

Riding Motorcycles: Is it a Lower Limb Hazard?

Fatimah Lateef

ABSTRACT

The morbidity and mortality among motorcyclists involved in road traffic accidents (RTA) in Singapore is high. Due to their relatively small size, they represent a vulnerable group of road-users. Many reports from studies performed overseas have shown that both lower limb and head injuries appear to be common among motorcyclists.

Objectives: To study the characteristics of lower limb injuries among motorcyclists involved in RTA, who present to the Department of Emergency Medicine of an urban, tertiary, teaching hospital for treatment.

Methods: The study was conducted prospectively from 1 July 2000 to 30 June 2001. Demographic data was collected together with details of the type of injuries, mechanism involved, management and disposition. SPSS (Chicago, Inc.) was utilised for data management and statistical analysis.

Results: Of the 1,809 motorcyclists studied, 1,056 (58.3%) sustained lower limb injuries, 328 (18.1%) had head injuries and 256 (14.2%), sustained facial injuries. The mean age was 26.4 ± 7.2 years and males made up the majority of the patients (1,733, 95.8%). Helmet usage was 100%. The commonest type of lower limb injury was fractures (531, 50.3%). The most common type of fracture was that of the shaft of the tibia and fibula (231, 43.5%), followed by fractures around the ankle (186, 35.0%). For those with more than one body region injured, head injury was noted to be not commonly associated with lower limb injuries.

The commonest mechanism of injury was collision with another vehicle, while approaching a turn (769, 42.5%). There were 96 motorcyclists (5.3%) who had clinical evidence of alcohol consumption on their breath at presentation. There were 533 (29.5%) patients who were admitted for in-patient management and the mean duration of stay was 4.8 ± 4.5 days. Amongst those with lower limb injuries, the admission rate was 30.5% (322 of 1,056) and the mean duration of hospitalisation was 5.3 ± 3.9 days.

Conclusion: Lower limb injuries represent the commonest form of injury among motorcyclists involved in RTA. Improved training via motorcycle rider education, better design of future motorcycles and protective footwear may help to reduce this problem.

Keywords: motorcyclist, lower limb injury, collision, fractures, head injury

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INTRODUCTION

Motorcyclists contribute a significant number to the mortality and morbidity statistics from road traffic accidents (RTA) in Singapore^(1,2). Over the years, there have been multiple road safety campaigns targeted towards this group of road-users. These include promotion of proper use of safety helmets, the “ride-bright” campaigns which encouraged motorcyclists to be adequately lighted up, especially at night and proper pillion riding⁽³⁾.

Motorcyclists represent a very vulnerable breed of road-users. Due to the relatively small size compared to other vehicles, they are often missed, not noticed, or fall in the blind spot of other drivers. The accidents are mostly speed-related or collision type of crashes. Relative to car crashes, motorcycle crashes have received relatively less attention by the research community despite the high mortality rates⁽⁴⁾.

It has been observed, from many different studies outside Singapore, that head and limb injuries are very common amongst motorcyclists. It has also been noted that the commonest cause of injury which results in hospitalisation among motorcyclists was lower limb injuries⁽⁴⁻⁸⁾.

OBJECTIVES

To study the patterns and characteristics of lower limb injuries in motorcyclists, involved in road accidents, who present to the Department of Emergency Medicine of an urban, tertiary-care, teaching hospital, for treatment.

Department of
Emergency
Medicine
Singapore General
Hospital
1 Hospital Drive
Outram Road
Singapore 169608

Fatimah Lateef,
MBBS (Singapore),
FRCS (A&E)(Edin)
Consultant

Correspondence to:
Dr Fatimah Lateef
Tel: (65) 6321 3558
Fax: (65) 6226 0294
Email: gaefal@
sgh.com.sg

MATERIALS AND METHODS

Data was collected prospectively for all motorcyclists involved in RTAs, who presented to the Department of Emergency Medicine (DEM), Singapore General Hospital, for treatment. The types of injuries were analyzed for a 12-month period, from 1 July 2000 to 30 June 2001. Those with lower limb injuries were then studied in detail to assess their characteristics. The patients with greater than one body region injured were also analysed. The different body regions included head, lower limb, upper limb, abdomen, chest, pelvis, spine and face.

Data management and statistical analysis was done using the SPSS (Chicago, Inc.) statistical program.

