The Management of Wounds with Grafts & Flaps
Northern Illinois Affiliate of the Wound Ostomy Continence Nurses' Society Professional Education Day
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Introduction

- Proper wound healing is relevant to all surgical specialties
- Skin / subcutaneous tissue / fascia / muscle / bone
  - Nerves / blood vessels / organs / implants
- Exposure of underlying structures – critical wound
- Complex process
  - Growth factors, cytokines, cells
  - Physiologic or physical disruptions can delay healing (eg, dehiscence) or cause wounds (eg, pressure sores)
  - Disruption of process or poor prevention can have disastrous consequences

Learning Objectives

- To review principles of wound healing
- To understand the principles of skin grafting
- To understand the difference between grafts and flaps
- To recognize when a wound requires surgical intervention
- To learn the indications for use of a graft versus flap for wound closure
- To review case examples
Phases

Wound Healing

- Hemostasis (Seconds to Minutes)
  - Vasoconstriction (TXA, prostaglandins)
  - Platelet activation*, coagulation cascade initiation
- Inflammation (3 to 5 Days)
  - Vasodilation (prostaglandins, histamine, serotonin, kinins)
  - Edema
  - Neutrophils phagocytosis of debris and bacteria
  - Monocytes* → macrophages (phagocytosis)
  - Failure to move past this stage results in a chronic wound
- Proliferation (4 to 14 Days)
- Remodeling (Day 8 to 1 Year)

* Platelets are the first cells to respond to a wound
Hemostasis (Seconds to Minutes)

Inflammation (3 to 5 Days)

Proliferation (4 to 14 Days)

- Process of re-epithelialization (contact inhibition)
- Angiogenesis (low oxygen tension stimulates this)
- Fibroblasts \( \rightarrow \) type III collagen
- Fibroblasts \( \rightarrow \) myofibroblasts (wound contraction)
- Scars become raised and pink

Remodeling (Day 8 to 1 Year)

- No net increase in collagen
- Protease collagen digestion = Fibroblast collagen production
- Type III replaced by Type I collagen
- Disorganized collagen bundles becomes laminar collagen
- Scars’ appearance should improve
- Pink and raised \( \rightarrow \) flat and pale
- Delay surgical scar revision until after remodeling complete

Chronic Wounds

- Day 1 to 3: Hemostasis
- Stop Bleeding
- Day 3 to 20: Inflammation
- New frame work for blood vessel growth
- Week 1 to 6: Proliferation or Granulation
- Pulls the wound closed
- Week 6 to 2 Years: Remodeling or Maturation
- Final proper tissue
Initial Assessment

- Consider wound and patient

- Cause?
  - Surgery
  - Trauma
  - Burns
  - Unrelieved pressure
  - Medical conditions (pyoderma gangrenosum, calciphylaxis)

- Contributing Factors?

Impediments

Poor Oxygen Delivery
- Peripheral Vascular Disease
- Radiation
- Poorly designed flap (tip necrosis)
- Inadequate debridement of wound bed
- Vasospastic disorders
  - Raynaud’s
- Unrelieved pressure
  - Pressure exceeds capillary closing pressure (12-32 mmHg)

Impaired Cascade
- Diabetes
  - Glycosylation impairs macrophage action and inflammatory cascade
- Nutritional deficiencies
  - Protein
  - Vitamin C, B12, folate, iron, zinc
  - Gastric bypass patients
- Steroids
- Chemotherapy
- Diseases
  - Ehlers-Danlos, Progeria, Elastoderma

Pressure Ulcers

Table 1. National Pressure Sore Advisory Panel Consensus Development Conference

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Skin intact but remains red &gt;1 hr after relief of pressure</td>
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<tr>
<td>II</td>
<td>Blister or other break in the dermis with or without infection</td>
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<tr>
<td>III</td>
<td>Subcutaneous destruction into muscle with or without infection</td>
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<tr>
<td>IV</td>
<td>Involvement of bone or joint with or without infection</td>
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Nutrition

- Labs
  - Albumin (t1/2 = 20 days)
  - Prealbumin (t1/2 = 3 days) – check weekly

- Protein supplementation
  - 1.5-3.0 g/kg/day
  - Ensure shakes tid between or with meals

- Adequate calories
  - Calorie counts
  - 25-35 cal/kg/day

- Micronutrients
- Supplemental NG/DHT feedings

CONSULT NUTRITIONIST

Initial Management

- Assess healing potential
  - Debride wound
  - Identify etiology/contributing factors and address them
  - Gauge severity of wound
  - Begin wound care
  - Monitor progress of healing
  - Consider surgical consultation
Surgery?

When to do Surgery?

- To expedite healing of a chronic wound
- When a vital structure is exposed
  - Implant
  - Denuded bone
  - Major vessels (and the heart)
  - Risk of infection, desiccation, bleeding

The Reconstructive Ladder
**Grafts vs. Flaps**

- **Graft** = tissue that does not maintain its original blood supply
  - Must survive off the recipient site's blood supply
  - Can graft skin, dermis, bone, cartilage, fat
  - Composite = multiple tissues in same graft

- **Flap** = tissue that carries its own blood supply (eg, random pattern vs. axial pattern flap)
  - Skin, fascia, muscle, bone, combination (composite flap)
  - Free vs. pedicled
  - Rotation, transposition, interpolation, advancement
  - Required to cover structures that won't other accept a graft (eg, denuded bone, tendon, exposed joints or neurovascular structures)

**Skin Grafts**

- Achieve coverage (epithelialization) of wounds
- Expedite healing in a wound that would otherwise heal on its own
- Success depends on
  - Fixing the cause (eg, pressure)
  - Fixing contributing factors
  - Preventing recurrence

1. Full thickness skin graft consisting of epidermis and the full thickness of dermis.
2. Split skin graft consisting of epidermis and a variable proportion of dermis. Split skin grafts are described as thin, intermediate or thick according to the thickness of dermis included.
Skin Graft Healing

- **Imbibition**  Day 1-3  “Drinking”
  - Diffusion of nutrients

- **Inosculation**  Day 3-5  “Vessels Kissing”
  - Vessels in graft form connections with vessels in wound bed

- **Revascularization**  Day 5+  “Angiogenesis”
  - Regrowth of blood vessels into graft
  - Graft turns pink

Skin Graft Failure

Skin Graft
Meshing

- Increases the surface area of the graft
- Interstices allow for fluid egress
- Re-epithelialization between the interstices

Long-Term Graft Remodeling

- **Contraction**
  - Amount of contraction is dependent on amount of dermis in the graft
  - Thinner graft = less dermis = more secondary contraction

- **Primary Contraction**
  - Elastic recoil of skin graft immediately after harvest
  - Greater in FTSG > STSG

- **Secondary Contraction**
  - Scarring and wound contraction months to years after graft application
  - Greater in STSG > FTSG
  - Caution when using STSG across joints, on the hand, eyelids, face → functional impairment related to contracture
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Flap Reconstruction

- **Indications**
  - Coverage of wounds that won’t accept graft
  - Filling of “bulk” (eliminate dead space)
  - Enhance blood flow to recipient site
  - Reconstruction of a specific structure (e.g., breast, muscle)
- **Requires donor site**
  - “Robbing Peter to pay Paul”

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- Open chest wound after mastectomy
- Open tibial fracture
- Pressure ulcers
  - Ischial
  - Sacral
Fig. 5. The design for the gluteus maximus rotation flap.

Fig. 6. V-to-Y advancement flaps for the sacrum.

Fig. 7. A posterior thigh V-Y advancement flap.
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Thank you!

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