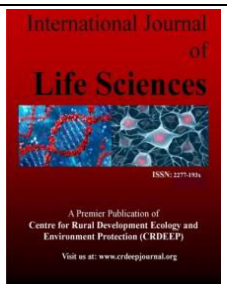
Vol. 8. No.4. 2019.

Contents available at:
www.crdeepjournal.org

International Journal of Life Sciences (ISSN: 2277-193x) SJIF: 5.79



Full Length Research Paper

Role of Integra in Post-traumatic Foot defects: A Case Report

Mahmoud Farouk Elsagheer
M.Sc, Ain Shams University, Plastic Surgery Department, Ahmed Maher Teaching Hospital, Cairo, Egypt.

ARTICLE INFORMATION

Corresponding Author:
Mahmoud Farouk Elsagheer

Article history:
Received: 21-07-2019
Accepted:24-07-2019
Revised: 30-07-2019
Published: 07-08-2019

Key words:
Integra-Foot defects-Post traumatic- Foot reconstruction- Dermal template- Dermal subsistitute.

ABSTRACT

Background: Integra dermal regeneration template is commonly used in the developed world. Methods: Three cases were reviewed of reconstruction after trauma that come to the ED in Ahmed Maher Teaching Hospital (AMTH).This study includes three patients after a road traffic accident with exposed tendons, bones and joints reconstructed with Integra as the first stage and after three weeks the second stage with thin split-thickness skin graft after removal of the external layer of Integra. Results: The results are accepted, pre and post-operative photos of the patients will show the cases. The skin graft was lost in one case of the three patients and re-grafted after two weeks. The most important disadvantage of the Integra is its high cost, but the advantage of the Integra it can solve significant problems of foot defects. The only other options to reconstruct these defects are a freeflap, distally based flaps and VAC therapy. Conclusion: In conclusion, Integra can be considered an ideal solution for complicated foot defects with exposed tendons, bones and joints in spite of the high cost.

Introduction

Skin graft compared to wound edge approximation shows an advantage in success rate and in healing time. However, for major defects, skin graft does not provide optimal coverage of the underlying structures (vessels, nerves, and tendons). Coverage with flaps shows some disadvantages such as failure rate and donor site morbidity. These features make flaps difficult to perform in the lower leg and foot associated with a high rate of necrosis(Almeida et al., 2002).

The primary indication for Integra placement in wounds that were not amenable to immediate split-thickness skin grafting was due to exposed bone or tendon. The reasons why these wounds were not candidates for tissue transfer were facilities deficiency and deficient training staff. The combination of Integra negative-pressure wound therapy,andan eventual skin graft was an effective technique for wound coverage in complex injuries with exposed tendon or bone. The overall primary success rate of 83 % compares well with that of the burn literature (evidence-based medicine level IV) (Iorio et al., 2012).

Integra appeared for the first timecommercially in 1997 and widely used especially in the last decade. It was successfully used for coverage of large deep full thickness burn after early excision. In reconstructive surgery it was used in cervical area, breast, donor areas, over flaps, prefabricated flaps, after tumor resection or after trauma.*Its main advantage is* the superior functional and cosmetic outcome and greater flexibility of the resulting skin, due to its thick dermal component. Its biocompatibility with low antigenicity and decreased host inflammatory response limits the granulation tissue and hypertrophic scar formation. The contraction of the myofibroblasts is inhibited, thus preventing wound contractions. *The main disadvantages* of Integra are its high cost (approx. 10 €/cm2) and its susceptibility to infection (Pieptu et al., 2014).

Materials and methods

Three cases of reconstruction were reviewed after trauma that come to the ED in Ahmed Maher Teaching Hospital (AMTH).This study includes three patients after road traffic accident (RTA) with exposed tendons, bones and joints reconstructed with Integra as the first stage and after two to three weeks the second stage with thin split-thickness skin graft after removal of an external layer of Integra.

Results

Case 1:

Female child nine years old presented to the ER by RTA with crushed Rt foot (fig: 1.1).1ry survey ABCDE was done. The 2ry survey was doneand consultations:

- Vascular surgery: intact dorsalis pedis and posterior tibial arteries with good capillary refilling.
- Orthopedic surgery: intact tibia, fibula, tarsus and meta-tarsal bones with no fractures. But suspicion of peroneus brevis tendon tear.

- Plastic surgery: good irrigation of the wound with twolitters of saline and antiseptic also confirmation of intact pulses. For intra-operative good assessment, debridement and coverage.

In the operative theatre: good washing and irrigation of the wound with gentamycin and two liters saline (80mg\500cc). Then aggressive debridement and good hemostasis (fig: 1.2). Application of Integra over the wound and fixation by tie-over, then dressing and splinting were done (fig:1.3).
The child stays in the hospital for the first dressing after four days, where the Integra is taken,and she is discharged after second dressing for twice dressing weekly (fig: 1.4 and 1.5). During out-patient clinic dressings, the wound shows some sort of infection so systemic and topical antibioticsare given.

