Chapter 3

Skin Grafts

Tertius Venter and Peter Nthumba

Skin grafts are a valuable option for the closure of wounds that cannot be closed primarily. On the wound closure ladder, when primary closure and delayed primary closure will not be possible, skin grafts are the next option. If acute wounds are clean but cannot be closed, then skin grafting should be done immediately—at the time of admission/first operation. Waiting for granulation tissue to develop, as practiced by many, should not be done.

Outline of skin grafts:

1. Split Skin Graft
   - Thin or thick
   - Sheet or meshed
2. Full Thickness Skin Graft
3. Composite Graft; skin, fat, cartilage

Thin STSG are 0.006 to 0.012 inches (0.015-0.30 mm), intermediate are 0.012 to 0.018 inches (0.30-0.46 mm), or thick 0.018 to 0.024 inches (0.46-0.61 mm). A split thickness skin graft consists of epidermis, and a variable thickness of underlying dermis, that is detached from its source of blood supply, and transferred to another site. Split-thickness grafts can be sheet grafts or meshed. Meshing provides holes in the graft to allow drainage of fluid, serum and blood. This allows for an improved take when absolute hemostasis cannot be performed. Meshing also allows for better molding of the graft into difficult recipient sites and provides more graft. A full-thickness skin graft includes all the dermis but it may be thick or thin according to the donor site.

Primary graft contraction is dependent on the amount of elastin in the graft, and therefore the thickness of the dermis. The thicker the dermal layer, the higher the degree of primary contraction. In full thickness grafts, primary contraction is greater than secondary contraction since it contains the entire dermis at the donor site. Secondary contraction is greatest in split thickness grafts. With burn contracture releases and split thickness skin grafting, re-contracture is likely over joints unless the joint is splinted out in extension for 6 weeks to several months.
Outline of differences between split and full thickness skin grafts:

<table>
<thead>
<tr>
<th></th>
<th>Split thickness skin graft (STSG)</th>
<th>Full thickness skin graft (FTSG)</th>
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<tbody>
<tr>
<td><strong>Anatomy</strong></td>
<td>Varying thickness of dermis</td>
<td>Contains entire dermis</td>
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<tr>
<td><strong>Donor sites</strong></td>
<td>Multiple, depending on amount of skin required. Heal spontaneously</td>
<td>Limited. Primary closure if small, otherwise split thickness grafting</td>
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<tr>
<td><strong>Graft ‘take’</strong></td>
<td>Less demanding on recipient site</td>
<td>Requires favorable recipient site; a well vascularized recipient site is needed.</td>
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<tr>
<td><strong>Adnexal structures</strong></td>
<td>Few. Depends on thickness</td>
<td>Contains adnexal structures (sweat glands, sebaceous glands, hair follicles, and capillaries)</td>
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<tr>
<td><strong>Contraction</strong></td>
<td>Secondary contraction significant. Primary contraction depends on thickness of dermis</td>
<td>Primary contraction significant. Minimal secondary contraction.</td>
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<tr>
<td><strong>Sweating</strong></td>
<td>Depends on number of sweat glands</td>
<td>Depends on re-innervation</td>
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<tr>
<td><strong>Sensory return</strong></td>
<td>Some sensation over 3 months</td>
<td>Greatest – presence of neurilemmal sheaths</td>
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**Harvesting of Skin grafts** (See Chapter 15 on Burn Reconstruction)

Split thickness skin grafts (STSG) are usually taken with a dermatome. Small full thickness skin grafts (FTSG) are harvested by hand and the donor site closed primarily. Large FTSG may be taken with a dermatome. A dermatome is the surgical instrument used for harvesting skin grafts. The dermatome may be manual, battery operated, electric or air-driven. The manual dermatome is the cheapest and most practical device for most of sub-Saharan Africa, as the only needed supplies are the blades. The Humby or Watson knife is the most popular. The width of the blade makes it difficult to use in children and over some body contours (Figures 4a – c). A modified shaving razor blade or a Weck (Pilling) blade is more useful in such circumstances. The illustration below shows the anatomical depth of each type of graft.
Comparing thick vs. thin Split thickness grafts

