

Case Report**Pediatric-Onset Humeral Osteomyelitis Managed With an Anterior Tibial Artery–Based Second Fibular Flap and Shoulder Prosthesis: A Rare Case Report**

Kamran Khalid¹, Ali Akbar Subhani¹, Urwah Kamran¹, Rabia Ahmad², Ahmed Faraz¹ and Muhammad Maaz Hassan³

1. Jinnah Burn and Reconstructive Surgery Centre, Allama Iqbal Medical College, Lahore, Pakistan
2. Histopathology Section, Punjab Institute of Neurosciences, Lahore General Hospital, Lahore, Pakistan
3. Department of Medicine, Bahria University Medical and Dental College, Karachi, Pakistan

Abstract:

Background: Chronic osteomyelitis of the humerus is usually a rare phenomenon in children and may lead to nonunion and failed reconstruction. This case demonstrates the long-term sequelae of such complications, resulting in extensive bone necrosis and reconstructive failure.

Case Presentation: We report the case of a 16-year-old male who presented with a five-year history of a painful, discharging sinus following a childhood humeral fracture initially treated with an external fixator. The patient then developed chronic nonunion with recurrent infection. Debridement and a free fibula flap were attempted; however, this failed. Examination and imaging showed extensive destruction of the humeral head and proximal shaft consistent with chronic osteomyelitis.

A shoulder prosthesis was placed, and a second vascularized fibular flap was used for reconstruction based on the anterior tibial artery. This provided both structural support and soft-tissue coverage. The patient developed no recurrence and had stable limb function at follow-up.

Conclusion: This case highlights the challenges of chronic humeral osteomyelitis in pediatric trauma and shows a case of successful limb salvage using a second fibular flap based on the anterior tibial artery after a previous flap failure.

Keywords: Chronic osteomyelitis; Humerus; Pediatric trauma; Free fibula flap; Anterior tibial artery; Nonunion

How to cite: Khalid K, Subhani AA, Kamran U, Ahmad R, Faraz A, Hassan MM. Pediatric-Onset Humeral Osteomyelitis Managed With an Anterior Tibial Artery–Based Second Fibular Flap and Shoulder Prosthesis: A Rare Case Report. J Univ Physicians Surg Pak (JUPSP). 2026; 6–9.

Corresponding Author: Ali Akbar Subhani: Email: draliakbarsubhani@gmail.com

Introduction

Osteomyelitis is an infection of bone characterized by progressive inflammatory destruction and new bone formation.¹ Humeral involvement is uncommon, accounting for only 2.6%–13.3% of all cases of osteomyelitis.² Chronic osteomyelitis typically presents with persistent pain, swelling, or a draining sinus lasting more than four weeks.^{3,4} Several classification systems exist, including the Lew and Waldvogel and the Cierny and Mader systems, which categorize the disease based on duration, mechanism of infection, anatomical involvement, and host physiology.^{5,6}

Staphylococcus aureus remains the most common pathogen in both acute and chronic

osteomyelitis, although other organisms, such as group B streptococci, *Escherichia coli*, *Streptococcus pyogenes*, *Haemophilus influenzae*, *Pseudomonas aeruginosa*, *Mycobacterium tuberculosis*, and *Salmonella species*—may also be implicated, depending on age and mechanism of injury.^{7–11} Infection may occur hematogenously, through contiguous spread, or via direct inoculation following trauma or surgery.^{7,12}

This case is noteworthy due to the uncommon site of pathology and the unusually long duration of chronic osteomyelitis following trauma. This was further complicated by nonunion, failure of a fibula flap reconstruction, and the requirement of

a prosthesis followed by a second vascularized fibular flap.

Case Presentation

A 16-year-old male presented with a five-year history of a painful, discharging sinus over the left mid-arm. He was involved in a road traffic accident at age six that resulted in a left humeral shaft fracture. This was initially managed with an external fixator; however, he developed nonunion within 6–8 months with a severe infection. The patient then underwent multiple surgical debridements. Later, at a tertiary care hospital, a free fibula flap reconstruction was attempted but subsequently failed, likely secondary to infection-related vascular compromise.

On examination, a 2 × 2-cm discharging sinus with surrounding induration and mild tenderness was noted over the left mid-arm (Figure 1). Shoulder movement was severely restricted in all directions, while elbow motion remained full and pain-free. Distal neurovascular status was intact.



Figure 1: A 2 x 2-cm discharging sinus on the left mid-arm.

Investigations included a complete blood count, wound culture, and radiographs. The CBC showed no significant abnormalities. Wound culture grew *Staphylococcus aureus*, which was vancomycin-sensitive. Radiographs demonstrated complete destruction of the humeral head and proximal shaft (Figure 2).

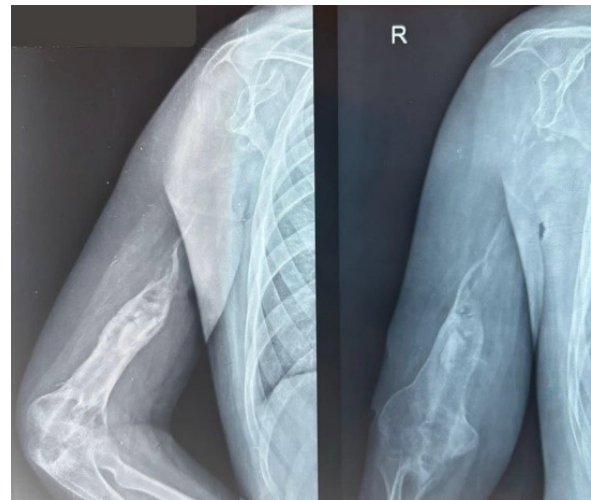


Figure 2: Radiograph showing necrosis of the humeral head and proximal shaft.

