

SKIN Grafts

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Outline

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Definition

Skin Graft is a patch of skin that is removed by surgery from one area of the body and transplanted, or attached, to another area.

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Skin Micro-Anatomy

Skin is the largest organ in the body (17% of body weight).

Layers of the skin

- **Epidermis nonvascular outer layer of skin.**
- **Dermis : 40-folds thicker than epidermis.**
 - It consists of connective tissue with blood vessels, nerve endings, hair follicles, sweat and sebaceous glands.

When dermis is destroyed all skin sensations are lost.

- **Subcutaneous Tissue** Contains major vascular networks, fat, nerves, and lymphatics.

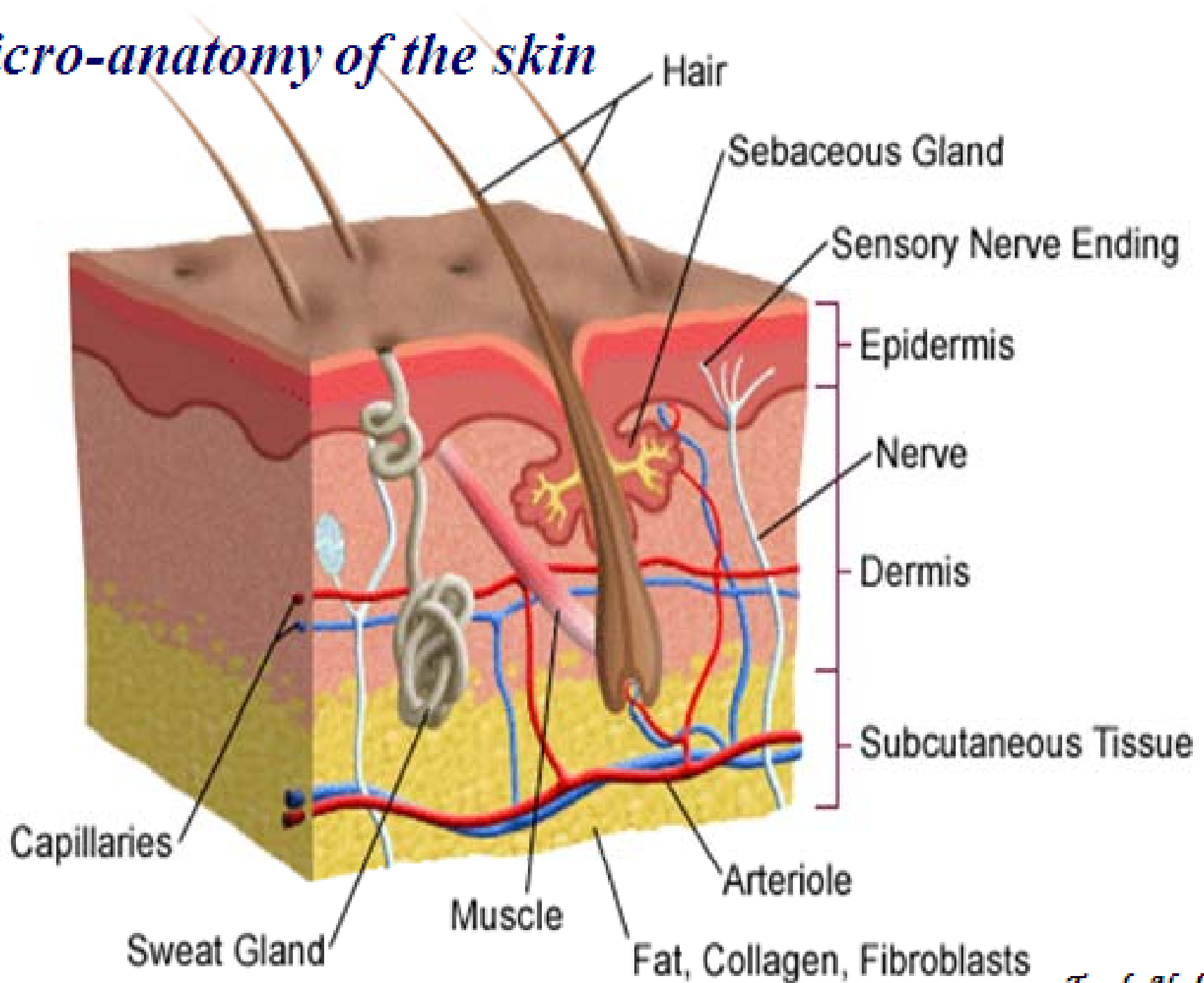
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Functions of the Skin

