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Original Research

Neurological consequences of maxillofacial trauma: An in-depth exploration

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ABSTRACT:
Background: The primary objective of this study was to assess the occurrence of neurological symptoms linked to maxillofacial trauma. In the realm of emergency medicine, maxillofacial injuries are frequently encountered. Over half of the patients grappling with such injuries exhibit multisystem trauma, necessitating a collaborative approach between emergency physicians and various surgical specialists, including those in oral and maxillofacial surgery, otolaryngology, plastic surgery, ophthalmology, and trauma surgery. This study aims to discern the patterns of brain injuries linked to maxillofacial trauma and explore their subsequent outcomes. These symptoms include but are not limited to loss of consciousness, post-traumatic amnesia, and other indicators of closed-head injury. **Methods**: A retrospective analysis was performed on the medical records of 100 patients who experienced maxillofacial trauma. Information regarding the cause and location of the trauma, Glasgow Coma Scale scores, occurrences of loss of consciousness, post-traumatic amnesia, and additional symptoms indicative of closed-head injury were systematically gathered. **Results**: In the study, about 36% of participants noted a loss of consciousness. Anterograde amnesia was observed in 3% of cases, and retrograde amnesia was reported in 18% of instances. This study establishes a correlation between the type of maxillofacial fracture and the nature of traumatic brain injuries. Among patients with epidural hemorrhage, the majority (50%) exhibited mid-face fractures, with a smaller percentage associated with upper and lower face fractures (25% each). The predominant link between subdural hemorrhage and mid-face fractures was noted in 75% of cases. Likewise, the majority of patients with brain contusions (75%) and all cases of pneumocephalus were associated exclusively with mid-face fractures. **Conclusion**: Maxillofacial trauma often comes with neurological manifestations, highlighting the importance of exploring their occurrence in patients with such injuries. This investigation is crucial for initiating appropriate management and preventing potential complications. The findings of this study underscore the importance of swift diagnosis and early intervention. Rapid actions are crucial not only in averting morbidity but also in preventing mortality, particularly in the context of traumatic brain injury. The prevention of such injuries is especially critical since even brief periods of hypoxia and edema can result in enduring and significant neurological deficits.
Keywords: Hemorrhage, neurological manifestations, fracture.

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INTRODUCTION

Trauma poses a substantial threat to global public health, standing as one of the leading causes of morbidity and mortality worldwide. Trauma is defined as damage to human tissues and organs resulting from the transmission of energy through the environment. Such injuries are typically caused by forms of energy that surpass the body's inherent resilience and tolerance.[1] Globally, trauma represents a significant health concern, ranking as the fifth leading cause of substantial disability. Notably, it remains the primary cause of mortality in the initial four decades of life, contributing to approximately one in 10 deaths worldwide.[2] Given its vulnerable position, the maxillofacial region is particularly susceptible to injuries, making it a common presentation in

