

Helmet shielding effect in mandibular fractures during road traffic accident

ABSTRACT

Objective: The objectives of this study are to evaluate the proportion of helmeted and nonhelmeted patients sustaining mandibular fractures.

Materials and Methods: A retrospective study was conducted on 200 patients reporting to oral and maxillofacial surgery (OMFS) unit, trauma center, and department of OMFS. A predesigned questionnaire was used to collect the necessary data. Patients were evaluated for age, gender, mode of transport (2/4 wheeler), presence of safety measure at the time of accident (helmet/seatbelt), maxillofacial injury in two wheeler (with helmet and without helmet), type of impact, and its association to maxillofacial fractures, particularly site of maxillofacial fractures. The association between mode of injury, presence of safety measures, impact type, and site of maxillofacial injuries was assessed using the Chi-square test. $P < 0.5$ was considered statistically significant.

Results: The mean age of patients was 30 years, and approximately 92.5% of accidents patients were male. In this study, 35% nonhelmeted riders were reported head injury and 5% of the helmeted rider reported head injury. 54.5% of the patients suffered frontal impact, 28% collision, and 17.5% lateral slide collision. Head injuries are the main cause of death among the riders of all two wheelers. Lateral sliding collision injuries (17.5%) resulted 60.6% of the fractures mandible, 24.2% midface injury, and associated injury (15.15%).

Conclusion: The use of helmet is strongly recommended to prevent head injuries and facial injuries. In the nonhelmeted riders in motorcycle accidents, the incidence of mandible fractures increases proportionally.

Keywords: Fracture mandible, helmeted riders, road traffic accidents

INTRODUCTION

Road traffic accidents have become a major public concern in India. The country recorded at least 467,044 accidents in 2018 leading to 151,417 deaths. The number suggests that at least 415 people died everyday in 1,280 road accidents, i.e., at least 17 deaths occurred in road accidents in 55 accidents every hour in the given time period. The National Highway traffic safety administration reports that per vehicle mile travelled, motorcyclists are 35 times more likely to die in a traffic crash than passenger car occupants.^[1]

The age profile of road accident victims for the calendar year 2018 reveals that the youth of age group of 18–25 years accounted for 21.6% (32,777 persons) and age group of 25–35 years accounted for a share of 26.4% (39,960 persons) and 35–45 years' age group accounted 21.6% (32,672 persons) in the total road accident fatalities.^[1,2]


Among road traffic accidents, two wheelers accounted for the highest share in a total number of road accidents (35.2%) in 2018, followed by cars, jeeps, and taxis (24.3%). 43,614 persons of two wheeler riders without using helmet were killed in road accidents during the calendar year 2018.

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Nonwearing of seat belts was also reported in 24,435 accident deaths during 2018. Among the main reasons, exceeding lawful speed accounted for a highest share of 66.5% in accidents and 64.2% of accident deaths. In India, Uttar Pradesh ranked 3rd in the list of road accident death with a percentage share of 9.1%.

Maxillofacial injuries occur in a significant proportion in road traffic accident patients. They can occur either in the isolation or in combination with other injuries. Many early and recent studies have confirmed motor vehicle collision to be the primary cause of maxillofacial trauma and are the most frequent cause of facial fractures.

Epidemiological studies help to evaluate the behavioral pattern of people affected with road traffic accident and can be used as a guide for further preventive measures by improving the quality of life of the involved subjects and decreasing the socioeconomic costs of motor vehicle collision injuries. The aim of this study is to evaluate the importance of helmets in preventing facial injuries in road traffic accident cases presenting at a tertiary center in North India.

MATERIALS AND METHODS

A 1-year cross-sectional study was conducted in the Department of Oral and Maxillofacial Surgery (OMFS) and Trauma Center of King George's Medical University, Lucknow.

A predesigned questionnaire was used to collect the necessary data. All the patients reporting to OMFS unit of the trauma center and department of OMFS were included in the study. Patients with severe head injury or patients not reporting to OMFS unit and trauma center were excluded from the study.

A detailed pro forma was prepared. Patients were evaluated for age, gender, mode of transport (2/4 wheeler), presence of safety measure at the time of accident (helmet/seatbelt) and maxillofacial injury in two wheeler with/without helmet, type of impact, and its association to maxillofacial fractures.

Patients were also evaluated for the time delay between the time of accident and patient reporting to trauma center. The presence of helmet or seatbelt worn at the time of accident was evaluated. The type of impact faced during accident was also evaluated whether the impact was frontal or lateral sliding or collision. Further the association of type of impact with site of maxillofacial injury was also evaluated. Fractures were classified on the basis of their anatomic site and involvement of the bone. Mandible fractures were further classified into symphysis, parasymphysis, and angle and condyle region.

