An autopsy Study of Patterns of Skull fractures in Road Traffic Accidents Involving Two Wheelers

Dr. R. Ravikumar, M.D

Abstract

Road Traffic accidents are the world's most serious health problem causing premature death and disability with increasing prevalence year by year. Incidences are more common among the two wheeler vehicles. As motorized two wheeler vehicles constitute a large portion of the vehicle fleet in India. Head is the most common site to be injured in road traffic accident [1]. Head injuries may result in injury to the contents of the skull, either alone or with a fracture of the skull. Hence the present study was conducted to know the pattern and distribution of skull fractures in fatal accidents involving riders and pillion riders of two wheelers. This study was conducted from 1st April 2009 to 30th Sept 2010 at Victoria Hospital Mortuary, Bangalore. A total of 245 cases of deaths due to two wheeler accidents were reported for the autopsy. Riders constituted (76.33%) and pillion riders (23.67%). Most victims were male (87.75%), skull fractures (67.75%) were observed in the two wheeler accidental death. Linear fracture (55.43%) was the commonest pattern of fracture observed in these accidents. Sub-dural haemorrhage was the commonest intracranial haemorrhage associated with head injuries.

Keywords: *Road traffic accidents; Riders; Two wheelers; Skull fractures; linear fracture.*

Introduction:

Road Traffic Injuries (RTIs) are one of the leading causes of deaths, hospitalizations, disabilities and socioeconomic losses in India. Large number of poor and middle-income family is compelled to use two wheelers, as they are not highly expensive. In the case of two wheeler occupants, the rider or the pillion can hit the colliding object, (which can be an incoming vehicle, a roadside stationary object or the ground) (at different speeds and velocities). The resulting energy release and its impact on the brain is determined by the amount of energy generated, presence or absence of protective equipment, viz., helmet, physiological characteristics of the injured person and energy threshold levels. Skull and brain injuries are produced by either static or dynamic forces. Skull fractures with or without brain damage is possible.

Skull fractures can be linear, depressed or compound depressed fractures. When pieces of skull bone penetrate or impact the brain, structural and neurological damage is commonly seen.

Corresponding Author:
Asst Professor, Department of Forensic Medicine,
Rajarajeshwari Medical College and Hospital
Kambipura Mysore road, Bangalore – 74

In this study a sincere effort has been made to study the pattern and distribution of skull fractures in riders and pillion riders involving two wheelers road traffic accidents and to suggest measures to be taken to decrease the road traffic accidents involving two wheelers.

Materials & Methods:

A cross sectional studyof total of 245 cases of deaths due to fatal road traffic accidents involving riders and pillion riders of two wheelers have been studied.

Inclusive Criteria : All cases of deaths due to head injuries in fatal road traffic accidents involving riders and pillion riders of two wheelers of both sexes all age groups, treated and untreated, irrespective of duration of survival was included in the study.

Exclusive Criteria Cases other than two wheeler road traffic accidents to Victoria Hospital Mortuary.

Detailed autopsy examination was done on the request from the investigating officer in annexure 146(i) and (ii). Relevant information was collected from police, relatives and friends of deceased. Rokitansky en-mass evisceration technique was followed in conducting the autopsy [2].

Then with all these findings, post mortem conclusion as to the cause of death in each case was drawn and analyzed.

Observations and Results:

All cases of deaths due to two wheeler RTA involving riders and pillion riders were autopsied in the Victoria Hospital Mortuary, Bangalore attached to Bangalore Medical College and Research Centre irrespective of Sex, Age groups treated and untreated and duration of survival for a period of 18 months from April 2009 to September 2010.

