DOI: 10.7860/JCDR/2025/77024.22060

Case Report

Orthopaedics Section

Methicillin-resistant *Staphylococcus aureus* Intraepiphyseal Osteomyelitis of Distal Femur: A Rare Case Report

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ABSTRACT

Epiphyseal osteomyelitis caused by Methicillin-resistant *Staphylococcus aureus* (MRSA) is a rare bone infection, usually occurring secondary to metaphyseal bone involvement due to a separate system of epiphyseal arteries that penetrate the epiphysis near the capsular insertion close to the growth plate. We report a unique case of a two-year-old girl who presented with a history of fever for one week, followed by pain and swelling in the left knee. She had a flexion deformity of 20 degrees. Laboratory findings showed elevated inflammatory markers, while blood cultures showed no growth. Magnetic Resonance Imaging (MRI) revealed epiphyseal osteomyelitis of the distal femur. Bone marrow biopsy confirmed MRSA infection. The patient underwent debridement of the epiphyseal lesion, taking care not to injure the growth plate, and STIMULAN® local antibiotic-impregnated dissolvable synthetic calcium sulphate beads were placed in and around the bone and knee joint. Postoperative purulent material and tissue cultures showed no growth. All inflammatory markers trended downward, and there were no further fever spikes. The patient recovered well without complications. High clinical suspicion is necessary for early diagnosis, and follow-up is important to detect any limb length discrepancy or deformities at an early stage.

Keywords: Deformity, Epiphyseal, Infection, Metaphyseal, Methicillin-resistant, Paediatrics, Purulent

CASE REPORT

A two-year-old female patient was brought to the casualty department with complaints of fever with chills for one week and swelling in the left knee for five days. The patient was apparently well one week prior, after which she developed fever with chills. Two days later, the mother noticed swelling in the left knee. The swelling was diffuse and insidious in onset. She also had insidious-onset pain, which increased with weight-bearing and knee bending. There were no constitutional symptoms. There was no similar past history or relevant family history. On examination of the left knee, there was diffuse swelling, a flexion deformity of 20 degrees, and further passive flexion of 10 degrees, after which movement was painfully restricted. Tenderness was present over the medial and lateral joint lines, along with a local rise in temperature.

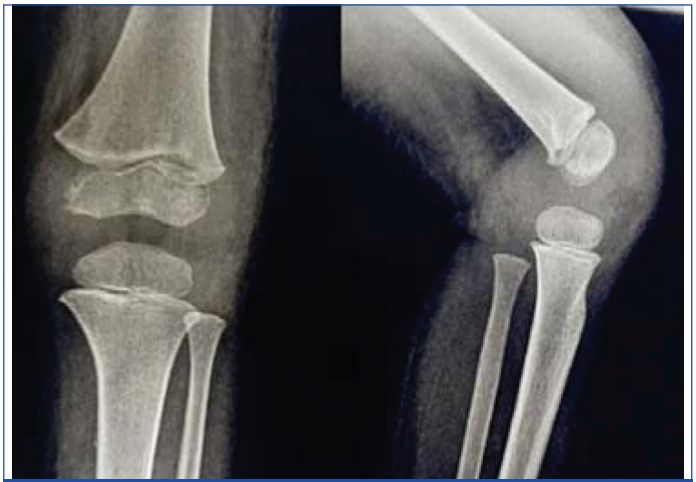
Initial laboratory work-up showed a total leukocyte count of 12,800/µL with neutrophilic predominance, an Erythrocyte Sedimentation Rate (ESR) of 58 mm/hr, and C-reactive Protein (CRP) of 24 mg/dL [Table/Fig-1]. Blood cultures showed no growth; however, bone marrow analysis and culture revealed MRSA. The preoperative X-ray image of the Knee has been in [Table/Fig-2].

Serum parameters	Preoperative values	Postoperative values
CRP (upto 5 mg/l)	293	64
ESR (<20 mm/hr)	60	48
WBC (5000-12000 µL)	18400	10700

[Table/Fig-1]: Preop and postop CRP, ESR, WBC values.