The thinner the graft is
- the easier it is to cover larger areas
- the easier the ‘take’ of the graft
- but less dermis will be present with more contracture and scar formation
- splinting and/or pressure garments is therefore very important
- donor area heals by rapid re-epithelialization – 10 days or less and may be re-harvested in approximately 3 weeks if thin (0.008—0.012)

The thicker split thickness grafts:
- may not take as well but will have less secondary contracture.
- when very thick skin is harvested the donor areas can take up to 3 weeks to heal
- the healing of the donor area may be expedited by a very thin split skin taken from an adjacent area at the initial surgery and grafted on the thick donor area.
- despite the ability to heal spontaneously, the thick split-thickness skin graft donor site is frequently scarred or discolored.
Care of the donor area is important especially with thick split thickness grafts and when thick Vaseline gauze is used. The outer gauze dressing must be removed on the first postoperative day if possible. (Vaseline gauze may be produced in a hospital pharmacy but this is often thick. Thinner, more expensive, non-adherent gauze is commercially available.)
Full thickness grafts are indicated:

- For smaller areas
- When color match/cosmesis is important as for face
- When skin elasticity/texture is important: fingers and hand
- Secondary contracture must be eliminated—eyelids, fingers
- Source: pre or postauricular, supraclavicular, upper inner arm are excellent sites for face. Also groin for larger grafts
- Recipient bed must be ideal as graft take is more difficult—fewer capillaries for alignment.
- Donor area is closed directly
Graft take:
Skin graft take is dependent on the recipient site providing sufficient nutrients and subsequent vascular ingrowth into the graft. Skin ‘take’ occurs through three phases:

- Imbibition phase – lasts 24 to 48 hours. Fibrin layer binds graft to bed.
- Inosculation – donor and recipient capillaries are aligned.
- Revascularization – graft revascularized through ‘kissing’ of capillaries.

Principles of skin grafting—Summary:
1. The recipient site must be well prepared in order to optimize graft take. Skin will rarely ‘take’ on bone, tendon or cartilage in the absence of periosteum, paratenon, or perichondrium, respectively. Exceptions to this rule include the flat bones of the skull: orbit and temporal bones, on which skin grafts may take in the absence of periosteum/pericranium.

2. Control of bleeding from débrided areas and donor sites: Soak gauze in a solution of 2-3 ml. of 1:1000 Adrenaline (cardiac adrenaline) in 200 ml. of saline. Apply gauze to wounds. After 5 minutes if there is still bleeding, apply this gauze again or use the electrocautery.

3. Grafts will not take on infected wounds. If a gram of skin has $10^5$ microorganisms, the wound is colonized and a graft will not take well. Through wound biopsies may be done in major centers, they are rarely performed even there. The majority of surgeons determine the status of a
wound by the appearance of the granulation tissue and the surrounding skin, erythema, presence of exudate, foul odor, etc. When grafts fail to take on a “good” surface, bed, then the surgeon must determine the cause— infection, lack of immobilization, bleeding, etc. Usually the cause of graft failure is obvious. Occasionally it may be possible to get reliable cultures in your district hospital.

4. The skin graft must be closely applied to the recipient site. Grafts are held in place by a non-adherent dressing as Vaseline gauze, moist cotton which molds the graft into irregular surfaces and crevices, a bulky wet dressing and circumferential wrapping of an extremity or a bolster, stent, dressings. The latter are used on the face, shoulder, neck, etc. where wrapping cannot be easily done to hold the graft in close apposition to the recipient site. In addition, joint and extremity immobilization with splints or casts is important after grafting to prevent movement and possible shearing of the graft with hematomas and seromas developing under the graft. These will lead to graft failure.

