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Liam P Hughes
Thomas Jefferson University

Steven Forman
Temple University

James C Krieg
Thomas Jefferson University

William Hughes
Thomas Jefferson University

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The Use of Integra Dermal Regeneration Templates and Cortical Bone Fenestrations over Exposed Tibia

Liam P. Hughes, BA*
 Steven Forman, BS†
 James C. Krieg, MD‡
 William B. Hughes, MD§

Summary: We present the case of an 86-year-old woman who suffered full-thickness soft tissue loss secondary to degloving injury to the lower left limb, resulting in an exposed tibia. This patient underwent drilling to create artificial fenestrations in the cortical bone followed by placement of Integra dermal regeneration template. The technique of drilling fenestrations to expose underlying vasculature of cortical bone has not previously been described in its relationship with Integra dermal regeneration templates in large degloving injuries of the lower limb. This technique enabled us to perform earlier skin grafting and ultimately resulted in complete and timely wound closure. We present this case as a comparable alternative treatment in cases of reconstructive surgery secondary to severe burns or trauma to reduce the time required for successful wound closure over exposed bone in full-thickness tissue loss injuries of the lower limb. (*Plast Reconstr Surg Glob Open* 2021;9:e3340; doi: 10.1097/GOX.0000000000003340; Published online 1 February 2021.)

Tibial exposure secondary to full-thickness soft tissue loss from degloving injury in cases of severe trauma to the lower limb presents an additional challenge to wound closure and successful skin grafting. Decreasing the amount of time required for tissue regeneration over exposed bone is critical to managing bone complications which may lead to potential infection and unnecessary amputations.^{1,2} It has been documented that granulation tissue growth can be facilitated by drilling fenestrations into exposed bone to reveal vascularized tissue before wound closure, but the use of this technique paired with the placement of Integra dermal regeneration template (Life Sciences, Plainsboro, N.J.) in full-thickness soft tissue loss of the lower limb has not been described.³ This technique enabled us to perform earlier skin grafting and ultimately resulted in complete and timely wound closure.

CASE REPORT

We present the case of an 86-year-old woman who was struck by a motor vehicle and presented with a segmental open fracture of the tibia and full-length degloving injury of the lower leg. This injury resulted in loss of tissue medially over the muscle, tibia, and Achilles tendon (Fig. 1). Upon admission, the patient underwent irrigation, debridement, and open reduction and internal fixation of the tibial fracture, as well as suture repair of the extensive degloving. Over the next 48 hours, much of the tissue which had been involved in the degloving injury became necrotic. Due to the nature of the injuries, the patient was transferred to the burn service.

Debridement of necrotic tissue was performed, and the patient received split-thickness skin graft over remaining viable muscle on the left leg using skin from a donor site on the same leg. The area of the wound after debridement was 250 cm², and the area of exposed tibia and tendon was 200 cm². There was no exposed hardware. To shorten recovery time, fenestrations were made on the exposed tibial bone with a 1/8 inch drill bit at 1 cm intervals, and Integra dermal regeneration template was placed over the exposed fenestrated bone and Achilles tendon. Premeshed Integra was used to reduce the risk of hematoma formation. Integra was affixed with staples and covered with an antimicrobial silver dressing. The Integra and skin graft were opened on postoperative day 6. The skin graft had good take, and on 21 days postoperatively, a neodermis had formed under the Integra on both the tendon and the fenestrated bone site. At this time, a split-thickness skin graft was performed on the neodermis with

From the *Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, Pa.; †Lewis Katz School of Medicine at Temple University, Philadelphia, Pa.; ‡Department of Orthopaedic Surgery, Rothman Orthopaedic Institute, Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, Pa.; and §Department of Surgery, Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, Pa.

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Fig. 1. The patient suffered an extensive degloving injury due to trauma. (A) Medial and (B) lateral views of the lower limb upon initial presentation to the emergency room.



Fig. 2. The Integra dermal regeneration template allowed for earlier skin grafting and complete wound closure. (A) Exposed tibia 21 days after initial Integra placement. (B) Follow-up visit 5 weeks after split-thickness skin graft placement.

complete take. A follow-up office visit the next month revealed a well-healed and successful skin graft (Fig. 2).

DISCUSSION

Degloving injuries occur as a result of a traumatic injury causing an avulsion of skin and subcutaneous fat from the soft tissue beneath.⁴ Injuries that result in full-thickness soft tissue loss with periosteal involvement can yield additional complications, including compromised blood flow to the affected limb, delayed wound healing, and amputation.⁴ It has been shown that periosteal damage increases the risk for fracture, reduces bone strength, delays healing, and decreases bone regenerative capacity.

Current management of a full-thickness soft tissue degloving injury with a tibial fracture is multidisciplinary. Depending on the location and severity of the fracture, surgical options include intramedullary nailing, open reduction

and internal fixation, and circumferential external fixation.⁵ The goal of treatment for a degloving injury is early recognition with preservation of maximal tissue and structure with swift revascularization, allowing for a successful replacement graft or replantation.⁴ A common treatment plan includes systemic antibiotics, soft tissue debridement of devitalized tissue, early wound coverage, and wound dressings until the site is ready for split-thickness skin graft.⁶

Integra dermal regeneration templates are bilaminar regeneration templates composed of cross-linked bovine collagen and glycosaminoglycan, with an outer layer of silicone.^{7,8} They are useful as a “scaffold” for neodermis formation, providing a viable skin graft recipient site over areas where primary skin grafting is not indicated.^{9,10} In a single-center prospective registry study (n = 88) analyzing the use of Integra in burn and trauma patients with injuries resulting in full-thickness tissue loss with exposed bone, tendon, or joint, there was a statistically significant difference in

the amputation rates between control and Integra groups (31.5% versus 5.7%, $P = 0.036$).² Limitations of Integra include its relatively high cost, the need for a second operation to place a skin graft over the neodermis, and the potential risk of bacterial growth within the layer.^{7,8,11}

Integra requires neovascularization and typically receives its vasculature during matrix formation over the wound bed. In a full-thickness degloving injury with periosteal damage, Integra is still able to form a vascularized neodermis—albeit from the margins of the wound bed, which delays healing. It is documented that granulation tissue growth can be facilitated by drilling fenestrations on exposed bone to reveal underlying vascularized tissue.^{1,3} In the case of exposed bone, revealing this vascular layer enables Integra to receive its vasculature from the margins of the wound bed and of the cortical circulation. This reduces the time required to form a neodermis and, ultimately, an adequate skin graft recipient site.

The technique of drilling fenestrations to expose underlying vasculature of cortical bone has not previously been described in its relationship with Integra dermal regeneration templates in degloving injuries of the lower limb. Comparable studies include Verbelen et al¹ using negative pressure wound therapy and Glyaderm and Pollard et al¹¹ using negative pressure wound therapy and Integra, which yielded times of 28 and 32 days, respectively, between dermal regeneration template and split-thickness skin graft placements. In our case, pairing Integra with artificial fenestrations resulted in a comparable recovery timeline, with 21 days between procedures. Typically, in our practice, drilling artificial fenestrations into exposed bone with placement of nonadherent dressing takes approximately 42–56 days until the site is ready for split-thickness skin graft.

CONCLUSION

We present this case as a comparable alternative treatment in cases of reconstructive surgery secondary to severe burns or trauma to reduce the time required for successful wound closure over exposed bone in full-thickness tissue loss injuries of the lower limb.

William B. Hughes, MD

Department of Surgery
Sidney Kimmel Medical College at Thomas Jefferson
University
1100 Walnut Street
Philadelphia, PA 19107
E-mail: william.hughes@jefferson.edu

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