



UNRECOGNIZED CRANIAL OSTEOMYELITIS POST-SCALP INJURY: INSIGHTS INTO DIAGNOSIS AND MANAGEMENT

Plastic Surgery

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ABSTRACT

This article presents a case of delayed-onset cranial osteomyelitis in a 5-year-old boy following a traumatic scalp injury. Three months after a fall, the patient developed a non-healing wound on his forehead, which failed to improve with initial treatment. Imaging revealed multiple lytic defects in the frontal bone, leading to a diagnosis of osteomyelitis. The patient underwent craniectomy, debridement, and primary repair, with negative cultures. He responded well to treatment, and no recurrence was noted at follow-up. The case highlights the importance of early recognition, advanced imaging, and timely intervention in managing cranial osteomyelitis, even months after mild head trauma.

KEYWORDS

Cranial Osteomyelitis, Traumatic Scalp Injury, Delayed-onset Infection, Frontal Bone Craniectomy, Pediatric Osteomyelitis

INTRODUCTION

Osteomyelitis refers to an inflammatory process in bone, characterized by progressive bone destruction due to an infecting microorganism. Historically, fulminant osteomyelitis of the skull was a common condition, but its prevalence has significantly declined with the advent of effective antibiotics. Currently, cranial osteomyelitis is more likely to present as a chronic condition, often associated with complications from craniotomies or traumatic scalp injuries, although it remains rare.⁽¹⁾

Despite its rarity, timely recognition and treatment are critical, as untreated cranial osteomyelitis can pose life-threatening risks. Advances in diagnostic tools and the widespread use of broad-spectrum antibiotics have improved treatment outcomes, reducing the likelihood of therapeutic failure. Early identification of nonspecific initial symptoms plays a vital role in successful management. However, delays in recognition and initiation of appropriate antibiotic therapy continue to pose challenges.

This report highlights a distinctive case of cranial osteomyelitis that developed three months after a traumatic scalp injury, underscoring the need for vigilance in post-traumatic wound management.

Case Report

A 5-year-old boy presented to the Department of Plastic Surgery at KLE's Dr. P.K. Hospital with a three-month history of a non-healing wound on his forehead (Fig. 1). The condition began following a fall, after which a blister developed in the forehead region, accompanied by pus and watery discharge. Initial treatment with oral medications at a local hospital failed to improve the wound, prompting referral to our center. A wound measuring approximately 4 × 3 cm was noted in the frontal region of the forehead. The surrounding skin appeared normal, but the area was warm and tender to the touch, extending to the anterior half of the scalp.



Fig. 1: Photograph Showing The Clinical Presentation Of The Patient.

A brain computed tomography (CT) scan was performed, revealing multiple circumscribed lytic defects with jagged edges in the frontal bone (Fig. 2).

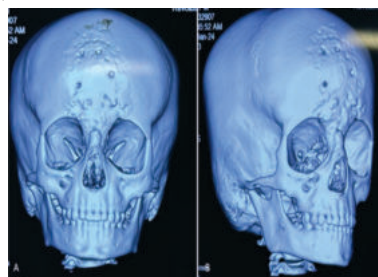


Fig. 2: 3D Reconstructed CT Brain Images (A & B) Displaying Lytic Defects And Destruction Of The Frontal Bone.

Considering the neuroradiological findings and the history of traumatic head injury, a diagnosis of frontal bone osteomyelitis was established. A neurosurgical opinion was sought, and the patient underwent frontal bone craniectomy to excise all diseased bone. The plastic surgery team subsequently performed debridement and primary repair (Fig. 3). Pus and bone cultures sent during the procedure were negative for any organisms.



Fig. 3: Intraoperative Photograph During The Procedure.

The patient responded well to the treatment, and follow-up evaluations to date have shown no signs of recurrence (Fig. 4).



Fig. 4: Post-treatment Follow-up Image Showing Complete Recovery With No Signs Of Recurrence.