emergency rooms and a significant contributor to the global burden of trauma. Maxillofacial trauma can manifest either as an isolated injury or in conjunction with other injuries, notably those affecting the head. Head injuries, even of the milder types, carry a significant potential for mortality and neurological morbidity, often leading to persistent and, at times, progressive long-term debilitating effects. Despite the limited existing literature on the connection between maxillofacial trauma and concurrent head injuries, studies indicate a high incidence of traumatic brain injury accompanying maxillofacial trauma. This correlation is attributed to the impact of forces transmitted through the head and neck during traumatic events. Understanding and addressing this association are crucial for comprehensive patient care and mitigating the potential long-term consequences of such injuries. Maxillofacial trauma demands specialized attention due to the presence of crucial sensory systems in the face, including visual, auditory, somatic sensory, and olfactory functions.[3] Additionally, vital structures in the head and neck region, such as the airway, blood vessels, nerves, and gastrointestinal tracts, are closely interconnected. Moreover, maxillofacial trauma often inflicts a significant psychological impact on the patient. In developing countries, jaw fractures are most commonly attributed to road traffic accidents (RTA), whereas in developed nations, assault takes precedence as the primary cause, with RTA ranking second. This distinction in causative factors highlights the varying patterns and contexts of maxillofacial injuries globally. Traumatic brain injury (TBI) is characterized by harm to the brain caused by external mechanical forces, such as sudden acceleration and deceleration impacts or blast waves. In TBI, there is a temporary or permanent impairment of brain function, and structural damage may or may not be discernible using current technological methods. This definition emphasizes the diverse and often intricate nature of injuries to the brain resulting from external physical forces. This underscores the importance of developing strategies to manage and prevent traumatic brain injuries, particularly in regions where the risk is elevated and healthcare resources are limited. The spectrum of symptoms experienced by patients with traumatic brain injuries (TBIs) varies depending on the severity of the injury, which is commonly classified as mild, moderate, or severe. The Glasgow Coma Scale (GCS), a widely used system for categorizing TBI severity, evaluates a person's level of consciousness based on verbal, motor, and eye-opening reactions to stimuli, with scores ranging from 3 to 15. Consequently, some patients with mild brain injuries, who may have experienced a period of altered consciousness, go undiagnosed, particularly in developing countries where the Glasgow Coma Scale is heavily relied upon for assessing the severity of brain injuries.[4,5] This underscores the need for improved diagnostic approaches to capture milder forms of brain injury, ensuring more comprehensive care for affected individuals.[4] In response to the challenge of the Glasgow Coma Scale's insensitivity to diagnosing milder forms of brain injury, the duration of post-traumatic amnesia has been incorporated as a complementary measure. Healthcare providers now assess the patient's level of consciousness, post-traumatic amnesia (both retrograde and anterograde), and GCS score collectively to more accurately gauge the severity of their brain injury. The objective of this research is to ascertain the prevalence of neurological manifestations linked to maxillofacial trauma.[6,7] These manifestations include loss of consciousness, post-traumatic amnesia, and other symptoms indicative of closed-head injury. By considering a broader set of indicators, including the duration of post-traumatic amnesia, this study aims to provide a more comprehensive understanding of the neurological impact associated with maxillofacial trauma.

MATERIALS AND METHODS

This study employed a retrospective cross-sectional design and was conducted in the PG department of Oral and Maxillofacial surgery, Indira Gandhi Government Dental College and Hospital Jammu. The primary objective was to investigate the prevalence of loss of consciousness, post-traumatic amnesia, and other symptoms associated with closed-head injury among individuals seeking medical attention at the hospital due to maxillofacial fractures. The investigation involved an exhaustive examination of the entirety of patient records that satisfied the predefined inclusion and exclusion criteria over a span of one year. Consequently, all eligible cases meeting the specified criteria were incorporated into the study, resulting in a sample size of 100 patients. This meticulous approach aimed to ensure a comprehensive and representative analysis of the relevant data, thereby enhancing the validity and applicability of the study findings to the broader population of patients with maxillofacial fractures. In the execution of this research initiative, an in-depth exploration of pertinent patient records was undertaken, utilizing a meticulously designed data collection sheet. This comprehensive document served as the repository for a myriad of essential variables, capturing key aspects of each case. The recorded data encompassed the age and gender of patients, the precipitating causes and specific sites of injury, the Glasgow Coma Scale (GCS) scores providing insight into the level of consciousness, and details regarding any loss of consciousness—complete with its duration. Additionally, the presence of post-traumatic amnesia and its corresponding duration were meticulously documented, along with the identification of any other symptoms indicative of closed-head injury. In this investigation, a total of 100 patients were enrolled, revealing a notable gender

distribution within the study cohort. Among the participants, 90 individuals, constituting 90.7% of the total sample, were identified as males. In contrast, the remaining 10 patients, comprising 9.3% of the cohort, were females. This gender breakdown, illustrated in Figure 1, emphasizes the predominant representation of males in the study population, shedding light on potential gender-related patterns or disparities in the context of maxillofacial trauma and its associated neurological manifestations. Upon arrival at the emergency department, patients underwent a comprehensive clinical evaluation. The initial assessment followed the ABCDE protocol (airway and cervical spine control, breathing, circulation, dysfunction of the central nervous system, GCS, and exposure), including monitoring O2 saturation. Subsequently, a meticulous abdominal examination was conducted to identify the nature of abdominal trauma. The patient's overall condition was then categorized as stable or unstable, guiding the determination of necessary investigations and the plan of management. Neurological examination involved assessing motor and sensory functions, reflexes, pupil condition, and GCS assessment. The investigative phase included a primary survey, incorporating focused assessment with sonography for trauma, chest X-ray, pelvic X-ray, and cervical spine evaluation. Brain CT scans were conducted, revealing findings such as subdural hemorrhage, epidural hemorrhage, subarachnoid hemorrhage, and contusion. Additionally, a 3D skull CT was employed to further investigate cranial structures. This comprehensive approach ensured a thorough understanding of the patients' conditions, guiding subsequent interventions and treatment plans.

