International Surgery Journal
Sharma S et al. Int Surg J. 2025 Dec;12(12):2201-2203
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20253855

Case Report

Volar forearm defect following high-voltage electrical burn managed with biodegradable temporizing matrix and split-thickness skin grafting: a case report

Saurabh Sharma*, Sunil Srivastava

Department of Plastic and Reconstructive Surgery, SMS Medical College and Hospital, Jaipur, Rajasthan, India

Received: 18 August 2025
Revised: 14 October 2025
Accepted: 15 November 2025

***Correspondence:**
Dr. Saurabh Sharma,
E-mail: saurabh0811@gmail.com

ABSTRACT

High-voltage electrical burns involving the volar forearm present formidable reconstructive challenges due to exposure of tendons and neurovascular structures. We report the case of a 52-year-old male electrician from a rural setting who sustained a high-voltage contact burn to the right volar forearm during occupational exposure. Following fasciotomy and serial debridements, the wound bed demonstrated extensive tendon exposure that precluded immediate grafting. A biodegradable temporizing matrix (BTM) was applied to promote neodermis formation. The matrix integrated fully within three weeks, after which split-thickness skin grafting was performed with 85% graft take. At 12 weeks, the patient achieved full wrist and finger motion with no contracture or hypertrophic scarring. The use of BTM allowed preservation of function, avoided the need for flap reconstruction, and achieved durable coverage with satisfactory cosmetic and functional results. This case highlights the efficacy of BTM in managing complex upper-limb electrical burns in resource-limited settings.

Keywords: Biodegradable temporizing matrix, Electrical burn, Volar forearm defect, Synthetic dermal substitute, Split-thickness skin graft, Tendon exposure

INTRODUCTION

Electrical burns constitute a small but devastating subset of burn injuries, accounting for 3-5% of admissions to burn units and often resulting in deep tissue necrosis disproportionate to visible skin injury.[1] High-voltage injuries (>1000 V) are particularly destructive, leading to damage of skin, subcutaneous tissue, muscles, tendons, and nerves.[2] The volar forearm, due to its dense concentration of vital tendons and neurovascular structures, is especially vulnerable, and the preservation of tendon glide and joint motion remains a reconstructive priority.[3]

Traditional reconstructive options include local, regional, and free flaps that provide durable coverage and vascularity. However, flap surgery may not always be feasible due to wound contamination, systemic instability, or limited microsurgical resources.[4] Dermal substitutes such as BTM have emerged as promising alternatives, providing a scaffold for cellular infiltration and neodermis formation.[5] Several clinical studies have demonstrated their usefulness in managing complex wounds involving tendon and bone exposure.[6-8] This case report details successful functional restoration using BTM and subsequent split-thickness grafting for a volar forearm defect following high-voltage electrical burn.

CASE REPORT

A 52-year-old right-hand-dominant male electrician from rural Rajasthan sustained a high-voltage contact burn to his right forearm while repairing an electrical connection.

There was no history of diabetes, hypertension, or smoking. On presentation, he was hemodynamically stable with a Glasgow coma scale score of 15. The local examination showed a full-thickness burn involving the volar forearm extending from the distal third to the wrist, with exposure of multiple flexor tendons, median nerve, and radial artery. Distal perfusion and digital motor-sensory function were preserved.

Initial management followed ATLS principles, including fluid resuscitation, analgesia, tetanus prophylaxis, and intravenous antibiotics. Following emergency fasciotomy and serial debridements, a clean, vascular wound bed was achieved, but tendon exposure precluded grafting. Considering the patient's reluctance for free-flap reconstruction and local resource limitations, BTM (NovoSorb®, PolyNovo, Australia) was applied, cut to size, and secured with stainless-steel staples. Dressings were changed every 3-4 days. A minor infection at two weeks was managed with daily dressings and antibiotics. By day 30, uniform pink coloration indicated full matrix integration. The sealing membrane was removed, and a meshed split-thickness skin graft from the ipsilateral thigh was applied and secured with staples. The wrist was immobilized in a volar splint for five days, followed by physiotherapy.

At one week, graft take was 85%, with small areas managed conservatively. By 12 weeks, the patient regained full active wrist and finger motion with preserved grip strength and no contracture or hypertrophic scarring.

DISCUSSION

Reconstruction of electrical burns involving exposed tendons is complex and often requires vascularized tissue for coverage.[9] Immediate grafting over bare tendons is rarely successful due to inadequate vascularity.[10] Flap coverage remains the gold standard but may not always be practical in contaminated or resource-limited scenarios.[11]

Dermal substitutes like BTM provide a synthetic scaffold that allows cellular infiltration and neovascularization, forming a neodermis suitable for later grafting.[12]

BTM consists of a porous biodegradable polyurethane foam bonded to a sealing membrane, offering resistance to infection, excellent handling properties, and cost-effectiveness compared with biological matrices.[13] Multiple studies have demonstrated successful outcomes using BTM for burns, trauma, and exposed structures, including tendons and bones.[14-16]

In our case, BTM provided stable coverage, avoided flap surgery, and allowed early rehabilitation. Functional results were excellent, consistent with previous reports of upper-limb reconstruction using BTM.[17-19]

CONCLUSION

This case illustrates that synthetic dermal substitutes can be safely and effectively used for high-voltage electrical burn reconstruction, preserving both form and function in challenging anatomical regions.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Sharma S, Srivastava S. Volar forearm defect following high-voltage electrical burn managed with biodegradable temporizing matrix and split-thickness skin grafting: a case report. Int Surg J 2025;12:2201-3.