Paparella: Volume IV: Plastic and Reconstructive Surgery and Interrelated Disciplines

Section 1: Plastic and Reconstructive Surgery

Chapter 2: Skin, Dermal, and Mucosal Grafting

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A skin graft is a segment of dermis and epidermis removed from a donor site and transplanted to a predetermined recipient site, where it must acquire a blood supply if it is to heal and remain viable. Skin grafts can be full thickness, including all of the dermis and epidermis, or partial thickness, including only a portion of the skin. Skin grafts are useful for either temporary or permanent covering over a wound. In general, skin grafts heal in any area that if left ungrafted would otherwise develop granulation tissue.

Skin grafts can be of different types. An autograft is skin transplanted from the donor to the recipient site in the same animal. An allograft (homograft) occurs in different animals of the same species. A xenograft (heterograft) occurs in different animals of different species.

Classification

Skin grafts can be full- (whole-) or split-thickness. Full-thickness grafts are composed of the entire thickness of skin, there being no dermal or epithelial elements left in the donor bed. The donor bed can only heal primarily by granulation tissue and epithelial migration from the edges. Most often the donor bed is closed primarily or covered with a split-thickness graft.

Since the thickness of the skin varies throughout the body, the thickness of a full-thickness graft depends on the donor site selected.

Full-thickness grafts have some advantages over split-thickness grafts: because of the complete layer of dermis, the graft is very much like normal skin, there is very little tendency for the graft to contract, it maintains its size and shape fairly well, and there is good color stability and little tendency for pigmentation. Also, full-thickness grafts do not have the thin, almost atrophic appearance that split-thickness grafts may have.

Full-thickness grafts are most frequently used for repair of defects around the face, especially when a local flap is not suitable or available.

Split-thickness grafts are the grafts most commonly used. They have a layer of epidermis and a variable amount of dermis. Since some dermis is left at the donor site, some adnexal remnants such as sweat apparatus and pilosebaceous glands remain. Thinner grafts have the advantage over thicker grafts of a better "take". However, thin grafts tend to contract as they heal, can acquire pigment as time goes on, and may have a sheen to their appearance.

Dermis is a strong tough tissue that becomes "mucosalized" when placed in the mouth, is epithelialized when exposed to air on the body surface, or remains dermis when buried

under the skin. It usually takes as well as split-thickness grafts and contracts minimally. The donor site either heals spontaneously or heals from the split-thickness graft, which was elevated to get to the dermis and then replaced on top of the dermal graft donor site bed.

General Principles

The survival or take of a skin graft is dependent on adequate nutrition and removal of metabolic waste products from the recipient bed until an adequate blood supply is acquired. For this to occur the graft and bed must be in close contact without separation and must lie immobile in the bed without shearing.

After the graft is initially placed on the bed, there is an adherence created by the fibrin exudate in the bed. The bed exudate a plasma through which there is the nutrition for the graft. It is this medium through which metabolic wastes are transported.

An outgrowth of capillary buds begins from the graft and the graft bed, which attempt to link up to create the new blood supply; this generally occurs by the third or fourth day. The fibrin that had been present begins to be infiltrated by fibroblasts, changing the fibrin adherence to a fibrous attachment. This attachment is established by the fourth or fifth day.

Because of this process, several conditions must exist for success.

The recipient bed itself must have the ability to secrete the fibrin exudate for nutrition of the graft. There must be an adequate blood supply and the ability to form healthy granulation tissue from which capillary buds will arise to form the new capillary network with the graft. Healthy granulations appear flat and red, do not bleed easily, and are free of exudate. A clean recipient bed is level and free from active bleeding. A good indicator of the ability of a bed to accept a graft is good marginal bleeding in the bed. Placing a graft on an irregular bed can cause tenting of the graft and a poor fibrin adherence. The bed should not be actively bleeding, since any hematoma that may form after graft placement could cause the graft to separate from the recipient area and prevent the fibrin adhesion. Care should be taken, however, to avoid excessive cautery to the bed, which will destroy the blood supply and create crusting in the wound. Excessive suture material in the wound also serves as a foreign body and minimizes graft take. Pressure with gauze sponges soaked in saline or epinephrine often creates adequate hemostasis.