RESULTS

This cross-sectional descriptive study aimed to assess the patterns of brain injuries associated with maxillofacial fractures in a cohort of 100 polytrauma patients. The age range of the participants varied from 5 to 70 years, with the majority falling between 20 and 30 years (40%). The study included a higher percentage of male patients (60%) compared to female patients (40%). Motor car accidents were the primary mechanism of trauma (54%), followed by falls from height (30%) and assault (15%), with no instances attributed to sports-related trauma. Findings from the study indicated that a significant proportion of patients experienced persistent vomiting (50%). Convulsions were observed in 30% of the cases, while the remaining 70% did not exhibit seizure activity.[8] The majority of patients who experienced loss of consciousness regained it in less than 30 minutes (50%), with a minority remaining unconscious for over 24 hours (20%). Regarding post-traumatic amnesia, the majority of patients (40%) experienced it for less than one day, while a minority (20%) had post-traumatic amnesia lasting more than 7 days. These insights contribute to a better understanding of the diverse clinical manifestations associated with maxillofacial fractures and their neurological implications in polytrauma patients.

Table 1: Shows Gender distribution of Maxillofacial Trauma patients

Gender	Number
Male	60
Female	40

Figure1: Gender distribution

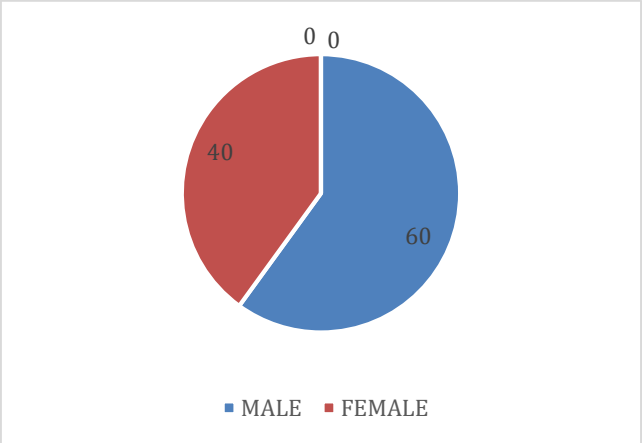


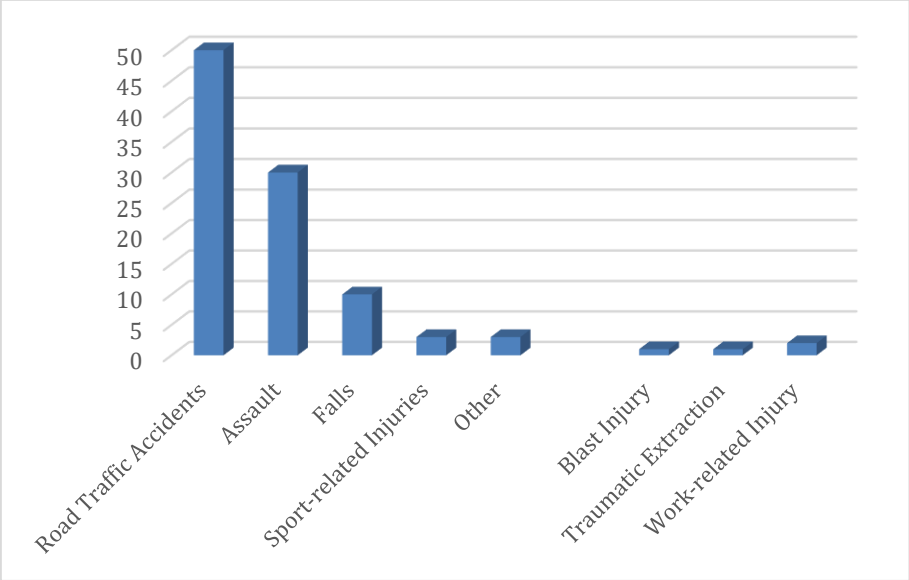
Table2: patient symptoms and outcomes

Symptom/Outcome	Percentage
Persistent Vomiting	50%
Convulsions	30%

No Seizure Activity	70%
Regained Consciousness <30 mins	50%
Unconscious for >24 hours	20%
Post-Traumatic Amnesia <1 day	40%
Post-Traumatic Amnesia >7 days	20%

This table summarizes the findings from the study regarding patient symptoms and outcomes. It indicates the percentage of patients experiencing persistent vomiting, convulsions, seizure activity, regaining consciousness time, duration of unconsciousness, and post-traumatic amnesia.

