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PEDIATRIC OCULAR TRAUMA MANAGEMENT: A CASE STUDY OF EFFECTIVE INTRA-ORBITAL FOREIGN BODY IOFB EXTRACTION

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ABSTRACT

Introduction: Penetrating Intraorbital Foreign Body (IOFB) injuries are a rare form of traumatic injury. Recognized as a surgical emergency, meticulous history-taking and a thorough examination are essential for determining the trauma's mechanism and cause, facilitating accurate diagnosis and effective disease management.
Case Illustration: In the emergency room, a 5-year-old female patient was presented with a craniofacial injury resulting from an IOFB. An evacuation procedure, conducted through a subsidiary incision, was performed to extract the foreign body. Interestingly, the object removed from the orbital cavity was a plastic foreign body, initially suspected to be a fractured orbital bone.
Discussion: The clinical presentation, management, and outcomes of orbital foreign body injuries can differ based on the material composition of the foreign body. In cases of intraorbital foreign body trauma, the primary treatment goal is foreign body removal.
Conclusion: Precise and accurate initial management in the emergency department is crucial. Early diagnosis, aided by a 3D head CT scan, is instrumental in locating the IOFB and identifying the involved anatomical structures. This, in turn, enables timely treatment decisions to minimize the risk of complications.

Highlights:
1. The rare nature of Orbitocranial Injury with Intraorbital Foreign Body (IOFB).
2. Utilizing a 3D Head CT Scan to ascertain the precise location of the IOFB and its impact on anatomical structures is pivotal in shaping immediate treatment strategies, thereby reducing the potential for complications.

INTRODUCTION

Approximately 14% of children's injuries are ocular, with foreign body-related injuries being a significant contributor to health issues and blindness.[1–3] Penetrating Intraorbital Foreign Body (IOFB) injuries in children under the age of five are infrequently encountered and constitute an uncommon form of penetrating trauma. Although relatively rare, this type of injury occurs across various geographic regions and constitutes approximately one-sixth of all orbital injuries. These incidents primarily affect young individuals and are typically associated with activities such as

recreational play or the application of significant craniofacial force, often resulting from accidents or routine domestic tasks.[4–6]

Diagnosing intraorbital foreign bodies can be challenging, especially with smaller objects that may not be easily visible in imaging. Failure to promptly remove these foreign bodies poses a significant risk of infection. Intraorbital foreign bodies can be categorized into metallic types, which can be further classified as magnetic or non-magnetic, and non-metallic objects, such as plant material, plastics, glass, and other materials.[6,7] The symptoms associated with this disorder are varied and depend on the extent of the injury, the composition of the foreign body, its trajectory, the speed of the impact against the orbit, among other factors. The first step to take is the stabilization of the patient to be able to perform a complete ophthalmological examination. It is important to note that not all periorbital foreign bodies need removal; the decision depends on the material and location characteristics.[5]

Computed tomography (CT) scans of the orbit and skull are important tools for identifying injury severity and making therapeutic decisions.[5,7] Even minute foreign bodies, measuring as little as 2 mm, can be readily identified in CT scans due to their typically high density. These foreign bodies typically enter the orbit and traverse the space between the orbital wall and the eyeball, often without impacting the eye itself. Rarely do they traverse the orbit to penetrate paranasal sinuses or intracranial spaces, which may potentially involve neurovascular components.[5]

Considering that craniofacial trauma, especially cases involving Intraorbital Foreign Bodies (IOFB), are considered surgical emergencies, the urgent need for swift diagnosis and management cannot be overstated.[4] An effective method is needed to conduct comprehensive clinical evaluation and perioperative management in accordance with standard protocols for handling injuries with Intraorbital Foreign Body (IOFB) in the eye in pediatric patients. In this report, we present a unique case of orbitocranial trauma in a pediatric patient. This case involves a substantial IOFB that traversed the orbit, penetrated the skull, and reached the temporal lobe without causing any harm to the eyeball.

CASE ILLUSTRATION

A 5-year-old female patient was brought to the Emergency Room after sustaining a craniofacial injury caused by an Intraorbital Foreign Body (IOFB) lodged in her right eye. This incident occurred when her father abruptly braked the motorbike during a vehicular accident, resulting in to the penetration of the motorbike's rear-view mirror shaft into her right orbital cavity.