- **Identification**
- **Cosmetic Appearance**
- **Production of Vitamin D**
- **Sensations of touch, pain and temperature**
- **Maintenance of Body Temperature**
- **A protective Barrier**
 - **Protection from environment – UV radiation**
 - **Prevents evaporative water loss**
 - **Protection from microorganisms**

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Micro-anatomy of the skin



Epidermis

- **No blood vessels.**
- **Relies on diffusion from underlying tissues.**
- **Stratified squamous epithelium composed primarily of keratinocytes.**
- **Separated from the dermis by a basement membrane.**

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*Indications of Skin
Grafts*

1) To achieve temporary cover

To close an open wound

To prevent infection

Hasten initial healing

Prevent exposure of underlying structures

2) For definitive cover:

To provide permanent sensate skin replacement.

To resurface areas of scarring or contracture.

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Indications of Skin Grafts

- **Extensive wounding or trauma**
- **Burns**
- **Extensive skin loss due to infection such as necrotizing fasciitis or Furnier's gangrene**
- **After Surgical removal of Skin (excision of skin cancers or debridement).**

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*Classification
of
Skin Grafts*

Classification of Grafts

Autografts – A tissue transferred from one part of the body to another.

Homografts/Allograft – tissue transferred from a genetically different individual of the same species (cadaver) ... only temporary cover

Xenografts – a graft transferred from an individual of one species to an individual of another species a temporary cover (donor- site).

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Allografts Survival

Prolongation of survival of alloskin grafts will prevent the onset of secondary infections and obtain healing with acceptable cosmetic results.

This can be done by:

- **Pre-treating the allograft with both Microglobulin monoclonal antibody (beta-2 mAb) and irradiations with ultra violet C. (UVC).**
- **No need to any immunosuppression of the burned patients.**

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Combined use of different types of Grafts

- **The benefit of combined use of allograft, and autograft epidermal cultures in therapy of burns lead to decrease in Hospital stay, reduction in patients suffering, and increases the survival rate.**
- * **The most common way to close a deep burn wound after removal of eschar is with the use of (non vascular skin transfers)**

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Types of Grafts

Grafts are described in terms of thickness or depth.

Split Thickness(Partial): Contains 100% of the epidermis and a portion of the dermis. Split thickness grafts are further classified as *thin* or *thick*.

Full Thickness: Contains 100% of the epidermis and dermis.

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Type of Graft	Advantages	Disadvantages
Thin Split Thickness	<ul style="list-style-type: none"> - Best Survival - Heals Rapidly 	<ul style="list-style-type: none"> - Least resembles original skin. - Least resistance to trauma. - Poor Sensation - Maximum 2ry Contraction
Thick Split Thickness	<ul style="list-style-type: none"> - More qualities of normal skin. - Less Contraction - Looks better - Fair Sensation 	<ul style="list-style-type: none"> - Lower graft survival - Slower healing.
Full Thickness	<ul style="list-style-type: none"> - Most resembles normal skin. - Min. 2ry contraction - Resistant to trauma - Good Sensation - Esthetically-pleasing 	<ul style="list-style-type: none"> - Poorest survival. - Donor site must be closed surgically. - Donor sites are limited.

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What is primary contraction?

What is secondary contraction?

What factor determines the degree of graft contraction?

- **The amount of graft contraction is directly related to the thickness of dermis in the graft.**

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The stage of vascular take of graft

Phase 1 (0-48h) – Plasmatic Imbibition

Diffusion of nutrition from the recipient bed.

Phase 2 – Inosculation

Vessels in graft connect with those in recipient bed.

