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Evaluation of skin natural change function in split-thickness skin graft

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ABSTRACT

Treatment for severe burns has improved rapidly in the last 20 years. Nowadays, patients can survive with burns covering up to approximately 90% of the body, although they often face permanent physical impairment. This type of research is a literature review. A literature review was conducted to gather information regarding the evaluation of skin natural change function in the split-thickness skin graft. This research is a type of review article that aims to obtain information about acne based on bio-markers. Source of data used secondary sources. The method of data collection through collecting data was from research articles taken within the last five years. Skin grafting remains an essential step on the reconstructive surgeon ladder. Meanwhile, the basic premise has remained similar results over the years. New techniques and devices have contributed to significantly improved functional and aesthetic results. Advances in the production of skin substitutes have provided better options to treat patients and will continue to be an essential and dynamic component of this field in the future.

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INTRODUCTION

According to the American Burn Association, more than 1 million burns in the United States each year require medical attention (Anonymous., 2020). About one-half of these require hospitalization, and about 25,000 burn patients are treated in specialized burn units. In the United States, about 4,500 people die from burns each year. On average, someone dies in a fire nearly every two hours, and another person is injured every 23 minutes. About half of the deaths occur in homes without smoke alarms (S. Gupta et al., 2022). In addition to deaths resulting directly from burns, as many as 10,000 Americans die each year from burn-related infections. Pneumonia is the most common infectious complication among hospitalized burn patients. The average size of a burn in a patient treated at a burn center is approximately 14% of the total body surface area. Minor burns covering 10% of the total body area or less account for 54% of central burn admissions, whereas more significant burns covering 60% or more account for 4% of admissions. Approximately 6% of patients who enter burn centers do not survive, mainly due to severe inhalation injuries in the fire (Mo et al., 2021).

Treatment for severe burns has improved dramatically in the last 20 years. Nowadays, patients can survive with burns covering up to approximately 90% of the body, although they often face permanent physical impairment (Liu et al., 2020). There has been significant progress in developing artificial leather substitute products in recent years. Although none have worked as well as the patient's skin, artificial skin products are essential because of the limited skin available for allografting in severely burned patients. Unlike allographs and xenographs, artificial skin replacement is not rejected by the patient's body and promotes the generation of new tissue. Artificial skin usually consists of a synthetic collagen-based epidermis and dermis. The artificial dermis comprises fibers arranged in a lattice that acts as a template for forming new tissue. Fibroblasts, blood vessels, nerve fibers, and lymph vessels from the surrounding healthy tissue grow into a lattice of collagen, which eventually dissolves as the cells and structures construct a new dermis. The synthetic epidermis, which acts as a temporary barrier during this process, is eventually replaced with split-thickness autograft or laboratory-cultivated epidermis from the patient's epithelial cells (Asuku et al., 2021; V. Gupta & Chanda, 2022).

Several artificial skin products are available for burns or non-healing wounds, including Integra®, Skin Regeneration Template® (from Integra Life Science Technologies), Apligraft® (Novartis), Transcyte® (Advance Tissue Science), and Dermagraft. Researchers have also obtained promising results growing or growing patients' skin cells in the laboratory. This cultured skin substitution reduces the need for autografts and can reduce complications in burns. Laboratory cultivation of skin cells can improve the prognosis for severely burned patients with third-degree burns of more than 50% of their bodies. The recovery of these patients has been hindered by the limited availability of injured skin from their bodies for grafting. Skin replacement can also reduce medical expenses and length of hospital stay. In addition, other studies have shown the possibility of using stem cells collected from bone marrow or blood for use in growing skin grafts (Notorgiacomo et al., 2022; Przekora, 2020).

Patients with less severe burns are usually treated in a doctor's office or hospital emergency room. They are usually transferred to the hospital by a particular burn unit: third-degree burns; partial-thickness burns of more than 10% of their total body area; electrical or chemical burns; smoke inhalation injury, or pre-existing medical disorder that can complicate management, prolong recovery or affect death. In addition, children burned in hospitals without qualified personnel must be admitted to hospitals with burn units. A surgical team treating burns and skin grafts will perform the necessary procedures. The team may include neurosurgeons, ophthalmologists, oral surgeons, thoracic surgeons, psychiatrists, trauma specialists, plastic surgeons, and dermatologists.

