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Research Paper: A Retrospective Autopsy-Based Study on the Pattern of Head Injuries in Pillion Riders Involved in Fatal Road Traffic Accidents and Proposed Safety Measures

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ABSTRACT

Background: Head injury is one of the commonest causes of mortality in motorcycle accidents. This study aims to determine the pattern of injuries in fatal cases of pillion rider accidents, because few studies have been conducted on this topic.

Methods: A total of 34 cases of pillion rider fatalities in Pondicherry, India were included in the study.

Results: Scalp injuries and fractures were more commonly seen over the occipital (41% and 47%, respectively) and temporal region (21% and 38%, respectively) of the head especially in females, also slip and fall off motorcycle (38%) was the commonest mode of injury.

Conclusion: Slip and fall was significantly higher (92%) in females as the position adopted by female pillion riders was usually the side saddle position and the impact part of the head, in falls from this position, usually involves the occipital or temporal region of the head. To prevent the slip and fall off the bike, a safety belt/harness can be used to control the fall of the pillion rider seated in a side saddle position, and this could reduce the mortality and morbidity in pillion riders to some extent.

1. Introduction

Head injury has been defined as "a morbid state, resulting from gross or subtle structural changes in the scalp, skull, and or the contents of the skull, produced by mechanical forces" [1]. Head injury is the major contributing factor in all trauma cases causing mortality [2] and is the commonest cause of mortality and morbidity following two-wheeler crashes [3].

The World Health Organization (WHO) puts Road Traffic Accident (RTA) as the sixth leading cause of deaths in India [4] that is four times more than in some developed countries such as the United Kingdom and Sweden and still increasing rapidly [5]. Fatalities of

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RTAs in India are estimated to increase up to 150% by 2020 [6]. Some of the factors that increase the risk of road crashes in India are unsafe traffic environment, poor road infrastructure, and encroachments [7].

Due to lack of protection around the riders, they come into direct contact with hitting objects, thus motorcycle is the least safe form of transportation [8]. Of particular significance are motorcycle accidents that involve passengers without wearing helmets, which result in severe injuries [9]. However, helmet regulation in India is not uniform and poorly enforced [10]. Few reports have shown the differential analysis of injuries and their severity among riders and passengers [11], especially the pattern of injuries in pillion riders are not well studied [12-14]. Hence, this study was carried out on the pattern of head injuries in pillion riders and to determine if any significant findings can be obtained.

2. Materials and Methods

This is a retrospective study of autopsy findings in 34 cases of pillion rider fatalities from 2012 to 2017 at Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry, India. Most of the cases are from areas in and around Pondicherry which were treated in JIPMER. This study aimed to describe the pattern of head injuries in pillion riders involved in fatal cases of RTA. All 34 cases were involved in motorized two-wheeler accidents. A detailed analysis of the cases was obtained from the police inquest reports, case files, and autopsy reports. History of the case like age, gender, vehicles involved, injuries sustained was recorded in a proforma and the data were statistically analyzed in Microsoft excel spreadsheet. Only cases conducted by the author were included in this study.

3. Results

Of 34 cases, the highest number of victims were in the age group of more than 50 years in 12(35%) cases followed by age group between 21 to 30 years in 10(29%) cases and age group between 31 to 40 years in 6(11%) cases (Figure 1). Of the victims, 20(59%) were males and 14(41%) were females (Figure 2). The duration of survival was between 2 to 7 days in 20(59%) cases followed by death within 24 h in 13(38%) cases (Figure 3). The commonest mode of injury (i.e. collision with heavy vehicle, light heavy vehicle, two-wheeler and slip and fall off motorcycle) (Figure 4) was slip and fall off motorcycle, which is described as the pillion rider falling off the motorcycle when sudden brake is applied or the rider loses control over the vehicle in 13(38%) cases (12[92%] females and 1[8%] male) (Figure 5) followed by impact with motorcycle in 8(23%) cases and others account for 4(12%) cases (hit the back of a cycle, an unknown vehicle, a pedestrian, or a tree). The cause of death was overwhelmingly due to craniocerebral injury in 29(85%) cases followed by multiple injuries in 3(9%) cases (Figure 6).

A gender-wise comparison of external injuries over the scalp, site of skull fracture and type of skull fracture was done. Scalp injuries and skull fractures were separated region-wise to determine which part of the head was prone to injuries. It was found that external injuries over the scalp in males was over the occipital region in 6(30%) cases followed frontal region in 5(25%) cases. In 8(40%) cases the scalp was intact, and in females, overwhelmingly most of the injuries to the scalp was found over the occipital region in 8(57%) cases followed by the temporal region in 4(29%) cases (Table 1).