An unhealthy bed has fibrous granulations from which capillary bud outgrowth occurs only with great difficulty. The granulations can become fibrous, exuberant, and edematous and have a glazed appearance. Pressure dressings over these granulations often reduce the granulations and create a more healthy bed.

Streptococcus pyogenes produces a fibrinolytic substance, and beds with this organism should not be grafted; these beds appear glazed and gelatinous and bleed easily.

When a recipient site appears unhealthy, systemic antibiotics, cleansing of the bed, and frequent wet-to-dry dressing changes often improve it. Occasionally, it is necessary to excise unhealthy granulation tissue and either graft immediately onto the bed or delay grafting until healthy granulation forms.

The capillary bud bridging phenomenon from the bed to the graft can occur when the bed is muscle, periosteum, or perichondrium but does not easily occur over bare bone, cartilage, or tendon. Bare bone, cartilage, and tendon do not easily produce capillary buds.

When a split- or full-thickness graft is placed in its recipient site, it is important to have it sit completely on or in the bed. There can be no tenting of the graft in any area, since this prevents healing. The graft must be held in place with enough sutures for movement to be minimal, to allow the best chance for capillary growth between the graft and recipient bed. In areas where some movement is anticipated, where the defect is depressed, or when an accumulation of fluid under the graft is anticipated, a bolster is placed over the graft to hold it in place. First, a nonadherent dressing is placed on the graft, cut to a size slightly larger than the graft. The bolster can be made from fluffed gauze, cotton, sponge, or any other slightly resilient material. It is tied in place with several sutures to hold the graft to the bed and left in place for about 5 days. In removing the bolster, care must be taken not to remove the graft with it. It is best to soak the bolster with saline, gently hold the graft down with cotton-tipped applicators, and lift the bolster off the bed.

Small edges of split-thickness grafts, which extend over the edges of the recipient site, will slough.

Dermal grafts under flaps are best sutured into place with absorbable sutures. Dermal grafts placed on mucosal surfaces frequently need a bolster to hold them in place.

Whole Skin Grafts

Full- (whole-) thickness skin grafts are best used where coverage is needed with minimal contraction, pigment change, and graft stability. In areas where trauma is expected, such as the alveolar ridge, full-thickness grafts should be used.

There are several suitable donor sites for full-thickness grafts. Small, thin, full-thickness grafts can be obtained from the upper eyelid. These are frequently employed for lower lid or contralateral lid grafting. A moderate amount of skin is usually available in elderly patients, and the donor site can be closed primarily. Since very few places on the body have this thin delicate skin, the eyelid should be considered when an eyelid defect exists.

The nasolabial area is frequently redundant, especially in elderly patients. Full-thickness grafts from this area yield skin with a texture and color similar to that of other facial areas. Replacement of skin over the nasal tip and cheek area is best done with skin from this region. The graft can be harvested in an elliptic manner with the incisions parallel to the nasolabial fold, relaxed skin tension lines, and the donor site closed to recreate the nasolabial crease.

Large amounts of full-thickness skin can be obtained from the retroauricular area. Here the donor site can extend onto the posterior auricle and onto the mastoid, if necessary. The site can usually be closed primarily, but patients who wear eyeglasses with a curved temple that extends behind the ear may have to remove the temple temporarily during the healing phase or change to glasses with a straight temple. Occasionally, if a very large full-thickness graft is needed, the postauricular donor site can be grafted with a split-thickness graft.

Postauricular skin has a fairly good texture, color, and thickness to match most facial areas.

