

Reconstruction of Chronic Wounds Secondary to Injectable Drug Use with a Biodegradable Temporizing Matrix

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Summary: Injectable drug use in the upper extremity often leads to chronic wounds complicated by osteomyelitis. Conventional reconstructive options are often not feasible and/or are contraindicated in this patient population. We have started using a synthetic, biodegradable temporizing matrix (BTM) for the treatment of these patients. We hypothesize that BTM is a safe, low-risk, and low-morbidity alternative reconstructive option. We report outcomes after staged debridement and BTM application followed by split-thickness skin grafting for two patients with large, chronic bilateral forearm wounds with concomitant osteomyelitis confirmed by MRI and biopsy. No acute surgical complications were encountered and at a mean follow-up of 13 months, both patients had maintained stable soft-tissue coverage. Reconstruction using BTM is a novel treatment option that can simplify the reconstruction, reduce donor-site morbidity, and optimize success for patients with chronic wounds resulting from injectable drug use. Initial outcomes are promising; however, further comparative studies are needed to better evaluate long-term outcomes of this technique. (*Plast Reconstr Surg Glob Open* 2021;9:e3678; doi: 10.1097/GOX.0000000000003678; Published online 12 July 2021.)

Management of chronic wounds secondary to subdermal injectable drug use (IDU) is challenging.¹⁻³ Repeated IDU results in local vascular destruction, skin necrosis, abscess formation, chronic ulceration, and osteomyelitis.⁴⁻⁶ Conventional reconstructive techniques are usually not applicable for these patients.^{2,3} Substantial soft-tissue defects with exposed bone and abundant scar tissue obviates skin grafting and severely compromises locoregional flap options.^{2,3} Although free tissue transfer might be indicated, biopsychosocial complexities in these patients may decrease the likelihood of successful outcome, and benefits must be scrutinized against the backdrop of potential drug abuse and relapse.⁷

The optimal reconstruction should minimize risk of failure while limiting donor-site morbidity. We have started using a novel synthetic dermal template (biodegradable temporizing matrix—BTM) (Polynovo Biomaterials Pty Ltd., Adelaide, Australia) for treatment of upper extremity soft-tissue defects and have had excellent clinical success.^{7,8} Its bioabsorbable matrix provides a scaffold for dermal proliferation and vascularization, over which split-thickness skin grafts (STSG) can be subsequently applied. We hypothesize that BTM could be a low-risk, predictive, reconstructive option for this patient population. We present outcomes in two cases of IDU upper extremity chronic wounds with underlying osteomyelitis, that were successfully debrided and reconstructed with staged BTM and skin grafting.

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CASE PRESENTATIONS

Case 1

A 36-year-old right-hand-dominant man presented with bilateral upper extremity soft-tissue defects that were sustained in the setting of work-associated thermal burn, complicated by IDU at the site of injury. The wounds were full thickness with exposed ulnae. Magnetic resonance imaging (MRI) was consistent with bilateral ulnar shaft osteomyelitis and myositis. Addiction medicine was

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involved, and serial debridement of the soft-tissue and bone were performed to healthy, bleeding tissue. Bone cultures grew pan-sensitive *Achromobacter denitrificans* and multi-drug resistant *Stenotrophomonas maltophilia*. The infectious disease team initiated oral minocycline 100 mg BID and a 6-week course of intravenous ceftazidime 2g TID. Before BTM application, the right- and left-sided wounds measured 57.5 cm² and 82.5 cm², respectively. They were covered with a perforated BTM and negative pressure dressing (NPD). Subsequent follow-up revealed well-adhered BTM without evidence of infection, fluid collection, or matrix loss. A meshed STSG measuring approximately 120 cm² was applied 4 weeks later, and at 22 months follow-up, the patient remained addiction-free with stable soft-tissue reconstruction.

Case 2

A 33-year-old right-hand-dominant woman with a 2-year history of bilateral forearm wounds secondary to IDU presented with worsening ulcerations (Fig. 1). Necrotic bone was present in the wound base, and MRI confirmed bilateral ulna osteomyelitis, myositis, and soft-tissue micro-abscesses (Fig. 2). Wound cultures grew methicillin-sensitive *Staphylococcus aureus* and culture-directed intravenous antibiotics were managed by our infectious disease team. Addiction medicine was consulted and 2 months later, the patient underwent soft tissue and osseous debridement with immediate application of BTM. After debridement the right- and left-sided wounds measured approximately 120 cm² and 84 cm², respectively (Fig. 3). Perforated BTM was covered with NPD. Biweekly follow-up visits over the next 2 months revealed satisfactorily adhered BTM. Seven weeks after application, a sheet STSG measuring 70 cm² was applied, and at 4-month follow-up, she demonstrated stable soft-tissue coverage without active signs of infection (Fig. 4).