MRI demonstrated an area of abnormal signal intensity in the ossification center of the distal femoral epiphysis, extending proximally to involve the posterolateral portion of the distal femoral physis and adjacent metaphysis. Gross knee joint effusion was noted, extending into the suprapatellar pouch. Edematous signal changes were also observed in the distal thigh muscles [Table/Fig-3a-d]. A diagnosis of intraepiphyseal osteomyelitis with spread to the surrounding metaphysis was made. Serial CRP levels were elevated.

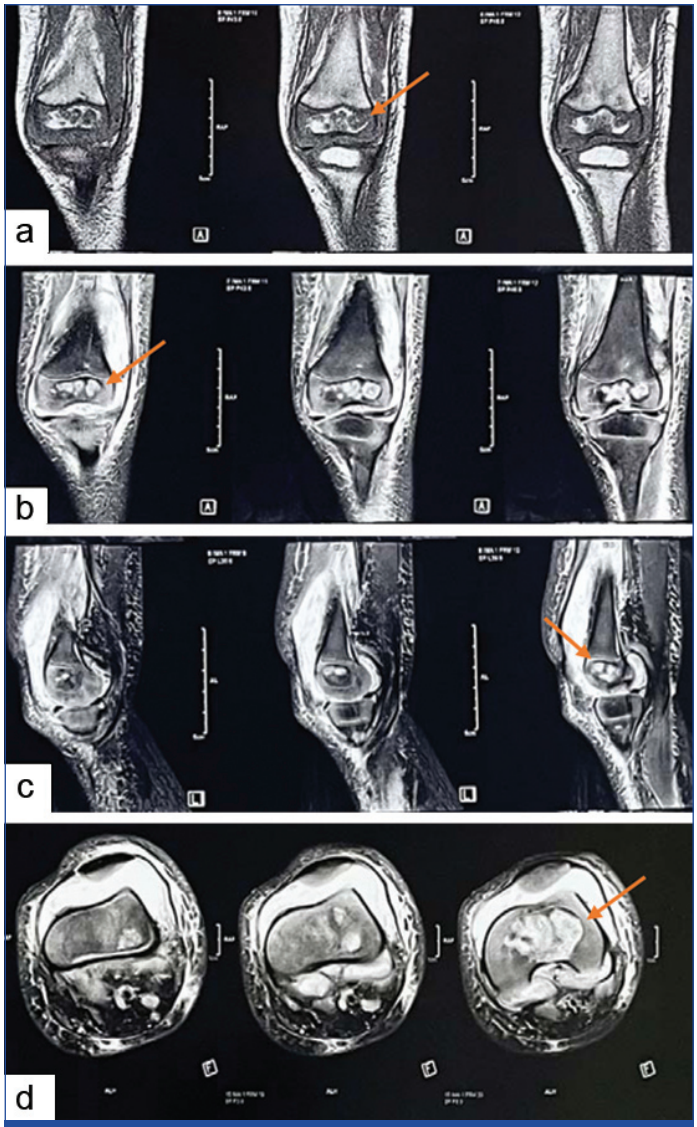
Treatment and surgical management: Injection vancomycin (20 mg/kg/dose) was administered thrice daily according to culture sensitivity for four weeks. The patient was taken for debridement using a lateral approach. The distal femoral epiphysis was identified under an image intensifier, and a bone window was created in the epiphysis, taking care not to injure the growth plate. Necrotic material was removed and sent for culture, sensitivity, and histopathology. Approximately 40-50 mL of purulent fluid was evacuated from the submuscular plane.



[Table/Fig-2]: Preoperative X-ray of Knee- showing osteopaenia at distal femoral epiphysis.

STIMULAN® beads, mixed with teicoplanin and vancomycin (as per culture and sensitivity results), were placed in the epiphysis and surrounding area. The surgical site was closed with a drain in place, and splinting was continued. Postoperative pus and tissue cultures were negative, and Cartridge-based Nucleic Acid Amplification Test (CBNAAT) was also negative. Histopathological examination revealed fragments of necrotic bone with few viable trabeculae. Haemorrhage, fibrin, and scattered neutrophils were observed, but no epithelioid granulomas were present.

