

Successful Reconstruction of Traumatic Finger Injury Using Integra® without Skin Graft during COVID-19 Crises

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Abstract

We report a case of middle-aged gentleman, who presented with delayed full thickness skin loss of the dorsal aspect of index of his dominant right hand. The defect was complex with exposed tendon of extensor indicis. Patient underwent a successful first stage reconstruction using Integra® dermal regeneration template. However, the standard second stage reconstruction with split-thickness skin graft was not carried because of COVID-19 pandemic crises, and the cancellations of all elective cases. To the best of our knowledge, this is the first reported case that describes successful reconstruction of complex finger injury using Integra® in single stage with no secondary coverage with split-thickness skin graft.

Keywords: Traumatic Finger Injury; Integra®; Skin Graft; COVID-19

Introduction

The reconstruction of extremity soft tissue defects still remains a challenging task in plastic reconstructive surgery. It is even more difficult when dealing with defects in the upper extremity due to the large number of critical structures that are prone to desiccation and infection resulting from prolonged exposure, It is essential to provide coverage as long as it is safe, and it usually require one or more secondary procedures to optimize function and appearance of the affected extremity [1]. Skin grafting is widely considered as a simple and efficient way of correcting traumatic skin defects, however, it's major limitation when it is used to repair defects that include exposed tendons, bone, or even nonbiological tissues [2]. Dermal substitutes have been used for approximately 15 years in burn management and reconstructive surgery, with increasing popularity [3]. The rationale is to provide a support that mimics the missing dermis, allowing better split thickness skin graft (STSG) take [4]. Integra® Bilayer Matrix Wound Dressing (Integra Life Sciences Corp., Plainsboro, N.J.) is a dermal regeneration template (DRT) initially approved for treatment of full-thickness burns [5-7]. The product is composed of a biodegradable matrix of cross linked bovine tendon collagen glycosaminoglycan covered by a semipermeable silicone membrane. After placement, the matrix serves as a biologic scaffold for neovascularization from the wound bed and formation of a neodermis, after neovascularization and removal of the silicone surface layer, epidermal grafting is performed. The structure permits placement over tissues not suitable for autologous skin grafting, such as tendon lacking peritenon or exposed bone stripped of periosteum [1]. Integra® entered clinical practice

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in the early 1980s for the treatment of major burn wounds [8]. Its use in burn therapy has made it possible to obtain healing zones that are more flexible than those achieved using a split-thickness skin graft (STSG) alone. The use of this dermal substitute may avoid the need for tissue transfer procedures. The use of Integra® has been implemented in the treatment of wounds related to burns, tumor resection, degloving injuries, traumatic wounds to the extremities, and pedicle donor flaps [9-11].

Although the use of DRT for treatment of traumatic wounds has expanded, only limited studies exist on its use for upper extremity injuries. Although the reported rates of successful autologous skin grafting after DRT placement are quite high, one prior study has noted that bacterial wound contamination may substantially reduce healing rates [12-15]. There are relatively little research on the use of DRT in contaminated and traumatic wounds. Our case describes a delayed, traumatic, contaminated wound resulted from a heated heavy object. The plan was for staged coverage with use of Integra® followed by thin STSG after 3 weeks. However, due to COVID-19 crises and stoppage of all elective cases, no second stage surgery was offered. Integra® alone gave a satisfactory result in shape and function of the lost tissue.

Case Presentation

A 36-year-old man previously healthy referred from causality department to the plastic and reconstructive surgery clinic with injury of his right index finger caused by heated heavy machinery object. On examination there was a 6 x 3 cm full thickness skin and soft tissue defect extending from dorsal aspect of second metacarpophalangeal (MCP) joint until second proximal interphalangeal (PIP) joint. There was also exposed tendon of extensor indicis with necrotic and unhealthy tissues around it (Figure 1). The wound was cleaned and irrigated by saline and debridement of dead tissue was done under local anesthesia. Dressings with silver containing alginate was used every other day. After one month of wound care, the wound became healthy with clean edges ready for coverage (Figure 2). There were two options for reconstruction with function preservation, first was local flap coverage using second Dorsal Metacarpal Artery Perforator (DMP) Flap. This flap demands hospitalization and longer operation time together with added morbidity from donor area. The second option for reconstruction was a simpler outpatient/day case procedure with dermal substitute followed by STSG after 2 - 3 weeks under local anesthesia. After discussing the options with the patient, he preferred to proceed with the second option. Under local anesthesia infiltration, the wound edges were refreshed and undermined, integra sheet was prepared as our protocol and applied, then sutured properly using non absorbable sutures. No negative pressure wound therapy system was applied, so to ensure proper fixation and avoid sheering movement between Integra sheet and wound bed, a simple tie over dressing was used and joint immobilization was achieved with slap. Dressing resumed for the wound using silver containing alginate every other day with observation and follow up (Figure 3). Our plan was to use very thin split-thickness skin graft over the integrated Integra® after three weeks. Unfortunately, because of COVID-19 pandemic crisis all elective operations were cancelled, and we could not complete our management plan. However, Integra layer was attached successfully, and the silicon membrane removed after eight weeks (Figure 4). Patient was given a special dressing composed of Protease Modulating Matrix, PROMOGRAN™, to fasten the healing and epithelialization. After six weeks of PROMOGRAN™ dressing and self-taught passive physiotherapy followed by active physiotherapy, the patient had fully healed wound with acceptable range of joint movement (Figure 5). The final result was satisfactory in shape and function, the patient was satisfied and happy of the result.

