Open Access

Original Article

Doi. 10.65433/mjms.v4i2.239

Severity of Maxillofacial Trauma in Motor Bike Riders Among Helmet Wearers vs. Non-Helmet Wearers

Wali Shah Rahmatzay[1], Muhammad Umar Farooq[2], Tanveer Ahmed Khan[3], Hira Ayaz[4], Juwayria Omar[5]

[1]*PGR- Oral and Maxillofacial Surgery, Pakistan Institution of Medical Sciences, Islamabad.*
[2]*HOD Professor of Oral and Maxillofacial Surgery, Pakistan Institution of Medical Sciences, Islamabad.*
[3]*MO/ADS- Consultant Oral and Maxillofacial Surgery, Pakistan Institution of Medical Sciences, Islamabad.*
[4]*MO/ADS- Consultant Oral and Maxillofacial Surgery, Pakistan Institution of Medical Sciences, Islamabad.*
[5]*Associate Professor, Community Medicine, Fazaia Medical College, Air University Islamabad*

Author`s Contribution

[1]Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work, [3,4,5]Drafting the work or revising it critically for important intellectual content, [2]Final approval of the version to be published

Conflict of interest: None
Funding source: None

Article received: 12-05-26
Article accepted: 10-06-26

Correspondence
**E: hira_k86@hotmail.com*

A B S T R A C T

Background: Maxillofacial trauma is a frequent consequence of motorcycle road traffic accidents and a major cause of morbidity. Helmet use reduces the risk and severity of craniofacial injuries; however, local evidence remains limited. So this study has been planned to assess the severity of maxillofacial trauma among helmeted and non-helmeted motorcycle riders.

Methodology: This comparative cross-sectional study was conducted at the Department of OMFS, PIMS Islamabad. A total of 260 patients with motorcycle-related maxillofacial trauma were enrolled, including 130 helmet wearers and 130 non-helmet wearers. Injury severity was assessed using the Glasgow Coma Scale (GCS) and Facial Injury Severity Scale (FISS). Data were analyzed using IBM SPSS version 28.

Results: The mean age was 26.65 ± 13.19 years in non-helmet wearers and 25.53 ± 8.71 years in helmet wearers. Helmet wearers had significantly better neurological status, with 99.2% having a normal GCS compared with 90.8% of non-helmet wearers ($p = 0.016$). The mean FISS score was significantly lower in helmet wearers (3.81 ± 3.23) than non-helmet wearers (5.72 ± 3.37, $p < 0.001$). Displaced fractures (79.2% vs. 54.6%) and surgical management (78.5% vs. 61.5%) were significantly more common among non-helmet wearers (both $p < 0.01$). More than 99% of patients recovered at discharge.

Conclusion: Helmet use was associated with significantly lower severity of maxillofacial trauma, fewer displaced fractures, and reduced need for surgical intervention, supporting stricter enforcement of helmet use.

Keywords: Maxillofacial trauma; Helmet use; Motorcycle accidents; Facial injury severity scale; Glasgow Coma Scale.

Introduction

Maxillofacial trauma can lead to life-threatening and complex injuries. It is considered as a major etiological factor for death of individuals below the age of forty years. [1] The head and face are the most exposed parts of the body resulting in an increased risk of hard and soft tissues injuries.[2] These injuries may vary from minor lacerations, contusions, abrasions, fracture of teeth to fractures of the major bones of the face. [3] The etiological factors of these injuries vary with the geographical location, with the primary cause in developed countries being assault while Road traffic accidents remain the major factor in developing countries.[4-5] In Pakistani population, road traffic accidents account for 39-54% of maxillofacial injuries. Men are more prone to trauma due to factors such as driving and contact sports. [6] Motorbikes are a general, economical and common means of transportation in poor and middle-income countries. Motorbike is regarded as the riskiest vehicle ever considering the balance concerns, design, size, weight, and instability, lack of safety equipment such as seatbelts and airbags, which adds to some high rate injuries. [7]

Multiple research studies conducted at various centers throughout the world have found a link between the uses or otherwise of helmets by motorbike riders and facial trauma. [8] In one such study conducted, the severity of maxillofacial trauma in non-helmet wearers was more than in helmet users, with a significant p-value. [9] The results of their study showed that mandible fractures were observed in helmet and non-helmet users as (22.0% vs. 46.1%, $p = 0.008$), zygomatic arch fractures as (4.9% vs. 48.0%, $p =$