DISCUSSION

Osteomyelitis is a severe infection of the bone marrow that can result from various pathogenetic mechanisms and has the potential to affect any anatomical site.⁽²⁾ Cranial vault osteomyelitis, although rare, is a life-threatening condition requiring prompt diagnosis and treatment to prevent complications involving the central nervous system.⁽³⁾ While primarily affecting children with chronic inflammatory diseases of the paranasal sinuses⁽⁴⁾, cranial osteomyelitis may also occur in adults as a consequence of otitis⁽⁵⁾, neurosurgical interventions, or traumatic brain injuries (TBI).^(3,6)

The hematogenous spread of microorganisms is the most common route of infection, though post-traumatic osteomyelitis typically results from direct bone contamination.^(7,8) Based on the infection's origin and pathogenesis, cranial osteomyelitis is categorized as sinorhino-otogenic (SRO) or non-SRO (NSRO), with the latter further divided into iatrogenic, post-traumatic, and hematogenous types.⁽⁸⁾ Post-traumatic skull osteomyelitis in adults frequently follows minor or major head injuries associated with cranial fractures, where bacterial penetration occurs through skull wounds.^(9,10) Cases of acute osteomyelitis complicating closed or open fractures have been well-documented, with *Staphylococcus aureus* identified as the predominant causative microorganism.⁽¹¹⁾ Chronic cranial osteomyelitis, however, may involve non-bacterial pathogens such as fungi, mycobacteria, or parasites.

Our case involved a chronic form of cranial osteomyelitis, which is relatively rare. Previous reports, such as one from 1998, described frontal osteomyelitis following an infected wound.⁽¹²⁾ Other cases include fungal infections caused by *Aspergillus fumigatus* after cranial trauma in an immunocompetent patient⁽¹³⁾, chronic scalp ulcers due to osteomyelitis in an 11-year-old boy⁽¹⁴⁾, and a case discovered over 50 years after the initial trauma.⁽¹⁵⁾

Accurate diagnosis forms the cornerstone of effective treatment for cranial osteomyelitis. However, the variability in clinical presentation, severity, and etiology complicates the establishment of standardized treatment protocols. Management may range from antibiotic therapy alone to combinations of surgical interventions, such as debridement, drainage, and reconstruction. Chronic destructive forms or intracranial extensions often necessitate aggressive approaches involving early surgical intervention to remove infected tissue and reconstruction with myocutaneous flaps, yielding favorable outcomes.⁽¹⁶⁾

Long-term antibiotic therapy remains a mainstay of treatment, often requiring 3–6 months of culture-guided antimicrobial agents for bacterial infections.^(17,18) Fungal infections, in contrast, typically necessitate high-dose amphotericin B.⁽¹⁸⁾ In cases of chronic infections associated with tissue hypoxia, hyperbaric oxygen therapy has proven to be a beneficial adjunct to antibiotics and surgical procedures.⁽¹⁸⁾

In our case, the infection likely originated from skin penetration, leading to initial galeal involvement and subsequent spread through the Haversian canals to the diploic bone.⁽⁸⁾ While laboratory tests such as erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and procalcitonin levels may not always be diagnostic, advanced imaging techniques are invaluable. CT scans effectively identify bone erosion and periosteal remodeling, while MRI offers superior sensitivity in detecting early pathological changes like bone marrow edema and assessing soft tissue or intracranial involvement.⁽¹⁹⁾

Cranial osteomyelitis, especially in its early stages, may mimic other

conditions such as bone tumors or Langerhans cell histiocytosis.⁽²⁰⁾ Diagnostic uncertainty can be resolved using labeled leukocyte scintigraphy or bone biopsy.⁽⁷⁾ Serial MRI imaging is particularly useful in monitoring disease progression and evaluating therapeutic response.

CONCLUSION

Osteomyelitis, a recognized inflammatory condition leading to bone destruction, remains a significant challenge in clinical practice. Early detection and timely intervention are crucial in managing this potentially life-threatening disease. This case underscores the importance of considering cranial osteomyelitis as a differential diagnosis, even months after a seemingly mild traumatic brain injury. Thorough evaluation of patient history, combined with detailed imaging studies, is essential for accurate diagnosis and effective treatment. This case reinforces the need for vigilance and comprehensive diagnostic approaches in managing delayed-onset cranial osteomyelitis.

Declaration of Patient Consent

The authors confirm that they have obtained all necessary consent from the patient. The patient has provided permission for their clinical details and images to be published in the journal, with the understanding that all efforts will be made to protect their identity. While anonymity is prioritized, absolute confidentiality cannot be guaranteed.

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