**RESEARCH PAPER**

# Antibiotic-Supplemented Autologous Platelet-Rich Fibrin (A-PRF) as a Local Drug Delivery Matrix for Surgical Management of Chronic Osteomyelitis in a Neglected Bilateral Mandibular Fracture: A Case Report

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**ABSTRACT**

**Background:** Delayed presentation of maxillofacial trauma predisposes to secondary chronic osteomyelitis, and this risk is amplified in chronic smokers because nicotine-mediated microvascular compromise impairs bony perfusion and healing. Managing an infected, ununited fracture in this setting is difficult because systemic antibiotics reach the avascular focus poorly. Autologous platelet-rich fibrin (PRF), a second-generation leukocyte- and platelet-rich fibrin matrix, has been explored as a local carrier that can be loaded with antibiotics before centrifugation to combine haemostatic/regenerative scaffolding with sustained, site-directed antimicrobial delivery.

**Case Presentation:** A 60-year-old male with a long smoking history presented three months after trauma with an unreduced, infected bilateral mandibular fracture (left body and right parasymphysis) and clinical/radiographic features of chronic osteomyelitis. Under general anaesthesia, aggressive surgical curettage and sequestrectomy were performed, and an autogenous chin (symphyseal) bone graft was placed. To circumvent the impaired local vascularity expected in a heavy smoker, 10 mL of autologous whole blood was combined with penicillin (2.5 mg/mL) and metronidazole (2.5 mg/mL) prior to centrifugation, yielding an antibiotic-supplemented advanced-PRF (A-PRF) matrix that was grafted directly into the debrided infected site. The patient was followed clinically and radiographically at defined postoperative intervals.

**Conclusion:** An antibiotic-loaded autologous A-PRF matrix, used as an adjunct to aggressive debridement and autogenous bone grafting, is a feasible chairside local drug delivery strategy for infection control in a compromised, delayed mandibular fracture setting. It may be a useful adjunct where systemic vascular delivery of antibiotics is expected to be unreliable, such as in heavy smokers; controlled studies are needed to confirm efficacy and define an optimal antibiotic-loading protocol.

**Keywords:** Platelet-rich fibrin; local drug delivery; chronic osteomyelitis; mandibular fracture; antibiotic carrier; smoking; bone graft

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## 1. INTRODUCTION

Mandibular fractures that remain unreduced for a prolonged period are prone to infection, non-union, and secondary chronic osteomyelitis, particularly when the odontogenic or wound flora is allowed to persist within the fracture gap. Chronic suppurative osteomyelitis of the mandible classically follows inadequately treated trauma, odontogenic infection, or irradiation, and is characterised by devitalised bone (sequestra) that perpetuates recurrent infection unless removed[1]. Recognised host and local risk factors for a poor outcome, recurrence, and complications in chronic suppurative osteomyelitis of the jaw include delayed or inadequate initial treatment, persistence of pathogenic teeth in the fracture line, and systemic conditions that compromise the inflammatory and vascular response[2].

Cigarette smoking is an independent contributor to impaired bone and soft-tissue healing: nicotine and associated vasoactive constituents reduce peripheral microcirculatory perfusion, blunt neutrophil and osteoblastic function, and lower local tissue oxygen tension, all of which limit the penetration of systemically administered antibiotics to an infected, poorly vascularised fracture site. This pharmacokinetic barrier is a central rationale for exploring local, site-directed antimicrobial delivery as an adjunct to surgical debridement in smokers, rather than relying on systemic dosing alone.

