

## Brodie's abscess, a pathology difficult to diagnose

### Absceso de Brodie, una patología de difícil diagnóstico

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#### What do we know about the subject matter of this study?

Clinical suspicion is essential for diagnosing Brodie's abscess, a sub-acute osteomyelitis of low incidence and difficult to diagnose. It can mimic several diseases, as it presents a clinical suggestive of bone tumors, both benign and malignant.

#### What does this study contribute to what is already known?

We present a clinical case describing the epidemiological and etiological characteristics as well as the difficulty in diagnosing it. In addition, we analyzed the literature on the pathology.

#### Abstract

Acute osteoarticular infections in children are rare pathologies, therefore early diagnosis and prompt treatment are crucial to avoid acute and long-term complications. Brodie's abscess (BA) is an uncommon type of subacute osteomyelitis, difficult to diagnose, so clinical suspicion is essential. **Objective:** To describe a case of Brodie's abscess and its etiological and clinical features. **Clinical Case:** A 14-year-old patient was seen at our clinic, who reported a one-month pain in the right thigh, with no history of fever or trauma. Physical examination revealed no volume increase, painful right hip range of motion, and increased sensitivity on superficial palpation of the right iliotibial band. X-rays where normal. Because of the pain persistence, an ultrasound was requested which showed a cortical irregularity. Magnetic resonance imaging (MRI) was performed and revealed a right femoral diaphysis, due to a possible bone tumor or an infectious process. Lab tests were normal. Biopsy and cultures were collected, identifying multi-sensitive *Staphylococcus aureus*. He was managed with debridement and intravenous antibiotics, responding positively. **Conclusions:** The BA's clinical features and lab tests are unspecific, therefore the non-specialist physician should strongly suspect this pathology as a possible differential diagnosis in patients who persist with pain and present imaging alterations, even when there are no other symptoms or normal inflammatory parameters. A bone biopsy is essential for the differential diagnosis of tumor pathologies.

**Keywords:**  
Osteomyelitis;  
Abscess;  
Brodie;  
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## Introduction

Acute pediatric osteoarticular infections have a low frequency, 10-80 per 100,000 children<sup>1</sup>, which require early diagnosis and appropriate treatment to avoid acute complications or long-term morbidity.

There are 3 types of osteomyelitis (OM): acute, subacute, and chronic. According to their pathogenesis, they can be classified as hematogenous, direct inoculation, and contiguous-focus. The most common form of presentation in children is acute OM, however, subacute hematogenous forms have been rising, due to increased host resistance, decreased bacterial virulence, and/or previous exposure to antibiotics, resulting in injury limited to the bone<sup>2</sup>. Surgical drainage of these bone infections results in positive cultures in 50-75% of patients. *Staphylococcus aureus* is the most common causal organism (30-60%), but there may be others such as *Streptococcus*, *Pseudomonas*, *Haemophilus influenzae*, *Kingella kingae*, and coagulase-negative *Staphylococci*<sup>2-4</sup>.

Through hematogenous seeding, the infection mainly affects the metaphysis of the long bones (better-irrigated area without basement membrane), invades the bone, initiates an inflammation process that conditions bone resorption, proteolytic enzymes are released, destroying the bone and forming pus. This increases intramedullary pressure and the pus can drain into the subperiosteal or medullary canal. Since in Brodie's abscess (BA) the germs are of low virulence, this process is long and reacts by forming new bone over the infected one, which is known as involucrum. If it drains into the periosteum, the infected bone has disruption of the blood vessels, so it becomes necrotic and forms a sequestrum<sup>4-6</sup>.

For this reason, there are two clinical forms in pediatric patients that depend mainly on the patient's age and etiology. The infantile form (age 6 months to 4 years) represents 85% of the patients with subacute OM. Improved diagnostic techniques, such as polymerase chain reaction (PCR), have shown *Kingella kingae* as the main microorganism, with low virulence, and low inflammatory response<sup>3,7,8</sup>. In the juvenile form (age > 4 years), the main cause is methicillin-resistant *Staphylococcus aureus* (MRSA). Host resistance is likely to exist and it may even contain a severe bone infection. Resistance can be explained by frequent colonization of MRSA in children; 20% of people are permanently colonized in the nose<sup>4-6</sup>.