RESULTS

From 1 July 2000 to 30 June 2001, there was a total of 1,809 motorcyclists brought into the DEM after being involved in RTA. There were five mortality cases, all of which represented male patients. There were 1,104 (61.0%) Chinese, 470 (26.0%) Malay, 219 (12.1%) Indian and 16 (0.9%) other races, amongst the motorcyclists. The mean age was 26.4 ± 7.2 years, with a predominance of male patients (1,733 or 95.8%) in the cohort. Of the non-fatal cases (1,804 patients), lower limb injuries represented the predominant type of injury seen (1,056 patients or 58.3%) (Table I). The next three commonest body regions involved were; head injuries (328, 18.1%), facial injuries (256, 14.2%) and upper limb injuries (170, 9.4%) (Table I). All (1,809, 100%) the motorcyclists surveyed used safety helmets while riding.

Of the 1,056 cases with lower limb injuries, 531 (50.3%) represented fractures, 195 (18.4%) were sprains/ strains, 165 (15.6%) were contusion, 158 (15.0%) were laceration/abrasion and 8 (0.8%) had soft tissue crush injury. There were more cases of closed fractures (459) compared to open fractures (72). The commonest type of fracture seen was that of the shaft of the tibia and fibula (231, 43.5%) and this was followed by fractures around the ankle (186, 35.0%) and fractures of the feet (78, 14.7%) (Table II).

When looking at the number of cases of injuries by body regions (Table I), there were 1,919 injuries recorded in 1,804 patients. There were 46 patients who sustained injuries in other body regions, in addition to the lower limb. We analysed this group of patients separately and found that there were 31 patients with two body region injuries (BRI), 12 with 3 BRI and three with 4 BRI. We also looked at the combination of injuries sustained by those with greater than one BRI (Table III). It was noted that head injury was not commonly found in those

Table I. Types of Injuries by Body Region.

Types of Injuries by Body Region	Number of Injuries*	Percentage (%)
Lower Limb Injuries	1,056	58.3
Head Injuries	328	18.1
Facial Injuries	256	14.2
Upper Limb Injuries	171	9.4
Abdominal Injuries	49	2.7
Chest Injuries	49	2.7
Pelvic injuries	8	0.4
Spinal Injuries	2	0.1

*: Numbers include the injuries mentioned in Table III (combination of body region injuries), thus the total number of injuries is more than the total number of patients.

Table II. Types of Lower Limb Fractures.

	Number	Percentage (%)
Total Number of Fractures	531 (of 1 056)	50.3
a) Closed Fracture	459 (of 531)	86.4
b) Opened Fracture	72 (of 531)	13.6
Femoral Fracture	36 (of 531)	6.8
Tibio-fibular Fracture	231 (of 531)	43.5
Ankle Fracture	186 (of 531)	35.0
Fracture of the Feet	78 (of 531)	14.7

Table III. Combination of Body Region Injuries (BRI).

Number of Body Region	Combination of Injuries	Number of Patients
2 BRI	Lower Limb + Upper Limb	14
	Lower Limb + Abdomen	7
	Lower Limb + Chest	6
	Lower Limb + Pelvis	2
	Lower Limb + Head Injury	1
	Lower Limb + Spine	1
3 BRI	Lower Limb + Upper Limb + Abdomen	6
	Lower Limb + Abdomen + Chest	3
	Lower Limb + Abdomen + Pelvis	2
	Lower Limb + Upper Limb + Head Injury	1
4BRI	Lower Limb + Head Injury + Abdomen + Pelvis	2
	Lower Limb + Head Injury + Abdomen + Chest	1

with lower limb injuries. The combination of head and lower limb injuries was seen in one patient with 3 BRI and one, with 4 BRI.

The different mechanisms of injury were as follows; 1,161 (64.4%) were due to collision with another vehicle (of these, 769 were due to "approaching turn collision", 392 were due to "head-on" collision), 510 (28.2%) resulted from skidding and there were 138 cases (7.6%), where the mechanism was not clear or unknown. At presentation, 96 (5.3%) of

the motorcyclists had clinical evidence of alcohol consumption on their breath.

There were 533 (out of 1,804 patients or 29.5%) patients who were admitted for inpatient management and the mean duration of hospitalisation was 4.8 ± 4.5 days. Among those with lower limb injuries (1,056), 322 were admitted, giving an admission rate of 30.5% and the mean duration of hospitalisation was 5.3 ± 3.9 days.