During the initial physical examination, the conscious patient displayed stable vital signs and exhibited a foreign body (a portion of the motorbike's rearview mirror shaft) lodged in the orbit of her left eye. She had an eyelid hematoma that hindered her ability to open the affected eye, but did not reveal any obvious eye involvement or bleeding. A portion of the shaft was partially visible within the eyeball, with approximately 10 cm protruding externally. After a comprehensive examination, no additional injuries were found. Subsequently, a 3D CT scan was performed for further evaluation.

A head scan was conducted to precisely locate the foreign bodies and assess the affected bone structures. The tomographic examination revealed that the foreign body had penetrated the right side of the intraorbital region and extended toward the temporal lobe above the left eyeball. Importantly, there were no indications of intraconal or intraocular lesions, and no signs of intracranial, subdural, or epidural hematomas, or retroconal bleeding were identified (Figure 1).

After obtaining the patient's informed consent for the foreign object removal procedure, she was transferred to the operating room. Subsequently, a procedure was performed to evacuate and extract the foreign body through a secondary incision. Interestingly, the object retrieved from the orbital cavity was identified as a plastic fragment, specifically from the motorbike's rearview mirror shaft. Initially, there had been suspicion of a fractured orbital bone.

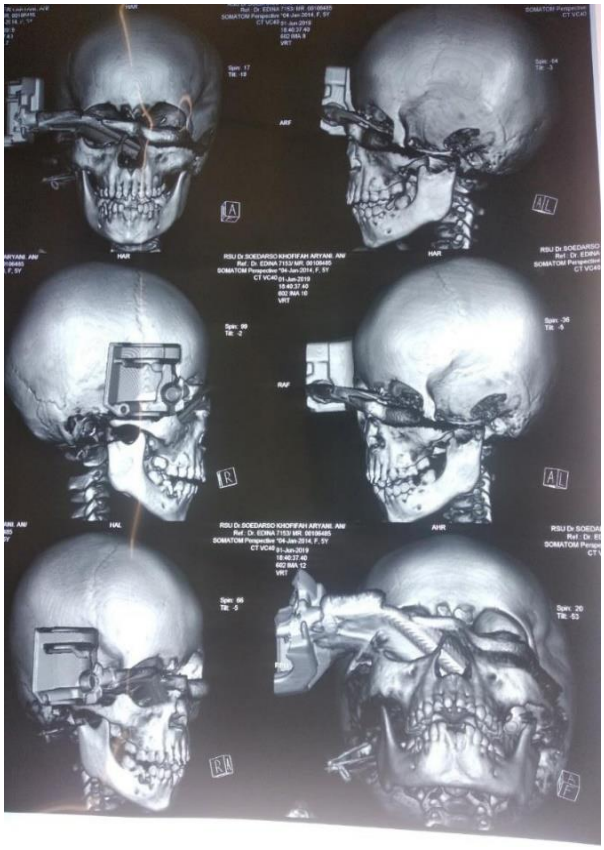

Figure 1. 3D Head CT Scan

Figure 2. Pre Operation

Figure 3. Post Operation

Figure 4. One Week Follow-up

The authors confirm that they have acquired requisite consent forms from all relevant patients, who have granted approval to report their images and clinical details in the journal. Patients acknowledge that their names will be withheld from publication, and diligent measures will be taken to obscure their identities. However, complete anonymity cannot be assured.

DISCUSSION

Injuries involving foreign bodies in the eyes of pediatric patients constitute approximately one-third of open globe injuries and introduce unique complexities in management and eye-related issues distinct from those in adults. This age group often experiences eye injuries due to active play activities and a lack of awareness of potential risks. The presence of an intraorbital foreign body (IOFB) in pediatric eyes introduces unique management complexities due to the anatomical and physiological differences compared to adults.[1]

