brain and it occurs when the force involved in head collision exceeds the mechanical integrity of the calvarium. Skull fractures involve the cranial vault and/or the base of skull. Based on the anatomy of the fracture line the cranial vault fracture may be linear, depressed or elevated. They are also classified as open or closed depending on the presence or absence of a wound on the overlying skin of the fracture site [1].

Skull fractures resulting from head trauma are a common reason for consultation and may be associated with brain injury which increases the risks of mortality and morbidity [2]. The documentation on epidemiology of skull fractures is limited in the literature. A study in South Africa by C. Mauritz reported assaults as a cause of skull fracture in 75% of cases [3]. While in a study done by Greenes and Schutzman in Boston evaluating infants with isolated skull fractures, falls were the most common reported mechanism of injury (89%) and non-accidental trauma accounted for 10% [4].

Linear skull fracture is defined as a fracture through the calvarium without displacement of fracture. They have minimal clinical significance except when they involve the middle meningeal artery groove – where there is high risk for extradural bleeding. They may present with swelling around the fracture line, decreased level of consciousness, headache, vomiting and cranial nerve injury due to associated injury of the neural structures. CT scan is the best diagnostic tool and the management is by close observation [1].

Depressed skull fracture occurs with high energy trauma when the force drives the piece of skull bone below the corresponding bone. This mostly causes injury to the brain parenchyma with subsequent high risk of CNS infection, convulsions and death. Loss of consciousness is a common presenting symptom with depressed skull fractures. The first line management of depressed skull fracture remains conservative management because the evidence has shown no benefit from operative elevation in terms of reducing risks of seizure, infection or neurological deficit [1]. Operative elevation and dural repair and cranioplasty may be of value in the case of depression greater than 1cm. Gross cosmetic deformity, evidence of dural tear, or associated operable intracranial lesions [1].

Elevated skull fracture is a rare form of fracture involving the cranial vault. It occurs when the fractured portion is elevated above the level of intact skull bone. The injury is by a sharp, heavy object which elevates the skull fracture. Few cases highlighting these have been mentioned in neurosurgical literature [5]. Decreased level of consciousness and presence of focal neurological deficits are common in these fractures due to associated underlying traumatic brain injury. Early surgical intervention

with wound debridement, duraplasty or decompressive craniotomy are cornerstones of treatment. Antibiotics are also essential for prevention of infection [6].

Basilar skull fractures involve bones of the skull base: cribriform plate of ethmoid bone, orbital plate of frontal bone, petrous and squamous portion of the temporal bone and sphenoid and occipital bones. These are classified into anterior, middle and posterior basilar skull fractures. There is a high risk for extra axial hematoma and its clinical presentations such as otorrhea and rhinorrhea as consequence of CSF leakage and hem tympanum. Battle' sign and raccoon eyes are also common [7]. Surgical treatment is considered if there is evidence of cranial nerve injury or persistent CSF leakage that persists more than 2 weeks.

In Rwanda, there is a scarcity of data on skull fractures. As discussed above, there are differences in mechanisms of skull fracture in developed countries compared to the developing countries, probably because of difference in lifestyle and environmental exposures. These factors impact on mechanisms of skull fracture occurrence, and it was the motivation to conduct this study looking at the clinical profile of skull fracture at Kigali University Teaching Hospital known also as CHUK (Centre Hospitalier Universitaire de Kigali). The Centre Hospitalier Universitaire de Kigali (CHUK) is a University teaching hospital in the Rwandan capital, Kigali that serves as the referral center for most Rwandan district hospitals. It is the only public neurosurgical center. We, therefore, aimed to assess and describe the clinical presentation of skull fractures, mechanisms of injury, evaluate management of skull fractures at CHUK and determine the outcome in terms of complication; clinical condition at discharge and mortality.

METHODS

A retrospective descriptive study conducted at CHUK from January 2014 to January 2015, collecting data from 241 patients with head injuries of whom 62 (25.7%) were diagnosed with skull fractures on the basis of CT scan findings. Hospital record data of these 62 patients were respectively collected. Patients who sustained head injury without skull fractures were excluded as well as patients without clear documentation of diagnosis and mechanism of injury.

RESULTS AND DISCUSSION

1. Demographic characteristics

1.a Skull fracture by age

The mean age of skull fracture was 26 years with high frequency in children under five-years of age.

1.b Gender distribution of skull fractures

Male patients were found to be at higher risk of skull fracture than female; (44) 71.2% and (18) 28.8% respectively. Our findings are consistent with other studies. For example AK Rastogi et al, in their study on demographic profile of head injuries in India, have documented that the majority of victims with head injury were middle aged male with 76% [8].

