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CASE REPORT

MULTIREGIONAL CRANIOFACIAL TRAUMA INVOLVING SKULL BASE AND ORBITAL STRUCTURES: A CASE REPORT IN HEAD AND NECK SURGERY

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Background: Craniofacial trauma is a major global health concern, most commonly resulting from high-energy impacts such as road traffic accidents. These injuries often involve complex maxillofacial and cranial fractures, leading to functional, neurological, and aesthetic challenges.
Objectives: To present a complex case of panfacial trauma with intracranial and ocular involvement, highlighting the staged surgical approach and importance of multidisciplinary management.
Results:A 26-year-old male sustained severe craniofacial injuries following a motorcycle accident. Imaging revealed multiple fractures including Le Fort II maxillary fracture, bilateral orbital rim and blow-out fractures, zygomatic tripod fracture, mandibular symphysis fracture, comminuted frontal sinus fractures, and anterior cranial base fracture, along with intracerebral hemorrhage, brain edema, and vitreous hemorrhage. Initial stabilization was achieved with interdental wiring and mandibular arch bar fixation. Definitive management included craniotomy with frontal sinus reconstruction, orbital exploration with scleral repair and hyphema evacuation, and orthopedic procedures for associated toe dislocations. The staged "bottom-to-top and outside-in" approach facilitated restoration of occlusion prior to cranial and orbital reconstruction.
Conclusion: This case illustrates the complexity of managing multiregional craniofacial trauma involving the skull base and orbit. Optimal outcomes depend on early imaging, a staged surgical strategy, and close multidisciplinary collaboration between maxillofacial, neurosurgical, ophthalmologic, and orthopedic teams.

Keywords: craniofacial trauma; skull base fractures; orbital injuries; multidisciplinary management

INTRODUCTION

Maxillofacial trauma refers to injuries involving the bones and soft tissues of the face, including the mandible, maxilla, zygomatic complex, nasal bones, orbital structures, and skull base. Such trauma may result from a variety of high-energy impacts, most commonly road traffic accidents, followed by interpersonal violence, sports-related injuries, and accidental falls. These injuries are particularly concerning because they affect both aesthetics and function, including mastication, vision, breathing, and speech. Depending on the severity and distribution, maxillofacial trauma can present as isolated fractures, combined midfacial injuries, or panfacial trauma, which involves multiple anatomical regions simultaneously. Panfacial and multiregional fractures are among the most challenging conditions faced in craniofacial surgery, as they often require immediate stabilization of vital functions while also demanding complex reconstructive procedures to restore facial symmetry and functionality. Globally, maxillofacial trauma constitutes a major public health problem. The World Health Organization (2023) reports that road traffic injuries are responsible for nearly 1.3 million deaths annually, and among survivors, facial and cranial injuries are frequently observed. The burden is particularly high in low- and middle-income countries, where the rapid increase in motorization, insufficient road safety measures, and limited access to trauma care facilities contribute to higher morbidity and mortality.

Young adult males between the ages of 20 and 40 years remain the most affected demographic group, often due to occupational hazards and higher exposure to traffic-related risks[1].

Epidemiological studies estimate that 10–15% of trauma admissions involve complex craniofacial fractures, with common patterns including Le Fort fractures, tripod zygomatic fractures, orbital blow-out injuries, and skull base involvement [2]. These injuries are not only life-threatening but may also be associated with long-term disability, including impaired vision, malocclusion, chronic pain, and psychosocial consequences due to facial disfigurement. A recent narrative review highlighted that the global burden of maxillofacial trauma continues to rise, with substantial socioeconomic implications, as affected patients are often in their most productive years of life [3]. From a clinical perspective, the initial priorities in managing maxillofacial trauma include ensuring airway patency, controlling hemorrhage, and stabilizing vital signs. Once life-threatening conditions are addressed, attention is directed to restoring occlusion, orbital integrity, and craniofacial symmetry. Modern management strategies emphasize a multidisciplinary approach, involving maxillofacial surgeons, neurosurgeons, ophthalmologists, and orthopedic specialists, depending on the extent of injury. Reconstruction typically follows a staged protocol, beginning with mandibular-maxillary stabilization to re-establish occlusion, followed by repair of zygomatic and frontal bones to restore projection and symmetry. In recent years, advances in three-dimensional imaging, virtual surgical planning, and patient-specific implants have significantly improved surgical outcomes and reduced complication rates [4]. Despite these advances, complex craniofacial trauma remains a formidable surgical challenge. Early recognition, prompt surgical intervention, and coordinated multidisciplinary care are critical to achieving favorable outcomes. Delayed or inadequate management may result in severe functional impairments, cosmetic deformities, and reduced quality of life. Thus, documenting and analyzing individual cases of complex craniofacial trauma is essential to enhance clinical knowledge, refine management strategies, and improve future patient care. This report presents a rare and complex case of multiregional craniofacial trauma involving the skull base and orbital structures in a young male following blunt force injury. The case emphasizes the need for timely diagnosis, staged reconstruction, and multidisciplinary collaboration to optimize both functional and aesthetic recovery[2].

