Principles of Plastic Surgery for the General Surgeon

September 29, 2008
Joyce Aycock, M.D.
Assistant Professor of Surgery
Division of Plastic and Reconstructive Surgery
University of Colorado Denver
What is plastic surgery?
• Plastic- from the Greek *plastikos*- to mold

Why plastic??
Plastic surgery began with nasal reconstruction in India in 3000 BC where nasal amputation was used as a punishment.

First detailed description of nasal reconstruction with a forehead flap by Sushruta around 600 BC
Tagliacozzi, an Italian surgeon, describes reconstruction of the nose with a flap from the arm in his book published 1597.
• In 1804, Baronio, an Italian physiologist performed and described successful skin grafting in sheep
• In 1817, the Royal College of Surgeons of England first record a successful graft in humans on an amputated thumb
Sir Harold Gillies (1882-1960)

Father of modern plastic surgery—established plastic surgery unit to treat war injuries in WWI

A burned soldier being reconstructed with tubed pedicle flaps
Here he uses the “Indian” forehead flap—which we still use today.
Gillies’ Principles

• Observation is the basis of surgical diagnosis
• Diagnose before you treat
• Make a plan and a pattern for this plan
• Make a record
• The lifeboat
• A good style will get you through
• Replace what is normal in normal position and retain it there
Gillies’ Principles

• Treat the primary defect first
• Losses must be replaced in kind
• Do something positive
• Never throw anything away
• Never let routine methods become your master
• Consult other specialists
• Speed in surgery consists of not doing the same thing twice
• The after-care is as important as the planning
• Never do today what can honourably be put off till tomorrow
Joseph Murray

Treated victims of WWII and became interested in rejection of skin grafts—it was known that the only successful allografts were between identical twins.

- In 1954, his team performed the first successful human kidney transplant between identical twins. Later research led to the development of immunosuppressive drugs.

- In 1990, Murray received the Nobel Prize for his work.
The Future

- Composite Tissue Allotransplantation

- Tissue engineering
  Adipose derived stem cells, Growth factors, Neuron regeneration, Bionic interfaces

Lengele, B et al. Plastic and Reconstructive Surgery 120(3); 803. 2007
What do plastic surgeons do?

We restore, repair and make whole those parts...
Which nature has given but which fortune has taken away,
Not so much that they may delight the eye
But that they may buoy up the spirit and
Help the mind of the afflicted.

Gaspar Tagliacozzi, 1597

Burget G, Walton R. Plastic and Reconstructive Surgery 120(5); 1171, 2007
The Defect
Wound Healing

• Inflammatory phase (First 4-6 days)
  – Hemostasis- coagulation cascade and formation of fibrin clot
  – Chemotaxis- cytokine signals attract neutrophils and macrophages that become activated to clear damaged extracellular matrix, bacteria and cellular debris

Wound Healing

- Proliferative phase (Days 4-14)
  - Epithelialization- epithelial cells at the edge are signaled to proliferate
  - Angiogenesis- endothelial cells are signaled to start forming new capillary tubes
  - Matrix formation- fibroblasts are signaled to migrate, proliferate and synthesize collagen. Some transform into myofibroblasts leading to wound contraction

Wound Healing

• Maturation and Remodeling Phase (up to 1 year)
  – Wound matrix is replaced by collagen in an organized manner
  – Wound strength
    • 1 week: 3%
    • 3 weeks: 30%
    • 3 months: 80%

What prevents wound healing?

Infection

– If the bacterial count in the wound is greater than $10^5$ organisms per gram or β-hemolytic streptococci are present - the wound will not heal by any means

– Bacteria cause prolonged inflammatory phase with phagocytosis and release of collagenase, causing breakdown of the wound and normal tissue
• How can we tell if the wound is infected?
  – Send quantitative cultures
• Treatment of infected wounds
  – Debridement of non-viable and infected tissue
  – Topical antibiotics
## Topical antibiotics