Phase 3 (day 3-5) – Neovascular Ingrowth

Graft revascularized by ingrowth of new vessels into bed.

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Requirements for Survival

- **Bed must be well vascularized.**
- **The contact between graft and recipient must be fully immobile.**
- **Low bacterial count at the site.**

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Systemic Factors that Contribute to Graft Failure

- **Malnutrition**
- **Sepsis**
- **Medical Conditions (Diabetes)**
- **Medications**
 - **Steroids**
 - **Immunosuppressive in organ transplant patients**
 - **Antineoplastic agents**
 - **Vasokonstrictors (e.g. nicotine)**

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What are unsuitable sites for grafting?

- **Bare Bone**
- **Bare Tendon**
- **Infected Wound**
- **Highly irradiated**

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Split Thickness

Used when cosmetic appearance is not a primary issue or when the size of the wound is too large to use a full thickness graft.

- 1. Chronic Ulcers**
- 2. Temporary coverage**
- 3. Correction of pigmentation disorders**
- 4. Burns**

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Full Thickness

Indications for full thickness skin grafts include:

1. If adjacent tissue has premalignant or malignant lesions and precludes the use of a flap.
2. Specific locations that lend themselves well to FTSGs include the nasal tip, helical rim, forehead, eyelids, medial canthus, concha, and digits.

Dr. [unclear]

Graft Donor Sites

Donor Sites

The ideal donor site would provide skin that is identical to the skin surrounding the recipient area.

Unfortunately, skin varies dramatically from one anatomic site to another in terms of:

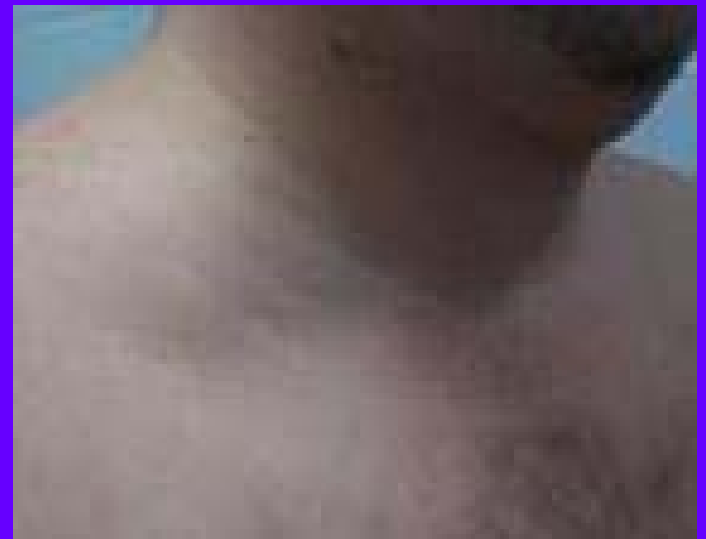
- Color**
- Thickness**
- Hair**
- Texture**

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Donor Site Selection

- **What would be the best donor site for a graft of the cheek?**

A donor site above the clavicles would provide the best color and texture match. In particular the postauricular area is a good choice.



Dr. [unclear]

*Management
of donor sites*

1. Split thickness skin graft donor sites:

- A. Application of pressure garments to prevent hypertrophic scar.**
- B. Massage with a topical lubricant after (5-10 days of epithelialization has occurred).**

2. Full thickness skin graft donor sites

- A. Sutures are removed at (7 to days).**
- B. Massage may be initiated 2 to 3 days after, suture removal to help soften**
- C. Application of pressure garments.**

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*Aftercare &
Physiotherapy
after Grafting*

- **Elevation is used to control edema.**
- **For 4 or 5 days post operative the graft are usually left undisturbed.**
- **The fifth post operative day when the graft is noted to be surviving dressing changes with non adherent gauze are instituted.**

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- The seventh to tenth post operative day the healing graft is well-vascularized > gentle range of motion exercises (passively)
- Usually by about 2 weeks postoperative the graft will be pink and adherent over its area and the graft appears to have taken well (compression crepe bandage wraps are applied).