Data were analyzed using the SPSS(Statistical Package for the Social Sciences), IBM 2009, New York, NY10022, USA. The association between mode of injury, presence of safety measures, impact type, and site of maxillofacial injuries was assessed using the Chi-square test. $P < 0.5$ was considered statistically significant.

RESULTS

There were a total of 200 road traffic accidents patients treated at OMFS unit, trauma center, KG Medical University from the year 2016–2017. Among the 182 two wheeler riders, 19 were helmeted and 163 were reported not to wear helmet.

Highly significant difference was found in the proportion of RTA according to age and gender ($P < 0.001$ for both) [Table 1 and Figure 1]. The mean age of patients was 30.2 ± 7.0 years, and majority 91.0% of accidents patients was male [Table 2 and Figure 2].

Actually, the number of accidents with age followed a Poisson distribution, having the following equation:

$$n = \frac{e^{-0.52} (0.52)^{\text{age}-25/10}}{([\text{age}-25]/10)!}$$

The above equation was matched with actual data with goodness of fit test, Chi-square = 4.47, $P = 0.107$.

The helmet nonusers were significantly more than the users in proportion (Chi-square = 113.9, $P < 0.001$) [Figure 3]. 49% patients were reported at trauma centre within 1-3 days of accidents [Figure 4].

All unhelmeted bike riders during road traffic accidents had fracture. Hence, a high risk of fracture was observed among unhelmeted cases (risk ratio [RR] = 4.75, $P = 0.0004$). Among the fracture in unhelmeted cases, mandible side was most frequent (55.21%), followed by the midface (43.56%) 4% frontal impact, 28% collision and 18% lateral slide resulted various combinations of facial fractures [Figure 5], while among with helmet cases only mandible fracture (21.05%) observed [Figure 6].

Among the fracture without helmet cases, angle and parasymphysis region was most frequent (36.81%), followed by the condyle and symphysis region (13.5%), while among with helmet cases, a single patient of angle and parasymphysis was observed. The risk of angle and parasymphysis region fracture among without helmet cases was significant in comparison to with helmet cases (RR = 6.99, $P = 0.047$) [Table 3].

