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Research Article

Infections Related to Osteosynthesis Materials: Epidemiological and Clinical Aspects in the Orthopedic and Trauma Surgery Department at the Gabriel Touré University Hospital

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Received: April 20, 2026; **Published:** June 23, 2026

Abstract

Introduction and Aim: Infections related to osteosynthesis hardware (IMO) represent a serious complication in orthopaedic surgery, with significant clinical and economic consequences. Surgical site infections associated with implanted devices remain a major concern due to increased morbidity, prolonged treatment duration, and healthcare costs [1,2]. The aim of this study was to describe the epidemiological, clinical, and microbiological aspects of osteosynthesis hardware infections at the Gabriel Touré University Hospital Center.

Materials and Methods: This was a retrospective and prospective study conducted from January 1, 2024, to December 31, 2024, including 40 patients presenting with osteoarticular infection.

Results: The frequency of IMO was 8.3% of surgical procedures, with a predominance among young men (80%, mean age 33.2 years). Open fractures (55%) and road traffic accidents (67.5%) were the main associated factors. *Staphylococcus aureus* was the most common pathogen (35%), showing high sensitivity to gentamicin. Hardware removal (60%) combined with appropriate antibiotic therapy led to a favorable outcome in 90% of cases; however, complications (nonunion, osteitis, amputation) occurred in 10% of patients.

Conclusion: Osteosynthesis hardware infections remain a major challenge, requiring early and multidisciplinary management. Strengthening preventive measures, optimizing antibiotic therapy, and improving aseptic conditions are essential to reduce their incidence and improve clinical outcomes.

Keywords: *Infections; Osteosynthesis Hardware; Staphylococcus aureus; Open Fractures; Prevention; Bamako; Mali*

Introduction

Surgical site infections (SSIs) are defined as healthcare-associated infections occurring within 30 days following a surgical procedure, or within one year in cases involving the placement of an implant, prosthesis, or prosthetic device [2]. Among these infections, osteosynthesis hardware infections (IMO) represent a specific subcategory, characterized by their occurrence after the insertion of metallic devices (plates, screws, nails, etc.) used to stabilize a fracture or an osteotomy [3].

Although bone surgery involving osteosynthesis hardware placement represents a major advancement in trauma and orthopaedic care, it remains one of the important causes of osteitis in adults, requiring complex management in which antibiotic therapy plays a central role [3]. IMO continue to be a serious complication, both at the individual and collective levels. They are associated with major diagnostic and therapeutic challenges, high morbidity, prolonged treatment duration, and substantial economic cost [1,2].

In developed countries, IMO affect between 2% and 5% of operated patients, with a rate of approximately 1.5% in orthopaedic surgery [9,15]. However, in developing countries such as Mali, bone surgery is often performed under difficult conditions, with limited resources in terms of equipment, materials, infection prevention programs, and qualified personnel. These constraints increase the risk of nosocomial infections and complicate their management [4,10].

Open fractures are particularly associated with increased infection risk due to initial bacterial contamination, soft tissue damage, and compromised vascularity [5,6].

Aim of the Study

The aim of this study was to describe the epidemiological, clinical, therapeutic, and microbiological aspects of osteosynthesis hardware infections at the Gabriel Touré University Hospital Center.

Materials and Methods

This was a retrospective and prospective study conducted from January 1, 2024, to December 31, 2024 (12 months).

Inclusion criteria: All patients presenting with infection of osteosynthesis hardware, including prosthetic devices, who were followed in the department were included in this study.

Exclusion criteria: The following patients were not included in this study:

- Patients who discharged themselves against medical advice;
- Incomplete medical records;
- Patients initially operated on in other departments.

Data were collected from hospitalization records, operative reports, and outpatient follow-up files. The information was recorded using an individual survey form.

The collected data were analyzed using SPSS software version 26.0. Data entry and processing were performed using Word 2021 and Excel 2021 for Windows.

Results

A total of 40 patients were included, giving a frequency of osteosynthesis hardware infections of 8.3% (40/483) of all surgical procedures. Males were predominant, with 32 cases (80%), corresponding to a sex ratio of 4. The mean age was 33.2 ± 15 years (Range: 15 - 75 years).

Seventy percent of patients were educated. Most patients (72.5%) were admitted through the emergency department, while 27.5% were seen in outpatient consultations. Sixty percent of patients presented within the first 12 hours. Preoperative general condition was good in most cases, with ASA I in 82.5% and ASA II in 17.5%, reflecting a relatively young and generally healthy trauma population.

Thirty percent of patients had medical histories, including diabetes (12.5%), hypertension (7.5%), and sickle cell disease (2.5%). The main indications for implantation were open fractures (55%), closed fractures (40%), and hip osteoarthritis (5%). Open fractures were predominantly Gustilo-Anderson types I and II (36.3% each). Lower limb involvement was most common (75%), particularly the leg (35%).

Regarding surgical classification, procedures were clean in 50% of cases, clean contaminated in 32.5%, contaminated in 12.5%, and dirty in 5%. Initial surgery was performed as an emergency in 72% of patients. The most frequent delay in management was 12-24 hours (37.5%), although 15% were treated after 72 hours.