BA has been described as a subacute form of OM that is difficult to diagnose due to the absence of systemic inflammatory signs and symptoms of acute disease<sup>9-11</sup>. It has an insidious onset and presents mainly with pain<sup>3,7</sup>. The primary area of bacterial spread is often unknown, however, it has been suggested that bone

susceptibility increases after minor traumatic events without open wounds or fractures.

This form of OM represents between 2.4% and 42% of primary bone infections in patients aged between 6 months and 39 years, mainly concentrated in the range of 2-15 years<sup>4,7</sup>.

The incidence is unevenly distributed worldwide, where developed countries are the most affected. Publications are predominantly from developed countries, which is likely to result in a publication bias on the global incidence of the disease<sup>10</sup>. In Chile, there is no record of its incidence.

This pathology can mimic several diseases since it presents signs and symptoms that would make suspect bone tumors, both benign and malignant<sup>12,13</sup>.

There are few good-quality studies in the literature, most of which are case reports. The objective is to report a case of AB and describe the etiological and clinical characteristics.

## Clinical Case

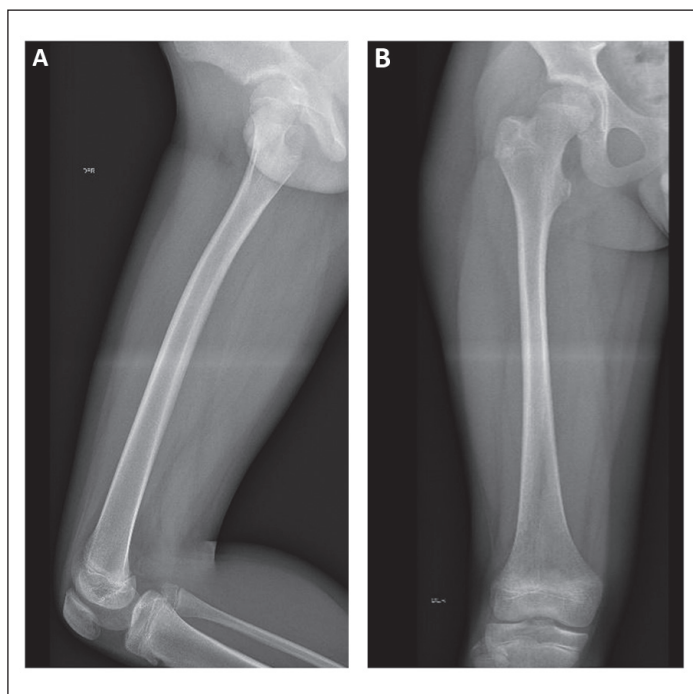
14-years-old male patient, with history of ADHD treated with Aripiprazole and Escitalopram, consulted due to a one-month pain in the right thigh, without fever or trauma. On physical examination, there was no increase in volume, painful right hip range of motion (ROM), and increased sensitivity in the right iliotibial band (ITB) on palpation. AP-Löwenstein pelvis x-ray and AP-Lateral right femur x-ray were performed, which showed no femoral bone injury or hip alterations (figure 1).

We initiated treatment with non-steroidal anti-inflammatory drugs (NSAIDs), rest from physical activity, local heat, kinesiotherapy, and soft tissue ultrasound.