Figure 2: Shows Causes of Injury



Concerning the etiology of injuries, road traffic accidents (RTAs) emerged as the predominant cause, contributing to 50 instances. Following closely, assault was identified as the cause in 30 cases, while falls accounted for 10 injuries. Sport-related injuries were responsible for 3 incidents. Additionally, there were 3 injuries categorized under "Other," comprising 1 blast injury, 1 traumatic extraction, and 2 work-related injuries. This comprehensive breakdown of injury causes provides valuable insights into the diverse range of circumstances leading to maxillofacial trauma in the studied population.

Table3: Key aspets of traumatic brain injury

Aspect of TBI and Maxillofacial Fractures	Percentage
Vitally Stable	70%
Vitally Unstable	30%
No Need for Airway Stabilization	76%
Need for Airway Stabilization	24%
Spontaneous Breathing	83%
Abnormal Breathing	18%

In our study, the majority of patients with traumatic brain injury (TBI) associated with maxillofacial fractures exhibited vital stability (70%), whereas a minority presented as vitally unstable (30%). The need for airway stabilization was minimal for most patients, with 76% not requiring such intervention, while a minority (24%) did necessitate airway stabilization. The majority of patients displayed spontaneous breathing (83%), while a smaller percentage presented with abnormal breathing (18%). These findings highlight the varied clinical presentations and the relatively favorable vital status in a significant portion of individuals with TBI and maxillofacial fractures.

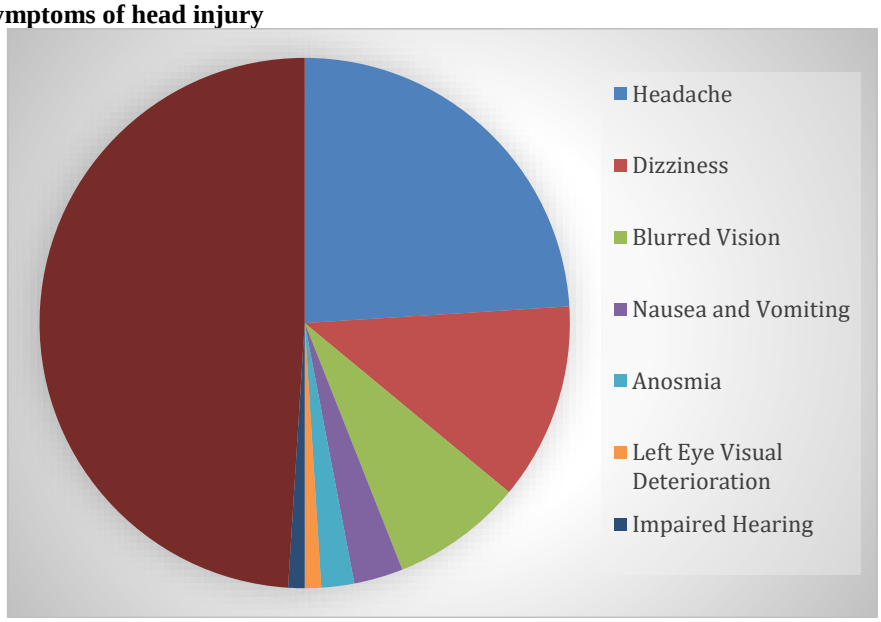
Table 4: GCS score

GCS score	No. of patients
GCS >13	30
GCS 9-12	49
GCS <8	21

Table 5: Shows other symptoms of head injury

Symptoms	Number of Patients
Headache	24
Dizziness	12
Blurred Vision	8
Nausea and Vomiting	3
Anosmia	2
Left Eye Visual Deterioration	1
Impaired Hearing	1
No Symptoms	49

Fig3: Other symptoms of head injury



Regarding additional symptoms associated with head injury among the 100 patients diagnosed with maxillofacial trauma, diverse manifestations were observed. Headache was reported by 24 patients, constituting 18.7% of the cohort. Dizziness followed, affecting 12 patients ,while blurred vision was noted in 8 patients .Nausea and vomiting, the least frequently encountered symptom, were reported by 3 patients .Beyond these common symptoms, specific cases presented unique challenges: 2 patients reported developing anosmia, and another patient reported left eye visual deterioration and impaired hearing. Interestingly, a significant portion of the cohort, comprising 49 patients ,did not experience any of these identified symptoms. This nuanced exploration of associated symptoms enriches our understanding of the diverse neurological manifestations accompanying maxillofacial trauma, highlighting the need for individualized approaches in patient care.