IOFBs can cause significant damage to the eye's structures and orbital contents in pediatric patients, as these organs are still in a growing and developing stage.[10] An Intraorbital Foreign Body (IOFB) is characterized as an object situated within the bony confines of the orbital walls, positioned posterior to the orbital septum, but external to the ocular globe. It can be situated either extraconally or intraconally. IOFBs may damage eye tissues, including the lens, retina, and optic nerve, potentially impacting vision and visual development in children. Managing eye injuries in children requires careful and coordinated approaches among ophthalmologists, surgeons, and other healthcare teams to ensure appropriate treatment and minimize long-term complications. Therefore, a deep understanding of the differences between pediatric and adult eye injuries, especially concerning IOFBs, is crucial for providing optimal care to pediatric patients with foreign body-related eye injuries. [6,8,9]

Ocular injuries account for about 8% to 14% of all injuries in children.[2] This type of open orbital trauma constitutes approximately one-sixth of all cases.[9] According to a study conducted by Singh et al[11]., the occurrence of penetrating and perforating ocular injuries in children is 67.7% and 10.9%, respectively. Intraorbital foreign bodies were found in 5% of cases.[12] These traumas can result in varying degrees of damage and may affect the patient's vision.[5] Trauma is a significant contributor to health problems and is a non-congenital cause of one-sided blindness in children.13 While intraorbital foreign body-related ocular trauma is infrequent in the pediatric population, it is considered a medical emergency when it does occur.[5,13]

The three most common causes of ocular injuries are unintentional accidents, deliberate attacks, and self-inflicted harm.[14] Pediatric orbital traumas typically arise from contusive or penetrating incidents, often occurring during recreational activities (59%) and accidental tumbles or falls (37%).[5,14] The most common cause of penetrating injuries in children involved sharp objects being either poked into the child's eye by the child themselves or thrown

at the child.[12] In children aged 3 years and younger, unintentional injuries often occur at the hands of caregivers, parents, or siblings.[15] Self-inflicted injuries are also prevalent in this age group due to underdeveloped hand-eye coordination and fine motor skills. Older children typically experience injuries from toys, pens, pencils, tree branches, and sports-related incidents. However, there is a gap in our knowledge regarding the frequency of injuries in children within our population.[16]

Injuries involving nonmetallic intraorbital foreign bodies (IOFBs) frequently occur in scenarios such as traffic accidents, accidental falls, bouncing injuries, or stab wounds during work or recreational activities. The primary factors contributing to these injuries are the high velocity and sharp nature of the foreign bodies. This study specifically investigated nonmetallic foreign bodies, including tree twigs/branches, chopsticks, bamboo toothpicks, wood sticks, glass, gravel, and plastic. Previous research has shown a higher incidence of such cases in children and young individuals, possibly attributed to falls during play and risks associated with carpentry work among the youth. In contrast, elderly patients constitute a smaller percentage, potentially due to less engagement in activities leading to these injuries.[16–19]

The clinical manifestations and potential complications depend on factors such as the material, size, shape, and placement of the foreign bodies.[20] The clinical presentation, treatment, and outcomes associated with orbital foreign bodies depend on the composition of the foreign body.[4,6] These objects can be categorized into three primary types based on their material: 1) metallic objects such as aluminum, copper, molten lead, steel, and iron; 2) inorganic non-metallic objects like plastic, glass, sand, concrete, rock, and other.; and 3) organic objects such as wood, plants, bones, grease, thorns, and vegetative materials.[4,14,16] In the context of penetrating foreign bodies within the orbit, the most common locations are the superior (26%), medial (30%), inferior (26%), and lateral (4%) orbital walls.[4]

Metallic foreign bodies, particularly those composed of materials such as iron, aluminum, copper, and lead, are frequently encountered and can be readily identified using computerized tomography (CT) scans. Conversely, nonmetallic foreign bodies pose diagnostic challenges in clinical settings due to their diverse compositions, complex shapes, and variable injury presentations, which can lead to them being overlooked or misdiagnosed. Despite technological advancements, the surgical removal of nonmetallic intraorbital foreign bodies (IOFBs) remains difficult and often associated with a relatively high rate of failure. Significantly, there is a scarcity of published literature regarding the management of nonmetallic intraocular foreign bodies (IOFBs), especially when compared to metallic IOFBs, despite the higher potential for serious complications.[21–23] The available literature is restricted to a handful of retrospective studies involving a limited number of cases.[24–27] Consequently, thorough examinations of cases with nonmetallic intraocular foreign bodies (IOFBs) are crucial for advancing comprehension and advancing clinical approaches for diagnosis and treatment in the future.[20]

