

Analysis of Limb Injury Patterns in Victims of two Wheeler AccidentsAnish Sam George^a and Murali Poduval^{a*}^aDepartment of Orthopedics, Pondicherry institute of medical sciences, Kalapet, Pondicherry, India**Abstract**

Objectives: A retrospective study was carried out to analyse the two wheeler accidents that presented over a one year period to a single institution and to study the pattern of limb injuries according to zones assigned to the limb. The mode of injury in the two wheeler accidents and the differences in limb injuries between the driver and the pillion riding passenger were also studied.

Methods: All the road traffic accidents that could be attributed to two wheelers were obtained with the help of trauma records and the nominal registers and ward records. Limb injuries were then assigned to various anatomical zones that were created for the purpose of the study. The upper limb and lower limb injuries were separately analysed for differences between the driver and the pillion rider.

Results: There were 242 two wheeler accidents seen between 1st jan 2008 to 31st dec 2008, of these 110 had limb injuries. 96 cases were eventually included and of these 67 were drivers. The most common mode of injury was a skid and fall of the vehicle (42%). Pillion riders were injured more often in collisions between two and four wheelers. The commonest injury in drivers was in wrist and hand regions of the upper limb and the tibia and ankle regions of the lower limb. In the pillion rider, lower limb injuries were commonest in the tibia and ankle whereas in the upper limb shoulder and wrist injuries predominated.

Conclusion: Two wheeler accidents cause significant morbidity in both the driver and pillion rider, the tibia and ankle are commonly injured in both the populations whereas minor differences in upper limb injury are seen between the two groups.

Keywords: Road traffic accidents; epidemiology; pattern of injuries.

1. Introduction

The hospital where this study is based is located near a very busy highway (East coast road). In addition, the local city also favours the use of two wheelers extensively. Hence these vehicles are probably the most commonly involved vehicle in accidents occurring in this region. Reckless driving, overloading the two wheeler and even the use of intoxicants by drivers are all contributory factors.

The data already published from India and elsewhere focuses on the severity of injury and their relation to the use of helmets.¹ Very few have analyzed the possible patterns of limb injuries and fractures that may arise from a road traffic accident that involves the victim who is riding a two wheeler. A pertinent study from Jamaica analysed the extremity injuries in motorcyclists and commented that the lack of safety equipment like air bags and seat belts puts a motorcyclist at serious risk of injury.²

They found that the exposed extremity was commonly injured in this population, males dominated the study population. Majority of these patients required surgical intervention more than half of the lower limb injuries were relatively minor soft tissue injuries.

When patients of two wheeler accidents were analysed in Nigeria, they represented 18% of all accidents, 13.5% were struck by articulated vehicles. Others were struck by buses or sustained secondary injuries after a fall from the motorcycle. An overwhelming 68% of victims who were riding motorcycles or were pillion riders were knocked down by cars.³ The commonest musculoskeletal injury has been documented to be fracture of the tibia comprising almost 50% of cases.⁴

In a study from Western Maharashtra which analyzed the pattern of injuries in road traffic accidents the authors made a number of interesting observations.⁵ Majority of the victims were males and they were in the age group of 20-29. As much as ten percent of the victims were children. Of all the road traffic accidents 35% were caused by two wheelers. Of the pedestrians who were injured almost 32 percent were injured by two wheelers. Driving without a license was found to be prevalent amongst two wheeler riders. There were 190 fractures and the commonest site was the lower limb (46.3%), followed by upper limb (24.7%) and the skull. No positive correlation existed between category of road user and severity of injury. They did note that studies involving motorcycle accidents report that upper limbs are more commonly involved than lower limbs in road traffic incidents. In another relevant study from south India by Jha et al, it was found that majority (83%) of victims were male of which labourers constitute the highest number.⁶ Of the motorised vehicles involved two wheeler drivers were almost 31%. The authors noted that majority of victims were in the third decade of life. It was interesting to note that there were nearly ten percent victims aged below 10 years of age. 22% were pedestrians, 35 percent were drivers and another 45 percent were occupants of the vehicles. The largest group amongst the drivers was bicyclists followed by motorized two wheelers. Pillion riders of motorized two wheelers were the least involved amongst the occupants.

Limb injuries analysed in a prospective study of road traffic accidents in Calabar, 7 showed that almost 63 percent of road traffic accidents were caused by motorcycles. Lower limbs were more commonly injured.

The commonest injury was a fracture and more than half of these were open fractures. Almost half the patients sustained multiple limb injuries.

We found only one study from our region studying the epidemiology and pattern of two wheeler accidents.⁶ We did not find any study documenting in detail the pattern of injury and relations of injuries to rider positions. Such a study from this region would therefore have definite value in providing data and preventive protocols. Existing literature as reviewed above clearly shows that two wheeler accidents dominate road traffic accidents in the country.