0.0001), soft-tissue injuries as (46.3% vs. 73.5%, p = 0.002), and dentalveolar fractures as (16.7% vs. 31.7%, p = 0.046). In non-helmet users, the victims of maxillofacial trauma experience challenges such as psychosocial, functional, and aesthetic problems affecting their quality of life.[10] It has been reported that wearing helmet decreases both morbidity and mortality leading to improved outcome. The risk of death and craniofacial injury is reduced almost by 40% with the use of a standard good quality helmet. [11-13] Due to the increase in the incidence of road traffic accidents in our population; the need of the hour is to assess the safety measures at hand in order to counter the increased rate of mortality and disability. Our study will evaluate the severity of maxillofacial trauma in relation to the use or otherwise of helmets in patients reporting to the emergency room at our tertiary care hospital. Extensive data about the trauma pattern in helmet wearers and non-wearers is not available in our local population. This study will help put an emphasis on the legislation regarding the traffic laws and the use of helmet. The policies in relation to motorbike use needs to consider the burden on public health as well its implication on finances. Recommendations will be drafted for possible forwarding to the concerned departments for strict enforcement of traffic rules including mandatory use of helmets by motorbike riders and heavy fines on the ones who do not abide by the laws.

Methodology

This comparative cross-sectional study was conducted in the Department of Oral and Maxillofacial Surgery (Emergency), Pakistan Institute of Medical Sciences (PIMS), Islamabad, over a period of four months from February to May 2026 after obtaining approval from the Institutional Ethical Review Committee. All eligible patients presenting to the emergency department with maxillofacial trauma following motorcycle accidents were consecutively enrolled after obtaining written informed consent. A total sample of 260 patients was included, comprising 130 helmet wearers and 130 non-helmet wearers. The sample size was calculated using the WHO sample size calculator with a 5% level of significance, 90% power of the test, and an expected population proportion of 22% for helmet users. A non-probability consecutive sampling technique was employed.

Patients aged 18 years or older of either gender who sustained maxillofacial injuries while riding a motorcycle, irrespective of helmet use, were included in the study. Patients with isolated head injury without maxillofacial trauma, patients with pre-existing facial deformity and non-participants were excluded.

Demographic and clinical data was collected on a structured proforma prepared for the purpose of the study after enrolment. Detailed clinical examination and radiographic evaluation were carried out in all patients. Initial emergency management provided if necessary, prior to definitive assessment. Clinical evaluation was performed with appropriate radiological investigations, in particular for the diagnosis of facial skeletal lesions, advanced imaging techniques such as computed tomography (CT) scans were used when necessary. A motorcycle injury that involved the facial bones, jaws, soft tissues or teeth was defined as maxillofacial trauma. Helmet use was divided into two groups: helmet wearers (riders who wore a helmet during the crash) and non-helmet wearers (riders who were not wearing a helmet during the crash).

Two validated scoring systems were used to determine the severity of the injury. Glasgow Coma Scale (GCS) was used to assess conscious level at admission and graded as mild (GCS 13–15), moderate (GCS 9–12) or severe (GCS ≤8). The severity of the maxillofacial injuries was quantified by Facial Injury Severity Scale (FISS), which takes into consideration the type and distribution of facial fractures. Patients were treated following diagnosis, depending on the nature and severity of their injuries including soft tissue repair, bridle wiring, conservative, closed reduction or open reduction and internal fixation (ORIF).

IBM SPSS Statistics (version 28) was used to enter and analyze the data. Data for continuous variables, including age, was summarized as mean and standard deviation; categorical variables (gender, helmet use, fracture pattern, injury severity, management modality) were summarized as frequencies and percentages. Independent sample t-test and Chi-square test were used to compare quantitative and qualitative variables between both groups. A p-value of ≤0.05 was considered statistically significant.

Results

A total of 260 patients with maxillofacial trauma following motorcycle accidents were included in the study, comprising 130 helmet wearers and 130 non-helmet wearers. The demographic characteristics of the study participants are presented in Table I. The mean age was similar in both groups (26.65 ± 13.19 years in non-helmet wearers vs. 25.53 ± 8.71 years in helmet wearers). The majority of patients were male, accounting for 92.3% of the non-helmet group and 100% of the helmet group. Students represented the largest occupational category in both groups (57.7% and 59.2%, respectively), followed by individuals involved in self-business. Suspected drug or alcohol influence at the time of injury was reported in 17.7% of non-helmet wearers and 16.2% of helmet wearers.