Platelet-rich fibrin (PRF) is an autologous, chairside-prepared leukocyte- and platelet-rich fibrin matrix obtained by centrifuging whole blood without anticoagulants or exogenous thrombin. The advanced-PRF (A-PRF) modification uses a lower relative centrifugal force and longer spin time than first-generation PRF protocols, which is reported to preserve a greater proportion of leukocytes and yields a matrix that degranulates growth factors slowly over several days, supporting angiogenesis, osteogenesis, and soft-tissue healing. Because PRF is essentially a fibrin sponge formed from the patient's own plasma proteins, it can additionally act as a local drug carrier when antibiotics are added to the blood sample before centrifugation or injected into the formed matrix; a systematic review of in vitro studies has summarised several such antibiotic-loading strategies and confirmed sustained local antibacterial activity without major loss of PRF's structural integrity[3]. Clindamycin- and beta-lactam-loaded PRF membranes have been shown to retain measurable antibiotic concentrations and in vitro antibacterial activity after preparation[4], and clinical work using penicillin- or clindamycin-loaded PRF placed into extraction/surgical sockets has reported reduced postoperative pain, swelling, and trismus compared with plain PRF[5,6], supporting the general premise that PRF can function as a local drug-delivery vehicle in the oral and maxillofacial region.

Antibiotic-loaded platelet concentrates have also been explored specifically for infected bone defects, where combining the wound-healing properties of a platelet-derived scaffold with sustained local antibiotic release was intended to improve both bacterial clearance and osseous repair[7], and PRF has been used as an adjunct within composite grafts for jaw bony defects[8] and even for management of osteoradionecrosis, a comparably ischaemic and infection-prone bony condition[9]. To our knowledge, the specific combination described in the present report — an autologous A-PRF matrix supplemented with both penicillin and metronidazole before centrifugation, used to treat established chronic osteomyelitis complicating a delayed, unreduced bilateral mandibular fracture in a heavy smoker — has not been widely reported, and is presented here as a case-based illustration of local, drug-delivery-oriented infection control in a vascularly compromised host, a theme relevant to the drug delivery and translational-therapeutics scope of this journal.

## 2. CASE REPORT

A 60-year-old male, a long-standing heavy cigarette smoker, presented with a three-month history of an untreated facial injury. Clinical examination revealed malocclusion, abnormal mobility at the left mandibular body and right parasymphyseal regions, purulent intraoral discharge, and localised tenderness with overlying soft-tissue induration, consistent with a chronically infected, unreduced bilateral mandibular fracture. Orthopantomographic and computed tomographic imaging confirmed fracture lines through the left mandibular body and right parasymphysis with surrounding osteolysis, sequestrum formation, and loss of normal trabecular pattern, in keeping with superimposed chronic osteomyelitis.



**Figures 1 and 2** show the preoperative clinical presentation.




**Figure 3** shows the preoperative radiographic presentation.

Given the chronicity of infection and the anticipated impairment of systemic antibiotic delivery to the fracture site in a heavy smoker, a combined surgical and local drug-delivery strategy was planned. Under general anaesthesia, aggressive surgical curettage of the infected fracture margins was performed, with removal of necrotic bone sequestra, fibrous interposed tissue, and granulation tissue until bleeding, viable bone margins were reached at both fracture sites. An autogenous corticocancellous bone graft was harvested from the symphyseal (chin) region and contoured to the debrided defect.

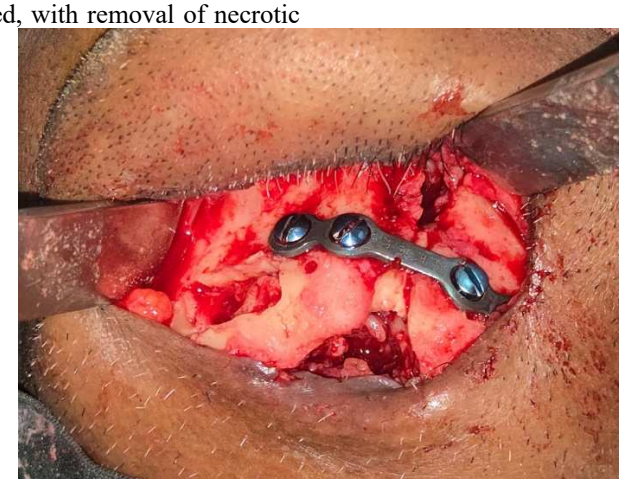


**Figure 4** illustrates the intraoperative curettage and chin bone graft harvest.

To engineer a local antimicrobial drug delivery matrix, 10 mL of the patient's autologous venous blood was drawn into plain (non-anticoagulated, glass-coated) tubes and supplemented with penicillin at a concentration of 2.5 mg/mL and metronidazole at a concentration of 2.5 mg/mL prior to centrifugation, following the general low-speed centrifugation principle used for advanced-PRF preparation. Centrifugation was carried out to produce a standard A-PRF clot/membrane, which was then compacted into a graft-compatible plug. The resulting antibiotic-supplemented A-PRF matrix was packed directly into and around the debrided, grafted fracture sites, combining the regenerative fibrin/growth-factor scaffold of A-PRF with a depot of two antimicrobials with complementary Gram-positive and anaerobic coverage, targeted at the mixed aerobic-anaerobic odontogenic flora typically implicated in mandibular osteomyelitis.