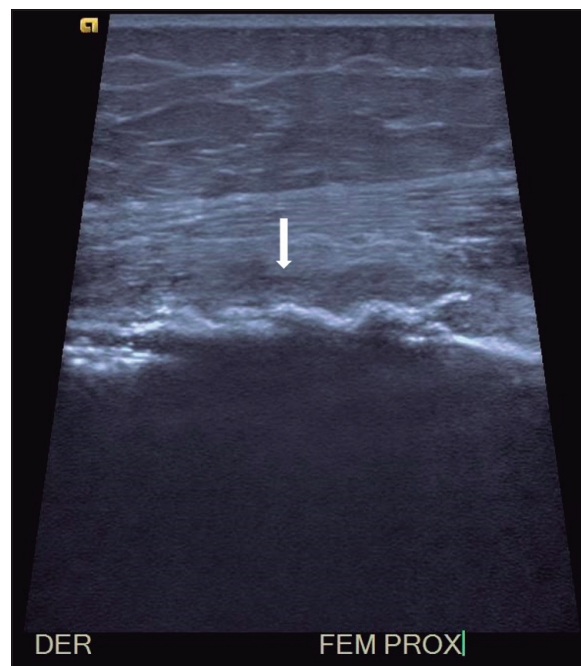
Due to persistent discomfort, soft tissue ultrasound was performed three weeks after the initial consultation, which showed a cortical alteration of the proximal femoral diaphysis, with an area of loss of cortical continuity and irregular bone proliferation (figure 2). It was complemented with femur x-ray, where we observed a poorly defined lytic, cortical, permeative lesion of 8 mm in the longitudinal axis (figure 3).

It was considered a bone tumor as a differential diagnosis, therefore, we decided to complement it with Magnetic Resonance Imaging (MRI) which showed a posterior proximal diaphysis and intracortical lesion of the right femur with characteristics highly suggestive of inflammatory-infectious strain lesion (intracortical Brodie's Abscess), with extensive reactive bone marrow edema, periosteal reaction, and edema and hyperemia of adjacent muscle planes (figure 4).

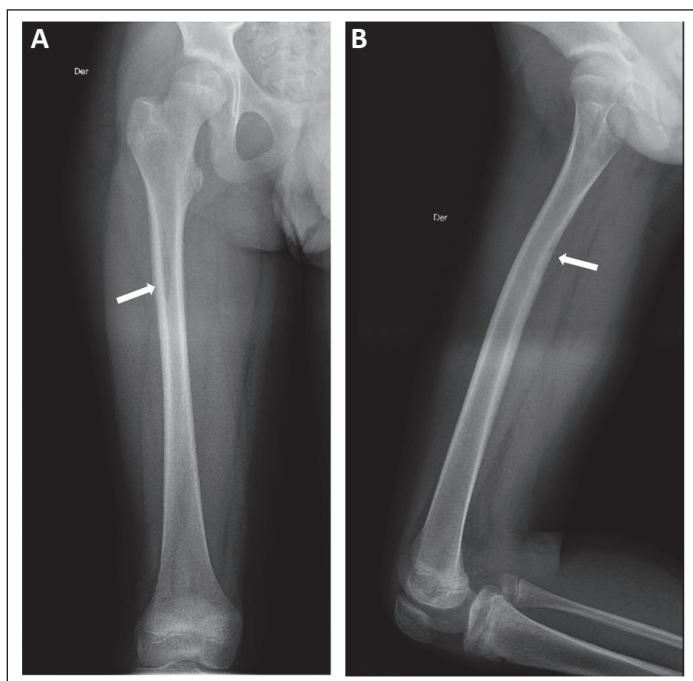
Biopsy of bone tissue was performed with oncology



**Figure 1.** X-ray of the right femur: **A)** lateral and **B)** PA. No evidence of a traumatic or destructive bone injury.



**Figure 2.** Echotomography of the right thigh: alteration and irregularity of the cortex of the right proximal femur, associated with periosteal reaction.



**Figure 3.** Femur X-ray: **A)** PA; **B)** Lateral. A poorly defined permeative cortical lytic lesion, measuring approximately 8 mm in the longitudinal axis, associated with immature periosteal reaction.

gical criteria due to the low probability of small-cells neoplastic lesion or histiocytosis X, due to the primary intracortical location, and sample collection for cultures.

