



NOVEL WOUND HEALING TECHNOLOGIES: A REVIEW

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ABSTRACT

A burn is a type of injury to flesh caused by heat, electricity, chemicals, light, radiation or friction. Most burns only affect the skin (epidermal tissue and dermis). Rarely, deeper tissues, such as muscle, bone, and blood vessels can also be injured. Burns may be treated with first aid, in an out-of-hospital setting, or may require more specialized treatment such as those available at specialized burn centers. Managing burns is important because they are common, painful and can result in disfiguring and disabling scarring, amputation of affected parts or death in severe cases. Complications such as shock, infection, multiple organ dysfunction syndrome, electrolyte imbalance and respiratory distress may occur. The treatment of burns may include debridement, applying dressings to the wound, administering large volumes of intravenous fluids, administering antibiotics and skin grafting. While large burns can be fatal, modern treatments developed in the last 60 years have significantly improved the prognosis of such burns, especially in children and young adults. In the United States, approximately 4 out of every 100 people with injuries from burns will succumb to their injuries. The majority of these fatalities occur either at the scene or enroute to hospital. ReCell technology by Avita medical is a newest feather in treatment of skin burns, it has shown promising results as compared to skin grafting. Apart from this other new technology by ACell called as MatriStem MicroMatrix has even been applied recently for regrowing tip of finger. This review paper deals with some new technologies which will in near future revolutionize treatment of skin burns and wound healing.

Keywords: Burn, Debridement, skin grafting, ReCell technology, Avita medical.

INTRODUCTION

In order to protect skin burn patients from losing blood it is essential that the wound is closed as quickly as possible, failing to do so can cause a life threatening situation to arise. In second and third degree burns, the kind of burns ReCell is designed to heal; the outer few layers of skin are damaged or destroyed. To heal the burned skin scientists currently can either graft skin from another part of the victim's body, or use artificial skin grown in Petri dishes, which can come from another donor or from the burn patient. Grafting is a favorable process with low chances of rejection but it requires a lot of skin, for example to cover a page's-worth of burned skin requires a page's-worth of healthy skin be removed. Hence skin grafting is not much of an option where the patient that has 40-50 percent burns. Another option is artificially grown skin from another donor. This is fast but also raises the risk of rejection, which can further increase the chance of a life-threatening infection. Skin can be grown using a patient's own cells, harvested from a much smaller area than a full graft, which is more reliable but takes weeks to grow.¹

ReCell combines the speed and reliability of a skin graft with the small donor site of artificially grown skin. Little skin is scraped from an area the size of a postage stamp. Once taken, the donor site looks like a small rug burn, raw and pink with pinprick bleeding. A full graft leaves the donor site bleeding.

While MatriStem MicroMatrix makes use of extracellular matrices (ECM), MatriStem MicroMatrix® is a revolutionary tissue repair product used to repair full

thickness wounds, such as finger trauma. The MicroMatrix particles are a complex collagen (protein) scaffold obtained from pig tissue, which has a collagen structure nearly identical to that of human tissue.^{2,5}

ReCell® TECHNOLOGY

ReCell® Spray-On Skin™ is a stand-alone, rapid, autologous cell harvesting, processing and delivery technology that enables surgeons and clinicians to treat skin defects using the patient's own cells in a regenerative process, accelerating healing, minimizing scar formation, eliminating tissue rejection and reintroducing pigmentation to the skin. ReCell has been designed for use in a wide variety of wound, plastic, reconstructive, burn and cosmetic procedures.

In this case a part of skin which is about a size of a postage stamp is selected, this part is scraped out, and it is around a six one-thousands of an inch-deep. Contained in those six-thousands of an inch are basal stem cells and melanocytes, cells that give skin its particular color and texture. The structural materials holding these cells in place are dissolved with trypsin, an enzyme harvested from pigs, and then sprayed back onto a burn site. Once on the burned area, the skin stem cells and melanocytes begin to divide and expand. In less than a week that stamp-sized donor site of skin can turn into a page's worth of new, healthy skin. Skin that matches the tone and texture of the original skin more closely than skin grafts usually do.