DISCUSSION

In the current study, a notable gender distribution was observed among patients with maxillofacial trauma, with 60% being males and only 40% females. The age range of the participants spanned from 2 to 70 years, with a calculated mean age of 33 years. These demographic characteristics align with findings from a study conducted by Sobin et al., where 88% of patients meeting the study criteria were males and 12% were females. The mean age reported in the study was 27.5 years. This parallelism in gender distribution and age trends between the two studies suggests consistent patterns across different cohorts, contributing to a broader understanding of the demographic aspects of maxillofacial trauma.[9] Maxillofacial injuries are frequently encountered in the field of emergency medicine, with over 50% of patients experiencing multisystem trauma. Effectively managing such cases requires coordination among emergency physicians and various surgical specialists, including those in oral and maxillofacial surgery, otolaryngology, plastic surgery, ophthalmology, and trauma surgery. Traumatic brain injury (TBI) is characterized by damage to the brain resulting from external mechanical forces such as rapid acceleration, deceleration impact, or blast waves. This injury leads to temporary or permanent impairment of brain function, and the associated structural damage may or may not be detectable with current technology. Notably, TBI was identified in 36% of maxillofacial cases, emphasizing the significant overlap and complexity in patients presenting with both

maxillofacial injuries and traumatic brain involvement. In this comprehensive investigation, the diverse landscape of causes and types of maxillofacial injuries was meticulously examined. Notably, the primary causes of these injuries showcased distinct patterns. Road traffic accidents (RTAs) emerged as the predominant contributor, responsible for 47% of the observed injuries. Assault followed closely, accounting for 29%, while falls and sport-related injuries each represented 16% and 4%, respectively.[10] The "Other" category, constituting 4% of injuries, featured specific instances such as a blast injury, traumatic extraction, and work-related injury. In contrast, a comparative analysis with the study conducted by Sobin et al. revealed substantial differences in the leading causes of maxillofacial injuries. Assault took precedence in Sobin et al.'s study, constituting a significant 75% of injuries, with sport-related injuries following at 13%, and RTAs at a comparatively lower 6%. Turning to the types of injuries, the study illuminated distinct patterns in the distribution of fractures. Fractures of the parasymphysis were notably prevalent, comprising 20.7% of cases, followed closely by fractures of the body of the mandible at 19.8% and the zygomatic complex at 18%. In contrast, fractures of the upper third of the face were less frequently encountered. This nuanced exploration sheds light on the specific anatomical regions most susceptible to injury in the context of maxillofacial trauma, offering valuable insights for both clinical management and preventive measures.[11] Above study presented a breakdown of Glasgow Coma Scale (GCS) scores among a group of patients, offering insights into their neurological status following traumatic brain injuries or other medical conditions. The data reveals that 30 patients have GCS scores greater than 13, indicating a relatively higher level of consciousness. Additionally, 49 patients fall within the GCS range of 9-12, reflecting a moderate level of consciousness. Notably, 21 patients have GCS scores below 8, suggesting a lower level of consciousness and potential severity in neurological impairment.[12] This distribution of GCS scores is instrumental for healthcare professionals in gauging the extent of neurological compromise and tailoring appropriate medical interventions based on the severity of each patient's condition. The table serves as a valuable tool in clinical assessment, providing a quick reference to the distribution of GCS scores within the studied population. The notable absence of recorded Glasgow Coma Scale (GCS) scores, limited to pre-operative assessments, introduces a potential bias in the reported distribution. This approach may not capture the full trajectory of patients' consciousness levels, as suggested by Michael J. Slater . Slater's assertion aligns with the dynamic nature of consciousness recovery, implying that patients might have initially presented with lower GCS scores but exhibited improvement by the time pre-operative evaluations occurred. This emphasizes the importance of considering the evolving nature of consciousness in the context of traumatic injuries.[13] Among the study participants, 38.7% reported experiencing a loss of consciousness. Within this subgroup, the duration of unconsciousness exhibited considerable variability. Specifically, 44.8% of individuals were unconscious for less than 30 minutes, 37.9% for a duration ranging from 30 minutes to 6 hours, and 17.2% were unconscious for over 6 hours. This diverse temporal profile underscores the complexity of traumatic experiences, emphasizing the need for individualized assessments and targeted interventions. Insights from Jennett, B., further elucidate the intricate relationship between consciousness and brain damage. While impairment of consciousness is recognized as an indicator of diffuse brain damage, Jennett highlights the possibility of marked local damage occurring without concurrent alterations in consciousness or amnesia.[14] This nuanced understanding adds layers to the interpretation of neurological symptoms associated with maxillofacial trauma. Examining the correlation between specific fractures and loss of consciousness, the study revealed that fractures of the body of the mandible and parasymphysis were most commonly associated with this symptom. Following closely were fractures of the zygomatic complex. This detailed analysis provides valuable anatomical insights into the regions of the maxillofacial skeleton most implicated in cases where loss of consciousness is reported. The interplay between fracture patterns and neurological manifestations contributes to a comprehensive understanding of the complex dynamics in maxillofacial trauma cases.