A total number of 245 cases of two wheeler Riders / Pillion riders' road traffic accidents were recorded. There were 187 (76.33%) two wheeler riders and 58 (23.67%) were pillion riders. The cases are seen more in the male victims (87.75% as compared to females (12.25%). (Table 1)

Our study showed that the two wheeler road traffic accidents are more in the third (115cases) & fourth decades (55cases) constituting 47.75% and 22.44% of total 245 victims. It was followed by 20 to 39 years constitutes 70.20% of total victims. (Table 2)

Among the total 187 RTA cases involving Riders, the evidence of Helmets used was recorded in 120 (64.17%) of the victims while 67 (35.83%) did not use. None of the pillion riders were wearing helmets at the time of accidents. (Table 3)

In this study Basal plus Linear fracture of Vertex constituted 44 cases (23.53%), out of 187 riders and 11cases out of 58(18.97%) of pillion riders. Linear fracture of vertex only comprised 26(13.90%) cases in riders, 11(18.97%) cases in pillion riders followed by fractures of the base only in 21 cases (11.23%) in riders and 08 cases (13.79%) in pillion riders, Depressed fractures of vertex was found 07 (5.60%) in riders and 02 (4.87%) in Pillion riders. Comminuted fractures were the least common in both riders and pillion riders. No fracture of skull was found in 62 cases, out of 187 riders and 17 cases out of 58 cases of pillion riders. (Table 4)

Linear fractures of vertex only were found in 26 cases in riders and 11 cases in Pillion Riders. Parietal regions alone had the maximum 8 cases in riders and 3 cases in pillion riders, followed by parieto-temporal regions 6 cases in riders and 3 cases in pillion riders (29.73 %). (Table 5)

There were 44 cases where both basal fractures and linear fractures of vertex were found. Basal fractures were associated with fractures in the occipital region in 8 cases in riders and 4 cases in pillion riders and with fractures in the temporal region in 10 cases in riders and 5 cases in pillion riders and with fractures at the temporo-parietal region in 12 cases in riders. (Table 6)

Basal fractures were divided according to regions as anterior cranial fossa fractures (ACF), Middle cranial fossa fractures (MCF) and Posterior Cranial fossa fractures (PCF), the rest were grouped under the different combinations of the above three regions. There were 21 cases of basal fractures in riders and 08 cases of basal fractures in pillion riders. MCF has the maximum number of cases 07 (33.33%) in riders and 03 (37.50%) in pillion riders. (Table 7)

We observed Sub dural haemorrhage (SDH) in 92.80% followed by sub arachnoid haemorrhage (SAH) in 76.80%, Intra cranial haemorrhage (ICH) in 17.60% and least is extra dural haemorrhage (EDH) in 4.83% in riders in this study while in pillion riders SDH in 87.80%, followed by SAH in 68.29%, ICH in19.51% and least is EDH in 7.30% in cases where skull fracture occurred.

EDH, SDH & SAH in relation to skull without fracture were found as SDH in 82.75% followed by SAH in 62.06%, ICH in 20.68% and least is EDH in 6.89% in riders, SDH in 100%, followed by SAH in 75%, and ICH in 25 % in pillion riders. (Table 8)

Discussion:

In the present study, motorcycle riders included 187(76.33%) and pillion riders comprised 58(23.67%) of 245 cases. Male preponderance was noted, as most of the motorcyclists were Male accounting for 215(87.75%) and Females accounting for 30(12.25%) similar to the findings of studies

Table 1: Total Fatal RTAs involving Riders/Pillion Riders of Two Wheelers

	Males%	Female%	Total %
Riders	177(94.7)	10(5.3)	187(76.3)
Pillion Riders	38(65.5)	20(34.5)	58(23.7)
Total	215	30	245

Table 2: Age wise distribution of cases

Age (Yrs)	Riders%	Pillion Riders%
0 – 9	0(0.00)	0 (0.0)
10 – 19	10(5.4)	6(10.3)
20 – 29	90(48.1)	27(46.6)
30 – 39	45(24.0)	10(17.2)
40 – 49	15(8.0)	4(7.0)
50 – 59	18 (9.6	8(13.8)
60 – 69	5 (2.7)	3(5.2)
⩾70	4(2.1)	0(0.0)
Total (n=245)	187	58