DISCUSSION

Successful reconstruction of chronic, infected soft-tissue defects with underlying osteomyelitis requires serial debridement of all nonviable tissues before

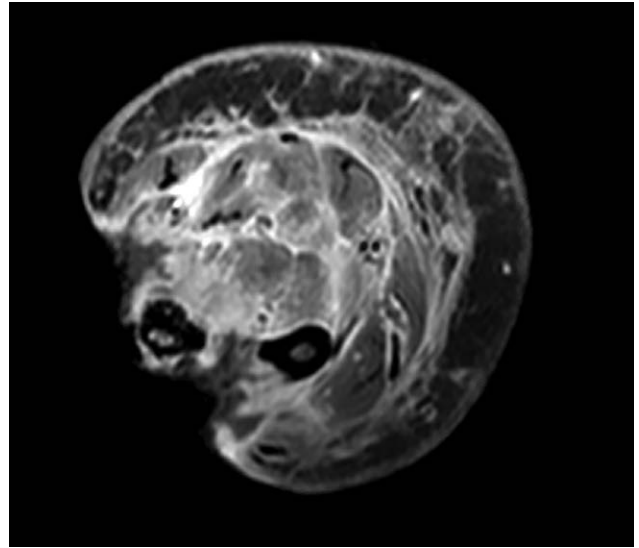


Fig. 2. Magnetic resonance imaging showing ulna osteomyelitis, myositis, and multiple soft-tissue micro-abscesses.



Fig. 3. Exposed bone and resulting soft-tissue defect after debridement.



Fig. 1. Right full-thickness chronic forearm wounds with exposed necrotic ulna.



Fig. 4. Stable soft-tissue coverage after skin grafting at 3 month follow-up visit.

reconstruction.^{9,10} Here, we present two patients with extensive bilateral forearm soft-tissue defects and osteomyelitis secondary to IDU successfully treated with IV antibiotics, debridement and staged reconstruction using BTM and STSG.

Free tissue reconstruction is the gold-standard for wounds with exposed bone devoid of periosteum, but is associated with increased donor-site morbidity, cost, and postoperative pain.^{11–13} These risks are magnified in the IDU population where ongoing drug use or relapse and poor adherence to postoperative care may increase the risk of complications and failure.^{3,12} Less complex options such as skin grafting or locoregional flaps may be contraindicated secondary to debridement of the periosteum, surrounding soft-tissue fibrosis, and persistent infection.² NPD can also be utilized to stimulate granulation for skin grafting; however, the size of the defect, possible persistent infection, and need for prolonged treatment may cause problems with this approach.

Dermal substitutes and subsequent STSG offer a potentially less complex, morbid, and costly alternative.^{11–13} Kozak and colleagues compared outcomes after free flap, local tissue rearrangement, and Integra for complex wounds with exposed bone and tendon and demonstrated that Integra achieved over 70% success rate, at a lower total cost.¹³ Dermal substitutes such as Integra and BTM also have decreased donor-site morbidity and operative times when compared with free tissue reconstruction.

To date, Integra is perhaps the best characterized dermal substitute. Its biologic matrix is derived from bovine tendon collagen and glycosaminoglycan, which facilitate host cell infiltration, neovascularization, and collagen deposition. The use of a biologic matrix, although effective, is associated with increased cost and susceptibility to infection and rejection. BTM is a novel, completely synthetic polyester–polyurethane matrix that functions similarly as a scaffold for cellular infiltration. The polyurethane is biodegradable by hydrolysis, and in vitro studies have shown that its byproducts are minimally cytotoxic.¹⁴ The fully synthetic framework also helps eliminate risk of cross-species antigenicity, and the nonbiologic matrix has been shown to be more resistant to infection.^{13,15–20} It is worth noting that the noncellular nature of BTM has been reported to help withstand wound contraction in animal models.²¹ In our cohort, although this was not the case, our treatment strategy utilized NPD to improve wound-healing in this high-risk population, which may have contributed to wound contraction.

Early outcomes presented here are encouraging; however, this report is not without limitations. The sample size, heterogeneity of patients/wounds, and relatively limited follow-up makes generalization problematic. It is possible that persistent, incompletely treated osteomyelitis could result in late wound breakdown. Our treatment strategy also involved staged and concomitant treatment modalities, including antibiotics, serial debridement, NPD, and skin grafting. Although we believe BTM was essential to healing, its effect alone could not be completely elucidated. It is also unclear the maximal area of

exposed bone that can be successfully covered using this approach. However, in our experience, BTM is able to successfully adhere to large areas of exposed bone devoid of periosteum. Despite these shortcomings, we feel that our successes are reproducible if a multi-disciplinary approach is applied as we have outlined above for this specific patient population, and this approach potentially decreases cost, risk, and morbidity.

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