<table>
<thead>
<tr>
<th>Topical agent</th>
<th>Coverage</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silvadene (silver sulfadiazene)</td>
<td>Gram positive and negative</td>
<td>Painless application</td>
<td>Doesn’t penetrate eschar</td>
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<tr>
<td></td>
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<td></td>
<td>Neutropenia, Gram negative resistance</td>
</tr>
<tr>
<td>Sulfamylon (mafenide acetate)</td>
<td>Gram positive and negative</td>
<td>Penetrates eschar</td>
<td>Painful to apply</td>
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<tr>
<td></td>
<td></td>
<td>Less resistance</td>
<td>Metabolic acidosis</td>
</tr>
<tr>
<td>Acticoat (silver dressings)</td>
<td>Gram positive and negative including MRSA, VRE</td>
<td>Painless</td>
<td>Expensive</td>
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<tr>
<td></td>
<td></td>
<td>Easy to apply</td>
<td></td>
</tr>
<tr>
<td>Silver nitrate</td>
<td>Gram positive</td>
<td>Painless, No hypersensitivity</td>
<td>Messy to apply</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No gram negative</td>
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</tbody>
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Ischemia

- Healing requires adequate supply of oxygen and glucose to create ATP
- Therefore, wound needs adequate vascular supply to heal
- Difficulty healing over non-vascularized surfaces - exposed bone without periosteum, tendon without paratenon
Foreign body

- Physical obstacle to healing
- Asylum for bacteria
- Necrotic tissue acts as a foreign body
Edema

- Elevated tissue pressures can decrease perfusion leading to increased ischemia
- Conditions associated with edema (leaky endothelium, low oncotic pressure, low peripheral pressure, histamine and cytokine release) contribute to poor wound healing
Other factors

• Malignancy (Marjolin’s ulcer)
• Nutrition
• Smoking
• Radiation
• Diabetes
• Renal Failure
• Corticosteroids
Reconstructive Ladder

- Organizing wound closure by level of complexity; however, we may skip over rungs to obtain the best functional outcome.
V.A.C.
Vacuum-assisted closure

• What does it do?
  – Provides negative pressure therapy to wound under an occlusive dressing
  – Increases rate of angiogenesis and cell proliferation
  – Decreases frequency of dressing changes
  – Removes fluid from wound
  – Provides some mechanical stability

V.A.C.
Vacuum-assisted closure

• What does it not do?
  – Heal infected wounds
  – Heal wounds that need to be debrided
  – Heal ischemic wounds

• V.A.C. can speed or aid healing of wounds, but one must still adhere to basic principles of wound healing
Grafts vs. Flaps

- Graft = tissue transferred without its own blood supply
- Flap = tissue transferred with its own blood supply

Or...

A graft is a piece of detached skin which is dead when you put it on and comes to life later.

A flap is a partly attached piece of skin which is alive when you put it on and may die later

- Sir Harold Gillies
Graft take

- Plasmatic imbibition
  - Bibere = to drink
- Inosculation
  - Osculare = to kiss
- Neovascularization
  - Vascularis = of tubes
What prevents graft take?

- Infection
- Seroma
- Hematoma
- Shear
- Non-vascularized bed
Flaps

- Require arterial and venous supply
  - Most flap loss is due to venous congestion
Random pattern
When is a flap useful?

• A flap transfers vascularized tissue from one part of the body to another
  – Cover vital structures
  – Cover exposed bone or tendon
  – Wound healing- previous infection, fill dead space
  – Protect from radiation
  – Supply deficient tissue
  – Provide specialized tissue
Cover vital structures

Patient after resection thyroid cancer invading manubrium and chest wall

- Pleura
- Trachea
- Innominate vein
- Common carotid

Pectoralis flap
Cover vital structures

Patient with exposed vascular anastomosis after removal of infected graft

Vein graft to SFA

Rectus femoris muscle flap
Cover exposed bone or tendon

Skin graft can sometimes bridge up to 1 cm gap. Periosteum or paratenon can support a graft.
Pt with lymphoma involving spine, s/p radiation.
Infected, non-healing wound for months following decompressive laminectomy for cord compression. Had to live in nursing home for wound care.

Partial latissimus flap based on lumbar perforator.
Fills dead space with vascularized tissue.
Wound Healing

Wound healed - patient went home!
Protect from radiation

Defect after wide excision of soft tissue sarcoma
Will require post-op radiation therapy
Protect from radiation

Rectus myocutaneous flap harvest from abdomen

Popliteal vessels

Peroneal nerve
Supply deficient tissue

Breast reconstruction after mastectomy with TRAM flap
Supply deficient tissue
Separation of components

After removal of skin graft

Separation of components
Separation of components
Provide specialized tissue
Choose the best method to accomplish goals

- Close wound
- Optimize function
- Acceptable appearance
"This is about all I have in your price range..."
Thank you

Lawrence Gottlieb, MD
David Song, MD
Robert Walton, MD
Charles Butler, MD