Supraclavicular skin is ideal when large amounts of skin are needed. neither the texture nor the color are quite as good as postauricular or nasolabial skin, but this is an area that can supply a large amount of skin. The donor site can be closed primarily with only a small amount of undermining. If a neck dissection is contemplated, use of this site is contraindicated. Supraclavicular skin is good for grafting large facial aesthetic units such as the entire upper lip.

The abdomen is a large donor area for full- and split-thickness skin grafts. However, the skin has a poor color and texture match for use on the face, is much thicker than any of the facial skin, and tends to have a waxy, yellow color. Its very thick character gives the recipient site a masked appearance. If large amounts of skin are needed and the abdomen is the only donor site, a thick split-thickness graft will probably give a better result than a full-thickness graft since the thickness will be closer to that of the face.

Cutting the Graft

A full-thickness graft is usually inserted into a very specific, usually irregular recipient bed. Since there is minimal contraction of the full-thickness graft, it is important to have the graft the exact size of the defect. This is best done by making a template from the donor site out of glove paper, the suture wrapper, or any other stiff, yet pliable material. Ash metal works quite well and has the advantage that it can be bent and cut and yet hold its shape. It is ideal when the defect crosses aesthetic facial units and changes direction (eg, a defect extending from the nose to the face). When a scarred or contracted area is grafted, it is important to excise the scar first and elevate and undermine so that the defect remaining is as close as possible to the size and shape that needs to be grafted. The template should be placed over the donor site, the skin around it pulled taut, and the graft cut.

In removing the graft, an attempt should be made to cut in the plane between the dermis and subcutaneous tissue. After the graft is removed, the bed can be closed primarily in any way that is adequate, leaving as minimal a defect as possible. If the graft is taken from an area where there is underlying fascia immediately under the surface, excision of this fascia often helps in the closure of the defect.

The full-thickness graft should be defatted with fine or iris scissors. The fat is not needed, only increases the metabolic requirements of the graft, and may decrease the chance of a successful take.

Split-Thickness Grafts

Split-thickness grafts are best used when large areas of coverage are needed (eg, for burns, flap donor sites, trauma), when the recipient bed granulation is not ideal, as a temporary dressing (eg, for areas that need to be observed for recurrent cancer), or to cover a large defect that may result when a full-thickness graft is used.

Several donor sites are available and the choice depends on the amount of skin needed, the relationship of color and texture to the area surrounding the recipient site, the convenience

of obtaining the graft, and the ensuing defect in the donor site. Commonly used sites for obtaining the graft include the abdomen, back, and thigh. Places less commonly thought of, yet excellent sources for small amounts of skin and a camouflaged donor site, are the inner aspect of the upper arm and the buttock.

Split-thickness skin grafts can be of any thickness. They are generally classified as thin (0.008 to 0.010 inch); intermediate (0.012 to 0.014 inch), approximately halfway through the dermis; or thick (0.016 to 0.018 inch), approximately two-thirds to three-fourths the way through the dermis.

Thin split-thickness grafts are translucent and very much like tissue paper. Thicker grafts are opaque and have the color of cadaver skin. The pattern of bleeding from the donor site provides a further indication of the thickness of the graft. The thin graft bed has multiple small bleeding points from the fine capillary bed on the surface. Thicker graft beds have larger bleeding points from the larger deeper vessels in the dermal-epidermal complex. In general, the thickness of the skin varies from one part of the body to another: lateral areas thicker than medial and distal thicker than proximal. Older individuals have thin atrophic skin and the pattern of bleeding points may be of little value.

When extensive skin coverage is needed and inadequate skin is available, the graft can be meshed. The multiple slits in the graft allow it to be expanded to several times the original size.

The ungrafted slit areas heal by epithelialization from the adjacent areas of the graft. Mesh grafting can be used for burns, trauma, or wounds that require drainage from infection, serum, or blood.