After three weeks a child is re-admitted again for the second session in which removal of stitches and silicone layer were done (fig:1.6). Preparation of the wound bed for grafting. Thin split-thickness skin graft (STSG) is harvested from the thigh. Fixation of the graft and tie-over were done. Dressing and splinting were done.

Fig 1: (1.1) Post-traumatic foot defect in ER. (1.2) After debridement in the OR. (1.3) Application of Integra. (1.4) Four days post-op. (1.5) Four days post-op. (1.6) Three weeks post-op: After removal of a silicon layer and preparation for applying STSG. (1.7) Five days post-op. (1.8) Two weeks post-op.

Case 2:

Twenty-four years old male patient presented to the ER with RTA crushed Rt foot (fig:2.1). 1ry survey ABCDE was done, the 2ry survey was done and other specialties:

- Vascular surgery: intact dorsalis pedis and posterior tibial arteries.
- Orthopedic surgery: X-ray films detect no fractures.
- Plastic surgery: good irrigation of the wound with twoliters of saline and antiseptic. For intra-operative good assessment, debridement,and coverage.

In the operative theatre: good washing and irrigation of the wound, then aggressive debridement and good hemostasis (fig: 2.2). Application of Integra over the wound and its fixation, then dressing and splinting were done (fig: 2.3). T where the Integra is takenand is discharged. During the out-patient clinic period, the dressing was done twice weekly (fig: 2.4). After three weeks,the patientis re-admitted again for the second session in which removal of stitches and silicone layer were done for preparation of the wound bed for grafting. Thin split-thickness skin graft (STSG) is harvested from the thigh. Dressing and splinting were done. The patient was discharged where dressings were done day after day in OPC (fig: 2.5).

Case 3:

Five years old female child presented to the ER by RTA with skin loss over the medial aspect of the Rt foot (fig: 3.1). 1ry survey ABCDE, 2ry survey and consultations were done:

- Vascular surgery: intact distal pulses.
- Orthopedic surgery: no fractures are detected by X-ray film.
- Plastic surgery: skin loss over the medial aspect of the Rt foot with exposure of medial malleolus and multiple abrasions.

In the operative theatre: good washing and irrigation of the wound with gentamycin and two litters saline (80mg\500cc). Then aggressive debridement and good hemostasis (fig: 3.2). Application of Integra over the wound and its fixation by staples, then dressing and splinting were done (fig: 3.3). The child stays in the hospital for one week, where the Integra is taken,and she is discharged after second dressing for twice dressing weekly. During out-patient clinic dressings, the

wound shows some sort of infection so systemic and topical antibiotics are given. After three weeks, the child is re-admitted again for the second session in which removal of stitches and silicone layer were done. Preparation of the wound bed for grafting. Thin split-thickness skin graft (STSG) is harvested from the thigh (fig: 3.4 and 3.5). Fixation of the graft, dressing and splinting was done. Graft loss occurs (fig: 3.6 and 3.7), and within two weeks, the child is re-grafted for the second time.

Fig 2: (2.1)Post-traumatic foot defect in OR.(2.2) Intra-op after debridement. (2.3) Application of Integra. (2.4) Dressing post-Integra. (2.5) Dressing post-graft.

Fig 3: (3.1)Post-traumatic foot defect in ER. (3.2) Intra-opdebridement. (3.3) Application of Integra. (3.4) and (3.5) Intra-op STSG. (3.6) Four days post-op. (3.7) Two weeks post-op shows graft loss.

Discussion

Lower extremity defects whether having loss of skin, or de-gloving injury exposing muscles, tendons and bones are common. The trauma of lower limb not only affecting function but also extend to compromise the social and economic status of the patient. Increasingly, urban trauma is becoming a major health-care issue. Large emergency departments are crowded with patients with multiple injuries, requiring state-of-the-art care. Most of these complex injuries involve trauma to the extremities, often due to road traffic accidents. The main cause of lower extremity defects is road traffic accidents which account for more than fifty percent of causes of lower limb soft tissue defects. The lower leg and foot are relatively not well protected, which anatomical property to make them more vulnerable to injury than other body parts (Klebuc and Menn, 2013).

Extremity injuries are best approached by multi-disciplinary teams that involve orthopedic, plastic, vascular surgeons and other specialties if needed. The severely traumatized lower extremity presents a complex problem that often requires the skills of surgeons familiar with orthopedic, soft tissue. It is more common for a team of orthopedic, plastic, and vascular surgeons to share responsibility for these devastating injuries(Kumar et al., 2017).