5. Granulation tissue may look good but it is infected tissue and should be débrided to optimize graft take. Granulation tissue should be débrided or shaved off down to near-normal tissue before grafting, preferably to bleeding dermis. This is best done with a Weck blade or Humby knife. The only good granulation tissue is that obtained after a VAC dressing application.

6. Preparation of chronic wounds for grafting or for a flap is discussed in the chapter on chronic wounds.

7. Skin grafts may be meshed, allowing for graft expansion and coverage of a larger defect. This is especially useful in children, patients with large defects or extensive burns. As mentioned, meshing also permits the drainage of serum and blood and a better “take” of the graft; however, it does lead to a
‘pebble stone’ appearance, a poor cosmetic appearance. This is not important in many areas of the body, but very obvious on the face, neck, dorsum of hands, etc. With large burns there may not be an alternative to meshing. Skin grafts may be meshed with a mesher or manually using a scalpel blade to make holes. Manual meshing does not allow even spreading out of the graft but is best for full thickness skin grafts.

8. One may secure the split thickness graft to the recipient area with sutures, staples, fibrin glue, Steri-Strips (adhesive strips), etc. The author uses absorbable suture (chronic, Monocryl) for small areas and staples if available for larger areas. Absorbable sutures do not need removal and are good for children. Sutures or staples may also be used deep in the wound to hold the graft into crevices or corners.

9. Dressing of skin grafts:
   A. Non-adherent dressing as Vaseline
   B. Then wet cotton (cotton balls), wet gauze and a bulky dry gauze dressing. The wet cotton (balls) is extremely important to help mold the graft into crevices and edges of the recipient wound.
   C. The wet dressings maintain a moist environment to ensure better healing. It has been shown that healing is better in a moist environment rather than a dry one.
   D. It is then wrapped with a gauze bandage or Ace type elastic bandage if an extremity. A gauze bandage around the dressing is safer than an elastic bandage which may compromise the blood supply.
   E. It is then splinted and wrapped with an additional non-elastic bandage. Non-elastic bandages may not be available. In this case, the elastic bandage must be carefully wrapped without tension. If there is swelling the graft could be lost.
   F. When the recipient site cannot be wrapped, as on the face or neck, then a bolster or stent dressing is used to decrease possible movement of the graft beneath the dressing. Non-absorbable sutures are used for the stent sutures. The wound is dressed as above and the stent sutures are tied down over the bulky dressing. Stent or bolster sutures should be one or two sizes larger than the skin suture one would use for the area.

10. The donor site is covered with a non-adherent or Vaseline gauze and cotton gauze. The cotton gauze is removed in 24 hours and non-adherent gauze exposed to air. This is allowed to peel off over 10-14 days

11. ELEVATION is very important for the first postoperative week!

12. Use of antibiotics—the author uses a single dose of a cephalosporin at the beginning of skin graft surgery. Prolonged use of antibiotics is debatable. If the grafts are on the lower extremities or if the recipient bed is not perfect,
then antibiotics may be continued for 24 hours. If the surgery is in a potentially infected area as the groin or perineum, antibiotics may be continued for 3 days or longer.

13. Timing of first dressing change: If a graft has been meshed, one may wait 5-7 days unless there is significant drainage or a foul odor. Some inspect a sheet or full thickness graft the day after surgery to check for hematoma or seroma. The graft must be inspected by day 3 even if limited manual meshing has been done. If there is no collection of fluid, then the wound will not need to be dressed again for 5-7 days. Often several small holes are placed in a sheet graft or full thickness graft just to allow any collection of fluid out. These may be done at the periphery so that cosmesis is unaffected. When the wound is re-dressed, non-adherent gauze should be applied for another week. Some will apply a thin coat of Silver Sulfadiazine to the skin graft after the first dressing.

14. When a stent or bolster dressing is used to mold and contour a sheet skin graft in the neck to provide a cosmetically pleasing result, the dressing is carefully inspected at day 3 and 5 for excess drainage but not removed until day 7. A bulky dressing and a neck collar are then used but the molding/contouring effect of the stent/bolster dressing is lost once it has been removed.

