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Impact of Different Helmet Types on Maxillofacial Injuries: A Review

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ABSTRACT

Injuries to the maxillofacial region arising from traumatic incidents, especially those impacting the head, pose a longstanding and significant public health issue. This comprehensive review explores the impact of different helmet types on maxillofacial injuries. Examining a range of studies, the review emphasizes the critical role of helmet design in influencing injury patterns. Full-face helmets emerge as superior in protecting against facial injuries, while uncertainties persist regarding their efficacy in preventing specific injuries such as jaw and tooth injuries. The association between helmet use and reduced maxillofacial fractures highlights the importance of stringent helmet legislation. Continuous research and innovation are essential to optimize helmet design, balancing protection and comfort for enhanced rider and sports person's safety.

Keywords: Full-face helmets, Helmet design, Jaw injuries, Maxillofacial injuries, Motorcycle accidents, Oral and Maxillofacial surgery

INTRODUCTION

Maxillofacial injuries resulting from traumatic incidents, particularly those involving the head, represent a persistent and substantial public health challenge.[1] The face, with its intricate anatomy and vital structures, is highly susceptible to trauma, often leading to both immediate and long-term consequences. Helmets have emerged as crucial protective gear, playing a pivotal role in mitigating the severity of head and facial injuries. While the overarching goal of helmets is to enhance overall safety, the specific impact of different helmet types on maxillofacial injuries has become a focal point of interest and investigation.[2] The global challenge of traffic accidents, causing significant human, economic, and social consequences, is highlighted by the World Health Organization's report of an unacceptably high annual death rate of approximately 1.35 million people. Motorcycles, particularly prevalent in lower-income countries, contribute significantly to fatal traffic accidents, with 65% usage in Asia compared to 16% in Europe and North America. Helmets play a crucial role in reducing head injuries, and there are three primary types: full-face, half-face, and open-face helmets. In Iran, which leads in traffic accidents, only 25% of motorcyclists use standard helmets. Not wearing helmets has severe consequences, with 87% of licensed individuals not using helmets, leading to dental and facial trauma.[3] Maxillofacial trauma resulting from motorcycle accidents in Iran has far- reaching effects, including physiological, aesthetic, and psychological problems. The associated healthcare costs are substantial, and patients with facial injuries may also suffer from traumatic brain injuries, airway closure, and nutritional problems. The choice of helmet type is influenced by user preferences for comfort and safety. Full-face helmets are gaining popularity due to their superior protection against facial injuries. However, the association between helmet use and jaw and tooth injuries remains uncertain, with no consensus on their effectiveness. As the use of helmets extends across various activities such as motorcycling, bicycling, sports, and industrial pursuits, the effectiveness of these helmets in preventing maxillofacial trauma remains a dynamic area of research.[4] Helmets provide a 63%-88% reduction in the risk of head, brain and severe brain injury for all ages of bicyclists. Helmets provide equal levels of protection for crashes involving motor vehicles (69%) and crashes from all other causes (68%). Injuries to the upper and mid facial areas are reduced 65%. Understanding the nuances of how different helmet designs influence the occurrence and severity of injuries to the maxillofacial region is imperative for the development of targeted injury prevention strategies.[5] This comprehensive review aims to explore and synthesize the existing body of literature surrounding the diverse types of helmets and their distinct roles in maxillofacial injury prevention.

TYPES OF HELMETS

Full-face helmets serve as comprehensive protective gear for motorcyclists, covering the entire head, face, and jaw. In the context of maxillofacial injuries, these helmets offer significant defense against fractures, lacerations, and dental trauma.[6] The robust coverage provided by the chin bar and face shield makes full-face helmets highly effective in preventing severe injuries to the maxillofacial region during motorcycle accidents. Open-face helmets, in contrast, leave the face exposed, rendering riders susceptible to a range of facial injuries. Open-face helmets, due to their design, expose the rider's chin and jaw, making them more vulnerable to maxillofacial injuries compared to full-face helmets. Maxillofacial trauma, including fractures, abrasions, and dental injuries, becomes a heightened risk due to the lack of full coverage. While open-face helmets protect the top and back of the head, they offer limited shielding for the face, making them less effective in preventing maxillofacial injuries compared to their full-face counterparts.[7] Bicycle helmets primarily focus on safeguarding the head against severe brain injuries in the event of accidents. However, they do not provide specific protection for the