2. Mechanism of skull fracture

Table 1. Mechanisms

Skull Fractures (n=62)	MECHANISMS	No.	Percent
(RTI) Road traffic Injury (n=36)	Pedestrians	12	33.3%
	Motorbikes	10	27.7%
	Vehicles	8	22.2%
	Bicycles	6	16.6%
Assaults (n=14)	Stone	8	57.1%
	Stick	4	28.6%
	Machete	2	14.3%
Fall from Heights (n=10)	Tree	7	70%
	Bed	1	10%
	Others	2	20%
Farming injuries (n=2)		2	3.3%

The most common mechanism of skull fracture (Table 1) identified in this study is RTI which accounts for 58% (36) in general, mostly involving pedestrians. Assaults were the second most common mechanism 22.6% (14), followed by falls from heights 16.1% (10) and farming 3.3% (2). Our findings are comparable to the results of a study in India by Rastogi AK et al. who found that accidents were the most common causes of head injury (59.2%), followed by assaults and fall from height with 10.8% and 8.8% respectively [8].

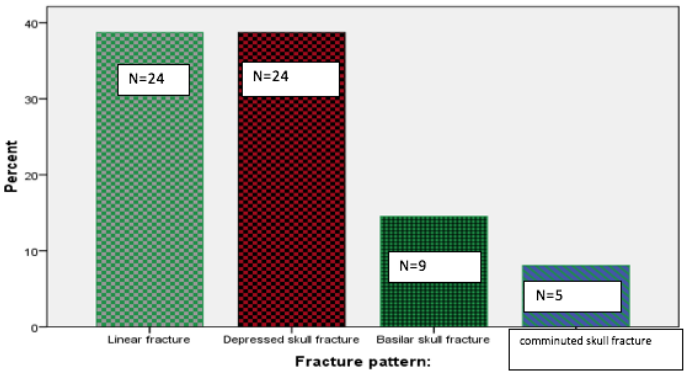
On the contrary, findings are different from a study done in South Africa by Van Den Heever et al reporting assaults as major causes of skull fractures with75% patients with skull fractures among head injury patients [3] . Greenes and Schutzman described falls from height as the most common mechanism in an infant population [9].

Among the 34 identified cases of RTI (road traffic injuries)-related skull fractures, pedestrians were the most involved (34.3%) followed by motorbikes (25.7%), vehicles (22.9%) and bicycle (6%).

The most common causes of assaults which lead to skull fracture identified in this study were assaults with stones (57.1%) followed by sticks (28.6%) and machetes (14.3%).

3. Clinical presentation of skull fracture

Figure1: Fracture patterns



Depressed skull fractures and linear skull fractures are the most common fracture patterns which represent 38.7% each one followed by skull base fractures and comminuted skull fractures with 14.5% and 8.1% respectively.

The most commonly fractured bone is the parietal bone with 40.3% followed by frontal bone, temporal bone and occipital bone representing 37%, 11.3% and 9.7% respectively. These findings are comparable to those described in the study done by R Braakman in Rotterdam who reported that frontal and parietal bone are the most involved bones: parietal 31%, frontal 25%, frontal basal 17%, occipital 14% and temporal 10% [10] .

Figure2: Clinical presentation on admission

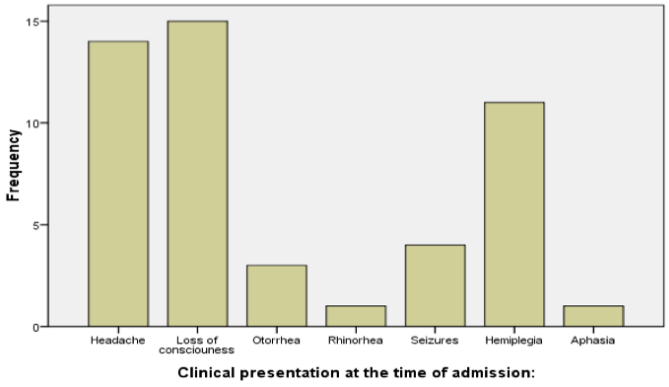


Fig 2: Some patients presented with more than one of these complaints. Loss of consciousness (59.2%) and headache (28.6%) were the most common symptoms reported from this study. Otorrhea (6.1%) and rhinorrhea (2%) were also found in some cases of skull fractures.

Type of Fracture

Closed skull fractures were the most common, 72.6% (45), while open skull fractures were found in 27.4% (17). Head injuries leading to skull fractures were mostly minor injuries (GCS ≥13) which were diagnosed in 60.3% of cases, while moderate (GCS≤12≥9) and severe (GCS≤8) head injuries represented 29.5% and 10.2% respectively. These results are more or less comparable to the findings by Stranjalis G et al who showed that mild head injury is 63%, moderate 11% and severe head injury 26% [11].

Table 2: Associated injuries

	Frequency	Percentage
Epidural hematoma	16	34.0
Subdural hematoma	7	14.9
Intracerebral hematoma	4	8.5
Brain contusion	16	34.0
Craniofacial injury	2	4.3
Chest trauma	1	2.1
Extremities	1	2.1
Total	47	100.0

Table 2: The most injury associated with skull is epidural hematoma, brain contusion and subdural hematoma with 34.0%, 34.0%, 14.9% respectively. Some patients sustained more than one of these conditions.