There were no further fever spikes, and CRP values decreased from 64 mg/L to 40 mg/L. Antibiotics were continued for a total of six weeks. At the eight-week follow-up, ESR, CRP, and WBC



[Table/Fig-3]: MRI of Knee-area of abnormal signal intensity in ossification centre of lower femoral epiphysis. The area appears hypointense on T1 images and hyperintense on T2 images. Arrows showing abnormal signal intensity in ossification centre of lower femoral epiphysis. a,b) Coronal T1 and T2; c) Sagittal; d) Axial.

counts were within normal limits [Table/Fig-4]. Knee X-rays were satisfactory, the wound had healed well, and the Range of Motion (ROM) of the knee was near full (0-120 degrees). The intraoperative and postoperative images has been showed in [Table/Fig-5]. The patient began weight-bearing walking, and at five months follow-up, no angular deformity or limb length discrepancy was noted. Regular follow-up was advised to monitor for any late deformity.

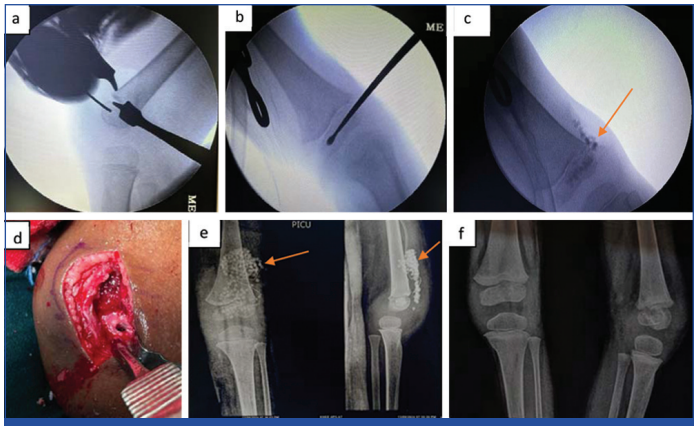
Serum parameters	Follow-up values
CRP (upto 5mg/)	1.75
ESR (<20 mm/hr)	5
WBC (5000-12000 µL)	8000

[Table/Fig-4]: Follow-up CRP, ESR, WBC values.

DISCUSSION

A separate system of epiphyseal arteries penetrates the epiphysis near the capsular insertion close to the growth plate. These vessels form an anastomosis just above the physeal line. Sluggish blood flow in these epiphyseal anastomoses allows bacterial growth, making the epiphysis prone to infection [1]. The knee joint is the most commonly involved site, with the distal femoral epiphysis being the most frequently affected, followed by the proximal tibial epiphysis. The large size of these epiphyses and their rich blood supply may explain this distribution pattern [2].

Other conditions that mimic epiphyseal osteomyelitis, such as infective or neoplastic lesions, should be ruled out [3]. In this



[Table/Fig-5]: Intraoperative and postoperative images; a) Intraoperative imaging of Epiphyseal window; b) Intraoperative imaging of Epiphyseal window; c) Intraoperative imaging after STIMULAN bead insertion (arrow showing STIMULAN beads); d) Clinical image of bone window; e) Postoperative X-ray - Showing evidence of intralesional beads and in anterior aspect of thigh (Arrow showing STIMULAN beads); f) 8 weeks follow-up X-ray showing improved radiolucency and complete absorption of beads at the epiphysis.

patient, blood cultures were negative while bone marrow cultures were positive, which corresponds with findings in other studies [2,4]. There is no single test to diagnose intraepiphyseal osteomyelitis; a high degree of clinical suspicion and multiple diagnostic tests are necessary. Bone biopsies and aspirates are culture-positive in 31-83% of cases, so negative growth does not exclude infection [4]. Very few cases of epiphyseal osteomyelitis have been reported. This case represented a unique instance of acute pyogenic epiphyseal osteomyelitis due to MRSA infection of the distal femur in an otherwise healthy child. The incidence of acute primary pyogenic osteomyelitis is 0.5-1 in 5,000 cases [5]. Although it can occur at any age, it is most common in children under four years, peaking between one and two years [2]. The patient was two years old. Long-term observation is necessary because late sequelae due to physeal or articular involvement are common. Treatment should be initiated as early as possible; delays can lead to joint destruction and are associated with poor prognosis. Inadequate curettage may also result in unfavorable outcomes [6]. In our short-term follow-up, no deformities were observed.

