

Autologous Platelet-Rich Fibrin to Treat Difficult Nonhealing Diabetic Foot Wounds with Exposed Bone – A Case Report of This Safe, Effective, and Economical Method

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Abstract

Diabetic wounds, especially with exposed bones, are notorious to cause complications. Various drugs and substances have been tried by different researchers in their quest for early painless healing. We report our patient with peripheral vascular disease (PVD) and chronic nonhealing wound with exposed bone successfully treated with autologous platelet-rich fibrin (PRF). Our patient with a diabetic foot ulcer and PVD underwent an amputation of the great toe. His wound could not be closed, and there was exposed bone on the floor of the ulcer. Regular treatment may have caused nonhealing, osteomyelitis, and spreading gangrene. His PVD contraindicated a vascular flap cover. Hence, we tried the use of autologous PRF on the wound. The hospital stay was minimized, adjuvant procedures were not needed, and the wound healed well in 4 weeks. PRF is a very economical and safe adjuvant in the fight to treat difficult wounds.

Keywords: Diabetic foot, platelet-rich fibrin, surgery, wound healing

INTRODUCTION

Diabetic wounds and those with exposed bones are notorious to cause complications requiring multidisciplinary care and long periods of time to treat successfully.

Platelet-rich fibrin (PRF) has been used for facilitating bone healing in implant dentistry.^[1] PRF accentuates cell migration, proliferation, and healing and promotes cicatrization in difficult situations like exposed bone.^[2,3] It has not been described in patients with associated peripheral vascular disease (PVD). We report our patient with a chronic nonhealing wound with exposed bone, successfully treated with PRF.

CASE REPORT

Our patient is a 60-year-old diabetic, reformed smoker with an infected, nonhealing ulcer over the right great toe extending to the medial aspect of the second toe. A nail prick to the great toe 2 weeks back progressed into an ulcer. After an initial

debridement at an outside hospital, the condition of the limb worsened and he was referred to us for management. On examination, there was a 5 cm × 4 cm × 3 cm circumferential ulcer over the lateral aspect of the right great toe encroaching the medial aspect of the second toe. There was inflammation around the ulcer with blackish discoloration at the tip of the great toe [Figure 1a and b]. Dorsalis pedis, posterior tibial, and anterior tibial pulsations were absent. The toe discoloration worsened after initial debridement in our hospital [Figure 1c and d].

Investigations

Culture from the wound showed heavy growth of multidrug-resistant *Klebsiella pneumoniae*. Routine blood investigations showed a total count of 13.58 K/uL, C-reactive protein – 108 mg/L, glycated

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Figure 1: (a) Preoperative picture on presentation to hospital showing ulcer at the base of great toe with wet gangrene, (b) Plantar view, (c) After initial debridement at our hospital, (d) wound worsening after the initial debridement, (e) after ray amputation of the right great toe showing exposed bone in the floor, (f) Application of negative pressure wound therapy

hemoglobin – 12.4%, and serum creatinine 1.31 mg/dl. Other parameters were within normal levels.

Arterial Doppler suggested diffuse atheromatous disease in both lower-limb vessels. Femoral, popliteal, and posterior tibial arteries showed biphasic flow on the right side with the absent flow in the anterior tibial artery, suggesting moderate vascular compromise in the right lower limb. Treatment – Since there was ascending infection with blackening of the tip of the great toe [Figure 1c and d] on the second day, the patient underwent right great toe amputation with debridement of the medial aspect of the second toe. However, intraoperatively, wound closure could not be obtained due to ascending infection and lack of skin. At the amputated site, the bone was exposed on the floor of the ulcer [Figure 1e]. Negative pressure wound therapy was done for 5 days [Figure 1f]. The wound did not show much improvement, and bone continued to stay exposed. Based on culture-sensitivity parenteral, cefoperazone-sulbactam 1.5 g was given twice daily to control the infection.

In view of poor blood supply to the region, we considered placing autologous PRF over the ulcer to promote wound healing. Based on earlier publications of the use of PRF in dental surgery,^[1,3] this option was discussed with the patient, and consent was taken for this new line of therapy. About 150 ml of the patients' own blood was collected in the blood bank in sterile 10 ml conical tubes and centrifuged at 3000 rpm for 10 min. The upper clear acellular plasma was discarded, and the yellow gel formed in the center of the tube was used. The ulcer was debrided and cleaned thoroughly, filled with this PRF, and the area was covered using a dry collagen

sheet [Figure 2a and b]. Wound inspection was done after 48 h. The patient was discharged with advice to continue daily saline dressings over the wound at home. At the end of 1 week, PRF was placed once more on the wound [Figure 2c]. At the end of 3 weeks, it was observed that the ulcer had completely filled up with healthy granulation tissue which covered the underlying exposed bone [Figure 2d and e]. Biofilm developing on the wound was excised, and one more PRF was placed on the wound at this point in the outpatient [Figure 2e and f]. The wound healed in 4 weeks with a healthy scar [Figure 3]. Since admission was limited to a minimum and there was very little requirement for major dressings or antibiotics, the treatment was found to be cost-effective.

DISCUSSION

Diabetic foot is an end-stage disease, causing neuropathy and severe arteriopathy, particularly in small vessels, resulting in ischemia, infection, and ulceration of the foot.^[4] Conventionally, treatment involves surgical debridement, antibiotic therapy for the infection, vascular procedure when indicated, and off-loading the ulcer. A host of newer adjuvant methods such as negative pressure therapy, hyperbaric oxygen therapy, and newer wound care products have been tried with beneficial effects.^[2]

Exposed bone in a diabetic foot increases the possibility of nonhealing, osteomyelitis, and of further higher amputation. Often, “out-of-the-box thinking” and expertise helps to successfully treat these ulcers.^[5] The safety and efficacy of topical application of recombinant human platelet-derived growth factor-BB in stimulating the healing of chronic,



Figure 2: (a) PRF being placed on the wound, (b) Collagen sheet placed over PRF, (c) wound inspection at one week showing healthy granulation tissue covering wound, (d) wound inspection at 3 weeks with biofilm, (e) Biofilm excised, (f) Second sitting of PRF at 3rd week



Figure 3: Healed wound

full-thickness, lower extremity diabetic neurotrophic ulcers has been validated.^[6]

PRF developed by Choukroun *et al.* has been used since 2001 by maxillofacial surgeons for facilitating bone healing in implant dentistry.^[1,3] The use of PRF in healing of ulcers has been a natural extension. It helps to promote wound healing, hemostasis, bone growth, and maturation. It is also useful to close difficult wounds.^[3,5]

PRF is a matrix of fibrin with platelets incorporated into it along with leukocytes, cytokines, and circulating stem cells. This fibrin matrix is polymerized in a tetra-molecular structure.^[7] Many studies have shown that this biomaterial is safe without any increased inflammatory activity. Since PRF accentuates cell migration and proliferation, it promotes cicatrization and healing in difficult situations like exposed bone.^[2,8] PRF has also been used along with bone grafts.

The cost of making the product is minimal and works out to about INR 300 (~\$5/3.5 €) in our institution. All it needs is about 60–150 ml of the patient's own blood depending on the size and volume of the wound.

Our patient had PVD, diabetic foot ulcer (DFU) with gangrene, and a difficult wound to close with an exposed bone. After the use of this modality of wound therapy, the wound healed efficiently. The limb could be salvaged using this autologous blood product.

CONCLUSION

In patients with DFU and exposed bone complicated by PVD, applications of PRF on the wound resulted in safe, cost-effective, and early healing of the wound.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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