face, jaw, or chin. In the context of maxillofacial injuries, bicycle riders are prone to fractures, lacerations, and dental trauma, especially during falls or collisions. The emphasis on head protection underscores the importance of combining bicycle helmets with additional face protection measures for a comprehensive safety approach. Sports helmets, designed for activities like football, hockey, and skiing, are tailored to protect the head during physical contact or high-speed impact. Maxillofacial injuries in these sports can include fractures, contusions, and dental trauma. While these helmets prioritize head protection, some designs incorporate faceguards or masks to mitigate the risk of maxillofacial injuries. The level of protection varies depending on the specific sport and the potential for facial impacts. Industrial helmets cater to the safety needs of workers in potentially hazardous environments.[8] These helmets protect the head from falling objects, impacts, or accidents that may occur in industrial settings. Workers may face the risk of maxillofacial injuries, including fractures, contusions, and dental trauma. Some industrial helmets come equipped with additional features such as face shields or guards to minimize the risk of maxillofacial injuries, ensuring a comprehensive approach to workplace safety. Modular helmets, also known as flip-up helmets, combine features of full-face and open-face helmets. They provide the option to flip up the chin guard and visor for an open-face feel while maintaining full-face protection when needed. Slightly heavier due to the hinge mechanism, they offer versatility at a higher cost. Modular helmets provide comprehensive protection similar to full-face helmets when the chin guard is engaged, reducing the risk of maxillofacial injuries. Half-shell helmets cover only the head, leaving the ear, neck, chin, and jaw exposed.[9] While lightweight and cost-effective, they compromise on safety by offering reduced coverage, making them less ideal for rider protection. Half-shell helmets expose a significant portion of the rider's face, increasing the risk of maxillofacial injuries compared to helmets with fuller coverage. Off-road helmets, designed for dirt biking, prioritize comfort and ventilation. They feature a one-piece construction with a sun peak and a long chin guard. Lack of visors is compensated by separate goggles for protection against dirt and wind. Offroad helmets, designed for lower speeds and off-road conditions, provide less comprehensive coverage for high-speed riding, potentially increasing the risk of maxillofacial injuries. Dualsport helmets combine features of off-road helmets with street-use adaptations for moderate speeds. They are suitable for soft off-road adventures and long-distance travel, featuring improved ventilation and a flip-up visor. Dual-sport helmets strike a balance, offering moderate coverage for off-road scenarios and improved protection for long-distance travel, potentially reducing the risk of maxillofacial injuries compared to purely off-road helmets.[10]