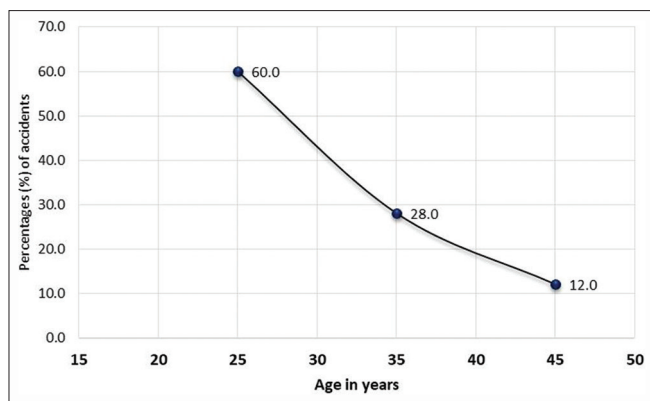


Figure 1: Age distribution of cases

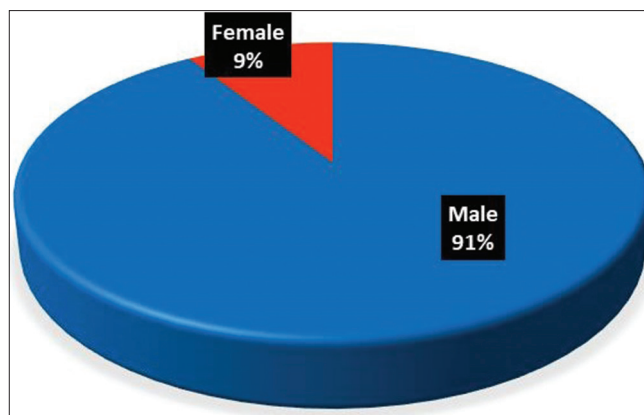


Figure 2: Sex distribution of cases

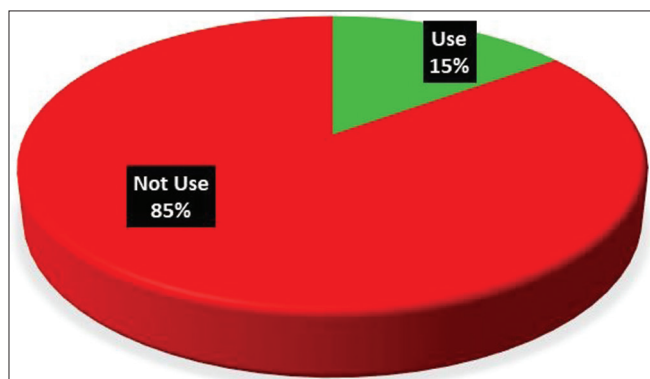


Figure 3: Distribution of cases according to helmet use

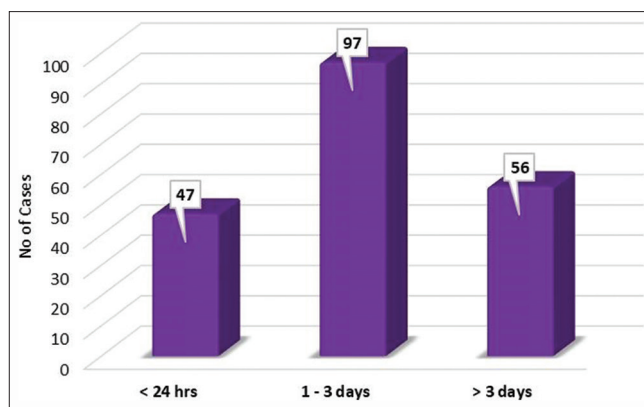


Figure 4: Time of reporting to the trauma center

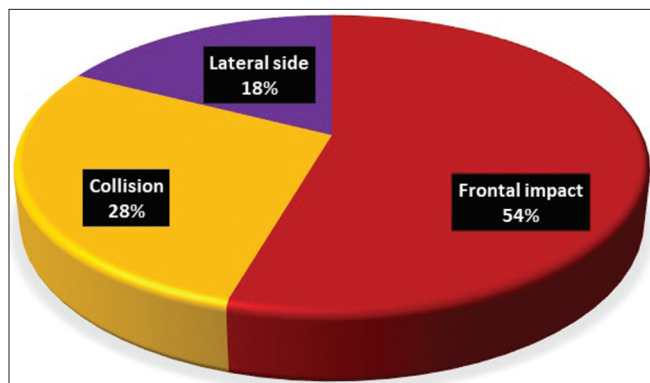


Figure 5: Distribution of the type of impact

Majority of the admitted patients in trauma center were suffered with head injury [Figure 7].

DISCUSSION

The aim of this study is to evaluate the importance of helmets in preventing facial injuries in road traffic accident cases presenting in one of the trauma center in North India. The result of this study shows that the incidence of mandibular fracture is significantly lower among helmeted riders involved in motorcycle accidents. The result also suggests that the frontal collision may result facial fractures in nonhelmeted motorcycle accidents.

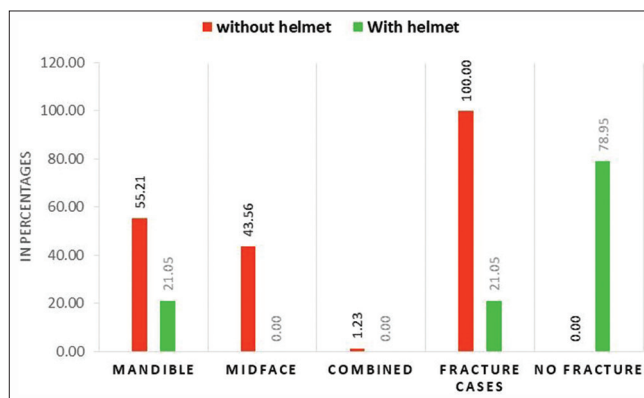


Figure 6: Association of fracture cases according to helmet use

In the present study, a total of 200 patients were enrolled. The maximum number of people was in the age group of 20–30 years (60%) followed by people in 30–40 (28%) years' age group. This correlated with other studies.^[2,3] Thus, the age group of 20–30 years was more vulnerable to injury.

In this study, the number of male patients were more than females, comprised only 7.5% in the study. The high incidence of male patients is attributed to the more usage of two wheelers by the males in comparison to the females. This observation

again coincides with other studies including Shekhar and Reddy,^[2] Pandey *et al.*,^[3] and Chaurasia and Katherya^[4] conducted in different parts of India. Another study by Subhashraj *et al.*^[5] also in confirmation with our findings and justified the male predominance due to their frequent participation in high-risk activities, as driving vehicles, sport and drug and alcohol habits, whereas females most often were confined to housework and drove vehicle less frequently and carefully and were less exposed to accidents, fights, and industrial works. Dibaie *et al.*^[6] observed that males were more prone to traffic accidents since they drove motor vehicles carelessly and most likely to be involved in interpersonal violence.