15. Where available, a VAC dressing may also be used over a skin graft but not directly on the graft. It should be placed on top of the Vaseline type gauze.

16. Length of splinting and immobilization depends on the site and the initial take of the graft. Lower extremities usually require immobilization for 2 weeks. After grafts have taken on the lower extremities, the grafted area should be covered for at least 4 weeks to protect from trauma.

17. Epidermis regenerates from adnexal structures after skin graft is harvested. Dermis however, cannot regenerate. The thickness of dermis determines the number of times that skin can be harvested.

18. Source of skin grafts:
   A. Split thickness skin grafts are normally harvested from the thighs, abdomen, buttocks, etc.
   B. Full thickness skin grafts require primary closure or skin grafting: full thickness skin grafts are commonly harvested from the groins. The medial aspect of the arm, post auricular areas and supraclavicular fossa are other possible sources. Skin above the clavicles closely resembles that of the face. For small skin grafts on the hand, antecubital fossa, volar wrist crease and hypothenar eminence are used. One can use the Humby knife to take both full and split thickness grafts from the thigh, just by varying the angle and
pressure. The split thickness graft can be used to reconstruct the full thickness donor site. (See Burn Reconstruction chapter.)

19. Thickness of grafts—location, age, size determine thickness of skin
   A. 0.012 to 0.016 inch (0.3-0.4 mm) is the thickness commonly used for STSGs.
   B. 0.010 inch (0.25mm) is used in burns when one needs considerable skin and with the need to will re-harvest from the same area in the future
   C. 0.020 (0.5mm) and above is a thick graft and suitable for the neck coverage after release of a contracture

20. Causes of graft failure:
   A. Seroma or hematoma formation with lifting up the graft off the recipient site.
   B. Infection is the second commonest cause of graft failure.
   C. Shearing/lack of adequate immobilization
   D. Skin grafts will also fail to take if inadvertently placed ‘upside-down’ – dermis up. The thinner the graft the easier it is to put the graft on upside down.

**TIPS from the authors:**

1. Silver sulfadiazine cream can be applied on the Vaseline gauzes as a topical antibiotic. This will maintain a moist environment. This dressing is then applied on the skin grafts as well as the donor sites, and is a much cheaper ‘antibiotic-coated’ dressing than those commercially available. Dressing changes in the ward likewise should use gauze impregnated with silver sulfadiazine if available.

2. When the recipient site is questionable and does not clean up quickly, a VAC dressing, as described in the VAC chapter, may be applied, with excellent results.

3. In cases where the recipient site bleeds excessively after débridement and there is a question about a sheet graft taking as on the neck, the graft may be stored overnight or several days at 4° Centigrade in a refrigerator. The recipient site is kept moist. This may be necessary after the release of burn contractures of the neck. The graft may then be placed on the recipient site 24-48 hours later without the fear of a wound infection.

4. If skin is harvested but not needed immediately, the skin may even be stored at 4° Centigrade for up to 3 weeks, but it should preferably be used within 7 days. The skin is paced in moist saline gauze and stored inside a 20 ml syringe (remove plunger to place the graft, and then
replace plunger. The syringe nipple is closed with a covered hypodermic needle).

5. Upon discharge from the hospital, the patient is directed to massage the grafts with Vaseline ointment at least twice a day. This keeps the graft lubricated before sweat and sebaceous glands develop and function. The massaging also helps protect the patient from the development of hypertrophic scars. In cases where hypertrophic scars or keloids are likely, pressure dressings should be used for several months. (See Chapter 32) Cocoa butter where available helps to decrease itching.

6. Pinch grafts can be used when dermatomes are not available. A needle or small forceps can be used to “tent” a small area of skin up and a blade is used to take a fingertip, small finger, split thickness portion of skin. Multiple grafts can be placed and there will be epithelialization between these to cover a wound.