The skin graft moves part or all of the skin layers from one place to another. It has been practiced in India since 2000 years ago. However, it still needs to develop a developed. During this time, skin grafts were introduced to the western world. Over the last 100 years, the tools and methods have significantly changed (Phua et al., 2021). Several names are related to the initial development of skin grafts, namely by skin grafts from the thigh to the nose. In 1869, Reverdin performed a small, thin skin excision (epidermic graft) placed on the surface of the area with granulation tissue. Oilier (1872) and Thiersch (1874) put forward. They developed about Muhamad Rizki Prayuda and Anggraeni Janar Wulan,| The Role of Split Thickness Skin Graft (STSG) in Open Degloving J Agromedicine Unila | Volume 5 | Number 2 | December 2018| 635 thin split-thickness skin grafts. The 15-skin grafting involves taking a piece of skin from an entire area (called the donor site) and using it to close an open wound. The graft does not carry any part of the donor site, so it receives all the nutrients from the wound site at the recipient site. Grafts are named according to their composition, such as epidermis, dermis, fat, hair, cartilage, and bone (Mershon & Baradaran, 2021). Skin grafts move part of the skin that has been separated from its local blood supply to another location. These can be divided into four types: full-thickness skin grafts (FTSG), split-thickness skin grafts (STSG), composite grafts, and free cartilage grafts.

The recovery process takes longer to carry out a skin graft (Phua et al., 2021; Przekora, 2020). The skin is the outermost organ and limits it from the outside human environment. An adult's skin area is 2 m^2, weighing approximately 16% of their body weight. The skin is an essential organ and a mirror of health and life. The skin is very complex, elastic, and sensitive, varying with climatic conditions, age, sex, race, and also depending on the location of the body. The skin has various functions: protection, heat exchanger, absorbent, sense of taste, and gum function. Likewise, the skin varies regarding soft, thin, and thick; elastic and loose skin is found on the lids, lips, and prepuce, and thick and tense skin is on the soles of the feet and hands in adults. There is thin skin on the face, with coarse hair on the head. The outline of the skin is composed of three main layers: the epidermis or cuticle layer, the dermis layer, and the subcutis layer. There is no clear line separating the dermis and subcutis, which is characterized by the presence of loose connective tissue and the presence of cells and adipose tissue (Huyan et al., 2020; Paw et al., 2020).

Skin grafts are performed on patients with extensive skin damage that interferes with the function of the skin itself, for example, in severe burns, ulcerations, biopsies, traumatic wounds, or infected areas with extensive skin loss. The placement of a graft in a wound aims to prevent infection, protect the underlying tissue, and speed up the healing process. The doctor will consider carrying out the skin graft procedure based on several factors, namely: the size of the wound, the site of the wound, and the ability of the skin to be healthy on the body. The recipient areas include extensive surgical scars that cannot be covered directly with the surrounding skin and require additional skin so that the surgical scar area can be covered and the healing process can take place optimally. (Stone et al., 2021)

The skin is the human body's largest organ, representing about 16% of the total body weight. While the protective and thermoregulatory functions are well recognized, the skin also has essential functions in protein metabolism and vitamin D metabolism. The human body produces the most significant amount of vitamin D in the epidermal layer of the skin; apart from providing a physical barrier against pathogenic organisms, the skin functions as an active immune organ with specific antigen properties, which plays a significant role in composite tissue allotransplantation. Despite its many beneficial properties, the skin is an organ that is often abused and underappreciated by individuals until compromise results in pain and loss of resistance to infection. Restoration of an intact barrier is significant and can be achieved in several ways, including grafting. Among the indications for skin grafts is the promotion of accelerated healing of burns and other wounds, reduction of scar contracture, increased cosmesis, reduction of insensible fluid loss, and protection from bacterial invasion.

Currently, a quarter of a million people visit a burn treatment center across the hospital annually. This number underestimates the actual figures since it does not include those presenting to their general practitioner or the local accident and emergency department. There are three phases to recovery from a burn injury. The immediate phase is the physiological consequences of the injury. The next phase is associated with wound closure and healing, and lastly, the cosmetic and functional consequences of the associated scars. Burn survivors' significant and lasting problems are those associated with healing and the outcome regarding scarring. Presently split-thickness skin grafts (SSGs) are considered the best material for surgical repair of an excised burn wound. In burns, it affects more than 50% of the body surface. The patient has insufficient areas of unaffected skin from which autograft SSG can be harvested. More available donor sites are needed to ensure rapid wound closure. This dilemma has been the impetus for developing and using various artificial skin replacement products to cover the burn wound when autograft is unavailable.

RESEARCH METHOD

This type of research is a literature review . A literature review was conducted to gather information regarding the evaluation of natural changes in skin function in the split-thickness skin graft. This research is a type of review article that aims to obtain information about acne based on biomarkers. Source of data used secondary sources. The data collection method was collected from research articles taken within the last five years (Sugiyono, 2017, 2018, 2019).