The commonest site of skull fracture in males was around the posterior cranial fossa in 8(40%) cases and in females also the posterior cranial fossa in 8(57%)

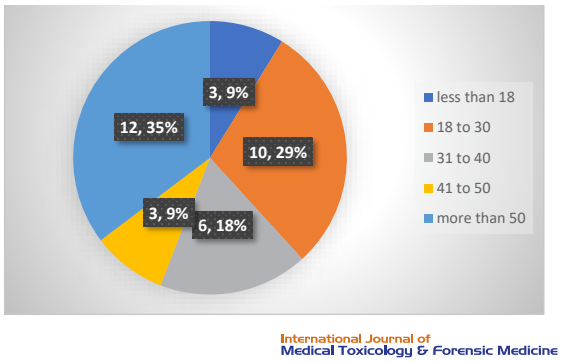

Figure 1. Age-wise distribution

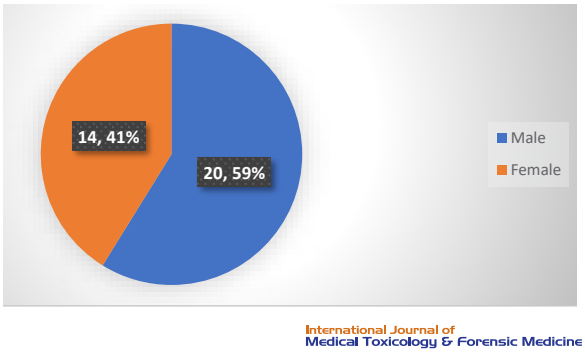

Figure 2. Gender-wise distribution

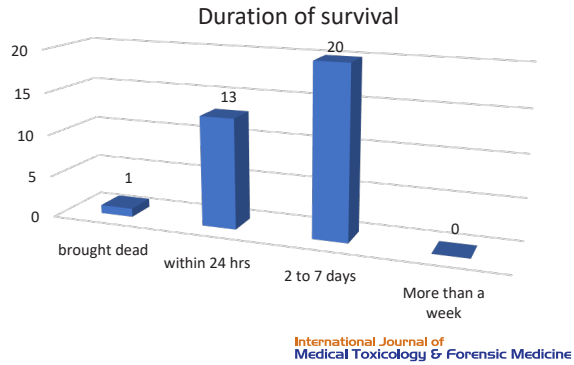

Figure 3. Duration of survival

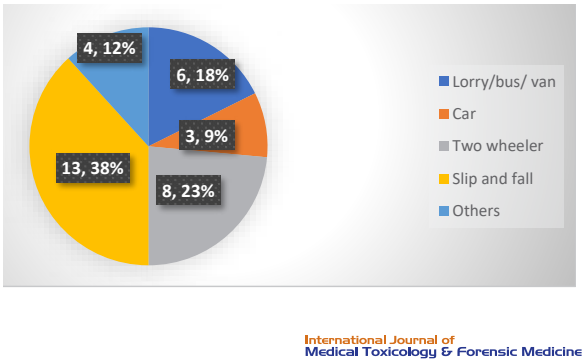

Figure 4. Mode of injury (impact with offending vehicle)

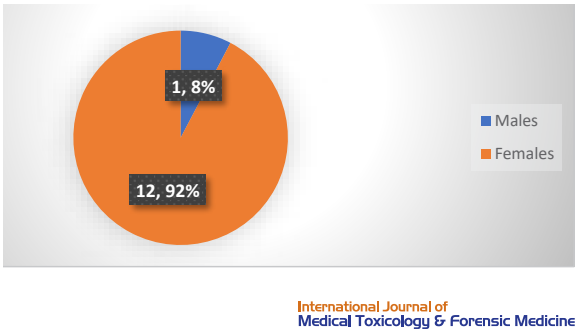

Figure 5. Mode of injury (slip and fall): Gender-wise distribution

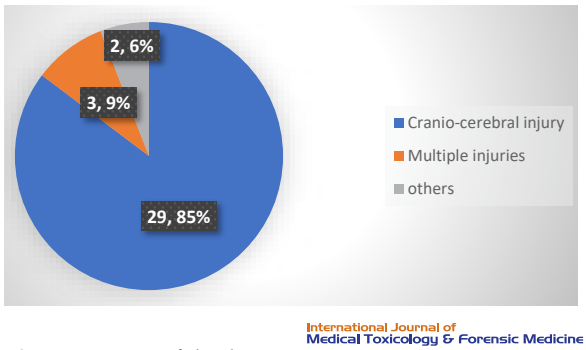

Figure 6. Cause of death

cases; this was followed by temporal bone fractures in males with 7(35%) cases and females with 6(43%) cases (Table 2).The skull was found to be intact in males with 8(40%) cases and females with 1(7%) case (Table 2).