4. Management of skull fracture at CHUK

72% of skull fractures were managed conservatively at CHUK while in 14.8% of cases the management was done by bone elevation plus wound debridement, duraplasty plus debridement represent 8.2 % of cases; and in 5% of cases wound debridement only was sufficient as the surgical treatment.

5. Outcome of skull fracture

Table4: Skull fracture pattern and with their outcome

Skull Fracture type	Outcomes (numbers of cases)				
	Symptoms free at discharge	Meningitis	Hemiplegia	Death	**Total**
Linear	21	1	1	1	24
Depressed skull	17	1	4	1	23
Basilar	4	3	1	0	9
Compound	2	0	0	2	5
Total	44	5	6	4	61

In general, the skull fractures at CHUK had good outcomes where 72.1% were symptom free at discharge, 9.8% had neurological deficits, 8.2% developed meningitis and finally 6.6% died.

Meningitis was most commonly found in basal skull fractures when compared to any other fracture pattern. Similar findings were reported in a study by Marion DW et al. on complications of head injury and their therapy states [12].

CONCLUSION

Skull fractures resulting from head injury are not uncommon. At CHUK, 25.72% (62) among head injury patients sustained skull fractures. Road traffic injuries (RTIs) involving vehicles, motorbikes, and pedestrians were the most frequently identified mechanisms of skull fractures. It is in this context we are recommending the public to be aware of accidents and road security services to emphasize on preventive measures. Wearing helmet for motorcyclists in many studies performed in city where Motocycle is the major source of transportation reduce the risk of head injury and crashes [13]. Other notable causes included 14 assaults (24.6%), 10 falls from heights (16.4%), and 2 (3.3%) farming injuries. Social and familial conflicts should be discouraged by peacebuilding education within the community and families. Epidural hematoma, brain contusion and subdural hematoma were the most common associated injuries. Appropriate evaluation to rule out associated intracranial lesions in skull fractures is paramount and the needs for continued attention to education of medical professionals especially neurosurgeons is recommended as there were one neurosurgeon at CHUK at the time of the study.

In general, skull fractures at CHUK had positive clinical outcomes where 72.1% of patients were found to be asymptomatic at hospital discharge. The basal skull fractures were more often associated with meningitis than with other fracture patterns; 3 patients out 5 patients who had meningitis as complication had the skull base fractures. There is controversy of antibiotics use in basal skull fracture in literature. Based on our finding we are recommending the use of antibiotics in basal skull fractures but further research is also recommended to provide adequate guidelines on antibiotics use in skull base fractures.
Incomplete capture of medical records, retrospective evaluation and single institution were the weakness and limitations of the study.

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REFERENCES

1. Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartl R, Newell DW, et al. Surgical management of depressed cranial fractures. Neurosurgery. 2006;58(3):S2-56.

2. Roberts JR. Head trauma in infants: the isolated skull fracture. Part 3 in a Series. Emerg Med News. 2006;28(12):21-4.

3. Van Den Heever CM, van der Merwe DJ. Management of depressed skull fractures: selective conservative management of nonmissile injuries. J Neurosurg.. 1989;71(2):186-90.

4. Greenes DS, Schutzman SA. Infants with isolated skull fracture: what are their clinical characteristics, and do they require hospitalization? Ann Emerg Med. 1997; 30(3):253-9.

5. Borkar SA PG, Gupta DK, Sinha S, Mahapatra AK. Compound elevated skull fracture: a clinical series of three patients with a review of the literature. Turk Neurosurg. 2013;23(4):514-7.

6. Adeolu AA, Shokunbi MT, Malomo AO, Komolafe EO, Olateju SO, Amusa YB. Compound elevated skull fracture: a forgotten type of skull fracture. Surg Neurol. 2006;65(5):503-5.

7. Flores LP, Almeida C, Casulari L. Positive predictive values of selected clinical signs associated with skull base fractures. J Neurosur Sci. 2000;44(2):77.

8. Rastogi A, Agarwal A, Srivastava A, Kumar A, Shandil A. Demographic profile of head injury cases in Agra region. 2012. J Indian Acad Forensic Med. 2012 Apr; 34(2):117-119.

9. Greenes DS, Schutzman SA. Infants with isolated skull fracture: what are their clinical characteristics, and do they require hospitalization? Ann Emerg Surg. 1997;30(3):253-9.

10. Braakman R. Depressed skull fracture: data, treatment, and follow-up in 225 consecutive cases. J Neurol Neurosurg Psychiatry. 1972;35(3):395-402.

11. Stranjalis G, Bouras T, Korfias S, Andrianakis I, Pitaridis M, Tsamandouraki K, et al. Outcome in 1,000 head injury hospital admissions: the Athens head trauma registry. J TraumaAcute Care Surg. 2008;65(4):789-93.

12. Marion D. Complications of head injury and their therapy. Neurosurg Clin North Am. 1991;2(2):411-24.

13. Kang-Min Sung:The preventive Effect of head injury by hermet type in motocycle crashes. Biomed Res Int; 2016: 1849134.