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Management of Infected Both-Bone Forearm Nonunion with Ulnar Plating and Radial Onlay Bone Graft

(A Case Report)

Abstract

Infected nonunion of both forearm bones presents significant therapeutic challenges. Conventional methods often involve prolonged stabilization or complex grafting techniques with variable functional outcomes. A 49-year-old diabetic female presented with purulent drainage and failed union after two prior surgeries for open forearm fractures. Radiographs confirmed infected nonunion with retained hardware. A staged protocol was performed as such: (1) Radical debridement, ulnar plating, and antibiotic-cement spacer placement in the radial defect; (2) After interim antibiotics, spacer wasremoved and radius reconstructed with tricortical iliac crest autograft, fixed with screws, and augmented by cancellous grafting. At 24-week follow-up, radiographic union was achieved with no infection recurrence. Approximately 90% of contralateral forearm range of motion was restored, with no donor site complication. This approach—combining immediate ulnar stabilization with staged radial reconstruction using the Masquelet technique—effectively resolved infection and restored function in complex both-bone nonunion. It represents a strategic balance of mechanical and biological principles for challenging upper limb reconstruction.

Keywords: Ununited Fractures, Osteomyelitis, Radius Fractures, Ulna Fractures

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Introduction

Nonunion of the forearm presents a complex and debilitating challenge in orthopedic trauma surgery, significantly impairing upper limb function. Infected nonunion—particularly involving both bones radius and ulna—further complicates management due to the dual burden of mechanical instability and persistent infection.[1] This condition remains relatively rare yet impacts patients' quality of life, occupational capacity, and healthcare resource utilization.[2]

Current strategies often involve staged protocols. Prasarn et al. addressed segmental defects with open iliac crest bone grafting and secondary wound healing, requiring prolonged intravenous antibiotics.[2] Ebied et al. employed the Ilizarov external fixator with bone grafting after initial debridement,[3] while Dhar et al. utilized the Masquelet ("induced membrane") technique with antibiotic cement spacers and delayed autografting.[4] Although these methods achieve union, limitations persist—including prolonged external fixation, donor-site morbidity, inconsistent functional recovery, and the need for multiple surgeries.

The forearm functions as a kinematic unit integrating the elbow, wrist, and interosseous membrane.[1, 5] Successful reconstruction thus demands not only eradication of infection and bone healing but also restoration of rotational stability and adjacent joint mobility. No consensus exists on the optimal approach for *both-bone* infected nonunions with segmental defects, where simultaneous mechanical stability and biological reconstruction are critical.

We present a modification of the Masquelet technique for infected both-bone nonunion: immediate ulnar plating combined with radius reconstruction using antibiotic cement spacer followed by later tricortical iliac onlay grafting. This approach aims to provide immediate stability to one bone while leveraging the induced membrane biology for the other bone, potentially optimizing functional outcomes.

Case Presentation

A 49-year-old woman with chronic diabetes presented to our clinic with recurrent infection and persistent wound drainage following two prior surgeries for an open both-bone forearm fracture. Her initial injury resulted in fractures of distal radius and ulna (figure 1), and after undergoing primary fixation elsewhere (figure 2), she developed infectious nonunion requiring revision surgery, which failed to resolve the infection. Upon presentation, severe purulent discharge was observed from the wound site, and radiographic evaluation confirmed infected nonunion with retained hardware involving both forearm bones. Under the orthopedic team's care, the patient underwent surgical debridement with removal of all previous hardware, followed by extensive irrigation and debridement. Forty-eight hours postoperatively, repeat irrigation and debridement were performed, after which antibiotic-impregnated bone cement was placed in the radial defect while the ulna, which demonstrated a clean wound bed, was stabilized with plate fixation. The patient then received culture-directed intravenous antibiotics for two weeks followed by four weeks of oral antibiotics as prescribed by the infectious disease specialist.

