

CASE REPORT

Using integra® dermal regeneration template in electrical burn injury defect reconstruction – a case report

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Summary

Introduction: Electrical burn injuries present a major public health issue in industrialized countries, and unlike electrical arc flash burns, they often result in deeper and more extensive injuries, especially in hands and feet. When choosing from the range of reconstructive modalities, prompt coverage of exposed defects is imperative, ensuring a better functional and cosmetic outcome.

Patient review: A 26-year-old male was admitted into our facility's Burns Unit following a high-voltage electrical burn injuries sustained on the same day. After several debridement sessions, the left foot was left with a 100 square centimeter dorsal surface defect with the involvement of ankle joint region. The defect was covered using Integra® Dermal Regeneration Template (IDRT) with a 100% success rate both with the template and later split-thickness skin graft (STSG) application. There were no reported perioperative complications, with satisfactory cosmetic and functional results at the 6-month follow-up.

Conclusion: IDRT can be considered a good surgical choice for effective defect coverage with satisfactory results. Nevertheless, the final outcome and patient recovery also often depend on a multitude of other factors, such as the defect size and the involvement of underlying structures.

Key words: electrical burn injuries, foot defect, Integra® Dermal Regeneration Template, skin graft

INTRODUCTION

Electrical burn injuries present a major public health issue in industrialized societies due to the serious outcomes they can have and large socioeconomic burden they present. Although they account for only 0.04-5% of all Burns Unit admissions in developed countries, the incidence can go as high as 27% in developing countries (1). Unlike electrical arc flash burns in which there is no current passage through the body, in electrical burns the current passes through the body often resulting in deeper and more extensive injuries with therefore higher morbidity and mortality (2). The hands are the most common entry point, followed by the head, while the feet are usually the ground point (3). With these types of tissue loss in extremities the primary wound closure is often unsuccessful and wounds are left to heal by secondary intention which involves granulation tissue filling the defect and marginal epidermal cells spreading from the wound edges, covering the tissue and forming a scar. These types of scars have a much higher contraction rate and, in most cases, adhere much more to the underlying structures, thus jeopardizing later extremity function (4). Using various reconstructive procedures does not only restore skin integrity more quickly, but it also shortens healing time, resulting in better functional and cosmetic outcomes (5). One of the many tools in plastic surgeon's arsenal are the acellular dermal matrices (6).

Integra Dermal Regeneration Template (IDRT) is an acellular bilayer membrane consisting of a cross-linked bovine tendon collagen and glycosaminoglycan matrix covered by a semipermeable silicone layer. This design ensures immediate coverage of large surface defects of different etiology (burns, trauma, tumors), followed by dermal regeneration which goes through four distinct histologic stages: imbibition, fibroblast migration, neo-vascularization, and remodeling and maturation (7,8). During dermal regeneration the silicone layer provides flexible but adherent coverage of the wound while increasing the tear strength of the template, ensuring

moisture control, and serving as an infection barrier (7). IDRT based reconstruction is typically two-staged, with the second stage taking place in 2-3 weeks and involving coverage of formed neodermis using split-thickness skin grafts (STSG) (8). In this article we present a case of a large electrical burn injury dorsal foot defect involving the ankle joint region managed by using IDRT.

CASE REPORT

We present a case of a 26-year-old male admitted to our facility's Burns Unit following high-voltage electrical burn injuries of multiple body parts sustained on the same day while performing reparations on a transformation station. The patient was initially admitted to the local hospital and then promptly referred to our facility for further treatment. Upon arrival, the patient underwent a thorough assessment and stabilization of his hemodynamic status. In later course multiple debridement sessions of devitalized tissue were performed. Since the injury distribution included the perianal region, a colostomy bag was derived. Dressing changes were performed regularly every 2 days. The patient was also treated using Hyperbaric Oxygen Therapy (HBOT). After final debridement session the foot was left with a defect that measured 100 square centimeters in size and covered the proximal part of the dorsum and ankle joint, with the underlying joint capsule remaining intact (**Figure 1a**). On the post-admission day 15, after surgical wound-bed preparation, Integra® Dermal Regeneration Template (IDRT) was placed and fixated using non-absorbable single sutures. Regular dressing changes were performed every 2-3 days, in correlation with the template's local status, and 18 days later the outer silicone layer was removed (**Figure 1b**), and wound bed covered using split-thickness skin graft (0.2 mm) harvested from the right calf region. Due to the extent of burn injuries, the 5th toe of the left foot was partially amputated with the wound closed directly using single non-absorbable sutures. No postoperative complications



Figure 1. Surgical treatment of the exposed foot defect: (a) the defect size after a number of debridement sessions; (b) neodermal wound bed after the removal of IDRT's silicone layer.



Figure 2. Functional and aesthetic outcomes at the 6-month follow-up session. Intact dorsal and plantar flexion can be noted.

were observed, with both IDRT and STSG acceptance rates at 100%. Due to the extent of his injuries and the requirement of other reconstructive procedures, the patient was hospitalized for additional 43 days, after which he was discharged and later followed by outpatient visits. No STSG failure or additional skin disruption was observed during a 6-month outpatient follow-up (**Figure 2**).

DISCUSSION

The use of Integra® Dermal Regeneration Template (IDRT) has been described on multiple occasions in the literature for covering wide spectrum of injuries such as burns and trauma, and post-oncologic resection defects (6). Although it was first synthesized as a primary skin replacement in treatment of extensive burns, its many advantages showed that it can be a very good solution, especially in defects involving regions with high functional requirements such as hands and feet. Although there is a substantial number of papers regarding the use of IDRT, only a handful have described its specific use on foot defects (9,10).