Table 3: Distribution of cases based on Evidence of Using Helmets among Riders

Helmets used	Used %	Not used%
0 – 9	0(0.0)	0(0.0)
10 – 19	7(5.8)	3(2.5)
20 – 29	59(49.1)	31(25.8)
30 – 39	31(25.8)	14(11.7)
40 – 49	10(8.3)	5(4.1)
50 – 59	8(6.7)	10(8.3)
60 – 69	3(2.5)	2(1.7)
⩾70	2(1.7)	2(1.7)
Total (n=187)	120 (64.1)	67(35.9)

Table 4: Types of Skull fractures in RTA Involving Riders & Pillion Riders

Types of skull fracture	Riders%	Pillion riders%
Linear Fracture of vertex	26(13.9)	11 (18.9)
Comminuted Fracture of vertex	4(3.2)	2(4.9)
Depressed fracture of vertex	7(5.6)	2(4.9)
Basal Fracture	21(11.2)	8(13.8)
Basal Fracture +linear fracture of vertex	44(23.5)	11(19.0)
Crush fracture of skull	23(12.3)	7(12.0)
No Fracture	62(33.1)	17(29.3)
Total	187(76.3)	58(23.7)

Table 5: Localisation of linear fracture of vertex only in Riders & Pillion Riders

Linear fracture of vault only	Riders%	Pillion riders%
Frontal	2(4%)	1(9)
Parietal	8(32%)	3(27)
Occipital	3(12)%	2(18)
Temporal	3(12)%	0(0)
Fronto Parietal	1(4%)	1(9)
Parieto Temporal	6(24%)	3(27)
Temporo Occipital	2(8%)	0(0
Fronto-Parieto Occipital	0(0%)	0(0)
Temporo-Parieto Occipital	1(4%)	1(9)
Total	26(70.27)	11(29.73)

Table 6: Localisation of Basal plus linear fracture of vertex only in Riders & Pillion Riders

Linear fracture of base and vault only	Rider %	Pillion riders%
Basal+ Frontal	5(11.3)	1(9)
Basal+ Parietal	2(4.5)	0(0)
Basal+ Occipital	8(18)	4(36.3)
Basal+ Temporal	10(22)	5(45.4)
Basal+Fronto Parietal	4(9)	0(0)
Basal+Fronto Temporal	2(4.5)	0(0)
Basal+Parieto Occipital	0(0)	0(0)
Basal+Tempero Parieto Occipital	0(0)	1(9)
Basal+Fronto Parieto temporal	0(0)	0(0)
Basal+Parieto Temporal	12 (27.2)	0(0)
Basal+Fronto Parieto Occipital	1(2.2)	0(0)
Total	44(80)	11(20)

Table 7: Localisation of Basal Fractures in Riders & Pillion Riders

Basal fractures	Riders %	Pillion riders%
Anterior Cranial Fossa (A.C.F)	6(28.5)	2(25)
Middle Cranial Fossa (M.C.F)	7(33.3)	3(37.5)
Posterior Cranial Fossa (P.C.F)	1(4.7)	0(0)
A.C.F.+ M.C.F.	6(28.5)	2(25)
A.C.F +P.C.F.	1(4.7)	0(0)
A.C.F+M.C.F.+P.C.F.	0(0)	1(12.5)
TOTAL	21(72.41)	8(27.59)

Table 8: Intra Cranial Haemorrhages in Riders & Pillion Riders

Riders	EDH %	SDH%	SAH%	ICH%
Skull With Fracture	6(4.8)	116 (92.8)	96 (76.8)	22 (17.6)
Skull Without Fracture	2 (6.9)	24 (82.8)	18 (62.1)	6(20.7)
Pillion Riders				
Skull With Fracture	3(7.3)	36 (87.8)	28 (68.3)	8(19.5)
Skull Without Fracture	0(0.0)	8(100)	6(75.0)	2925.0)

of Kumar et al [4] were males belonging to 88.22% and females 11.77% and in the study of Singh YN et al [5] males belong to 86.96% and females belong to 13.04%.