DISCUSSION

Singapore is highly urbanised and well-developed in terms of infrastructure. It has an efficient transport system. It has a land area of 647.5 square kilometers, with a population of four million. One in three fatal road accidents in Singapore involves a motorcyclist. This is despite there being only one motorcycle for every four cars on the road today^(1,9). Most motorcycle accidents, according to the National Safety Council, are the result of poor riding habits and the riders not paying attention on the roads. Those involved in accidents are generally young as shown in this study and studies from other centres⁽⁹⁻¹¹⁾. The Malays had a slightly higher representation in this study, compared to their proportion in the population of Singapore (i.e. 26.0% versus 15.0%, which represents the proportion of Malays in Singapore)⁽¹²⁾. The three commonest sites of injury were the lower limb (58.3%), followed by head injuries (18.1%) and facial injuries (14.2%). This pattern is not peculiar to Singapore⁽¹³⁾. It has been noted in studies and surveys conducted in New Zealand^(4,14), Hong Kong⁽⁵⁾, the United Kingdom^(6,15), Malaysia⁽¹⁶⁾ and the United States of America⁽¹⁷⁾.

The possible reasons for lower limb injuries have been suggested to be multifactorial. These include lack of training and skills, lack of preventive strategies such as leg protection device and unsuitable or inadequate footwear of both motorcyclists and pillion riders^(5,10). As for the motorcycle itself, the poor assembly of the rear wheel has often been cited as a possible cause for lower limb injuries^(7,18-20). Fractures represented the commonest lower limb injury seen in this study. This was also the trend seen in studies performed elsewhere^(5,6,14).

Craig GR et al⁽⁶⁾, in a study on lower limb injuries in motorcyclists, found that in severe cases, the shin was described as the most vulnerable area. "Crash bars" were also found to be ineffective in reducing the incidence and severity of lower limb injuries. Other general factors that contributed to accidents include poor riding habits such as weaving in and out of traffic, not being adequately lighted up in the dark, not wearing light-coloured clothing at night, improper

helmet use (e.g. not strapping the helmet or wearing an incorrectly sized helmet) and lack of skills, especially among new riders⁽²¹⁻²⁴⁾. Helmet use was 100% among the riders as this is compulsory in Singapore. Helmet use for both motorcyclists and their pillion riders have been mandatory since 1971, with fines imposed on those not complying with the law. It is conjectured that motorcyclists who have helmets on while riding, may have a false sense of security and "feel safe enough" to ride as they please. It may thus be informative to study their attitude towards personal safety which may affect their riding practices. Wearing helmets may reduce the incidence of head injuries but does not protect against facial and other body region injuries.

Alcohol consumption was clinically evident on the breath of 5.3% of the motorcyclists at presentation. No blood alcohol level or breath analyser analysis was carried out. In Singapore, the penalty for driving with blood alcohol levels above the legal limit of 80 mg per dl is immediate disqualification from holding a driver's licence for a period of not less than 12 months and a fine of not less than S\$1,000 for a first time offender. Collision with other vehicles is the most common mechanism of injury. This highlights the fact that cooperation, awareness and concern for others as well as good driving/riding habits are essential among all road-users.

For those with multiple BRI, some interesting trends were noted; those with lower limb injuries rarely have associated head injuries. The exact reasons for this is not evident from this study, but possible explanations include, the difference in site of the anatomy of the lower limbs and the head, the mechanism of landing upon impact in the collision and protection provided by helmet usage.

From the observations made in this study, the following suggestions are proposed to help curb motorcycle accidents⁽²⁵⁾;

1. Persistent action by the authorities to regulate motorcyclists riding conduct.
2. The formation of special motorcycle lanes on our roads. This may help control the tendency of motorcyclists to weave in and out of traffic or between larger vehicles on the roads.
3. To make it compulsory for all motorcyclists to have their headlights on at all times during riding, so that they are more readily spotted and seen by other road-users.
4. To enforce the use of suitable footgear when riding.

CONCLUSIONS

Lower limb injuries represent the commonest form of injury among motorcyclists involved in RTA,

brought into the DEM at SGH. Head injury does not appear to be commonly seen in those with lower limb injuries. Perhaps, the compulsory use of helmets in Singapore and the emphasis on public education, has made motorcyclists more complacent about the risk of injuries to other body regions, such as the extremities. Improved training via motorcycle rider education, better design of future motorcycles and proper use of protective gear and footwear are suggested to help reduce this problem.

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