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The early use of pressure garments

- Started by 2 weeks post operatively
- Careful application to prevent shearing forces.
- Zippers are helpful.

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- Splint may be applied over the pressure garment to maintain the grafted part in its maximally lengthened position.
- In the later stages of healing (3 to 4 weeks post operative) after the wound is closed, gentle massage is used, with a topical, lubricant. To keep the skin pliable, to mobilize the skin and underlying scar.

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- **Positioning with Splinting at night and at rest**
- **Functional exercises then gait training.**
- **When recovery of sensation starts (about 6 weeks postoperatively) Ultrasound physiotherapy will improve circulation ... Followed by cold application or hydrotherapy to gain relaxation... Then active stretch followed by prolonged passive stretch that should be graduated until 20 minutes.**

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Advices the patient should be caution against exposure of either graft donor or recipient sites to the sun for at least 6 months.

Pressure garments and sun screens are helpful in protecting the graft from exposure.

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Graft Harvesting

Harvesting Tools

- **Blades**
- **Grafting Knives (Blair, Ferris, Smith, Humbly, Goulian)**
- **Manual Drum Dermatomes (Padgett, Reese)**
- **Electric/Air Powered Dermatomes (Brown, Padgett, Hall)**

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Padgett Dermatome

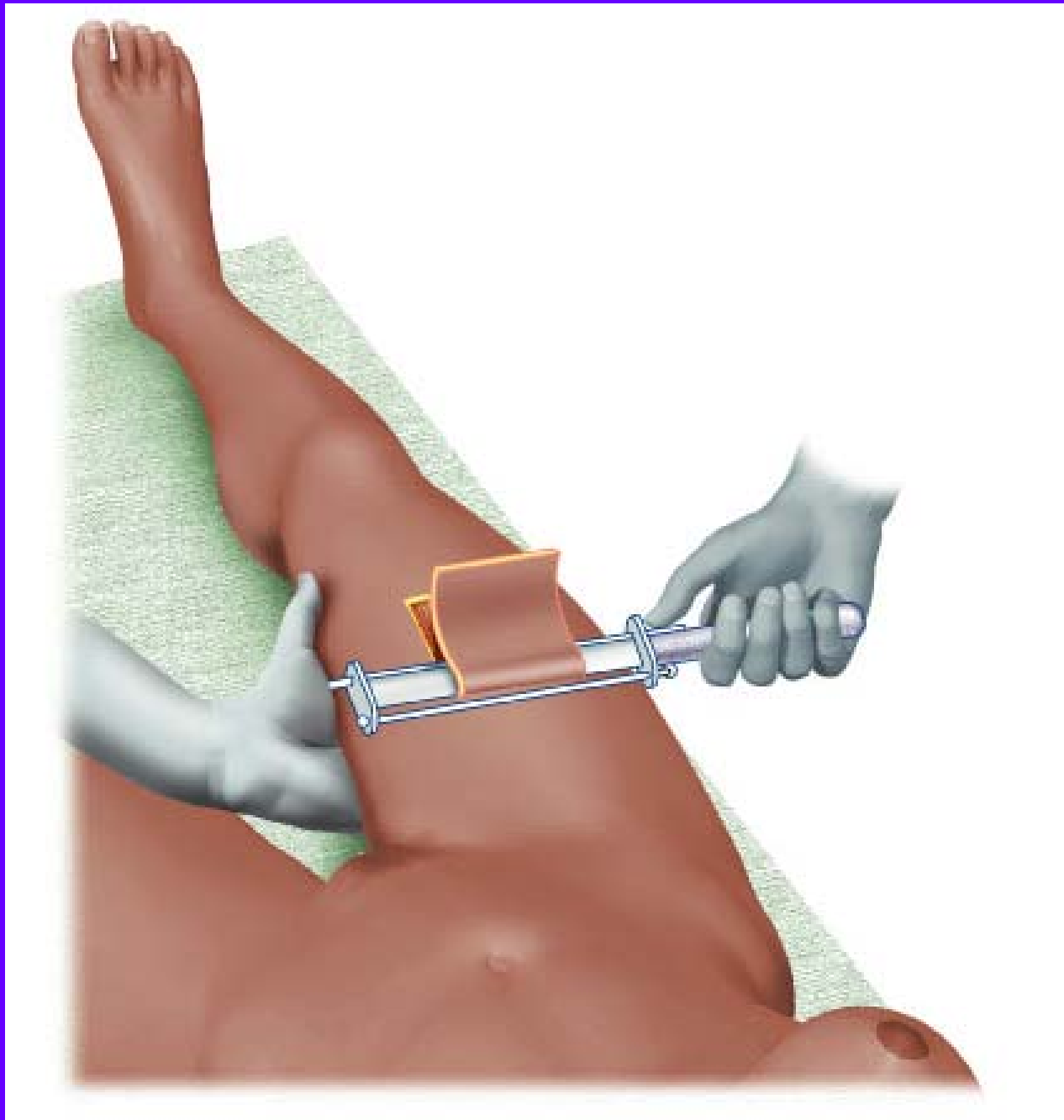


Goulian Blade



SKIN GRAFTING HANDLE







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*Complications
of skin grafts*

Early:

- Failure of take due to inadequate contact between graft and its recipient bed: (Inadequate fixation or hematoma)
- Failure of take/graft lysis due to infection

Late:

- Avoidable scarring/contracture
- Excessively expanded mesh graft
- Graft margins crossing anatomical segment & trophic
- ulceration/trauma .Graft insensate
- Graft too thin for permanent cover

Donor Site Problems:

- Failure to heal
- Infection

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Skin

Substitutes



Skin Substitutes

- **Skin substitutes are used in the temporary or permanent closure of many types of wounds.**
- **Although they are not substitutes for adequate surgical debridement or standard surgical treatment, such as flap coverage, they offer alternatives when standard therapies are not desirable.**

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Uses of Skin Substitutes

- **Skin substitutes are very important in cases of massive burns where autografts are insufficient to provide adequate skin cover.**
