

Infected nonunion caused by multidrug-resistant *Klebsiella pneumoniae*: A case series on the use of a synthetic biodegradable osteoconductive bone substitute combined with amikacin

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1. INTRODUCTION

- Fracture-related infection (FRI) is a complex complication of orthopedic trauma.
- Gram-negative bacilli account for a significant proportion of FRIs in Brazil, representing 33.3% to 38.5% of isolates, with *K. pneumoniae* being particularly prominent.
- KPC-producing *K. pneumoniae* presents limited therapeutic options.

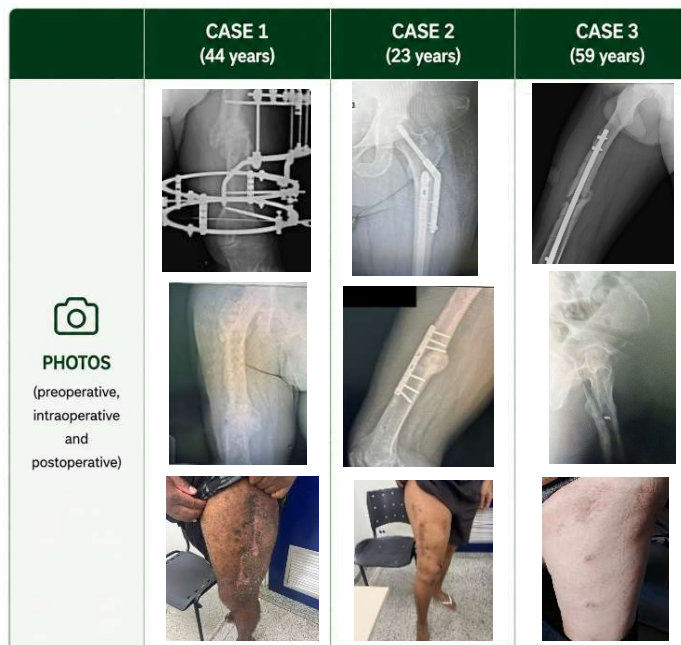
2. OBJECTIVE

- **Primary objective:** To describe three cases of chronic femoral fracture-related infection (FRI)/nonunion caused by KPC-producing *K. pneumoniae*, treated with locally administered amikacin incorporated into PerOssal®.

3. METHODS

- **Study design:** Retrospective, descriptive case series of 3 clinical cases of FRI followed at a tertiary-care hospital.
- **Criteria and analysis:** Cases were characterized according to international FRI criteria; resistance was defined based on the susceptibility profile of each isolate.

4. CASES



5. RESULTADOS

ASPECTS	CASE 1 (44 years)	CASE 2 (23 years)	CASE 3 (59 years)
 Microbiology	<i>Klebsiella pneumoniae</i> producing KPC, isolated from 3 bone fragments (March 2025).	<i>Klebsiella pneumoniae</i> producing KPC, isolated from 3 bone fragments and 1 soft-tissue sample.	<i>Klebsiella pneumoniae</i> producing KPC, isolated from 3 soft-tissue samples.
 Susceptibility (S) / Resistance (R)	S: amikacin and ceftazidime-avibactam. R: gentamicin, meropenem, cefepime, and piperacillin-tazobactam.	S: exclusively to amikacin among the antimicrobials tested.	S: amikacin, gentamicin, and ceftazidime-avibactam.
 Local and systemic antibiotic therapy	PerOssal® + amikacin 2 g + polymyxin B 500,000 IU, combined with meropenem + IV amikacin for 6 weeks.	PerOssal® + amikacin 2 g + vancomycin 2 g; meropenem 2 g q8h + amikacin 500 mg q12h for 6 weeks.	PerOssal® + amikacin 2 g + vancomycin 2 g; meropenem 2 g q8h + amikacin 500 mg q12h for 6 weeks.
 Outcome	Infection control, with no need for new antibiotic therapy; external fixator removal and fracture union, with no need for further interventions through June 2026.	Infection control, wound healing, absence of sinus tract formation/drainage, and complete fracture union, with no signs of active infection.	Infection control, absence of new sinus tract formation or clinical signs of infection, and progressive fracture union.

6. CONCLUSION



Rationale for local therapy:
allows high concentrations of antimicrobials directly at the focus.



Interpretation of the cases:
the three cases demonstrate feasibility and favorable evolution, but the outcome resulted from a multimodal approach, so the success cannot be attributed solely to PerOssal®.



Gaps and safety:
there is a need for more studies to identify the standardized dose.



Future research:
studies are needed to define dose, concentration, elution kinetics, safety, and efficacy of amikacin.



PerOssal®:

Amikacin + PerOssal® was effective as adjunctive strategy in complex FRI caused by KPC-Kp with limited therapeutic options.