RESULTS AND DISCUSSIONS

By necessity, the harvested skin graft is completely separated from its vascular supply before transplantation at the recipient site. The graft goes through several physiological stages before the newly grafted tissue is assimilated (i.e., "takes in"). The initial stage of graft healing, called plasma imbibition, occurs within the first 24-48 hours after the graft placement in the recipient's bed. During this process, donor tissues receive their nutrition through the absorption of plasma from the recipient wound bed through capillary action. In the healing phase, the graft is white and may appear slightly swollen. Furthermore, because nutrients can be absorbed more effectively over short distances, thin grafts tend to survive better in the healing stages of the graft. Additionally, a fibrin network was created during the healing phase between the graft and the recipient bed. The recipient bed produced buds that grow blood vessels into the fibrin network (Dubin et al., 2020; Martignago et al., 2020).

Post-imbibition is the healing phase of the graft, called inosculation. This phase begins 48-72 hours after grafting and will continue for one week after grafting. During this time, the vascular bud anastomoses with pre-existing and newly formed vessels. This revascularization of the skin graft, which occurs more rapidly in an STSG than in an FTSG, is initially accompanied by a mottled appearance and then an erythematous flush of the vessels or, occasionally, a slightly cyanotic appearance. In most recipient areas, revascularization occurs from both the base and the periphery of the recipient bed during this process (Dunev et al., 2020; Grunzweig et al., 2019).

Lymphatic tissue develops in the graft about one week after transplant, and graft reinnervation may begin as early as the first few weeks. However, many grafts may have some degree of permanent anesthesia. A unique phenomenon of vascular bridging has been described to account for revascularization in relatively avascular recipient beds. In this phenomenon, vascular ingrowth occurs from a relatively highly vascularized aspect lateral to the recipient bed and bridges across the avascular base of the recipient bed. However, the receiving area must remain small for vascular bridging to occur, and the area surrounding the graft must be highly vascularized. The essential part of any skin graft procedure is proper wound preparation. Skin grafts will not survive tissue with a limited blood supply (cartilage or tendons) or tissue damaged by radiation treatment. The patient's wound must be free of any dead tissue, foreign matter, or bacterial contamination. After the patient has been anesthetized, the surgeon prepares the wound by rinsing it with a diluted saline or antiseptic solution (Betadine) and removes the dead tissue by debridement. In addition, surgeons stop blood flow to the wound by applying pressure, tying the blood vessels, or administering a drug (epinephrine) that causes the blood vessels to constrict (Kanapathy et al., 2021; Kitala et al., 2016).

After wound preparation, the surgeon then harvests the tissue for grafting. A split-thickness skin graft involves the epidermis and a small amount of the underlying dermis; The donor site usually heals within a few days. The surgeon first marks the wound outline on the skin of the donor site, enlarging it by 3-5% to allow for tissue shrinkage. The surgeon uses a dermatome (a particular instrument for cutting thin slices of tissue) to remove a split-thickness graft from the donor site. The wound must not be too deep if a split-thickness graft is to be successful because the blood vessels that will nourish the grafted tissue must originate in the dermis of the wound itself. The graft is usually taken from an area generally hidden by clothing, such as the buttocks or inner thigh, and spread over the bare area to be covered. Gentle pressure from a layered dressing is applied, or small sutures are used to hold the graft in place. A non-adherent sterile dressing is then applied to the raw donor area for about three to five days to protect it from infection (Lee et al., 2018).

These grafts involve both layers of skin. The full-thickness of autografts is more complicated than partial-thickness grafts but provides better contour, more natural color, and less contraction at the grafted site. A skin flap with underlying muscle and blood supply is transplanted into the area to be grafted. This procedure is used when the tissue loss is extensive, such as after an open fracture of the lower leg, with significant skin loss and underlying infection. The back and abdomen are common donor sites for full-thickness grafts. The major disadvantage of full-thickness skin grafts is that the wound at the donor site is more significant and requires more careful management. A split-thickness graft must be used to close the donor site. A composite skin graft is sometimes used, consisting of a combination of skin and fat, skin and cartilage, or dermis and fat. Composite grafts are used in injured patients requiring three-dimensional reconstruction. For example, an incision of the skin containing the ear and cartilage can be used to repair the nose (Chou et al., 2019).

A full-thickness graft is removed from the donor site with a scalpel instead of the dermatome. After the surgeon has trimmed around the edges of the pattern used to determine the size of the graft, it lifts the skin with a unique hook and trims off any fatty tissue. The graft is then placed on the wound and secured with absorbable sutures. Optimal skin graft success is influenced by several factors, which must be addressed with the recipient site preparation thoroughly prior to grafting. A well-vascularized recipient bed is of paramount importance in the survival of a skin graft. Through a few exceptions, skin grafts rarely pick up when placed on bone, cartilage, or tendons without the presence of the periosteum, perichondrium, or paratenon. The use of dermal substitutes such as AlloDerm (LifeCell, Branchburg, NJ) or Integra (Integra Life Sciences Corp., Plainsboro, NJ) has been described as a method to address such circumstances, as it provides an adequate supply for subsequent vascular split-thickness skin graft placement. Early tangential excision of burns is considered the standard of care for burns that are not anticipated to heal within three weeks. Special considerations in burn excision are associated with burns to the face and hands. The aesthetic unit of the face must be considered during excision, which can often be performed using a hydrosurgery system such as Versajet (Smith & Nephew, Hull, UK) for shallow partial thickness burns (see image below). When excising burns on the dorsum of the hand, special care must be taken to avoid injury to the extensor tendons and peritenon in order to provide a vascularized bed for the corrupted to recover and maintain maximal postoperative hand function (Fukuoka et al., 2021; Gokkaya et al., 2020).