We designed a study to identify the population of patients that were reported to our casualty ward with two wheeler accidents over a period of one year and to analyse the limb injuries due to fractures sustained by this group with the purpose of trying to identify definite patterns.

2. Materials and Methods

A retrospective study was designed with the objectives of analyzing the data on polytrauma available in the trauma and orthopaedic wings of the hospital. We aimed to analyse the pattern of limb injuries occurring due to two wheeler road traffic accidents presenting to our casualty and to document possible patterns with respect to position of rider and mechanism of injury.

A proforma was designed to document relevant data. The study design was a retrospective descriptive study involving all patients fulfilling the inclusion criteria who presented to the casualty from 1st January 2008 to 31st December 2008. The study was carried out from May 2009 to June 2009. We included two wheeler accidents with limb injuries including both rider and pillion riders, and involving motorised two wheelers like scooters and motorcycles. We excluded those victims of two wheeler accidents in which the victim has no limb injury. Any two wheeler accidents in which the victim was a third party and not the rider or pillion rider of the vehicle were excluded as were non motorised two wheeler accidents like bicycles.

Data was acquired from the medico-legal registers, nominal registers, and patient's medical records. Initially a list was prepared from the casualty register of the accidents in the period of one year denoted for selection of cases. From here, the case files were then requested from the medical records section, cases that were fulfilling the selection criteria were included in to the study. No consent form was necessary but due permission in written format was obtained from the administration for accessing medicolegal records and the protocol was passed through and permission obtained from the ethical committee and research committee in the institution to carry out the study. The data acquired was then entered into a pre prepared format. The upper limbs and lower limbs were classified into various zones to enable ease of analysis. These were created for the purpose of the study (Appendix 1). Data was then compiled in a datasheet using Microsoft Excel (version 2007).

The data so obtained was subjected to simple statistical analysis to determine the incidence of limb injuries in the study population, the distribution of upper and lower limb injuries, open injuries and catastrophic occurrences like severe life threatening injuries, amputations and death.

3. Results

Casualty records were analysed for the period 1st Jan 2008 to 31st Dec. 2008. 367 road accidents were observed during this period. Of these 242 involved two wheelers. One hundred ten cases had limb injuries associated with fractures in this group. Fourteen patients of this group had insufficient data available on record to justify addition to the data sheet. Ninety six cases were

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eventually included in to the study protocol. There were 67 drivers and the rest were pillion riders.

The mode of injury was most commonly skidding and fall of the two wheeler. Forty two of 96 patients had injury due to this mode (43.7%). The next more common mode of injury was a collision between a four wheeler and a two wheeler (30 cases, 31.25%). Other modes of injury seen were collision between two wheelers, a collision between a two wheeler and a stationary object and between a two wheeler and a three wheeler. The rider (driver) was more commonly injured in a skid and fall (33.95%) followed by a two wheeler to a two wheeler collision. The commonest mode of injury for a pillion rider was a collision between a two wheeler and a four wheeler (12 cases, 41.38 percent), closely followed by a skid and a fall injury (31%) (table 1).

Table 1: Mode of injury

Mode of injury	Driver	Pillion
Two wheeler to stationary object	2 (98%)	0 (0 %)
Two wheeler to two wheeler	12 (17.9%)	5 (17.24%)
Two wheeler to three wheeler	2 (2.98%)	3 (10.34%)
Two wheeler to four wheeler	18 (26.8%)	12 (41.38%)
Skid & fall	33(49.25%)	9 (31.03%)
Total	67	29

There were 19 open fractures in the drivers who were injured (28.35%) whilst the pillion riders had only 7 open fractures (24.41% of pillion rider group). However the incidence of both closed and open fractures is nearly the same in both groups (table 2).

Table 2: Incidence of Closed & Open fractures in the injured population

	Driver	Pillion
Open fracture	19 (28.35%)	7 (24.14%)
Closed fracture	43 (64.18%)	21 (72.41%)
Both open and closed fractures	5 (7.46%)	1(3.45%)
Total	67	29

When the zones of injury (Appendix2) were analysed it was observed that the commonest injury was in zone 3 of the upper limb (34.48%) and zone 4 of the lower limb (38.81%), which means that the commonest injuries were in the wrist and hand regions of the upper limb, and the tibia and ankle regions of the lower limb in the injured driver population. (Table 3& 4).