The type of skull fracture in most cases were fissured fracture in 22(65%) cases and no fractures were present in 9(26%) cases (Table 3). The commonest type of intracranial hemorrhage was found to be subdural and subarachnoid hemorrhage in 24(71%) cases followed by only subarachnoid hemorrhage in 5(15%) cases (Table 4). Of the other injuries not related to the head, abrasions on the body were the commonest injuries seen in 16(80%) males and 7(50%) females (Table 5).

4. Discussion

Few studies on the pattern of head injuries in pillion riders have been carried out. The present study was done to critically analyze the history (i.e., the age, gender, vehicles involved in the accident) given and injuries sustained by the pillion rider to determine any significant findings. Incidentally, it was found that there was some variation in the pattern of injuries based on gender. Most scalp injuries in females were confined to the occipital region in 8(57%) cases when compared to males with 6(30%) cases. Most significant finding was in the skull fractures, where the posterior cranial fossa was involved in majority of the cases, i.e. 8(57%) cases in females.

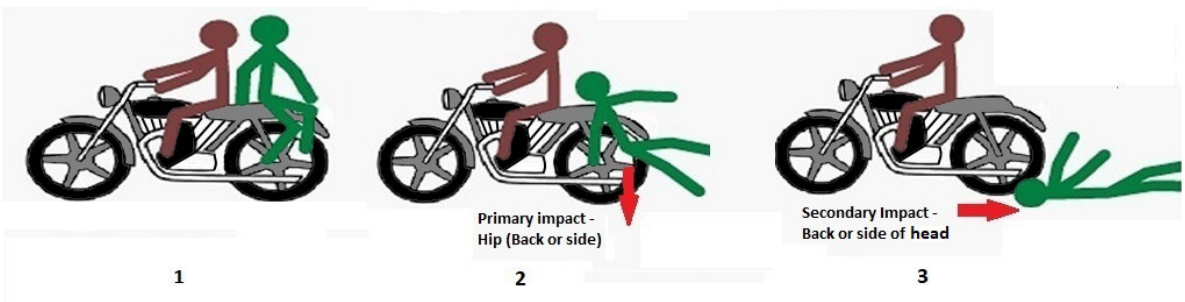

Figure 7. Diagram representing slip and fall of a pillion in side sitting position

Figure 8. Safety belt/harness for pillion riders in side sitting position (front and side view)

As seen in most cases, the sustained injuries in females were due to slip and fall off motorcycle in 12(92%) cases. This could be attributed to the fact that many females in India adopt a side saddle position, because the traditional dress worn by many Indian women is the saree/pardha which prevents them from adopting a cross-saddle seated position over the back seat, hence the side saddle position is the most convenient way of sitting on the back seat of a motorcycle. The pillion, when adopting a side saddle posi-

Table 1. Region of the scalp involved in injuries sustained (contusion/laceration)

Region of Scalp	Male (n=20)	Female (n=14)	Total (n=34)
Frontal (F)	5(25%)	1(7%)	6(18 %)
Parietal (P)	4(20%)	3(21%)	7(21%)
Temporal (T)	3(15%)	4(29%)	7(21%)
Occipital (O)	6(30%)	8(57%)	14(41%)
Intact	8(40%)	3(21%)	11(32%)

Combined injuries were separated region-wise.

Table 2. Bones involved at the site of skull fracture

Site of Skull Fracture*	Male (n=20)	Female (n=14)	Total (n=34)
Frontal (F)	0(0%)	1(7%)	1(3%)
Parietal (P)	3(15%)	1(7%)	4(12%)
Temporal (T)	7(35%)	6(43%)	13(38%)
Anterior cranial fossa	4(20%)	2(14%)	6(18%)
Middle cranial fossa	6(30%)	2(14%)	8(24%)
Posterior cranial fossa	8(40%)	8(57%)	16(47%)
Intact	8(40%)	1(7%)	9(26%)

* Occipital bone included in fractures of posterior cranial fossa

Combined fractures were separated region-wise.