Most Vulnerable age group is the active population of the study resulting were those persons of third decade 48.13% followed by fourth decades 24.06% showing 72.20% of riders and 63.80% of pillion riders. Findings found in the studies by Kumar A et al [4] results show that the younger economical active groups 21-30years followed by 31-40 years.

Helmet use was infrequent among Motor cyclists in our study. 67(35.82%) Riders, among 187 riders have not been wearing a helmet at the time of accident. None of the pillion riders have been wearing Helmet. Lack of wearing the helmet resulted in increased incidence of head injuries in pillion riders also. To reduce the incidence of head injury in pillion riders they should wear crash helmet as suggested by Modi. [6] Failure to wear a helmet resulted in a significantly higher incidence of head injury and death among both riders and pillion rider motorcycle crashes similar to studies by Cawich SO et al [7]. Study by Mumtaz B et al [8] showed frequency of helmet use is 56.6% and that of non-users in 43.3%.

It is observed that head injuries constituted as a major pathology behind the death of the deceased, similarly studies by Bairagi KK et al. [9], Most of the head injuries are associated with skull fractures which increases the fatality of victims Kraus JF et al (2003)[10].

Skull fractures are not a dictum to be present in all fatal head injury cases. In this study skull fractures were present in 166 (67.75%) cases. Compared to 69.63% of cases in the study by Kumar A et al and Singh B et al. [4, 11]

Cranial Vault was involved in 31.32%, base of skull in 17.47% and both Vault and Base in 33.13% of cases. Compared to 62% of cases of skull fractures, cranial vault involved in 38%, base of skull in 34% and both Vault and Base of skull in 28% of cases in study conducted by Menon A (2005)[12].
The dominant type of skull fractures found was the linear (fissured) fracture in 55.43% cases followed by basilar fracture in 17.47%, Crushes fracture in 18.07%, Comminuted fracture in 5.42% and depressed fracture in 3.62% is consistent with Akhilesh Pathak□s study [13]. Fissured fracture was the most commonly observed fracture (57%) in study of Menon A et al. [12]

The sites of skull fractures most commonly involved in our study is Parietal, followed by Temporal, Temporo-Parietal and Middle cranial fossa. 29.72%, 13.51%, 24.32% and 34.48% of cases respectively, in contrast to 22%, 20% and 26% Parietal, Temporal and middle cranial fossa in study by Menon A et al [12] Similar involvement of parietal and temporal bones are found in Kumar A. et al [4] and according to Vij. K(2008)[14] and in Knight's(2004)[15].

In Basal fractures, middle cranial fossa was commonly involved which was also observed in Harnam Singh's study [16]

More number of skull fractures observed in this study can be explained by restricted movement of the head receiving maximum force, more striking surface area of skull in all directions, least protection offered by the scalp musculature when compared to limbs and other parts of the body.

The commonest variety of Intra Cranial Haemorrhage found was subdural haemorrhage 90.83%, followed by sub arachnoid haemorrhage 70.53%, Intra cerebral haemorrhage 20.64% and least is extra dural haemorrhage found in 4.75% of cases as studied by others.[5] The most common cause of death which was Intra Cranial Haemorrhage from head injury in study by Nzegwu.et al. [17]

A fracture of the skull with associated brain injury is the most common cause of death in our study. We found multiple injuries in most of cases involving other systems a typical feature of fatal motor cycle accidents as mentioned by Parikh CK. [18]

Conclusion:

RTIs are considered as a public health problem and comprehensive efforts are made to understand the problem and to identify and implement remedial measures. As this study shows head injuries were common among motorized two wheelers, among them, injuries to skull and brain is the single most important type of injury which lead to death and poor quality of life among those who survive. Helmets offer protection to two-wheeler riders and pillions. The presence of helmet law increases usage of helmets thereby resulting in decline of deaths, serious head injuries, neurological disabilities, duration of hospitalization and associated medical and social costs. Development of policies and their strict implementation based on these risk factors can reduce severity and burden of head Injuries in India. As the maximum number of cases of head injury is due to vehicular accidents and proved to be fatal for life, the safety measures, for both the drivers and the passengers should be addressed.