Table 3: Pattern of upper limb fractures in the injured population

	Driver	Pillion Rider
Zone I	12 (17.91%)	3 (10.34%)
Zone II	8 (11.94%)	1 (3.44%)
Zone III	10 (34.48%)	3 (10.34%)
Zone I & Zone II	2 (2.96%)	-
No upper limb injury	35	22 (75.86%)

Table 4: Pattern of lower limb fractures in the injured population

	Driver	Pillion rider
Zone I	1 (1.49%)	0 (0%)
Zone II	1 (1.49%)	6 (20.69%)
Zone III	5 (7.46%)	3 (10.34%)
Zone IV	26 (38.81%)	12 (41.38%)
Zone V	2 (2.98%)	2 (6.89%)
Zone I & Zone II	1 (1.49%)	
Zone II & Zone IV	1 (1.49%)	
Zone III & Zone IV	3 (4.48%)	
Zone IV & Zone V	2 (2.99%)	
No lower limb injury	25 (37.31%)	4 (13.79%)
Zone V		2 (6.89%)
Zone II, Zone III & Zone IV		1 (3.45%)
Zone I, Zone III & Zone IV		1 (3.45%)

In the pillion riders it was found that the commonest injuries were in zone 1 and zone 3 in the upper limb (10.34% each) and zone 4 in the lower limb (41.38%). Therefore, tibial and ankle injuries predominated in the lower limb, whereas shoulder and wrist injuries were quite common in the upper limb. However in either group, it was not possible to determine whether the dominant or non dominant upper limb was injured as this was rarely mentioned in the case records.

Drivers were noted to have suffered more severe limb injuries as seen from the combination of injuries suffered in the upper limb and lower limb (Table 3 & 4). As many as 7 suffered multiple zone injuries in the lower limb and two suffered multiple zone injuries in the upper limb in contrast to just 2 pillion riders who suffered multiple lower limb injuries.

In both groups, lower limb injuries were higher than upper limb injuries. However limitations in data collection and case sheets prevented us from actually determining the extent of severity in individual cases. Many of the case sheets were incomplete and further data on follow up of X-ray records was found to be missing.

4. Discussion

Motorised two wheelers are a major cause of accidents in the developing and the developed world. The incidence has been studied by many authors.⁵⁻⁷. Not

much detailed data is available from India besides the studies by Jha and Patil.^{5,6}

The analysis of the 97 cases that fit the study criteria of this study, showed that more drivers (67) than pillion riders (29) were injured. Upper limb injuries as well as lower limb injuries were also more numerous in the drivers, and so were open injuries. Combinations of multiple upper limb injuries, and multiple lower limb injuries were also more in the drivers than in the pillion rider group. The commonest injuries in the drivers were in the region of the wrist and the hand, and the tibia and ankle in the lower limb. In the pillion riders, tibial and ankle injuries were predominant in the lower limb, whereas in the upper limb, shoulder and wrist injuries were common.

The mode of injury was varied but the most common mode was a skid and fall. Other modes of injury were collisions with other two wheelers, with four wheelers, with stationary objects and with three wheelers. The study shows that the drivers of two wheelers are the more commonly and more seriously injured and have multiple injuries as compared to the pillion riders. The higher incidence of lower limb injuries, especially ankle and tibia, may be explained by two possibilities, the use of very basic footwear or no footwear by many people in these areas, and probably inadequate safety guards on the motorised two wheelers.

This study has its own limitations. The numbers of cases are rather few, which may be explained by the remote location and limitations of the institute where the study was conducted. It is possible that more cases can be included by increasing the duration of the study period. As short student research project, the number of parameters that could be included and studied was also limited as it is a study to be completed in a 2-3 month period. In that possibility this may be considered as a pilot study and we have proposed to continue the data collection beyond the periods of this study. As case sheets were often incomplete, data on serious infections and amputations was not obtainable, and admission data, although obtained in master sheet, was not suitable for analysis. Further details like helmet use, relations or multiplicity of admissions from a single accident could not be obtained from the case records itself. It is proposed that a detailed trauma profile be created in a computerised format for every case presenting to casualty to enable data analysis from trauma records in the future. This has already been implemented on a trial basis. Further, information on concomitant injuries, time to presentation from index injury, number of procedures undergone and many other factors need to be analysed to get a complete picture. Follow up studies must address these deficiencies in combination with a better trauma registry.

5. Conclusion

Two wheelers are a major cause of injury in road traffic accidents. The drivers of the two wheelers are most commonly injured rather than the pillion riders. Drivers of the two wheelers suffer more upper limb and lower limb injuries. Injuries in the region of the tibia and ankle are common in both groups of pillion riders and drivers of the two wheelers.

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Appendix 1

Upper limb:

Zone 1: Shoulder+ arm (clavicle + acromion joint + shoulder + humerus shaft); **Zone 2:** Elbow + forearm (lower end of humerus + forearm excluding wrist); **Zone 3:** Wrist + hand

Lower limb:

Zone 1: Pelvis; **Zone 2:** Hip + proximal femur + femur shaft (including acetabulum); **Zone 3:** Lower end of Femur and knee; **Zone 4:** Tibia and ankle; **Zone 5:** Foot.