- **Skin substitutes provide reconstructive solutions that may be superior to other available methods because they may require a less vascularised wound bed, increase the dermal component of the healed wound, reduce or remove inhibitory factors, reduce the inflammatory response and provide rapid and safe coverage.**
- **Also these avoid donor site morbidity like pain and hypertrophic scar formation.**

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Ideal Skin Substitute

- **Epidermal and dermal components**
- **Easy to prepare, Easy to store, Easy to use**
- **No antigenicity**
- **Long-term wound stability**
- **Ability to resist shearing forces**
- **Ability to resist infection**
- **Ability to withstand wound hypoxia**
- **Cost-efficient**

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*Acellular skin
substitutes*

Biological Skin Replacements

Human amniotic membrane

- **Human amniotic membrane has been used since 1910.**
- **It provides protection from evaporative loss, as well as barrier function, whereas the fibronectin and collagen matrix provide some dermal function.**
- **It is transparent, and is minimally adherent, which facilitates dressing changes every 2 days.**
- **It is difficult to obtain, prepare, and store; it must be changed frequently; and it has a potential for infectious disease transmission.**

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Potato peels and Boiled banana leaf

- These have been used as temporary dressings for burn patients but are not technically skin substitutes.
- Potato peels and banana leaves are organic materials that help in limiting moisture loss from burns involving large parts of the body and thus help in limiting fluid and electrolyte losses.

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*Bioengineered
Skin Replacements*

Integra

- **Integra® is composed of two layers; a bovine collagen-based dermal analogue, which integrates with the patient's own cells and a temporary epidermal silicone sheet that is peeled away as the wound heals (Hansen et al. 2001).**
- **A very thin autograft is then applied onto the neo-dermis.**
- **Integra® is indicated for the post-excisional treatment**
- **of full thickness or deep partial thickness burns (Hansen et al. 2001).**

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Biobrane

- **Biobrane[®] skin substitute started in the late 1970s.**
- **It consists of a nylon mesh, which acts as a “dermis” and a silicon membrane which acts as an “epidermis”, both are embedded in porcine collagen.**
- **It is mainly used as a temporary coverage for partial thickness wounds, burns and donor-sites.**
- **However, there is a risk of infection and some studies have reported cases of toxic shock syndrome due to accumulation of exudate underneath it.**