To address these cases effectively, a thorough clinical assessment involving ultrasound and CT scans, along with examinations conducted under general anesthesia, is essential. The perioperative management of intraocular foreign bodies (IOFB) should adhere to a standardized protocol but also be customized to each patient's specific needs. This approach includes determining the necessity and timing of surgical intervention, deciding on the number of surgical stages required, and addressing any potential complications.[1]

The Key considerations in the assessment and treatment of such cases include Clinical Evaluation (Thorough

clinical assessment, including a detailed history and comprehensive eye examination, is crucial. Identify the nature, size, and composition of the foreign body. Evaluate the extent of ocular trauma and associated injuries); Imaging Studies (Utilize imaging modalities such as X-rays, CT scans, or MRI to precisely locate and characterize the IOFB. Assess the depth and proximity of the foreign body to ocular structures); Ophthalmic Examination (Conduct a detailed examination of the anterior and posterior segments of the eye. Assess visual acuity, intraocular pressure, and signs of inflammation or infection); Surgical Intervention (The primary approach often involves surgical removal of the foreign body to prevent complications. Consideration of the timing of surgery is crucial, balancing the urgency of removal with the patient's overall condition); Customized Treatment (Tailor the treatment plan to the specific characteristics of the IOFB, including its size, composition, and location. Address any associated injuries to ocular structures); Complication Management (Be vigilant for potential complications such as infection, inflammation, or damage to vital ocular structures. Administer appropriate prophylactic antibiotics to prevent infection); Follow-Up and Rehabilitation (Schedule regular follow-up visits to monitor the patient's progress post-surgery. Consider rehabilitation measures, such as visual therapy, to optimize visual outcomes); Multidisciplinary Approach (In complex cases, involve a multidisciplinary team, including ophthalmologists, radiologists, and possibly neurosurgeons, to ensure comprehensive care; Patient Education (Educate the patient about the importance of compliance with medications and follow-up appointments. Provide information on potential long-term effects and rehabilitation options); Research and Advancements (Stay updated on the latest research and advancements in the field of ocular trauma and IOFB management).[1]

The characteristics of nonmetallic IOFBs, including symptoms, visual prognosis, and the necessity for surgical intervention, depend on the specific composition of the foreign object. Comprehensive imaging is crucial for formulating a surgical plan, considering factors such as the structure and location of the foreign body, as well as the presence of secondary infections. Larger foreign bodies are generally easier to diagnose and remove, while smaller ones pose a greater risk of missed diagnoses and challenging surgical procedures.[28]

For suspected IOFB cases, thorough ophthalmic and imaging examinations are essential to assess the foreign body's location, size, and material, as well as to evaluate potential surgical damage. Additionally, a full understanding of treatment options and prognosis is crucial, with equal consideration given to the opinions of both the ophthalmologist and the patient in making final treatment decisions.[20]

Precision and accuracy are imperative in the emergency department. The preferred initial diagnostic imaging method for assessing the location of intraorbital lesions (intraconal, extraconal, or intraocular) and determining the subsequent treatment plan is a 3D Head CT scan.[5,29] The main approach for treating patients with intraorbital foreign bodies involves removing the foreign body. The management of intraocular injuries varies based on factors such as the involvement of the optic nerve or the neurovascular bundle of the retina and the severity of the injury.[5]

Small nonorganic intraorbital foreign bodies that are relatively inaccessible can often be left in place without significant subsequent complications. However, larger intraorbital foreign bodies pose a considerable risk to adjacent structures and have the potential for intracranial extension, depending on their depth. In such cases, surgical removal should be considered,

necessitating careful and meticulous treatment planning and execution.[29,30]

The decision to proceed with surgery must be personalized, taking into account the surgeon's evaluation of the potential surgical risks compared to the risks associated with retaining the foreign body, which may result in delayed complications like infection and fistula formation. Surgical removal of the foreign body is recommended when patients exhibit neurologic compromise, mechanical restrictions affecting eye movements, acute or chronic infections, or chronic suppurative reactions to the foreign body.[30]