Lower extremity reconstruction requires a team approach that carefully assesses the costs, technical considerations, functional results, and psychosocial aspects of the treatment plan. The choice for wound coverage is determined by the size of the defect, type of tissue deficit, state of the wound and location of the injury. Additional factors, such as aesthetic results, cost and donor-site morbidity, should also be taken into consideration (Ong and Levin, 2010).

The primary goal of surgical reconstruction of the lower extremity is to restore or to maintain lower limb function. The function requires a stable skeleton capable of supporting the patient's weight and a stable surrounding soft-tissue envelope. Accurate preoperative evaluation of the patient with a complex lower extremity wound is essential in developing a successful treatment plan (Pu et al., 2009).

The mainstay of management of extremity soft tissue wounds has centered on surgical debridement, proper local wound care and dressing application, as well as off-loading strategies to facilitate an ideal healing environment (Iorio et al., 2012).

Local options available for soft tissue coverage of foot include muscle flaps (soleus or proneus muscle) and fascio-cutaneous flaps (distally based flaps). Free tissue transfer (free flap) has now become the gold standard but not all trauma centers can conduct free flaps and not all patients fit for these major approaches. Among recent trends in lower extremity reconstruction is a resurgence of support for local and fascio-cutaneous flaps in leg and foot reconstruction. These pedicled flaps are touted as being similar to free flaps regarding morbidity, reliability, and even aesthetic results. Perforator flaps are now also used in the lower extremity. Striving beyond form, contour and optimal soft-tissue coverage, some surgeons report progress with sensitive free flaps to the heel and weight-bearing foot (Ong and Levin, 2010).

More recently, with the advent of tissue engineering, wound management has utilized the development of dermal construct of the numerous, currently available acellular dermal matrices, the overwhelming majority of currently available clinical data focus on just two products, Integra (Integra Life Sciences, Plainsboro, N.J.) and Graft Jacket (KCI, San Antonio, Texas) (Iorio et al., 2012).

Integra is a bi-laminar template comprised of bovine tendon collagen cross-linked with glycosaminoglycans. This layer is applied directly to the wound bed and serves as the scaffold for native capillary and cellular in-growth. The top layer is made of polysilaxone or silicone. The silicone layer is semi-permeable and aids in preventing moisture evaporation from the underlying biologic layer. Additionally, the silicone layer provides strength and resistance to any shear forces. Once the collagen-GAG layer has been remodeled via dermal regeneration, the overlying silicon layer is removed to allow for epidermal in growth and/or split-thickness auto-grafting in the case of larger wounds (Iorio et al., 2012).

Integra is a completely a cellular artificial matrix. The outer silicone layer simulates the epidermis, serving to control moisture loss and prevent invasion by microorganisms. The inner layer is a three-dimensional porous matrix of cross-linked collagen and glycosaminoglycan of bovine origin that acts as a dermal regeneration template. Following the migration of endothelial cells and fibroblasts this results in the formation of neo-dermis that, histologically and functionally, is very similar to the normal dermis (Gonza´lezAlan˜a et al., 2013).

A second surgical procedure is necessary for removal of the silicone layer and split-thickness skin grafting. This is often done after three to four weeks with thin autografts (STSG, not meshed) (Trah et al., 2018).

Other benefits of Integra include minimal pain and discomfort, favorable scarring, and the ability to cover lesions without sacrificing tissues surrounding the wound. The advantage to applying Integra is that reconstruction of the wound area will be elastic and expand. In children, this allows for growth without recurrence of contractures across joints or damage of the surrounding soft tissues (Nicoli et al., 2016).

The rationale for the application of Integra in these cases was to remove devitalized tissues that were causing ongoing issues, minimize further donor site morbidity, improve cosmesis and provide a reconstruction with superior elasticity to accommodate growth (Nicoli et al., 2016).

The first surgical goal is to create a clean surgical field in preparation for the Integra application. Devitalized tissues were excised and dirty open areas were also debrided, removing potential foci of contamination/ infection. Integra (dermal regeneration template) must be kept between 2°C and 30°C (Nicoli et al., 2016).

To maximize success of Integra application, the following must be respected: (1) preparation of clean, well debrided vascular wound bed and meticulous haemostasis; (2) postoperative immobilisation;(3) adequate timescale to allow neovascularization prior to skin grafting; (4) some form of antibacterial dressing; and (5) regular review and two theatre episodes (Nicoli et al., 2016).

Conclusion

Considering these advantages, supported by our department's previous experience, we advocate that Integra could be a better option for foot coverage than the traditionally accepted

regional flap (reversed sural flap), VAC therapy and free tissue transfer. Integra could be considered an ideal solution for complicated foot defects with exposed tendons, bones and joints in spite of its high cost.

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