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Alloderm

- The Alloderm[®] skin substitute is essentially formed from acellular matrix derived from a cadaveric dermis.
- It is processed by salt to remove the epidermis and then extracted with a solution to remove any cellular material.
- It is then freeze-dried to render it inert immunologically, although its basement membrane remains intact.
- It has no epidermal layer... However, the acellular matrix provides a good natural medium for fibroblast and endothelial cells to regenerate from the neo-dermis

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*Cellular Allogenic
skin substitutes*

TransCyte

- **The Transcyte[®] tissue engineered skin substitute is made from a nylon mesh and a silastic semi permeable and biocompatible layer.**
- **Allogenic fibroblasts from neonatal foreskin are embedded in the mesh and allowed to grow for 3-6 weeks to produce a cellular matrix of collagen and growth factors which may enhance wound healing.**
- **It is left in place until either spontaneous separation occurs which indicates wound bed healing or the wound is dealt with surgically.**
- **It has been licensed by the FDA for use in burns.**

TransCyte

Apligraf

- Apligraf® is a bilayered living skin equivalent composed of type I bovine collagen and allogeneic keratinocytes and fibroblasts obtained from neonatal foreskin (Hansen et al. 2001).
- It has to be applied “fresh”, as it has a shelf-life of five days at room temperature (Hansen et al. 2001) and has been used as a temporary covering over meshed expanded autograft for excised burn wounds (Waymack 2000).

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Dermagraft

- **The Dermagraft[®] skin substitute is similar to Transcyte[®] but it lacks the silicone layer and also contains viable fibroblasts.**
- **It is produced by mixing living neonatal foreskin fibroblasts with a biodegradable mesh from polyglycolic acid (Dexon or Vicryl) in a bag with circulating nutrients.**
- **The fibroblasts are cryopreserved at -80°C to maintain viability and when implanted to the wound, these start to proliferate and produce a variety of growth factors and extracellular collagen matrix components.**
- **The polyglycolic acid mesh is absorbed within 3-4 weeks. It has been used effectively in vestibuloplasty after mucogingival junction and supra-periosteal dissection.**

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*Cellular Autogenic
skin substitutes*

Cultured Epidermal Autograft (CEA)

- The culture of autologous keratinocytes involves taking a skin biopsy from the patient, removing the dermis and subcutaneous tissue and then mincing the epidermis with trypsin enzymes.
- The suspended keratinocytes are then cultured on a medium containing epidermal growth factors.
- Keratinocytes may not help in full thickness wounds or burns. Blisters develop on minimal friction since the dermal epidermal junction is not completely developed.
- Scarring, contracture and hyperkeratosis may also develop.

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Cultured Epidermal Autograft (CEA)

- **CEAs are very expensive 2X2 inch graft costs about \$550 (in 1996).**
- **They require a very vascularised bed**
- **They are extremely sensitive to infection**
- **Sheets of CEAs are very fragile and hard to handle.**
- **CEAs lack langerhans' cells and T-lymphocytes.**

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Cultured Skin Substitutes (CSS)

- Cultured skin substitutes have both epidermal and dermal components.
- It is a permanent autologous graft , It can be handled easily and does not form blisters because the dermal-epidermal junction is well formed.
- Several types were developed recently with different dermal biosynthetic scaffolds. The most commonly used type is a hyaluronic acid derived substitute.
- Hyaluronic acid facilitates the growth and movement of fibroblasts, controls matrix hydration and osmoregulation.

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Biological Skin Replacements

- Biological skin replacements are defined as materials derived from wholly biological sources.
- The gold standard for surgical repair after excision of a burn wound is the skin autograft harvested from the patient's own skin.
- Alternatively, if autograft is scarce, an homograft (donor or cadaver skin) or a xenograft (animal skin products) may be used to temporarily close the wound bed.
- Only autograft usually remains permanently. As homografts and xenografts are allogeneic, they are rejected after a variable period.

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