Care should be taken to avoid injury to the growth plate. Common complications arise from physeal stimulation, and premature physeal arrest has been reported, leading to limb length or alignment discrepancies and loss of movement [6]. Children under two years of age are at a higher risk of developing disseminated disease and severe complications [7]. Regular follow-up is required to identify any angular deformity or articular cartilage thinning early in the course of the disease.

In this patient, postoperative tissue and pus culture samples showed no growth, likely due to initiation of antibiotics prior to surgery. Aggressive surgical removal of necrotic and infected tissues, combined with prolonged antibiotic therapy, is considered the treatment of choice for eradicating bone infection in osteomyelitis [8].

Drug-laden calcium sulphate has been used in the treatment of osteomyelitis in children, although the method and effectiveness are not well defined, and there are limited studies on its use for paediatric haematogenous osteomyelitis both nationally and internationally [9]. Calcium sulphate is an osteoinductive and absorbable material that is gradually resorbed, and helps manage the dead space created by removal of necrotic bone. In a retrospective study by Liu D et al., on the treatment of haematogenous osteomyelitis in children using calcium sulphate, none of the patients required reoperation [9]. [Table/Fig-6] explains the few cases of acute pyogenic epiphyseal osteomyelitis [2,5,6,7,10-15].

Author and year	No.of cases	Causative organism	Management	Follow-up	Outcome
Shah MM et al., [2], 2020	18	11- *M. tuberculosis* 6- *S. aureus* 1- Brucella.	Surgical (Arthrotomy)-9 Non-surgical-9	66 months	No complications-13 Thinning of A.C-4 Complete erosion of A.C-1
Hwang HJ et al., [5], 2016	1	Joint fluid and tissue – *S. aureus*	Surgical	18 months	No complications
Yoo WJ et al., [6], 2014	8	4- *M.bovis* bacille Calmette Guerin 3- *M.tuberculosis* 1- non tuberculous mycobacterium	Surgical-4 Non-surgical-4	49 months	No complications- 3 Physeal damage-4 Valgus angulation-1
Abdelgawad AA et al., [10], 2007	1	Tissue culture-Salmonella Typhi B	Surgical	N/A	No complications
Kao FC et al., [7], 2003	2	Tissue culture-Salmonella enteritidis	Surgical	16 months 6 months	No complications
Rasool MN [11], 2001	2	N/A	Surgical	2.4 years	No complications
Longjohn DB et al., [12], 1995	2	Blood and tissue culture-*S. aureus*	Surgical	6 years 2 years	No complications
Maffulli N and Fixsen JA [13], 1990	1	Tissue culture-negative	Surgical	10 months	No complications
Sorensen TS et al., [14], 1988	3	Tissue culture negative-2 Tissue culture-*S. aureus*	Surgical	9 months 9 years 3 years	Partial Epiphysiodesis-1 (9 year follow-up) No complications-2
Kramer SJ et al., [15], 1986	1	Blood culture-Negative Joint fluid-*S. aureus*	N/A	N/A	N/A

[Table/Fig-6]: Literature review of articles describing acute pyogenic epiphyseal osteomyelitis [2,5,6,7,10-15].
AC: Articular Cartilage; M: Mycobacterium; S: Staphylococcus; N/A: Not available

CONCLUSION(S)

Although rare, epiphyseal osteomyelitis should be considered in the differential diagnosis of a painful, swollen knee in children. Multiple diagnostic modalities are necessary to confirm the condition. Aggressive surgical intervention followed by antibiotic therapy is crucial to prevent joint destruction. Care must be taken to avoid injury to the physis during surgery, as damage can lead to future deformities.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Dec 03, 2024
- Manual Googling: Jul 10, 2025
- iThenticate Software: Jul 12, 2025 (9%)

ETYMOLOGY: Author Origin

EMENDATIONS: 9

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Dec 03, 2024**
Date of Peer Review: **Mar 07, 2025**
Date of Acceptance: **Jul 14, 2025**
Date of Publishing: **Dec 01, 2025**