As definitive treatment, a custom shoulder prosthesis was implanted to restore joint anatomy and function. However, due to persistent soft-tissue deficit and instability in the surrounding musculature, a second free fibula flap reconstruction was performed. This time, the flap was harvested from the contralateral leg and based on the anterior tibial artery (Figures 3 and 4). The flap was designed to reconstruct the proximal humerus using the fibular head. As the vascular supply of the fibular head is primarily derived from the anterior tibial artery, the graft was harvested based on this arterial pedicle to ensure adequate perfusion and structural viability. It included both muscle and skin components for composite reconstruction. At 1-year follow-up, the patient showed excellent recovery, with a pain-free left shoulder, improved range of motion, no signs of infection, and complete graft integration (Figure 5).



Figure 3: Harvesting of the free fibula flap.



Figure 4: Harvested free fibula flap.

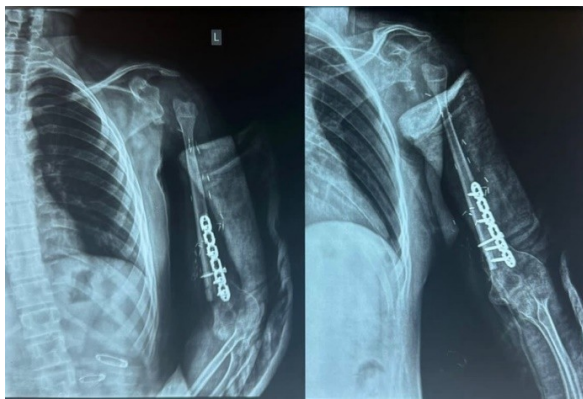


Figure 5: Radiograph of the fibula.

Discussion

Osteomyelitis of the humerus is relatively uncommon compared with long bones such as the femur and tibia, accounting for only a small proportion of cases.² In this patient, chronic osteomyelitis developed following an open fracture sustained during early childhood. External fixation is widely used for such injuries but carries a notable risk of infection and delayed union, with reported complication rates as high as 38.7%.¹³ The presence of a discharging sinus for more than five years in our patient reflects the chronicity of the infection.

The pathophysiology of chronic osteomyelitis is influenced by microbial virulence, host immunity, and bone vascularity.¹⁴ Persistent infection leads to sequestrum formation and involucrum development, which are characteristic of chronic disease.^{5,15} Histological

features such as necrotic bone, mononuclear infiltration, and sinus tract formation further support the diagnosis.^{7,16} Clinically, our patient exhibited classic features including localized pain, swelling, restricted joint mobility, and a persistent draining sinus.¹⁷

Open fractures with significant soft-tissue injury are a major risk factor for osteomyelitis, particularly in the upper extremity.¹⁸ Systemic comorbidities such as diabetes or sickle cell disease also increase the overall risk.⁵ Our patient had no such conditions, suggesting that the initial injury and subsequent surgical procedures were the main contributors.

Diagnosis of osteomyelitis relies on clinical assessment supported by laboratory tests and imaging. While plain radiographs have limited sensitivity in early disease, they remain useful for identifying chronic changes such as bone destruction, as seen in our patient. Advanced diagnostic imaging, including MRI and bone scintigraphy, increases diagnostic accuracy in complex cases.^{14,15}

Management of chronic osteomyelitis requires a multidisciplinary approach. Antibiotic therapy should be guided by culture results, with empiric coverage directed toward *Staphylococcus aureus* when necessary. Surgical debridement is essential in chronic cases, and reconstruction may require vascularized bone grafts. Free fibula flaps provide both structural support and vascularized tissue, helping control infection and promote healing.¹⁶ In our patient, the initial fibula flap failed, likely due to persistent infection and compromised vascularity. A second free fibula flap based on the anterior tibial artery was therefore performed, offering adequate bone stock and soft-tissue coverage. As the dominant blood supply to the head of the fibula is the anterior tibial artery, whereas the diaphysis is supplied by the peroneal artery, the flap was based on the anterior tibial artery.¹⁷

Despite appropriate treatment, recurrence rates in chronic osteomyelitis remain high, and additional procedures may be required in extensive disease.¹⁸ Potential complications include persistent infection, bone necrosis, sinus formation, joint involvement, and growth disturbances in children.¹³ Encouragingly, our patient demonstrated excellent functional recovery and no evidence of recurrent infection at the 1-year follow-up.

Conclusion

This case demonstrates the complexity of treating a long-standing chronic osteomyelitis of the pediatric humerus complicated by nonunion and flap failure. A second vascularized free fibula flap based on the anterior tibial artery led to a successful salvage of the upper limb, combined with a prosthesis placement. This case further highlights the importance of early infection control, individualized reconstructive planning, and innovative microsurgical techniques in restoring function and quality of life in challenging musculoskeletal infections.

Declarations

Informed Consent of the patient: Written informed consent was obtained from the patient and his guardians for publication of this case report and accompanying images.

Artificial Intelligence (AI) Use: The authors declare that no artificial intelligence tools were used for the generation or analysis of scientific content in this manuscript

Funding: No external funding was received for the preparation of this manuscript.

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this case report.

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