Discussion

Full-thickness hand wounds present a challenge for the reconstructive surgeon to provide long-term adequate functional results. Integra® is gaining a lot of support in the literature in a wide variety of reconstructive settings, such as trauma, burns, and post oncologic resection [8,10], mainly due to its ability to provide effective and immediate closure to wounds and the low risk for scar contracture or hypertrophy, maintaining the wound's functionality, and gives cosmetically acceptable results without the associated morbidity of skin grafting [8,10,17,19,20]. Additional advantages of Integra is that it can be applied in a poorly vascularized wounds followed by a partial-thickness skin graft, after neovascularization of the dermal regeneration template occurs [18]. Most of the existing published literature on Integra's use are from salvage therapy cases or situations where options were limited [21]. In most cases, Integra is a bridge to skin grafting [8-10,14]. Reynolds, *et al.* [11] produced excellent results of skin grafting after using Integra to cover complex hand wounds from



Figure 1: 6 x 3 cm full thickness defect extending from dorsal aspect of second MCP joint until second PIP joint.



Figure 2: After one-month, healthy wound with clean edges and exposed tendon of extensor indicis.



Figure 3: Close up of the Integra in situ after 12 days, showing 90% integration with successful coverage of the tendon with vascularized DRT.



Figure 4: Eight weeks after integra application, two weeks after silicon layer removal. Notice the excessive red granulation, that was brushed to achieve faster epithelialization.



Figure 5: Four months post Integra application. Figure shows acceptable scar both aesthetically and functionally.

cancer resection and nonburn trauma. Adani, *et al.* [22] exhibited similar results with hand and forearm flap donor site Integra coverage with definitive skin grafting. There are two major challenges when reconstructing hand or finger full-thickness wounds. One is limited options of the treatment of a full-thickness skin wounds either by full- or partial-thickness skin grafting. Second is reduced functionality caused by wound contracture due to the coverage over the tendons.

All reconstructive approaches must be chosen on a case by case basis, taking in consideration patient age, comorbidities, dominant hand, job and socioeconomic status. Since our patient is right-handed manual worker and his meticulous hand work requires preservation of all small hand joint function, the two reconstruction options offered were tailored to his needs. The authors' vast experience with Integra® assured obtaining similar results of local perforator flap with avoidance of donor site resultant functional morbidity. The original plan was for staged coverage with use of Integra® followed by thin STSG after 3 weeks. However, due to COVID-19 pandemic crises and halting of all elective surgeries, no second stage STSG surgery was offered. Fortunately, we were able to achieve complete defect coverage with satisfactory functional outcome. Despite the early mild sensory deficits, the patient was satisfied with the results and return of his hand full function during short-term follow-up. Jacoby, *et al.* [23] reported excellent results in single-stage use of Integra for fingertip wounds coverage. There is no single reported case using Integra solely for coverage of dorsal finger injuries across MCP, PIP or DIP joints. Our case, although unintentionally, was covered using Integra alone over full thickness skin loss over the dorsal aspect of index across both MCP and PIP joints with acceptable scar and functional outcome.

Conclusion

Integra-based reconstructions of the hand is safe and reliable, with good functional and esthetic results. The use of Integra without further skin grafting appears to be effective, avoids the morbidity of the donor site and avoids a second surgery with excellent functional outcome. Further larger studies with longer follow up periods are required to adapt this technique as a solution for certain, selected cases of finger full thickness defects.

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