The comparison of injury characteristics is shown in Table 2. The type of collision differed significantly between the two groups ($p < 0.001$). Motorcycle-to-motorcycle collisions were the most common mechanism of injury in both groups (46.9% vs. 40.0%), while collisions with four-wheelers were more frequent among helmet wearers (36.9%) than non-helmet wearers (12.3%). A significantly greater proportion of helmet wearers had a normal Glasgow Coma Scale (GCS) score of 15 (99.2%) compared with non-helmet wearers (90.8%, $p = 0.016$). Severe GCS scores were observed only among non-helmet wearers (5.4%). Similarly, the mean Facial Injury Severity Scale (FISS) score was significantly higher in non-helmet wearers than helmet wearers (5.72 ± 3.37 vs. 3.81 ± 3.23, $p < 0.001$), indicating greater injury severity among riders not wearing helmets.

Table I: Distribution of Demographic Characteristics of the Patients.

Variables	No Helmet Worn		Helmet Worn	
	N	%	N	%
Age of the patients				
Mean ± SD	26.65 ± 13.188		25.53 ± 8.714	
Gender of the patients				
Male	120	92.3	130	100.0
Female	10	7.7	0	0.0
Occupation				
Student	75	57.7	77	59.2
Self-Business	28	21.5	35	26.9
Private/Govt. Job	15	11.5	9	6.9
House wife/ Retire	12	9.2	8	6.2
Jobless	0	0.0	1	0.8
Drug/alcohol influence suspected				
Yes	23	17.7	21	16.2
No	107	82.3	109	83.8
Total	130	100.0	130	100.0

The comparison of radiological findings, treatment, and outcomes is presented in Table 3. CT scan was the most frequently used imaging modality in non-helmet wearers (83.1%) compared with helmet wearers (43.1%), whereas conventional radiographs were more commonly sufficient in the helmet group ($p < 0.001$). Displaced fractures were significantly more common among non-helmet wearers (79.2% vs. 54.6%), while the absence of significant fractures was observed more frequently in helmet wearers (35.4% vs. 12.3%) ($p < 0.001$). Surgical treatment was required in a significantly higher proportion of non-helmet wearers (78.5%) compared with helmet wearers (61.5%), while conservative management was more common among helmet wearers (38.5% vs. 21.5%, $p = 0.003$). Almost all patients recovered and were discharged successfully (99.2% of non-helmet wearers and 100% of helmet wearers), with only one death recorded in the non-helmet group. However, the difference in discharge outcomes between the groups was not statistically significant ($p = 0.316$).

Table 2: Comparison of Type of Collision, GCS and FISS between both Groups

Variables	No Helmet Worn		Helmet Worn		P-value
	N	%	N	%	
Type of Collision					
Single vehicle Accident	41	31.5	24	18.5	0.000
With another Motorbike	61	46.9	52	40.0	
Four-wheeler	16	12.3	48	36.9	
Pedestrian	12	9.2	6	4.6	
GCS					
Normal (15)	118	90.8	129	99.2	0.016
Mild (13)	4	3.1	1	0.8	
Moderate (10)	1	0.8	0	0.0	
Severe (8)	7	5.4	0	0.0	
Facial Injury Severity Scale (FISS) Scoring					
Mean ± SD	5.72 ± 3.372		3.81 ± 3.233		0.000

Table III: Comparison of Imaging Technique, CT Scan findings, Type of treatment and Outcome of discharge between both groups.

Variables	No Helmet Worn		Helmet Worn		P-value
	N	%	N	%	
Imaging					
AP View	14	10.8	53	40.8	0.000
AP View/OM View	8	6.2	21	16.2	
CT Scan	108	83.1	56	43.1	
CT Scan finding					
No Significant Fracture	16	12.3	46	35.4	0.000
Linear	11	8.5	13	10.0	
Displaced	103	79.2	71	54.6	
Type of Treatment					
Conservative	28	21.5	50	38.5	0.003
Surgical	102	78.5	80	61.5	
Outcome of Discharge					
Recovered	129	99.2	130	100.0	0.316
Death	1	0.8	0	0.0	
Total	130	100.0	130	100.0	

Discussion

The present study demonstrated that motorcycle riders who were not wearing helmets sustained significantly more severe maxillofacial trauma than helmet wearers. Non-helmeted riders had significantly higher Facial Injury Severity Scale (FISS) scores, poorer Glasgow Coma Scale (GCS) scores, a greater proportion of displaced facial fractures, and were more likely to require surgical management. These findings provide further evidence that helmet use

substantially reduces the severity of maxillofacial injuries following motorcycle crashes, consistent with the existing literature. [14,15]

The majority of patients in the present study were young males with a mean age of approximately 26 years, which is comparable to findings reported in previous epidemiological studies. Young men constitute the largest proportion of motorcycle users and are more frequently involved in high-speed travel, risky driving behaviors, and occupational commuting, placing them at greater risk of facial trauma. [16] Students represented the largest occupational group in our study, reflecting the widespread dependence on motorcycles as an economical means of transportation among young adults in Pakistan and other low- and middle-income countries.