The investigation into additional symptoms associated with head injury among the study participants revealed a spectrum of experiences. Headache emerged as the most prevalent symptom, reported by 18.7% of patients. Following closely, dizziness was noted in 14.7% of individuals, while blurred vision was reported by 8%. Nausea and vomiting, the least commonly encountered symptom, were reported by only 2.7% of patients.

The study provides valuable insights into the correlation between the type of maxillofacial trauma, the mechanism of injury, and their respective frequencies.[15] Notably, the findings reveal that a significant proportion of upper maxillofacial fractures (39%) and mid-face fractures (50%) were attributed to road traffic accidents. This suggests a compelling association between these types of fractures and vehicular incidents. Intriguingly, lower maxillofacial fractures exhibited a different pattern, with 20% of cases resulting from assault. This observed difference in the mechanism of injury for lower maxillofacial fractures, compared to upper and mid-face fractures, was deemed statistically significant. These outcomes align with a study conducted by Mabrouk et al., providing additional support for the association between the site of maxillofacial fractures and the

cause of injury.[16] In the referenced study, it was found that 50% of mandibular fractures were more likely to occur in instances of violence, highlighting a strong correlation between the location of the fracture and the nature of the trauma. Conversely, upper face fractures showed a mere 4% likelihood of occurring due to violence, whereas mid-face fractures demonstrated a higher association, with 52% of cases linked to motor car accidents.

Together, these findings not only corroborate the significance of understanding the interplay between the type of maxillofacial trauma and the mechanism of injury but also emphasize the nuanced patterns that may exist among different facial regions.[17] Such insights are pivotal for informing preventive measures, enhancing trauma management strategies, and ultimately contributing to a more comprehensive understanding of maxillofacial injuries in diverse clinical contexts. Intriguingly, specific cases presented unique challenges: one patient reported developing anosmia, a loss of the sense of smell, while another reported left eye visual deterioration and impaired hearing. These distinctive manifestations underscore the diverse and multifaceted nature of neurological consequences associated with maxillofacial trauma. It is noteworthy that a significant proportion of the study population, comprising 56% of patients, did not experience any of the identified symptoms.[18] This finding highlights the heterogeneity of responses to maxillofacial trauma, with a substantial portion of individuals exhibiting no overt neurological symptoms. This underscores the importance of individualized assessment and tailored care strategies, considering the variability in symptomatology among patients with similar traumatic experiences.

CONCLUSION

The study's findings shed light on a noteworthy connection between maxillofacial trauma and neurological manifestations, particularly emphasizing the potential oversight of head injuries within this context. The data suggests that a considerable number of these injuries, especially those associated with head trauma, may be overlooked during initial assessments. This underscores the critical importance of systematically exploring the presence of head injuries in patients with maxillofacial trauma. A meticulous and thorough evaluation is not only essential for accurate diagnosis but also for initiating timely and appropriate management strategies. The apparent underdiagnosis of head injuries in the realm of maxillofacial trauma underscores the need for increased clinical vigilance and a more nuanced approach to patient assessment. The intricate interplay between maxillofacial injuries and potential neurological consequences necessitates a comprehensive evaluation to mitigate the risk of further complications. Detecting and addressing head injuries early in the course of maxillofacial trauma management is imperative, not only for immediate patient outcomes but also for preventing potential long-term sequelae associated with undiagnosed or inadequately managed neurological manifestations. In conclusion, the study advocates for a heightened awareness within clinical settings regarding the potential co-occurrence of head injuries in individuals presenting with maxillofacial trauma. This awareness, coupled with a thorough evaluation, is crucial for optimizing patient care, ensuring accurate diagnoses, and implementing timely interventions to address both the immediate and long-term implications of maxillofacial injuries with associated neurological manifestations.

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