CASE REPORT

A 26-year-old male, Mr. X, was brought to Dr. Soetomo General Hospital after sustaining severe injuries from a motorcycle accident in which he collided with a stationary truck. Although the patient was wearing a helmet, he experienced a brief loss of consciousness at the scene and was referred from a secondary hospital for further management. On arrival, his vital signs were stable: blood pressure 136/84 mmHg, heart rate 96 bpm, respiratory rate 22 breaths/min, temperature 36.7 °C, and oxygen saturation 98%. The patient was conscious but appeared weak and in distress. Physical examination revealed extensive craniofacial trauma. There was an open wound on the frontal region with bloody rhinorrhea, periorbital hematoma, edema, and nasal deviation. Palpation showed step-off deformities along the infraorbital rim and frontonasal junction, with crepitus over the nasal, maxillary, and mandibular bones, as well as mobility of the maxilla. Ophthalmologic findings included limited ocular assessment due to agitation, periorbital swelling, and scleral laceration of the right eye. Examination of the extremities revealed open dislocations of the second and third toes of the left foot. (figure 1).

Figure 1. Radiographic and Clinical Images of Multiregional Craniofacial Trauma with Associated Foot Injury

Radiological work-up included plain X-rays, cervical and pelvic imaging, and computed tomography (CT). CT scan of the head demonstrated multiple complex fractures involving the glabella, frontal bone, nasal bone, bilateral zygomatic processes, left zygomatic arch, and septum nasi (figure 2).

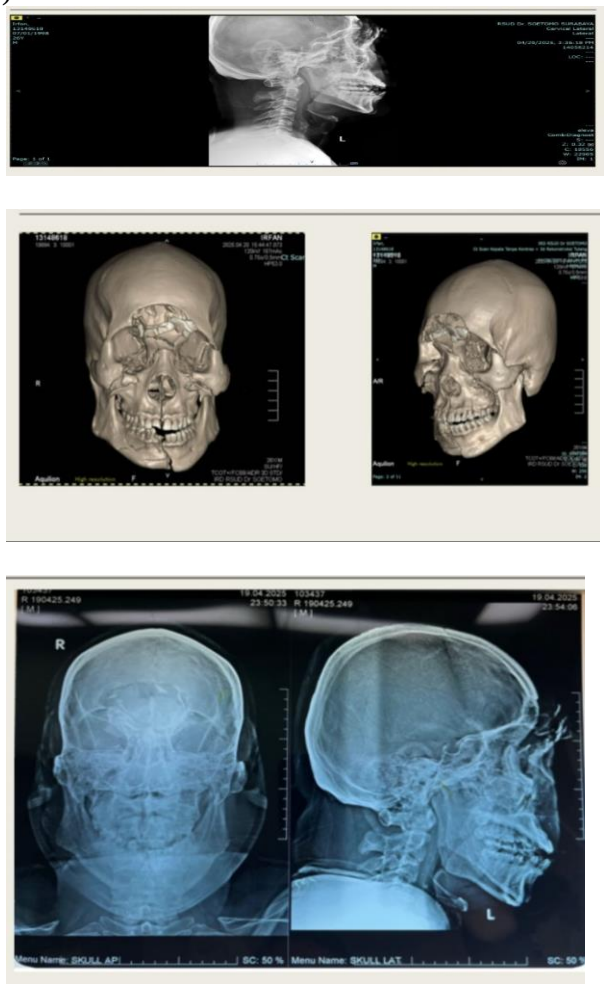

Figure 2. Radiographic and Three-Dimensional CT Imaging of Multiregional Craniofacial Fractures

Additional fractures were noted in the ethmoid air cells, maxillary sinus walls, alveolar processes of the maxilla and mandible, and anterior cranial base. Bilateral orbital blow-out fractures were accompanied by tortuosity of the right optic nerve and vitreous hemorrhage. Intracerebral hemorrhage was detected in the right frontal cortical-subcortical region with diffuse cerebral edema, along with pneumocephalus and panhematosinus.