ReCell is packaged as an "all in one" kit with everything needed to harvest the healthy cells, culture them to expand their numbers, and then deliver them onto the



wound via a hand-held spray. The cell harvest procedure is designed to grab all the various cell types important to heal burns and other injuries. These include structural cells (fibroblasts), cells involved in healing (keratinocytes) and even the cells that provide pigment (melanocytes). This approach not only promotes healing, but also insures that the patient avoids extensive and ugly scarring, which in itself can lead to body-image issues and a loss of self-confidence.

The concept behind ReCell is the brainchild of world-renowned Australian plastic surgeon Dr. Fiona Wood and has been continually undergoing development since the early 1990s. For a long time, the standard treatment for burns was skin grafting, where healthy skin from the patient is harvested and used to cover the damaged area. Another common treatment for burns and other skin defects is known as cultured epithelial autograft (CEA). In this process, healthy skin is again harvested from the patient and grown into "sheets" in the laboratory before being used to treat the injured skin. And while both of these techniques have saved countless lives, they have several limitations that the proponents of ReCell hope to address.³

Advantages of ReCell® Spray-On Skin™

One of the biggest advantages of ReCell is how quickly it can help heal wounds. Research has found that the longer it takes a wound to heal, the greater the risk of scarring and other complications. While CEA treatment can take several weeks to culture enough cells to be applied to the wound, ReCell can usually be ready in less than 1 week, reducing the risk of extensive scarring from approximately 75% to about 4%.

ReCell can also be used to treat patients without the need to put them under general anesthesia. Sure, surgery and the field of anesthesiology have come a long way since the days when you were just as likely to die from anesthesia as the reason for the surgery. But there is still a risk involved when drugs are used to render someone unconscious and it should be avoided when an alternative is available. Further, ReCell should also provide improvement over the current treatments when it comes to treating burns and wounds in children. When a child receives a graft or CEA treatment, the skin may not always grow or grow correctly as the child grows. This often means repeated surgeries until the child has finished growing. With ReCell, the skin can grow and stretch as normal, allowing the patient to avoid multiple, painful procedures.^{3,4}



Figure 1: The effect of ReCell® Spray-On Skin™ on child burn (20 months after treatment), the 3rd panel shows the results of grafting in same time frame.³

MATRISTEM MICROMATRIX

MatriStem MicroMatrix® is a revolutionary tissue repair product used to repair full thickness wounds, such as finger trauma. The MicroMatrix particles are a complex collagen (protein) scaffold obtained from pig tissue, which has a collagen structure nearly identical to that of human tissue. While the MicroMatrix particles offer many of the same benefits as human donor tissue (allograft), the natural proteins within the MicroMatrix may help the finger wound restart the natural healing process.

It is important to note that the surgical use of pig tissue is an established practice and a variety of pig tissues have been implanted in humans for medical than 40 years purposes for more. The MicroMatrix particles are manufactured from the bladder tissue of a pig.

The initial outpatient surgical procedure involves removing damaged tissue around the wound in order to prepare the wound site for placement of the particles. A thin layer of particles are placed over the surface of the wound and covered with a bandage.

The wound will remain open and look like a raw wound while it is healing. New tissue growing on your finger during dressing changes until the wound completely heals can be noticed. The new tissue growth may be crusty and look brown and black in color.

Healing will take about 8-12 weeks depending on how severe the trauma is to the finger. After the wound closes, finger will continue to heal on the inside for another 1 to 2 months. Depending on the injury, the fingernail may or may not re-grow.⁵



Disadvantages

Various complications and reactions are possible with all wound repairs.

- Excessive pain, redness, swelling or blistering
- Unexplained fever or chills
- Bleeding

Using the MicroMatrix will not guarantee added finger length. However, studies indicate that wound may heal without scarring.⁵

Comparison between the two technologies

Difference between ReCell and ACell's wound powder is that the wound powder only serves to promote healing via recruitment of the patient's own cells. It does not

actually apply cells to a wound as ReCell does. And on the surface, it doesn't appear as if one approach is far superior to others, but the only way to find the best treatment is to test different ideas and see which works for which type of injury.³

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