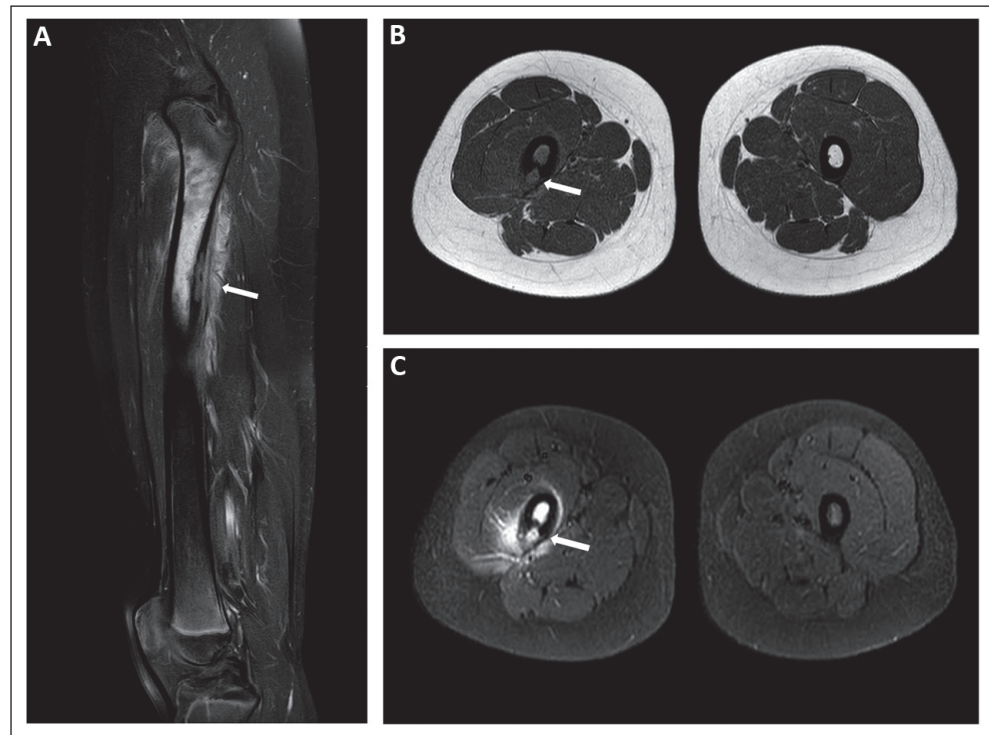
At the time of diagnosis, inflammatory parameters showed a leukocyte count of 7700/ $\mu$ L, CRP of 0.03 mg/dL, and an erythrocyte sedimentation rate of 10 mm/hr, all within normal ranges.

After 24 hours, a positive culture of bone tissue was reported for *Staphylococcus aureus* and the anatomopathological report showed biopsy compatible with osteomyelitis, without evidence of neoplasia.

Surgical debridement was performed showing positive cultures for MRSA, starting intravenous antibiotic treatment with Vancomycin and Ampicillin/sulbactam for 14 days, with good clinical response. He was discharged from the hospital with indication of relative rest plus oral antibiotics (Rifampicin 300 mg/12 hours and Ciprofloxacin 500 mg/12 hours) for 2 months.

The patient completed the medical treatment with oral antibiotics, obtaining a clinical and radiographic improvement of the lesion. He continued with outpatient follow-up for approximately 1 year and returned to sports practice.

**Figure 4.** MRI of the right femur. **A)** Sagittal STIR; **B)** Axial T1; **C)** T1 axial with Gadolinium. An intracortical lesion (white arrow) compatible with Brodie's abscess is observed in the posterolateral cortex of the proximal third of the femur. The extensive bone edema of the medullary, periosteal and neighboring muscles stands out.



## Discussion

In most cases of AB, patients present with persistent pain as the main symptom, along with local sensitivity. Symptoms are usually present for 2 weeks or more before diagnosis. On physical examination, localized tenderness may be associated with heat, redness, or soft-tissue edema with subcutaneous bone involvement. Pain may occur with movement of the adjacent joint, and there may be joint effusion, but these are usually mild. The surrounding muscles occasionally show inflammatory involvement<sup>14</sup>. The patient in our case presented pain in the right thigh for one month before consultation, painful ROM of the hip, and increased sensitivity to superficial palpation of ITB, without increased volume.

In laboratory tests, the common findings are usually negative blood cultures, leukocyte counts within the normal or slightly elevated range, and slightly elevated measurements of erythrocyte sedimentation rate and CRP, however, they may be within the reference ranges in 30-50% of patients<sup>2</sup>. In our case, the inflammatory parameters were not altered.