Acknowledgement:

Work attributed to Department of Forensic Medicine, Bangalore Medical College, Bangalore, Karnataka.

Conflict of interest statement: None.

References:

1. Reddy KSN. The essentials of Forensic Medicine and Toxicology, 29th edition, published by K. Sugana Devi, 2010; p218.
2. Otto saphir. Autopsy Diagnosis and technique. Paul Hober Inc. third edition.
3. Mohan D. Mechanics of Head Injury and Politics of Brain Damage. Current Science, 65(10), 749-60, 1993.
4. Kumar A, Lalwani S, Agarwal D, Rauti R, Dogra TD. Fatal Road Traffic Accidents and their relationship with head injuries, An Epidemical survey of 5 years; Indian Journal of Neurotrauma 2008, 5(2): p63-67.
5. Singh YN, Bairagi KK, Das KC. An epidemiological study of road traffic accident victims in medico-legal autopsies, JIAFM, 2005, 27(3); 166-169.
6. B.V.Subramanayam (editior). Modi's Medical Jurisprudence and Toxicology, 22 ed., edited by 2001; 393-396.
7. Cawich SO, Harding HE, Evans NR, Crandon IW, Mitchell DIG, Martin AC et al. " Strategies for secondary prevention of Motorcycle road traffic injuries" Time for policy re-evaluation in Jamaica, The internet journal of emergency med, 2010; 12(1).
8. Mumtaz B, Hussain Khan M, Wasif Khan M, Ahmed M, Mahmood A. Frequency of helmet used among motorcycle riders in Rawalpindi, Professional Med Journal, 2007 Dec; 14(4): p663-668.
9. Bairagi, KK, Barbhuiyan SI, Hazarika N. Injuries in riders and pillion riders of two wheeler road traffic accidents in city of Guwahati, Indian Journal of Forensic Medicine and Toxicology; Jul-Dec 2010, 4(2), p25.
10. Kraus JF, Rice TM, Peek Asa C, Mc Arthur DL. Facial Trauma and the risk of intracranial injury in motor cycle riders, Ann Emerg Med, 2003 Jan, 41(1); 18-26.
11. Singh B, Palimar V, A run M, Mohanty MK. Profile of trauma related mortality

at Manipal, Kathmandu University Medical Journal, 2008, 6(3); 393-398.
12. Menon A, Nagesh KR. Pattern of fatal head injuries due to vehicular accidents in Manipal, Journal of Indian Academy of Forensic Medicine, 2005, 27(1); 19-22.
13. Akhilesh Pathak, NL Desania, Rajesh Verma. Profile of road traffic accidents and head injury in Jaipur.JIAFM; 30(1):6-9.
14. Krishan Vij. Text Book of Forensic Medicine and Toxicology, 4th Edition Elsevier, A division of Reed Elsevier India Private Limited, 2008, 387-388.
15. Pekka Sauko, Bemad Knight. Knight□S-Forensic Pathology, 3rd Edition , Arnold, A Member of the Hodder Headline Group, London, 2004, p290,291.
16. Haarnam singh, AD Agarwal. Fatal road traffic accident in motorcyclists not wearing helmets. Journal Of Punjab Academy of Forensic Medicine and Toxicology (online) 2011; 11(1).
17. Nzegwu MA, Aligbe JU, Banjo AAF, Akhiwu W and Nzegwu CO. Patterns of Morbidity and Mortality amongst motorcycle riders and their passengers in Benin City, Nigeria, Annals of African medicine, 2008; 7(2); p82-85.
18. Pareikh CK. Text Book of Forensic Medicine and Toxicology. CBS Publishers and Distributors, 6th Edition, 2002;p4.144-4.146.