Several methods are available for harvesting a split-thickness graft. A number of free hand knives are available, such as the Blair, Humby, and Boderham. The drum dermatomes (Padgett-Hood and Reese) have been popular and allow precisely cut thicknesses of skin to be obtained. Each drum of skin requires careful preparation of the skin in the drum and therefore does not permit easy, quick, repeated harvesting of skin segments. It is also difficult to change thickness of skin once the harvesting is in process.

The electric (Brown) and air-driven dermatomes allow large amounts of skin to be quickly harvested. They can easily cut grafts of uniform width and thickness, thick or thin, or even from the same donor site. These are fragile instruments and the thickness and the calibration easily become inaccurate. The thickness of the graft can be judged by looking through the dermatome head at its opening.

The goal in caring for the donor site is to obtain a dry wound that remains free of infection and will epithelialize. The donor site should be covered with moist sponges at the time the graft is harvested; these are left on with some pressure applied to obtain hemostasis. The sponges are replaced until bleeding has stopped. The area can then be covered with Xeroform gauze, fluffs, and a soft compression dressing such as Kerlix. Twenty-four hours later the dressing is removed down to the Xeroform. If the wound is wet, heat lamps or a hair dryer can be used to dry it. Over the next 1 to 2 weeks, as epithelialization occurs, the Xeroform will elevate at the periphery and can be trimmed. After 10 to 14 days, if this has

not occurred, the patient can get into a tub and soak the dressing off. If the wound has not epithelialized, delayed healing and possible scarring can be expected.

Purulent drainage is best treated with frequent dressing changes and heat lamps to the area.

Several commercially available semipermeable dressings (eg, Duoderm, Opsite, and Viglion) are available that allow oxygenation of the tissue and trap any accumulated fluid. Healing of split-thickness grafts occurs from epithelial outgrowth from remaining sweat glands and pilosebaceous apparatus. Thinner split-thickness grafts heal more rapidly than thicker grafts. Thin grafts usually heal within 10 days leaving only a faintly visible scar. Thick split-thickness grafts heal over 3 to 8 weeks depending on the thickness. The donor site often heals with a thick hypertrophic scar; the surface has a thin atrophic epithelium and the undersurface a thick dense scar. The thin atrophic epithelium is easily injured. If a graft is so thick that none of the dermal elements are left, the donor site will heal by means of epithelial migration from the lateral edges of the donor site.

When thin and intermediate grafts have been harvested, the donor site may be harvested again in 2 to 3 weeks.

Dermal Grafts

A dermal graft is obtained by harvesting a thin split-thickness skin graft, which is left attached at one end. The dermis is then removed from the bed below. Dermal grafts are usually 0.010 to 0.014 inch thick. Hemostasis is obtained and a pressure dressing applied with Xeroform fluffs and Kerlix, much as with split-thickness grafts. The skin graft is placed back on the donor site and sutured into place with absorbable sutures.

Mucosal Grafts

Mucosal grafts are occasionally needed to line the nasal cavity, conjunctiva of the eye, or oral cavity. They can be obtained from these sites, and the donor site either closed primarily or allowed to heal by secondary intention.

Causes of Graft Failure

One of the most common causes of graft failure is the formation of hematoma or seroma under the flap. Since the skin graft survives by the ingrowth of blood vessels from the capillaries of the recipient bed, anything that blocks the graft from contacting the recipient bed will prevent graft take.

External mechanical forces are another cause of graft failure. These can result from pressure, graft movement, or trauma.

Grafts will not take if the bed contains unhealthy granulation tissue or lacks granulation tissue. If the bed is fat, nerve, exposed bone, or cartilage or tendon without perineurium, periosteum, or paratenon, the graft will not take. When grafting over bare bone, it is wise to drill holes in the cortex and allow for granulation tissue to bud through the holes

from the cortical bone before attempting grafting. Granulation tissue can be stimulated over bare bone, cartilage, and tendon with the use of benzoyl peroxide dressing changes.

Infection is another cause of graft failure. Group A, beta-hemolytic, streptococcal infections have resulted in rapid and complete loss of skin grafts.