The ultimate success of a skin graft, or its "take," depends on nutrient uptake and vascular ingrowth of the recipient bed, which occurs in 3 phases. The first stage lasts for the first 24-48 hours. The graft is initially bound to the recipient site via the formation of a fibrin layer. It undergoes diffusion of nutrients by capillary action from the recipient bed by a process called plasma imbibition. The second stage involves the process of inosculation, in which the donor and recipient ends of the capillaries align and form a vascular network (Greenwood, 2017).

Graft revascularization is accomplished by either capillary or ingrowth of new vessels through neovascularization in the third and final phase, generally completed within 4-7 days. Reinnervation of skin grafts begins approximately 2-4 weeks after grafting and occurs by ingrowth of nerve fibers from the recipient bed and surrounding tissue. The sensory return is more significant in the full-thickness graft because it contains a higher content of the neurilemmal sheath. Similarly, hair follicles can be transferred with full-thickness grafts, allowing the graft to show hair growth from the donor site. Split-thickness grafts are ultimately hairless (Dunev et al., 2021; Gostian et al., 2020).

The amount of dermis present in the graft determines the rate of contraction immediately after harvest from the donor site and following placement and revascularization in the recipient bed. Freshly harvested grafts undergo retrograde due to elastin in the dermis in a phenomenon called primary contraction. Therefore, harvesting contracts full-thickness skin grafts more initially following as containing the dermis as a whole. The secondary contractions are probably due to myofibroblast activity and are defined as contractions of the healed graft. The rate of secondary contraction is inversely proportional to the thickness of the skin graft (Fernandez et al., 2021). Therefore, the split-thickness skin graft contracts more than the full-thickness graft following placement in the recipient bed. Therefore, full-thickness grafts should be used in areas significantly impacted aesthetically or functionally with scarring or scar contractures, such as the head and neck, hands, genitals, or breasts. Current investigations into methods to reduce the initial contraction and subsequent need for contracture release include initial mechanical restraint immediately after grafting as well as the application of topical agents to delay keratinocyte differentiation or prevent crossling formation (Dardari et al., 2022).

Once a skin graft has been put in place, it must be maintained with care even after it has healed. Patients with grafts on their feet must remain in bed for seven to 10 days with their feet elevated. For several months, the patient must support the graft with an Ace bandage or Jobst stocking. Grafts in other body areas must also be supported after healing to reduce the amount of contracture (Kane et al., 2019).

The grafted skin does not contain sweat or oil glands and must be lubricated daily for two to three months with mineral oil or other bland oil to prevent drying and cracking. Aftercare for patients with burns usually includes psychological or psychiatric counseling, wound care, and physical rehabilitation, significantly if the patient's face has been disfigured. The severe pain and long recovery periods involved in burn treatment are often accompanied by anxiety and depression. Suppose a burn patient occurs in combat, a transportation disaster, a terrorist attack, or another fire involving many people. In that case, he or she is at high risk of developing post-traumatic stress disorder (PTSD). Doctors treating survivors of a nightclub fire in Rhode Island in February 2003 gave them anti-anxiety medication within days of the tragedy in order to reduce their risk of PTSD (Parnham et al., 2018; Poinas et al., 2019).

A skin graft should provide a significant improvement in wound site quality and be able to prevent serious complications associated with burns or non-healing wounds. Usually, new blood vessels begin to grow from the donor site into the transplanted skin within 36 hours. Sometimes, skin grafts are unsuccessful or do not heal properly. In this case, repeat grafting is necessary. Although the skin graft must be protected from trauma or significant stretching for the two to three weeks of split-thickness skin grafting, recovery from surgery is usually rapid. Depending on the graft site, the dressing may be required for one to two weeks. Any exercise or activity that stretches the graft or puts it at risk of trauma should be avoided for three to four weeks. A hospital stay of one to two weeks is often required in full-thickness grafts, as the recovery period is longer (Borrelli et al., 2019; Stone et al., 2021).

CONCLUSION

Skin grafting remains an essential step on the reconstructive surgeon ladder. While the basic premise has remained the same over the years, developing new techniques and devices has significantly improved functional and aesthetic results. Advances in the production of skin substitutes have provided better options to treat patients and will continue to be an essential and dynamic component of this field in the future.

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