Furthermore, the published articles were generally focused on post-traumatic defects or chronic wounds (5,9,10), with no references to electrical burn injuries. These types of injuries present a real surgical challenge for multiple reasons. Firstly, the body distribution of burned tissue can often be quite unpredictable, both regarding the Total Body Surface Area (TBSA) involved,

as well as the depth and underlying structures involvement. More complex procedures, such as axial or microvascular flaps require healthy blood vessels unaffected by the passing electrical current which can lead to endothelial and smooth muscle disfunction, increasing the future risk of thrombosis or stenosis in the injured region (11). For these patients, acellular dermal matrices (ADM)s offer a better chance of reducing the donor site morbidity and leaving the potential donor sites available for covering more urgent exposed regions.

Even if the IDRT does fail, no native patient tissue is lost, and donor region morbidity is avoided. The lack of donor region has also allowed this method to be especially advantageous in elderly patients, or with patients not suitable for general anesthesia involved in longer and more complex reconstructive procedures, such as free flap surgery (12). IDRT application can be done in both local or regional anesthesia, and the two-staged approach provides dressing changes being done in an outpatient setting thus reducing the hospital stay duration and costs.

Using DRT as a reconstructive tool also allows better contouring in cases of extensive tissue loss. Even if the initial resurfacing is inadequate and not bulky enough, the procedure can be repeated multiple times, with multiple layers of IDRT offering aesthetically a more pleasing scar and avoiding over bulking commonly seen with pedicle flap reconstruction (5). Opposite to flap surgery, using skin grafting as a method of choice often leads in the hollow appearance, when compared to the unaffected foot.

Shortening the grafting time allows lesser scar tissue development which improves the final aesthetic and functional outcomes. In their study, Weigert et al. reported that the use of IDRT lead to more rapid restoration of extremity function regarding everyday living activities (5).

Amplifying the IDRT take rate can also be achieved using Negative Pressure Wound Therapy (NPWT) as a bolster, which strengthens the template's adherence to the wound bed. In a study conducted on a series of 16 combat-related wounds, Helgeson et al. reported an overall success rate of 83% while using this method (10), while Park et al. reported a 100 % success rate, with no complications during a 3-month follow-up period (13).

Some disadvantages of IDRT use are the need for a two-stage reconstruction with regular dressing changes done by individual versed in IDRT-based reconstruction management, the risk of infection or hematoma resulting in DRT failure, and its high price per square centimeter which makes it unavailable in limited resources clinical settings. The infection could be avoided by providing a clean well prepared wound bed, using meticulous wound handling techniques during and after the surgery, using preventive dressing options such as nanocrystalline silver dressings, and antibiotic prophylaxis (14).

Regardless of the reconstruction method used, surgeons should fully inform the patients of the primary goals of the procedure (defect closure), and the impact of the initial trauma damage on later functional recovery.

CONCLUSION

Integra® Dermal Regeneration Template can be a valuable tool for covering a wide spectrum of foot defects, often resulting in very satisfactory functional and aesthetic results. Nevertheless, the patient should always be fully informed that final results also vary and depend on multiple factors, such as the initial defect size and the underlying structures involved.

Acknowledgments

None.

Conflicts of interest

None to declare.

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UPOTREBA INTEGRA® DERMALNE REGENERATIVNE PLOČE U REKONSTRUKCIJI DEFEKTA STOPALA ZAOSTALOG NAKON ELEKTROKUCIJE- PRIKAZ SLUČAJA

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Sažetak

Uvod: Elektrokucije predstavljaju veliki javno zdravstveni problem u industrijski razvijenim zemljama jer za razliku od elektrokombustija izazvanih voltinim lukom često rezultuju dubljim i ekstenzivnijim povredama, posebno šaka i stopala. Prilikom odabira rekonstruktivnih opcija, promptno pokrivanje defekta ima prioritet jer obezbeđuje pacijentima bolji funkcionalni i estetski rezultat.

Prikaz slučaja: Muškarac star 26 godina primljen je u Jedinicu intenzivnog lečenja odeljenja opekotina naše ustanove radi lečenja povreda zadobijenih visokovoltaznom elektrokucijom istog dana. Nakon više sukcesivnih nekrektomija devitalizovanog tkiva, zaostao je defekt veličine oko 100 cm² koji zahvata skočni zglob i dorzum

levog stopala. Defekt je rekonstruisan u dva akta, upotrebom Integra® Dermalne Regenerativne Ploče (IDRP), sa stoprocentnim stepenom prihvatanja kako ploče, tako i autotransplantata kože parcijalne debljine. Postoperativni tok pacijenta protekao je bez komplikacija uz postignute zadovoljavajuće funkcionalne i estetske rezultate na šestomesečnom kontrolnom pregledu.

Zaključak: IDRP predstavlja dobar izbor za efektivno pokrivanje defekta uz postizanje zadovoljavajućih rezultata. Međutim, finalni ishod lečenja i stepen oporavka često zavise i od mnogobrojnih drugih faktora kao što su veličina defekta i zahvaćenost dubljih struktura povredom.

Ključne reči: elektrokucije, opekotinske povrede, stopalo, Integra® Dermalna Regenerativna Ploča, autotransplantat

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