Neurological and facial injuries were much less severe in helmeted riders compared to non-helmeted riders. Almost all riders wearing helmets had a normal GCS score, while only riders riding without helmets had a severe GCS score. Accordingly, helmet users had significantly lower mean FISS scores, signifying less facial injury severity. These findings agree with the systematic review and meta-analysis by Cavalcante et al., which concluded that helmet use significantly decreases both the occurrence and severity of facial fractures among motorcyclists. Similarly, recent studies have demonstrated that helmets are effective in absorbing and dissipating impact forces, which helps to decrease the transmission of energy to the craniofacial skeleton and brain. [15]

The radiological data in the present study also revealed a significantly higher percentage of fracture dislocations in non-helmet The radiological data in the present study also revealed a significantly higher percentage of fracture dislocations in non-helmet wearers, which resulted in more frequent CT scan procedures in the former group of riders than in the latter. Helmet users, on the other hand, were more likely to have no significant fracture patterns or less complex patterns. These results agree with previous studies that found the use of helmets is associated with lower rates of mandibular, zygomatic, and midfacial fractures and fewer advanced imaging tests or operative interventions.[17,18] wearers, which resulted in more frequent CT scan procedures in the former group of riders than in the latter. Helmet users, on the other hand, were more likely to have no significant fracture patterns or less complex patterns. These results agree with previous studies that found the use of helmets is associated with lower rates of mandibular, zygomatic, and midfacial fractures and fewer advanced imaging tests or operative interventions. [17,18]

The requirement for surgical treatment was significantly higher among non-helmet wearers in our study. The proportion of riders without helmets who required operative management was more than three-quarters of those with helmets (76.4% versus 66.1%). In recent trauma research, the same trends have been shown; that wearing helmets is correlated with fewer surgical procedures, shorter hospital stays, and lower healthcare expenses. [19,20]

Discharge outcomes were good in both groups, but injury severity was significantly lower for those who wore helmets. This observation underscores the need for the consistent use of helmets to reduce morbidity due to motorcyclist crashes. Helmets remain one of the most promising interventions to reduce motorcycle-related deaths and serious injuries according to the World Health Organization. Enforcement of helmet laws, educating the public and advocating the use of a certified standard helmet can significantly decrease the impact of maxillofacial trauma in Pakistan.

Conclusion

The present study showed that the severity of maxillofacial injuries varies greatly between helmeted and non-helmeted motorcycle riders. Riders wearing helmets had less severe facial injuries, had better Glasgow Coma Scale scores, lower Facial Injury Severity Scale scores, fewer displaced fractures, and required surgical management less frequently than non-helmet wearers. These findings highlight the protective role of helmets in reducing the severity of maxillofacial trauma and underscore the need for stricter enforcement of helmet laws and greater public awareness to improve road safety and reduce trauma-related morbidity.

References

1. Bynoe RP, Kerwin AJ, Parker HH, Nottingham JM, Bell RM, Yost MJ. Maxillofacial injuries and life-threatening hemorrhage: treatment with transcatheter arterial embolization. J Trauma. 2003;55(1):74-9. https://doi.org/10.1097/01.TA.0000026494.22774.A0
2. Singaram M, Vijayabala GS, Udhayakumar RK. Prevalence, pattern, etiology, and management of maxillofacial trauma in a developing country: a retrospective study. J Korean Assoc Oral Maxillofac Surg.2016;42(4):174-81. https://doi.org/10.5125/jkaoms.2016.42.4.174
3. Arifin MZ, Rajanikanth BR, Prasad K. Soft tissue injuries of the maxillofacial region occurring from