Given the extent of injuries, a multidisciplinary surgical approach was undertaken. Initial management consisted of stabilization with maxillary dentoalveolar wiring and mandibular arch bar fixation to restore occlusion. On postoperative day seven, definitive surgical interventions were performed, including craniotomy with obliteration and reconstruction of the frontal sinus, orbital exploration with scleral repair and hyphema evacuation, and debridement of contaminated wounds. Orthopedic surgery included open reduction and intramedullary pinning of the dislocated phalanges of the left second and third toes with joint fixation. Postoperative care involved close neurological and ophthalmologic monitoring, pain control, and infection prophylaxis (figure3).

Figure 3 Preoperative dan postoperative

Follow-up evaluation showed stable hemodynamics and satisfactory wound healing. Imaging confirmed appropriate realignment of craniofacial structures. Although residual edema persisted, ocular integrity was preserved, and mandibular occlusion was maintained. The patient was mobilized gradually, with multidisciplinary input from maxillofacial, neurosurgical, ophthalmologic, and orthopedic teams throughout recovery. This case highlights the extreme complexity of multiregional craniofacial trauma involving the skull base and orbital structures. Such injuries pose a significant challenge not only in acute stabilization but also in reconstruction to restore both function and aesthetics. The case emphasizes the importance of early comprehensive imaging, timely surgical intervention, and coordinated multidisciplinary management. Collaborative efforts across specialties were crucial in ensuring an optimal functional and cosmetic outcome in this young patient.

DISCUSSION

Craniofacial trauma is among the most devastating injuries encountered in trauma surgery, particularly when multiple anatomical regions are involved. Multiregional fractures affecting the midface, orbit, and skull base carry high risks of airway compromise, intracranial involvement, ocular morbidity, and long-term disfigurement. The complexity of these cases demands not only early recognition but also a carefully staged surgical approach and multidisciplinary collaboration.

Epidemiology and Global Burden

Maxillofacial trauma primarily affects young adult males, often due to high-energy mechanisms such as road traffic accidents. According to the World Health Organization (2023), nearly 1.3 million people die annually from traffic injuries, while millions more survive with significant trauma, including craniofacial fractures WHO, 2023. Epidemiological studies report that 10–15% of trauma admissions involve complex craniofacial fractures, with panfacial patterns representing the most severe spectrum [2]. These injuries are not only medically

challenging but also impose substantial socioeconomic burdens, as they typically affect individuals in their most productive years [3].

Clinical Priorities and Imaging

The priorities in maxillofacial trauma are to secure the airway, control hemorrhage, and stabilize vital signs. Midfacial fractures can obstruct the airway through posterior bone displacement or swelling. Once stabilized, computed tomography (CT) remains the gold standard for evaluating the full extent of injuries, including orbital and cranial base involvement [5]. Advanced imaging not only aids in diagnosis but also guides surgical planning and helps anticipate complications.

Principles of Surgical Management

The traditional principle of "bottom-to-top and outside-in" remains central in reconstructive sequencing: mandibular and maxillary stabilization to restore occlusion, followed by midface and orbital repair, and finally frontal bone and cranial base reconstruction [6]. This approach provides structural stability and facilitates accurate anatomical realignment. In this case, early stabilization with arch bars was followed by craniotomy with sinus reconstruction and orbital exploration.

Orbital fractures pose a unique challenge due to their impact on vision. Early repair is associated with reduced rates of diplopia and enophthalmos [7]. In this patient, scleral repair and hyphema evacuation preserved ocular integrity. Delayed intervention, conversely, is linked with higher complication rates [8].