Road traffic accident was the major cause of injury. This has also been proved and supported by various previous studies.^[2] The burden of motor RTA in terms of mortality and morbidity is increasing rapidly due to rapid motorization associated with economic growth. Road traffic accidents in India are mainly due to mixed nature of road traffic on roads with pedestrians, bicycle, E-rickshaw scooters, car, trucks, and buses sharing the same road.^[7]

In our study, also observed similar observation that two wheelers riders were more involved in accidents (165) than four wheelers (35). Furthermore, the participants driving two

wheelers were mostly males (89.1%). Two wheelers were most commonly involved in RTA in our study. This may be explain on the basis that the two wheeler are the cheaper modes of transport and easy to move in congested lanes/street and youngster prefer due to its fast acceleration. Nowadays, two wheelers have replaced the bicycle in India due to its availability and cheaper maintenance. This is also in coincidence with other studies.^[2,8] Sung *et al.*^[9] reported that low- and middle-income countries often have a high prevalence of motorcycle use and the rate of helmet usage in these countries is low (31%–59%).

In this study, only 10% bike riders reported wearing helmet during accident, and none of the riders were female.^[10] The bike riders of 20–30 years' age group were found more prone to injury due to inadequate helmet usage than in 30–40 years' age group. The use of cheap nonstandardized helmets may be the reason for increased maxillofacial injuries in young adults. Another important factor, the vehicle speeds of young rider is found to be much higher than middle aged patients, which can be also correlated with the higher occurrences of injury. The helmeted riders causally wear unfastened or loosely fastened helmets to follow traffic rule and avoid penalty, so wearing a helmet improperly might not be effective to prevent facial injuries. In Northern India, helmets are considered a burden, due to hot weather condition and rider wrong presumption that helmet will cause hearing obstruction due to its design.

In this study, 35% nonhelmeted riders were reported head injury and 5% of the helmeted rider reported head injury. In

Table 1: Distribution of road traffic accident cases according to age and gender

Variable	Cases, n (%)	χ^2	P
Age (years)			
20-30	120 (60.0)	71.68	<0.001
30-40	56 (28.0)		
>40	24 (12.0)		
Mean age (year)		30.2±7.00	
Gender			
Male	182 (91.0)	134.5	<0.001
Female	18 (9.0)		
Helmet use			
Use	19 (10.4)	113.9	<0.001
Not use	163 (89.6)		
NA (car)	18 (9.0)		

NA: Not applicable

Table 2: Association of fracture cases according to helmet use

Fracture	Without helmet, n (%)	With helmet, n (%)	RR	95% CI for RR	P
Mandible	90 (55.21)	4 (21.05)	4.75	1.99-11.35	0.0004
Midface	71 (43.56)	0 (0.00)	NA	NA	0.0002
Combined	2 (1.23)	0 (0.00)	NA	NA	0.627
Fracture cases	163 (100.00)	4 (21.05)	4.75	1.99-11.35	0.0004
No fracture	0 (0.00)	15 (78.95)	Reference	-	-
Total cases	163 (100.00)	19 (100.00)	-	-	-

RR: Relative risk, CI: Confidence interval, NA: Not applicable

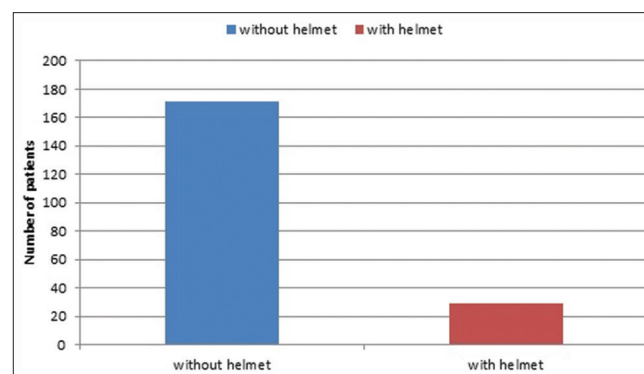


Figure 7: Status of head injury

Table 3: Distribution of cases according to the combination of fractures

Combination fracture	Without helmet (N=163)		With helmet (N=19)		RR (relative risk)	95% CI for RR	P-value
	No	%	No	%			
Angle+para	60	36.81	1	5.26	6.99	1.03-47.62	0.047
Condyle+symphysis	22	13.50	0	0.00	NA	NA	NA
Condyle+para	11	6.75	0	0.00	NA	NA	NA