MECHANISMS OF MAXILLOFACIAL INJURY

The mechanisms of maxillofacial injury often involve the transmission of impact forces to the facial region during accidents or traumatic events. The intricate anatomy of the maxillofacial area makes it susceptible to various types of injuries, with the severity influenced by the magnitude and direction of the impact forces applied. The relationship between helmet types and injury patterns is a critical consideration in understanding maxillofacial trauma.[11] Studies indicate that various helmet designs provide differing levels of protection against specific injuries. For example, full-face helmets are associated with enhanced protection against facial injuries, while the efficacy in preventing jaw and tooth injuries remains a subject of investigation. Tailoring helmet choices to injury patterns is essential for optimizing protection in different scenarios. Biomechanical factors play a pivotal role in the occurrence and severity of maxillofacial trauma. Understanding the biomechanics involved in facial injuries is crucial for developing effective preventive measures. Biomechanical considerations encompass the study of forces, impact dynamics, and the response of facial structures to trauma. This knowledge aids in the design and evaluation of protective gear, such as helmets, to mitigate the biomechanical aspects contributing to maxillofacial injuries.[12] The efficacy of different helmet types in preventing maxillofacial injuries is a crucial aspect of rider safety. Various studies have explored the relationship between helmet design and the protection afforded to the facial region during accidents. Full-face helmets, characterized by their comprehensive coverage, have demonstrated superior efficacy in preventing facial injuries, including fractures and soft tissue damage. However, the effectiveness of helmets in specifically mitigating jaw and tooth injuries remains uncertain, warranting further investigation. The choice of helmet type emerges as a critical factor in influencing injury patterns, emphasizing the need for tailored monitoring and enforcement of helmet use to optimize maxillofacial injury prevention strategies. Overall, ongoing research seeks to enhance our understanding of how different helmet designs contribute to overall rider safety, particularly concerning the intricate and vulnerable maxillofacial region.[13]

HELMET DESIGN FEATURES

One key aspect of helmet design involves the selection of materials and their impact absorption capabilities.[6] The materials used play a critical role in determining the helmet's ability to absorb and dissipate forces during impacts. Innovations in material science aim to enhance helmets' overall protective qualities, providing improved safety for users. Facial protection components are integral to helmet design, especially in safeguarding the vulnerable maxillofacial region.[7] Chin guards, face shields, and visors contribute to facial protection, reducing the risk of injuries during accidents on the roads as in sports.. Advancements in these components focus on optimizing their structural integrity and functionality for enhanced safety. Helmet design features also address ventilation and comfort considerations to ensure user compliance with wearing helmets. Adequate ventilation prevents discomfort associated with heat accumulation, making helmets more tolerable for extended use. Striking a balance between protection and wearer comfort is a crucial aspect of modern helmet design. Continual technological innovations play a pivotal role in advancing helmet design. Integration of smart technologies, such as impact sensors, communication systems, and augmented reality visors, represents a cutting-edge trend. These innovations aim to elevate the overall safety and functionality of helmets, making them more effective in preventing injuries and enhancing the overall riding and sporting experience.[13]

REVIEW OF LITERATURE

The selection of helmet type is influenced by individual preferences for comfort and safety. Full-face helmets have gained popularity due to their superior protective capabilities compared to open-face helmets, offering heightened defense against facial injuries. While some studies have explored the relationship between helmet use and jaw/tooth injuries, a consensus on the efficacy of helmets in protecting motorcyclists from such injuries remains elusive, questioning the overall benefit of helmet use in this specific context. Thompson's comprehensive review, encompassing five case-control studies, affirms the effectiveness of bicycle helmets in reducing head, brain, and severe brain injuries by 63%-88% across all age groups.[14] The study demonstrates consistent protective benefits in crashes involving motor vehicles (69%) and other causes (68%), emphasizing the crucial role of helmets in mitigating bicycle-related injuries. An independent survey conducted by the Italian National Health Institute reported a significant rise in correct helmet use after the implementation of the law.