The primary complication associated with retained intraorbital foreign bodies is infections. Therefore, patients with intraorbital foreign bodies should receive tetanus prophylaxis and broad-spectrum antibiotics that can penetrate the blood-brain barrier due to the proximity to the central nervous system.[31] In suspected intracranial infections, a common recommended antibiotic regimen involves high-dose third-generation cephalosporin and vancomycin.[8]

When foreign bodies are situated in the anterior segment without penetrating the eye globe, and the patient initially shows good visual acuity, the outlook for visual acuity is typically more positive. Research indicates that in cases where there is no globe involvement, no subsequent loss of vision has been observed.[8]

The diagnosis and treatment of nonmetallic IOFBs are complex processes with diverse conditions and potential complications. Organic foreign bodies, predominantly encountered in such cases, contribute to varying clinical manifestations. CT imaging aids in identifying foreign body materials, although foreign objects may be occasionally misdiagnosed. MRI can assist in detecting wooden foreign bodies and grease. Surgical treatment for IOFBs is intricate and may necessitate a multidisciplinary team approach. The complete removal of residual organic IOFBs is crucial to prevent infections and inflammation.[32]

The research describes an uncommon and intriguing case involving a pediatric patient with an intraorbital foreign body (IOFB) that penetrated the orbital cavity and extended into the temporal lobe. Medical terminology is used appropriately, balancing technical details with readability. The report explicitly mentions the absence of complications such as intraconal or intraocular lesions, as well as intracranial, subdural, or epidural hematomas. This information is crucial for understanding the extent of the injury and its potential complications. The use of 3D Head CT scan for diagnostic evaluation is highlighted as an essential and precise tool for determining the location of the IOFB and therapeutic planning. The head scan precisely locates the foreign body, assesses affected bone structures, and rules out various types of lesions or hematomas. The study emphasizes the importance of individualized treatment decisions based on the risks and benefits of surgical removal of IOFBs. The discussion on infection as a common complication of retained IOFBs and the recommended antibiotic regimen adds valuable insights to clinical practice.

The case illustration involving a plastic foreign body penetrating the orbital cavity and reaching the temporal lobe presents a unique and unusual scenario. The study underlines the significance of 3D Head CT scans in managing IOFB cases, providing a valuable perspective on diagnostic tools in this context. The emphasis on personalized treatment decisions based on individual patient factors adds a novel aspect to the discussion of IOFB management.

The study primarily focuses on a single case, which limits the generalizability of the findings. The study mentions the predominance of these injuries in young individuals but does not provide detailed demographic information, such as age groups, gender distribution, or socioeconomic factors. Including a larger

sample or additional cases would enhance the robustness of the conclusions. While the study discusses the importance of precise action in the emergency department, it would benefit from more detailed information about the surgical procedure and post-operative care, which could provide additional guidance for healthcare professionals. The paper briefly mentions the outcomes of IOFB treatment without providing comprehensive data or follow-up information on the presented case, making it challenging to assess the long-term prognosis and potential complications. The emotional and psychosocial aspects of the patient and her family, especially considering the young age of the child, are not discussed. The impact of the incident on the child's well-being and potential psychological support measures are relevant considerations.

CONCLUSION

Pediatric cases involving intraorbital Foreign Bodies (IOFBs) are infrequent but require immediate attention as surgical emergencies. The initial management in the emergency room must be conducted with precision and accuracy. Early diagnosis through the use of a 3D Head CT Scan is pivotal for determining the IOFB's location and understanding the anatomical structures involved. This timely diagnosis enables healthcare professionals to make immediate treatment decisions, thereby reducing the risk of complications.

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CONFLICT OF INTEREST

This study does not involve any conflicts of interest.

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AUTHOR CONTRIBUTION

YJF conceived and designed the study, collected and analyzed the patient's clinical data, and wrote the initial draft of the case report. AS provided critical input in diagnosing and treating the patient, reviewed and revised the manuscript, and contributed to the intellectual content. LZS performed the literature review and introduction research, helped in manuscript editing, and assisted in obtaining patient consent and data. DS supervised the entire case report, ensured compliance with ethical standards, coordinated among authors, and finalized the manuscript for submission.

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