Table 3. Type of fracture

Type of Fracture	Total (n=34)
Fissured	22(65%)
Comminuted	3(9%)
Intact	9(26%)

International Journal of
Medical Toxicology & Forensic Medicine

Table 4. Type of intracranial hemorrhage

Intracranial Hemorrhage	Total (n=34)
Extradural hemorrhage	1(3%)
Subarachnoid hemorrhage	5(15%)
Subdural and Subarachnoid hemorrhage	24(71%)
Subarachnoid and intracerebral hemorrhage	1(3%)
Intact	3(9%)

International Journal of
Medical Toxicology & Forensic Medicine

tion, tends to slip off the motorcycle on to the road when sudden brake is applied or the rider loses control over the vehicle, and the impact surface is usually the back or side of the head (Figure 7). This is because women have minimal options for where to place their hands for support and the added handles for additional support is not positioned in a natural ergonomic position, and they require a side-saddled rider to bend her shoulder and twist at the waist [15].

Hence, something like a safety belt/harness can be designed (Figure 8) which besides being comfortable, serve the purpose of stopping the fall of the pillion rider from the motorcycle and preventing the head from hitting the road. This idea of using a safety belt/harness should be tested before it is brought into use. Though the use of a safety belt/harness will not be as effective as a helmet, it can be an alternative method of preventing fatal head injuries in pillion riders in places were helmet rule is not imposed, especially in rural areas. The use of a safety belt/harness in pillion rid-

Table 5. External and internal injuries over the body excluding head injuries

Type of Injury	Males (n=20)	Females (n=14)	Total (n=34)
Abrasion	16(80%)	7(50%)	23(68%)
Contusion	1(5%)	1(7%)	2(6%)
Laceration	3(15%)	0(0%)	3(9%)
Crush injuries	2(10%)	0(0%)	2(6%)
Liver laceration	3(15%)	0(0%)	3(9%)
Lung laceration	2(10%)	0(0%)	2(6%)
Spleen	1(5%)	0(0%)	1(3%)
Kidney	1(5%)	0(0%)	1(3%)
Facial bone fractures	2(10%)	0(0%)	2(6%)
Intact	1(5%)	5(36%)	6(18%)

International Journal of
Medical Toxicology & Forensic Medicine

ers seated in a side saddle position involved in an RTA will reduce the mortality and morbidity to some extent.

On the whole, though most of the victims were males with 20(59%) cases, the number of female fatalities were also quite high accounting for 14(41%) cases which contradicts a study which states that females who sat sideways had fewer injuries and lesser mortality as compared to male passengers who sat astride [12]. Duration of survival was 2 to 7 days in most cases (59%). The commonest mode of accident was slip and fall off motorcycle (38%). Most common cause of death was due to craniocerebral injuries (85%).

In the profile of head injuries, injuries to the scalp was predominantly seen over the occipital (41%) and temporal (21%) region. The posterior cranial fossa fracture (47%) was the commonest skull fracture followed by the temporal bone (38%) fracture. Fissured fracture (65%) was the commonest type of skull fracture. Finally, the commonest form of intracranial hemorrhage was a combined form of subdural and subarachnoid hemorrhage (71%).

5. Conclusion

Based on the study results, most of the injuries to the head involved the occipital and temporal region, and regarding the mode of injury slip and fall off bike was disproportionately higher in females than males accounting for 12(92%) out of the 13 cases. This may be attributed to the fact that most females (especially those who wear a saree/pardha) adopt a side saddle position. Therefore, they are prone to falls when the rider brakes suddenly or loses control over the vehicle and the impact surface of the head with the road is usually the occipital or temporal region. It is suggested that a safety belt/harness be designed to stop the fall of the pillion rider sitting in this position.

Of course, a trial should be conducted before this design is put to use. The use of a safety belt/harness should not discourage people from wearing a helmet, but in the current scenario, in India, where there is poor implementation of the helmet rule, this could be used as an alternative to prevent more head injuries. The use of safety belt/harness will reduce the mortality and morbidity to some extent and its use is suggested only in people adopting a side saddle position which is commonly used by women in India. This paper is unique in a way that the history and pattern of injuries were critically analyzed and appropriate steps suggested to take precautionary measures to reduce the mortality and morbidity in pillion riders.

Ethical Considerations

Compliance with ethical guidelines

This is a retrospective study. Data was obtained only from police inquest reports and autopsy reports of the author. Identity of individuals have not been revealed. Done in compliance with ethical standards.

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Conflict of interest

The author declared no conflict of interest.

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