Risk factors identified included smoking (27.5%), traditional treatment (25%), obesity (10%), and immunosuppression (2.5%). Osteosynthesis was performed in 92.5% of patients and arthroplasty in 7.5%. Implants used included plates and screws (42.5%), external fixators (22.5%), intramedullary nails (12.5%), pins (10%), total hip prostheses (7.5%), and screws alone (5%).

Forty percent of patients had hospital stays longer than two weeks. Antibiotic therapy duration varied, with 50% receiving treatment for less than two months. Infection management consisted of hardware removal (60%), debridement (22.5%), sequestrectomy (10%), and debridement with hardware replacement (7.5%).

Microbiologically, *Staphylococcus aureus* was the most frequently isolated organism (35%), followed by *Escherichia coli* (15%), *Proteus mirabilis* (10%), *Morganella morganii* (5%), and *Klebsiella pneumoniae* (2.5%). Mixed infections were also observed, and 22.5% of cultures were sterile. The most commonly used antibiotics included gentamicin (19 cases), amikacin (15), ciprofloxacin (13), imipenem (11), amoxicillin-clavulanic acid (8), cefixime (5), and cotrimoxazole (5).

Outcomes were favorable in 90% of patients. Complications occurred in 10% of cases and included nonunion (3 cases), delayed union (3 cases), osteitis (2 cases), and amputation (1 case). No statistically significant association was found between the studied variables (sex, age, ASA score, risk factors, infection site, type of surgery) and outcomes (all p-values > 0.05).

Figure 1: *Infection of the left leg exposing the tibial plate.*

Figure 2: *Infection involving an external fixator of the right leg.*

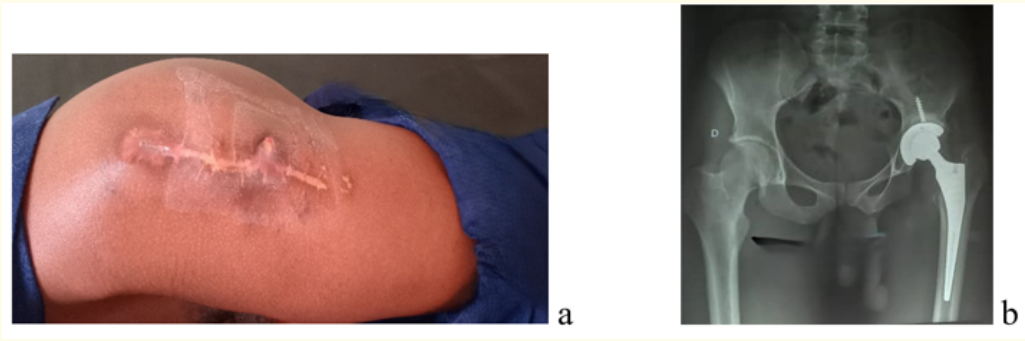

Figure 3: *Superficial infection of the left total hip prosthesis: (a) clinical view; (b) radiographic image.*

Discussion

The frequency of osteosynthesis hardware infections was 8.3%, higher than that reported in developed countries (1 - 5%), likely reflecting context-specific challenges such as limited resources, delays in management, and suboptimal aseptic conditions. Similar increased rates of surgical site infections have been reported in orthopaedic surgery settings in developing countries, where infrastructure limitations and infection prevention challenges contribute significantly [4,9,10,15].

Open fractures were the leading indication and are well known to carry a higher risk of infection due to initial contamination, soft tissue injury, and impaired local vascularization. Previous studies have demonstrated that inadequate soft tissue coverage, bone loss, and fracture severity are important predictors of infection following open fractures [5,6].

Medical histories were present in 30% of patients, with diabetes being the main risk factor (12.5%). Diabetes is recognized as an important contributor to postoperative infection due to impaired immune response, delayed wound healing, and altered tissue repair

mechanisms [7]. Smoking was the most common risk factor (27.5%), negatively affecting bone and tissue healing through reduced vascularization, impaired angiogenesis, and altered inflammatory responses [11].

The predominance of *Staphylococcus aureus* is consistent with the literature, where it is recognized as the primary pathogen involved in osteosynthesis hardware infections because of its ability to adhere to implants and produce biofilms [13,14]. Biofilm formation on metallic implants represents a major therapeutic challenge because it reduces bacterial susceptibility to antibiotics and contributes to persistent infection [13,14].

The effectiveness of management, particularly hardware removal combined with appropriate antibiotic therapy, explains the favorable outcomes in most patients. However, the occurrence of complications highlights the severity of these infections and the importance of early diagnosis, adequate surgical management, and appropriate antimicrobial therapy [3,13].

The delay before surgical management may also influence infection risk, particularly in traumatic injuries. Delayed intervention has been associated with increased infection rates in some trauma settings due to prolonged bacterial exposure and tissue compromise [12].

Conclusion

Although outcomes were favorable in 90% of cases due to appropriate surgical and medical management, the observed complications underscore the severity of these infections and the need for early intervention. Risk factors such as smoking, traditional treatment, and delays in management highlight the importance of awareness campaigns and improved healthcare organization.

Furthermore, the predominance of *Staphylococcus aureus* and increasing antibiotic resistance require careful selection of antimicrobial therapy and improved microbiological practices. Strengthening infrastructure and preventive protocols is essential to reduce the incidence of osteoarticular infections and improve clinical outcomes in this setting.

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Volume 17 Issue 4 April 2026