Figure 1: Pre- Operative Radiographic Findings Demonstrate Fractures of The Distal Radius and Ulna

Two weeks after cement placement, the antibiotic spacer was removed during the second-stage surgery, and a tricortical bone graft was harvested from the iliac crest and contoured to fit the radial defect. This graft was secured with three screws, and the surrounding defect was filled with autogenous cancellous bone harvested from the same iliac site (figure 3). Postoperatively, a long arm cast was maintained for eight weeks, after which supervised physiotherapy was initiated to restore range of motion.

Figure 2: Images Demonstrating the Internal Plate and Screws Placed During the Initial Surgery

At final follow-up, radiographic union was confirmed (figure 4) and the patient achieved approximately 90% range of motion compared to the contralateral forearm (figure 4), with no complications reported at the iliac graft donor site.

Discussion

Infected nonunion of both forearm bones represents a formidable clinical challenge, compounded by the complex biomechanics of the forearm as an integrated functional unit involving the elbow, wrist, and interosseous membrane.[6, 7] This case illustrates how a staged protocol—combining immediate ulnar plating with radial Masquelet reconstruction—can simultaneously address infection eradication and functional restoration. The rationale for differential management of the two bones merits careful consideration. By plating the ulna during initial debridement, we achieved immediate stability in a bone with viable soft tissue, while the radial defect was contained within an antibiotic cement spacer. This approach aligns with Richards' principle of treating the forearm as a kinetic chain,[1] where stabilizing one bone preserves functional anatomy during the infection-control phase.

Figure 3: Final Surgery a: X-ray (lateral view) b: X-ray (AP view)

The biological strategy for radial reconstruction leveraged the induced membrane technique,[4] which generated a vascularized environment conducive to graft incorporation. Our use of tricortical iliac autograft differs significantly from Davis et al.'s bulk allograft method,[8] where 57% of patients required secondary procedures for union. The autograft's osteogenic properties likely contributed to our first-attempt union, avoiding allograft incorporation failures. Moreover, avoiding external fixation—as used in Ebied et al.'s Ilizarov protocol[3]—precluded pin-site complications and enabled earlier rehabilitation.

Comparative analysis reveals critical advantages over alternative approaches. Regarding infection control, our protocol achieved definitive eradication without recurrence, mirroring Dhar et al.'s Masquelet outcomes[4] but surpassing Prasarn et al.'s open grafting technique,[2] which reported reinfection in diaphyseal defects. Comparing functional outcomes, our patient regained about 90% of range of motion, exceeding the rotational recovery in Ilizarov cohorts[3] and approaching the plating results in Regan et al.'s non-infected series.[9] Considering technical efficiency, the immediate ulnar fixation reduced total treatment time compared to dual-bone staging, aligning with Hoit et al.'s emphasis on early mechanical stability in infected nonunions.[10]

Notably, the success in this diabetic patient—a population at high risk for impaired healing[11]—underscores the technique's biological efficacy. However, limitations warrant acknowledgment. As Steinmetz et al. emphasiz,[11]

Figure 4: (a) functional outcome. (b) pronation

Infection management requires culture-directed antibiotics, yet our interim regimen followed standard protocols rather than pathogen-specific data. Additionally, while tricortical grafting sufficed for this defect, larger segmental losses might necessitate vascularized grafts as in Davis et al.'s series.[8]

Conclusion

This case demonstrates that staged management of infected both-bone forearm nonunion—combining initial ulnar plating with delayed radial reconstruction via the Masquelet technique and tricortical iliac autograft—represents a viable alternative to conventional methods. The protocol achieved definitive infection eradication, radiographic union, and restoration of approximately 90% of the contralateral limb's functional range of motion. While the approach proved successful in this diabetic patient with prior failed surgeries, its efficacy warrants further validation in larger cohorts. Nevertheless, it offers a strategic balance of mechanical stabilization and

biological augmentation for complex upper limb reconstruction.

Ethics Statement

Written informed consent was obtained for publication. Institutional review was waived per local policy for de-identified case reports.

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