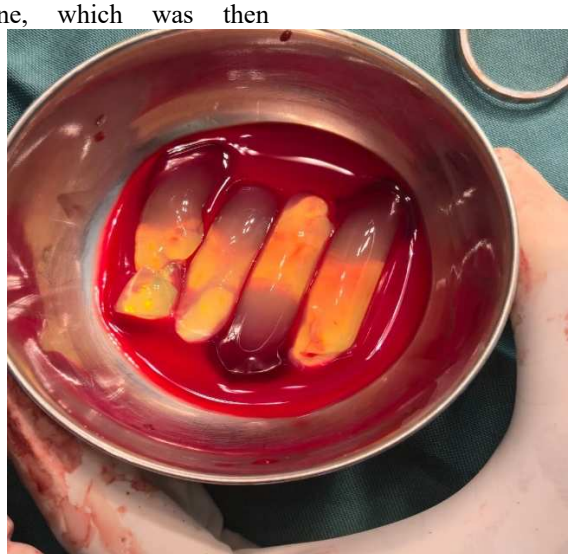


**Figure 5** depicts preparation of the antibiotic-supplemented A-PRF matrix.

Primary closure was achieved in layers, and the patient was maintained on maxillomandibular guidance/fixation as clinically indicated and received a postoperative systemic antibiotic regimen. The patient was reviewed postoperatively at 1, 4, 12, and 24 weeks. No further surgical intervention was required during the follow-up period described.





**Figures 6 and 7** show the postoperative follow-up findings.



**Figure 8** shows the postoperative radiographic findings at 12 weeks.

**Table 1** summarises the composition of the antibiotic-supplemented A-PRF protocol used.

**Table 1.** Composition of the antibiotic-supplemented A-PRF protocol

| Component | Quantity / concentration | Purpose |
|---|---|---|
| Autologous whole blood | 10 mL | Base substrate for A-PRF matrix formation |
| Penicillin | 2.5 mg/mL (added to blood before centrifugation) | Local antimicrobial cover — Gram-positive/odontogenic flora |
| Metronidazole | 2.5 mg/mL (added to blood before centrifugation) | Local antimicrobial cover — anaerobic flora |
| Centrifugation | Low-speed A-PRF protocol | Formation of leukocyte- and platelet-rich A-PRF fibrin matrix |
| Autogenous chin bone graft | Harvested intraoperatively | Osteoconductive/osteogenic scaffold at debrided defect |

## 3. DISCUSSION

Chronic suppurative osteomyelitis complicating a delayed mandibular fracture presents a therapeutic dilemma: definitive cure requires both mechanical debridement of infected, poorly vascularised bone and sustained antimicrobial exposure at the site, yet the same avascularity that predisposes to chronicity also limits the delivery of systemically administered antibiotics. This problem is compounded in chronic smokers, in whom nicotine-related vasoconstriction and impaired neutrophil/osteoblast function are recognised contributors to delayed bone healing and non-union. The rationale for the approach used in this case — combining aggressive surgical debridement and autogenous bone grafting with a locally placed, antibiotic-supplemented A-PRF matrix — was to place a sustained-release antimicrobial depot directly at the compromised site, bypassing reliance on unpredictable systemic perfusion.