Many imaging techniques have been described to diagnose Brodie's abscess; X-ray, CT scan, MRI, and nuclear medicine. MRI has proven to be superior to plain radiography in diagnosing osteomyelitis in adults, and in children, it is the technique of choice

for distinguishing between infection, bone tumor, and other lesions<sup>10,15</sup>. However, this imaging technique is not available in all hospitals, so sometimes it is necessary to complement the radiological study with other tests (ultrasound, CT scan, bone scan). In our case, the initial X-rays did not present any alterations.

As the picture persisted, an ultrasound was performed and new X-rays were taken that showed lesions in the right diaphyseal femoral cortex. The study was complemented with MRI to distinguish an infectious process from a bone tumor. It was observed an extensive reactive bone marrow edema, periosteal reaction, and edema and hyperemia of adjacent muscle planes, suggesting an infectious process.

Classic BA, first described by Sir Benjamin Brodie, is a well-defined lytic metaphyseal lesion surrounded by sclerosis. Currently, the Gledhill classification modified by Roberts et al<sup>16</sup>, allows the characterization of the radiological findings of the lesions based on their location, morphology, and similarity with neoplasms. Based on this classification and the radiographic characteristics of malignant or benign neoplasms, possible differential diagnoses can be proposed according to the patient's age, signs, and location.

Some benign neoplasms would be the osteoid osteoma, eosinophilic granuloma, and solitary bone cyst. Ewing sarcoma and metastases are some of the malignant neoplasms<sup>12,16</sup>.



According to Roberts et al. classification, Type III and Type IV lesions are diaphyseal. They can present single-layer or multilayered periosteal reaction, with or without bone destruction. In addition, a soft tissue inflammation that covers the lesion can be observed<sup>16</sup>. The clinical case was a type III cortical proximal femoral lesion with a periosteal reaction.

The penumbra sign in T1-W MRI imaging helps to exclude the presence of a tumor and thus supports the diagnosis of subacute osteomyelitis. They show a thick layer of highly vascularized granulation tissue. It is a discrete peripheral area, with a signal intensity slightly greater than the abscess cavity and the surrounding marrow edema, and of lower signal intensity than the bone marrow<sup>13,17</sup>.

The treatment of subacute hematogenous OM is medical-surgical. Considering the low viability of the cultures, most of the time we must start an empirical antibiotic treatment (EAT), based on the distribution of the germs according to age and risk factors. The empirical treatment should always include coverage of *Staphylococcus aureus*; if the agent is identified, the treatment should be adjusted according to sensitivity.

The treatment is mainly a sequential regimen of intravenous and then oral EAT. Currently, the clinical and laboratory response (CRP levels) is used to decide the switch to oral EAT. The total duration of treatment should not be less than 6 weeks<sup>10</sup>.

The principal role of surgery is to drain purulent collections, thus improving the affected area to allow the access of the EAT. If the bone does not regenerate, a permanent defect can be produced. The surgery also allows the removal of necrotic remains and thus avoids the evolution to chronicity. It consists of periosteal incision and removal of all exudate and necrotic content. In large defects, antibiotic cement beads can be introduced. It may be necessary to repeat surgical debridement, depending on the evolution of the patient. Once controlled the infection, some authors recommend the introduction of bone graft in the defect<sup>18</sup>.

By carrying out an adequate medical-surgical treatment, there are success rates of 95 to 98% of cases<sup>10,18</sup>. In our case, surgical debridement and intravenous antibiotic treatment were performed for 14 days, with good clinical response. Oral antibiotic treatment

was continued for 2 months, obtaining a successful clinical response.

## Conclusion

The medical history, physical examination, inflammatory parameters, and imaging studies are not enough for an accurate diagnosis of BA. The non-specialist physician must have a high index of suspicion of this pathology as a possible differential diagnosis in patients who persist with pain and present a radiological alteration, even in the absence of other normal inflammatory parameters and symptoms. It is important to perform a bone biopsy to rule out tumor pathologies.

## Ethical Responsibilities

**Human Beings and animals protection:** Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

**Data confidentiality:** The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

**Rights to privacy and informed consent:** The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

## Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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