helmeted group, it may be either open face helmet or loosely fastened helmet resulted head injury. Similar observations were reported by Yu *et al.*,^[11] who observed that people who did not wear helmets were four times more likely to sustain a head injury than helmeted and risk of head injuries associated with open-face helmets was twice that of full-face helmets.^[12] The current literature on the topic of the effect of helmet on facial injuries is equivocal. Liu *et al.*,^[13] Lima *et al.*,^[14] and Albuquerque *et al.*^[15] reported that wearing a helmet has decrease the risk of mortality and head injury in accidents. Hooten and Murad^[13,16] and Vaca^[17] have reported the well-established protective effect of motorcycle helmet regarding head injuries. Gopalkrishna *et al.*^[18] reported helmeted motorcyclists involved in crashes sustained 36.8% of facial injury compared to 53.8% of nonhelmeted riders. Among moped and motorcycle riders, head injuries account for about 75% of death in Europe and 55%–88% in Malaysia. Servadei *et al.*^[19] reported that helmets reduced fatal and serious injuries by 20%–45%, whereas the United States found that nonstandard helmets used by half of all motorcyclist produced more frequent head injuries than nonwearing a helmet at all. Vaughan *et al.*^[20] showed that the risk of injury to the face was reduced by a half or two-third. Brewer *et al.*^[21] reported a 73% reduction in the relative risk of sustaining facial fractures. Whitaker^[22] found that the rate of facial injury among helmet full-face helmet rider was lower than for nonhelmeted rider. Wu *et al.*^[12] and Ruslin *et al.*^[23] reported that the full-face helmet lowered the risk of facial injury by two-third and confirmed that a full-face helmet offers better protection against facial injury than other type helmet. In contradict to our observation, Cini *et al.*^[24] observed that the incidence of mandible fracture was 8% equal in both full-face helmeted group and open-face helmeted group.

In our study, 54.5% of the patients suffered frontal impact, 28% collision, 17.5% lateral slide collision during accident. In motor cycle accidents, frontal impact of force applied in anteroposterior direction, transmitted posteriorly to the condylar region. This study also observes a correlation between the type of impact and the facial bone fracture. The frontal impact (54.5%) resulted 85% of the fracture mandible, while 15% involve the midface and rest associated injuries. Lateral sliding collision injuries (17.5%) resulted 60.6% of the fractures mandible, 24.2% midface injury, and associated injury (15.15%). In collision, injures (28%) involve 58.3% of

the fractures mandible, 25% are midface fractures, and 16.6% are associated fractures. Similar study was also reported by Oginni *et al.*^[25] that most motorcycle crashes involved head-on collisions (58.5%) with a high mean FISS score than other forms of collision. Morris *et al.* and^[26] Lee^[27] also reported similar observation that a high-velocity blunt injury such as motorcycle collisions resulted condylar fractures, while the mandibular angle is the common fracture sited involved in a low-velocity blunt injury like assault or struck injury. Intracranial and traumatic brain injures were observed in 19% of trauma patients with mandibular fractures. Lin *et al.*^[28] reported 24.7% incidence of mandibular fracture followed by nasal fracture (22.8%) but less than molar and maxillary bone fractures. In their study, motorcycle accidents accounted for the major cause of mandibular fractures and the condylar neck fracture were followed by the parasymphysis, symphysis, angle and ramus, and body in Southern Taiwan. Ko-Chien *et al.*^[11] did not found any correlation of helmet-wearing status and the location of fracture mandible and Cavalcante *et al.*^[29] observed similar observation of significant association with the type of helmet with Le fort fractures. Usha *et al.*^[30] reported the incidence of facial fractures in helmeted 14% and nonhelmeted group were 53%, which highly significant and shows that helmet do give good protection against the fractures of facial skeleton. Fitzpatrick *et al.*^[31] also reported similar observation and suggested that helmet's anterior projection makes contact with the ground before the upper part of the face and also helps to reduce trauma to the midface.

Limitations

The present study had observed some limitations that few serious head injury trauma patients could not include in this study as those patients were directly transferred to the neurosurgery department. Some of the patients were reluctant to disclose information about vehicle speed and alcohol consumption. Information about impact type, helmet conservation, whether the helmet fastened correctly, or without tightening strips was not possible due to ignorance of the patients/their attendant.

CONCLUSION

Helmet use definitively reduces the incidence of mandibular fracture, while in unhelmeted rider, the incidence of mandible fractures increases proportionally.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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