Advances in Technology and Reconstruction

In recent years, Virtual surgical planning (VSP) including, Computer-Aided Design and Manufacturing (CAD-CAM), has significantly revolutionized and changed the way of bony reconstruction [9]. 3D printing technology demonstrated efficacy in the treatment of acetabular fractures. It may improve surgery-related and clinical outcomes. More prospective studies using a rigorous design (e.g., randomized trial with blinding) are warranted to confirm the long-term effects of 3D printing technology in orthopedics surgeries [10]. Bone grafting and vascularized free flaps, such as fibula free flaps, remain the cornerstone for reconstructing large defects. Virtual surgical planning has enhanced the accuracy of free flap reconstruction, improving both functional and cosmetic results [4]. A systematic review also highlighted the superiority of patient-specific implants in restoring orbital and cranial base anatomy compared with conventional methods [11].

Multidisciplinary Care

Optimal outcomes in craniofacial trauma rely on teamwork. Maxillofacial surgeons, neurosurgeons, ophthalmologists, and orthopedic specialists all play critical roles. Approximately one quarter of polytrauma patients has facial injuries, which usually lead to loss of form and function. Several specialties are involved in the acute and reconstructive phases of facial injuries, such as oral and maxillofacial surgery, otorhinolaryngology, plastic surgery, ophthalmology and dentistry [12]. In this case, the staged collaboration across specialties allowed comprehensive care of both craniofacial and extremity injuries [13].

Complications and Long-Term Outcomes

Craniofacial trauma carries the risk of early and late complications. Acute issues include CSF leaks, meningitis, and intracranial hemorrhage. Long-term complications include malocclusion, sinus obstruction, visual impairment, chronic pain, and psychosocial sequelae. Post-traumatic stress and depression are frequently reported among patients with disfiguring injuries [14]. Therefore, long-term rehabilitation, including psychological support and physiotherapy, is as important as surgical repair.

Prognosis

Maxillofacial trauma represents a major cause of injury to the soft tissues and bony structures of the face. This type of trauma is characterized by specific clinical features, diverse treatment modalities, and varying outcomes. Understanding the prognostic risk factors in maxillofacial trauma is essential for optimizing treatment strategies and improving patient outcomes li Z et al., 2024

Several factors have been identified as significant predictors of prognosis in patients undergoing maxillofacial reconstructive surgery. These include patient age, postoperative nutritional status, psychological factors such as anxiety scores, wound healing conditions, and the presence of complications. Each of these factors can substantially influence both the functional and aesthetic outcomes following facial trauma surgery [15].

outcomes. However, delayed treatment or inadequate reconstruction may result in permanent disability and reduced quality of life [14].

CONCLUSION

This case highlights the extreme complexity of multiregional craniofacial trauma involving the skull base and orbital structures following a high-energy motorcycle accident in a young male patient. The constellation of injuries, including Le Fort II fracture, bilateral orbital rim and blow-out fractures, mandibular and dentoalveolar fractures, comminuted frontal sinus fractures, and anterior cranial base involvement, reflects the severity of panfacial trauma that can result from blunt force impact. The presence of associated intracerebral hemorrhage, brain edema, and ocular injury further compounded the risks and increased the urgency for timely intervention. The management of this patient underscores several important principles in craniofacial trauma care. First, early stabilization and comprehensive imaging were essential

for identifying the full extent of injury and guiding surgical planning. CT scanning provided a clear map of fractures and associated complications, enabling a systematic operative approach. Second, staged reconstruction following the "bottom-to-top and outside-in" principle ensured restoration of mandibular-maxillary occlusion before addressing orbital and frontal sinus injuries. This sequence provided stability and facilitated accurate anatomical realignment. Multidisciplinary collaboration proved vital to the patient's recovery. Maxillofacial surgeons, neurosurgeons, ophthalmologists, and orthopedic specialists worked in concert to address the complex interplay of facial, cranial, and extremity injuries. Such coordinated management not only minimized perioperative risks but also optimized both functional and aesthetic outcomes. The preservation of ocular integrity, restoration of occlusion, and stabilization of craniofacial symmetry in this case demonstrate the effectiveness of a team-based, staged approach.

Ultimately, this case reinforces that early recognition, thorough radiologic evaluation, staged surgical intervention, and multidisciplinary care are the cornerstones of successful outcomes in complex craniofacial trauma. Beyond acute survival, long-term rehabilitation—including functional, aesthetic, and psychosocial recovery—remains equally important. Documenting rare and severe cases such as this contributes valuable insights to refine clinical strategies and improve future patient care.

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Informed Consent: Not applicable.

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