Motorcyclists represented 45% of road traffic accident victims, with helmeted riders constituting 31% of the 925 individuals studied. The study aimed to investigate the law's impact on maxillofacial injuries. Study by Colangeli revealed that full-face helmets were more effective in protecting against severe head and maxillofacial injuries compared to openface helmets. Before the law, helmet use was low, particularly in south and central Italy; however, compliance significantly increased post-law implementation, especially in the northern and central regions (90%–95%) compared to the south (50%–70%).[15] Novelli's study affirms that full-face helmets are unequivocally recognized as providing enhanced protection against facial trauma, a substantial risk factor contributing to the severity of head injuries.[16,17] The selection of helmet type significantly impacts the likelihood of requiring surgical intervention in the context of craniofacial trauma. Høye observed a 23% reduction in traumatic injuries with helmet use, although these reviews focused on general traumatic injuries rather than specifically on maxillofacial injuries.[18] H. S. Stassen's study highlighted the significant protective effect of helmets against the risk of maxillofacial injuries in cyclists, underscoring the imperative for stringent helmet use legislation.[19] In Ruslin's study, it was found that half- coverage helmets offered motorcyclists restricted protection for the head and facial regions.[20] Motorcyclists without helmets experienced similar injuries when compared to those using half- coverage helmets. A study by Aries revealed that motorcycle accident victims who used helmets experienced a lower incidence of facial fractures. The absence of a helmet and the use of open helmets were particularly associated with the prevalence of the zygomatic-orbital complex fracture. However, other types of facial fractures did not show a significant association with the use of open-face and/or articulated full-face helmets. The findings emphasize the impact of helmet usage on reducing facial trauma, suggesting the need for more stringent monitoring and enforcement of compulsory helmet use to mitigate these injuries.[21] Wu's study indicates that among motorcycle (MTW) users, full-face helmets offer superior facial protection compared to other helmet types.[22] However, there is no discernible evidence of differences in the level of protection provided to the skull or the brain. Hamzani's study demonstrated that the likelihood of head injury and the incidence of hard tissue and dentoalveolar injuries decrease with helmet use. Paradoxically, wearing a helmet was linked to an elevated occurrence of soft-tissue injuries.[23]

CONCLUSION

In conclusion, this comprehensive review sheds light on the multifaceted impact of different helmet types on maxillofacial injuries, offering valuable insights into rider as well as sports persons safety. Examining various studies, it becomes evident that helmet design significantly influences the incidence and severity of maxillofacial trauma. Full-face helmets emerge as more protective, particularly against facial injuries, while the efficacy in preventing specific injuries like jaw and tooth injuries remains a subject of ongoing research. The association between helmet use and the reduction in maxillofacial fractures underscores the importance of stringent helmet legislation and enforcement. As technology and materials evolve, continuous research and innovation are vital to optimize helmet design, ensuring a harmonious blend of protection, comfort, and adherence to enhance overall safety.

REFERENCES

1. Arif MZ, Rajanikanth BR, Prasad K. Soft tissue injuries of the maxillofacial region occurring from motorcycle accidents. J Maxillofac Oral Surg. 2019;18:432–9.
2. 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):2503–2506. doi: 10.1016/j.joms.2014.07.015.
3. Rice TM, Troszak L, Ouellet J V, Rice TM, Troszak L OJ V., Erhardt Taryn, Smith GS, et al. Motorcycle helmet use and the risk of head, neck, and fatal injury: Revisiting the Hurt Study. Physiol Behav. 2017;176(3):139–148. doi: 10.1016/j.aap.2016.03.002.
4. Cini MA, Prado BG, Hinnig PF, Fukushima WY, Adami F. Influence of type of helmet on facial trauma in motorcycle accidents. Br J Oral Maxillofac Surg. 2014;52(9):789– 792. doi: 10.1016/j.bjoms.2014.05.006.
5. Al Saffar MMA, Verdonschot RJCG, Stassen HS, Wolvius EB, Rozeboom AVJ. The Association of Helmet Use with the Occurrence of Maxillofacial Injuries Following Bicycle or Scooter Accidents: A Retrospective Cohort Study. Craniomaxillofac Trauma Reconstr. 2022 Mar;15(1):21-27. doi: 10.1177/1943387521998199. Epub 2021 Mar 3. PMID: 35265273; PMCID: PMC8899353.
6. https://www.acko.com/bike-guide/different-types-of-helmets/
7. . Boffano P, Roccia F, Gallesio C, Karagozoglu KH, Forouzanfar T. Bicycle-related maxillofacial injuries: a double-center study. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2013;116(3):275–280.

8. Olivier J, Creighton P. Bicycle injuries and helmet use: a systematic review and metaanalysis. *Int J Epidemiol*. 2017;46(1):278–292.