motorcycle accidents. J Maxillofac Oral Surg. 2019;18(3):432-9. https://doi.org/10.1007/s12663-018-1149-5
4. Exadaktylos AK, Eggensperger NM, Eggli S, Smolka K, Zimmermann H, Iizuka T. Sports-related maxillofacial injuries: the first maxillofacial trauma database in Switzerland. Br J Sports Med. 2004;38(6):750-3. https://doi.org/10.1136/bjsm.2003.008581
5. Hashim H, Iqbal S. Motorcycle accidents are the main cause of maxillofacial injuries in the Penang Mainland, Malaysia. Dent Traumatol. 2011;27(1):19-22.https://doi.org/10.1111/j.1600-9657.2010.00958.x
6. Nyameino S, Butt F, Guthua SW, Macigo F, Akama MK. Occurrence and pattern of maxillofacial injuries caused by motorcycle crashes presenting at two major referral hospitals in Nairobi, Kenya. Craniomaxillofac Trauma Reconstr Open. 2018;2(1):e1-e7. https://doi.org/10.1055/s-0038-1660434
7. Hasan O, Sheikh S, Fatima A, Abbas A, Zahid N, Baloch N. Motor vehicle crash patient injury patterns from a level I trauma center in a metropolitan city: a cross-sectional study. Cureus. 2019;11(2):e4073. https://doi.org/10.7759/cureus.4073
8. Komakech JO, Okullo I, Lakor F, Rwenyonyi CM. The role of helmet use on severity and pattern of maxillofacial injuries among motorcycle crash victims attending Mulago Hospital. J Dent Oral Implants.2017;1(4):15-24. https://doi.org/10.14302/issn.2473-1005.jdoi-16-1193
9. Lam C, Wiratama BS, Chang WH, Chen PL, Chiu WT, Saleh W, et al. Effect of motorcycle helmet types on head injuries: evidence from eight level I trauma centres in Taiwan. BMC Public Health. 2020;20:78. https://doi.org/10.1186/s12889-020-8191-1
10. Carvalho FSR, Feitosa VP, Fonseca SGC, Araújo TDV, Soares ECS, Fonteles CSR, et al. Physicochemical and rheological characterization of different Carnoy's solutions applied in oral and maxillofacial surgery. J Raman Spectrosc. 2017;48(10):1375-84. https://doi.org/10.1002/jrs.5227
11. Ruslin M, Wolff J, Yusuf HY, Arifin MZ, Boffano P, Forouzanfar T. The influence of helmet use on the prevention of maxillofacial fractures sustained during motorcycle accidents. Cogent Eng. 2018;5(1):1476031. https://doi.org/10.1080/23311916.2018.1551170
12. Carter PM, Buckley L, Flannagan CAC, Cicchino JB, Hemmila MR, Bowman PJ, et al. The impact of Michigan's partial repeal of the universal motorcycle helmet law on helmet use, fatalities, and head injuries. Am J Public Health. 2017;107(1):166-72. https://doi.org/10.2105/AJPH.2016.303525
13. Christian JM, Thomas RF, Scarbecz M. The incidence and pattern of maxillofacial injuries in helmeted versus non-helmeted motorcycle accident patients. J Oral Maxillofac Surg. 2014;72(12):2503-6. https://doi.org/10.1016/j.joms.2014.07.015
14. Cavalcante DKF, Veloso SRM, Durão MA, Melo VC, Monteiro GQM, Porto GG. Do helmet use and type influence facial trauma occurrence and severity in motorcyclists? A systematic review and meta-analysis. J Oral Maxillofac Surg. 2021;79(7):1492-506. https://doi.org/10.1016/j.joms.2021.02.028
15. Stassen HS, Atalik T, Haagsma JA, Wolvius EB, Verdonschot RJCG, Rozeboom AVJ. Effect of helmet use on maxillofacial injuries due to bicycle and scooter accidents: a systematic literature review and meta-analysis. Int J Oral Maxillofac Surg.2024;53(1):28-35. https://doi.org/10.1016/j.ijom.2023.01.013
16. World Health Organization. Global status report on road safety 2023. Geneva: World Health Organization; 2023.
17. Amponsah G, Gorleku PN. Bony injuries in trauma patients diagnosed by radiological examination. Ghana Med J. 2015;49(2):97-101. https://doi.org/10.4314/gmj.v49i2.6
18. Goh EZ, Beech N, Johnson NR. E-scooters and craniofacial trauma: a systematic review. Craniomaxillofac Trauma Reconstr. 2023;16(3):245-53. https://doi.org/10.1177/19433875221118790
19. World Health Organization. Global plan for the decade of action for road safety 2021–2030. Geneva: World Health Organization; 2021.
20. Pandey A, Chaturvedi TP, Sharma NK, Singh AK, Kumar JA, Mishra N. The immediate impact of mandatory helmet law on maxillo-facial trauma: a comparative study in a major trauma center, Uttar Pradesh. Natl J Maxillofac Surg. 2024;15(1):116-20. https://doi.org/10.4103/njms.njms_313_21
21. World Health Organization. Global status report on road safety 2023. Geneva: World Health Organization;2023.