PRF and its advanced (A-PRF) variant are attractive local carriers for this purpose because they are autologous, inexpensive, prepared chairside without additives, and already used widely in oral and maxillofacial surgery for their regenerative properties. Incorporating an antibiotic into the whole blood before centrifugation, as performed here with penicillin and metronidazole, is one of several loading strategies described in the literature, alongside injecting antibiotic into an already-formed PRF membrane or pre-treating the donor systemically; a recent systematic review of in vitro evidence found that antibiotic-loaded PRF generally retains measurable, sustained antibacterial activity, although release kinetics and structural effects on the fibrin matrix vary by antibiotic class, concentration,

and loading method[3]. Comparable pharmacokinetic work with clindamycin-loaded PRF membranes prepared from patients already receiving intravenous therapy has demonstrated that clinically relevant antibiotic concentrations can be recovered from the resulting membrane[4], and controlled clinical studies of penicillin- and clindamycin-supplemented PRF placed in extraction or surgical sockets have shown measurable reductions in postoperative pain, swelling, and trismus compared with unsupplemented PRF or systemic antibiotics alone[5,6], supporting the biological plausibility of the antimicrobial-release effect exploited in the present case.

The use of an antibiotic-loaded platelet-derived scaffold specifically for an infected bone defect, rather than a soft-tissue extraction socket, has also been investigated, with in vitro and animal data suggesting that combining sustained antibiotic release with a regenerative wound-healing scaffold can support both infection control and bone repair simultaneously, although antibiotic loading can attenuate growth-factor release and disturb the platelet-fibrin ultrastructure to a degree that depends on the antibiotic and its concentration[7]. This trade-off is relevant to the protocol used here: the concentrations of penicillin and metronidazole chosen were intended to provide effective local antimicrobial cover without excessively compromising the structural and regenerative properties of the A-PRF matrix, but the present case cannot itself quantify that balance, and pharmacokinetic confirmation (e.g., measured local antibiotic concentration and release profile) was not performed. PRF-based composite grafts have similarly been used to support healing of substantial jaw bony defects[8], and PRF placement has been reported as part of successful management of osteoradionecrosis, a condition that shares the combination of chronic infection and severely compromised local vascularity seen in the present smoker[9], reinforcing that a locally delivered, biologically active scaffold can be a useful adjunct when the vascular substrate for systemic drug delivery or spontaneous healing is unreliable.

From a surgical standpoint, the combination of thorough curettage/sequestrectomy with autogenous bone grafting remains the accepted cornerstone of chronic suppurative osteomyelitis management, since devitalised, infected bone acts as a persistent nidus for infection irrespective of any local or systemic antimicrobial strategy[1,2]. The antibiotic-supplemented A-PRF matrix used in this case is therefore best understood as an adjunct to, rather than a replacement for, adequate debridement: it was intended to provide sustained local antimicrobial cover across the immediate postoperative window during which vascular ingrowth into the grafted, previously infected site is still establishing, and during which reliance on systemic antibiotic penetration in a heavy smoker was judged unreliable.

This report has the inherent limitations of a single case: outcome cannot be attributed with certainty to the antibiotic-loaded A-PRF component as distinct from the debridement and grafting themselves, no comparator (e.g., plain A-PRF or systemic-antibiotic-only) group was available, and local antibiotic concentration/release at the graft site was not measured. Larger comparative series or controlled studies, together with pharmacokinetic characterisation of antibiotic release from A-PRF prepared by this blood-supplementation method, are needed before the approach can be recommended more broadly for infected, vascularly compromised fracture sites.

## 4. CONCLUSION

In a heavy smoker with a neglected, infected bilateral mandibular fracture and chronic osteomyelitis, surgical debridement and autogenous chin bone grafting supplemented with a penicillin- and metronidazole-loaded autologous A-PRF matrix provided a practical, low-cost, site-directed local drug delivery strategy that bypassed the limitations of systemic antibiotic delivery through compromised vasculature. The approach illustrates a broader translational-therapeutics principle — using an autologous, chairside-prepared biomaterial as an antimicrobial carrier — that merits further controlled evaluation as a local drug delivery system in similarly compromised maxillofacial infection settings.

### Conflict of Interest

The authors declare no conflict of interest.

### FUNDING

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### Ethical Approval and Consent

This case report was conducted in accordance with institutional ethical guidelines. Written informed consent was obtained from the patient for publication of this case report and any accompanying clinical images/radiographs.

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