9. Marcelo Augusto Cini, Bárbara Grassi Prado, Patricia de Fragas Hinnig, Walter Yoshinori Fukushima, Fernando Adami,Influence of type of helmet on facial trauma in motorcycle accidents, British Journal of Oral and Maxillofacial Surgery,Volume 52, Issue 9,2014,Pages 789-792,

10. Hakim, D. I., Huwae, J. T. R. . and Hananto, E. . (2023) "Comprehensive Assessment of Full-face Helmet Utilization in Preventing Head and Neck Injury in Motorcycle Accidents : A Systematic Review", Journal of Asian Medical Students' Association. Kuala Lumpur, Malaysia, 10(1).

11. Mousavi-Shalmaei, S.M.A., Hosseinnia, M., Mohtasham-Amiri, Z. *et al.* Helmet Use and Jaw and Tooth Injuries in Motorcyclists Admitted to a Referral Hospital. *J. Maxillofac. Oral Surg.* **22**, 603–608 (2023).

12. Gopalakrishna G.,Peek-Asa C, Kraus J.F. Epidemiologic features of facial injuries amongst motorcyclists.Ann. Emerg. Med. 1998; 32: 425-430

13. https://www.nationalelfservice.net/dentistry/oral-and-maxillofacial- surgery/facialtrauma-motorcyclists-helmet/

14. Thompson DC, Rivara FP, Thompson R. Helmets for preventing head and facial injuries in bicyclists. Cochrane Database Syst Rev. 2000;1999(2):CD001855. doi: 10.1002/14651858.CD001855. PMID: 10796827; PMCID: PMC7025438.

15. Dupaix JP, Opanova MI, Elston MJ, Lee LSK. A comparison of skeletal injuries arising from moped and motorcycle collisions. Hawaii J Health Soc Welf. 2019;78(10):311–315.

16. Colangeli, Walter & Cordaro, Raffaella & Boschetti, Ciro & Apice, Carmine & Novembre, Daniela & Lo Faro, Carmelo & Cristofaro, Maria Giulia. (2021). Protective Effects of Helmet Type on Facial Injuries. Journal of Craniofacial Surgery. Publish Ahead of Print. 10.1097/SCS.0000000000007414.

17. Novelli, Giorgio; Moretti, Mattia1; De Ponti, Elena2; Bozzetti, Alberto; Sozzi, Davide; Canzi, Gabriele3. Analysis of Different Safety Devices in the Prevention of Motorcycle-Related Craniofacial Trauma - A Retrospective Study. Annals of Maxillofacial Surgery 11(2):p 293-297, Jul–Dec 2021. | DOI: 10.4103/ams.ams_203_21

18. Høye A. Bicycle helmets—to wear or not to wear? A meta-analyses of the effects of bicycle helmets on injuries. Accid Anal Prev 2018;117:85–97.

19. H. S. Stassen, 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: 28–35

20. Muhammad Ruslin, Jan Wolff, Harmas Yazid Yusuf, Muhammad Zafrullah Arifin, Paolo Boffano & Tymour Forouzanfar | Zhongmin Jin (Reviewing editor) (2018) The influence of helmet on the prevention of maxillofacial fractures sustained during

21. Aires CCG, Araújo HT, Souza RRL, Santos AJFD, Vasconcellos RJH, Vasconcelos BCDE. Relationship between the use and types of helmets with facial injuries - a prospective study. Rev Col Bras Cir. 2023 Jan 6;49:e20223387. doi: 10.1590/01006991e-20223387-en. PMID: 36629720; PMCID: PMC10578819.

22. Wu, D., Dufournet, M. & Martin, JL. Does a full-face helmet effectively protect against facial injuries?. Inj. Epidemiol. 6, 19 (2019).

23. Hamzani, Y., Bar Hai, D., Cohen, N. et al. The impact of helmet use on oral and maxillofacial injuries associated with electric-powered bikes or powered scooter: a retrospective cross-sectional study. Head Face Med 17, 36 (2021).