Art and Science of Burn Care
The Plastic Surgeon’s Responsibility

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No Relevant Disclosures
Question:

Why does burn care management **NOT** play a greater role in today’s residency training?
Bias:

As a plastic surgeon and residency program director, I believe that the elements of wound healing and the fine detail necessary to treat a burn wound are identical to those that make an excellent plastic surgeon.
“For burn patients, reconstruction actually starts with acute care”

Stephen Milner, MD
Johns Hopkins University Burn Center
General surgery resident rotations in surgical critical care, trauma, and burns: what is optimal for residency training?


- Analysis of surgical rotations of general surgery residents (n=7,299) for 8 years
- Burn rotation duration was median 1.0 months (max: 0 to 6) 60 month programs

*It is an ideal time to determine the optimal curriculum and duration of these important rotations for general surgery residency training.*
Medical student chat room:

I was wondering if anyone knew how to go about training to do burn grafting at a burn center?

I recently assisted in grafting in the OR and really loved the artistic aspect of it and the fact that it will not be going minimally invasive, as many surgical specialties are doing.

I initially assumed general surgery (so I could manage pts in Burn ICU also) followed by a burn fellowship, but then someone clued me in that burn fellowships were not necessarily effective.

Plastics was suggested, but I didn't see anything about plastics residencies that specialize in burns. Plus, on the plastics threads, it seems most people say they don't really get ICU-type training, just the reconstruction.
Facts:

- Burn care is an art and a science
- Incidence of major burn injuries decreasing
- Insufficient training during primary residencies

*Who will be responsible for quality burn care?*
What is a burn?

A burn is an injury to skin, or other tissues, caused by heat, cold, electricity, chemicals, friction, or radiation.

Flame, scald, or contact.
Classification

• First Degree
• Superficial Second Degree
• Deep Second Degree
• Third Degree (Full Thickness)
• Fourth Degree
ANATOMY OF THE SKIN

Epidermis

Nerve Endings
Sebaceous Gland

Dermis

Hair Follicle

Subcutaneous

Sweat Gland

Muscle

Blood Vessel

Bone
partial thickness
superficial

partial thickness
dee

full thickness
First Degree Burn
Superficial Second Degree Burn
Superficial Second Degree Burn
Second Degree: Superficial to Deep
Pathophysiology of Burns

Capillary Permeability
Deep Second Degree

![Image of hands with deep second degree burns]
Deep Second Degree Burn
Third Degree
Electrical Injury

• Electrical to thermal energy
• Flash burn
• Entrance / Exit
• Secondary clothing ignition
Etiology
Etiology
Electrical Burns

- Fourth degree
- Skip areas
- Requires second look
Chemical
Friction Burns
## Impact

<table>
<thead>
<tr>
<th></th>
<th>Burn Injuries Reported</th>
<th>Burn Related Deaths</th>
<th>Burn Hospitalizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>500,000</td>
<td>4000</td>
<td>40,000</td>
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<tr>
<td>Global</td>
<td>11,000,000</td>
<td>180,000</td>
<td>unknown</td>
</tr>
</tbody>
</table>
History of Skin Grafting

- 1500 BCE – India
- 1869 – Reverdin pinch
- 1886 – Thiersch – pinch STSG
- 1872 – Wolfe – FTSG
- 1930 – Blair – knife
- 1939 – Padgett drum
- 1948 – Brown dermatome
- 1985 – Air driven dermatomes
Cocoanut Grove 1942
Historical Burn Care

Francis Moore, MD / Oliver Cope, MD  Mass General / Boston City
• Fluid resuscitation
• Smoke inhalation injury
• Penicillin for infection
• Mass casualty triage
Assessment

- Healing
  - First
  - Superficial 2nd°
- Scarring
  - Deep 2nd°
  - Grafting?
- Reconstruction
  - 3rd°
  - 4th°
Immediate Concerns

• Etiology and type
  • Thermal
  • Electrical–secondary fall??

• Airway
  • Supraglottic
  • Inhalation

• Ocular
  • Thermal
  • Chemical
CO and HBO

- Immediate cause of death
- Decrease in oxyhemoglobin saturation
- Symptoms over 20%
- Half life carboxyhemoglobin:
  - 250 min on room air
  - 60 min on 100% oxygen
  - HBO over 25%, 30 min on HBO
Level of Concern

- Specific discussion:
  - Family
  - Patient

- Devastating alterations
  - Cosmetic appearance
  - Change in self image
  - Employment opportunities
  - Acceptance by society

- Multidisciplinary care to achieve maximum recovery
Assessment

• Cause of burn injury
• Estimate depth
• Prioritize per %BSA
• Protect airway
• Protect the cornea
Acute Care

- Evaluate burn severity
- Topical antibacterials
- Surgical excision and grafting
- Post surgical splinting / therapy
Body Surface Area – Rule of 9s
“Conservative Management”
Early Excision
Sheet Graft or Mesh
Sheet Graft or Mesh
Early Attention to Detail
Goal of Treatment
Physical / Occupational Therapy

• Who is a candidate?
• When does it start?
• How long will therapy continue?
• What will my results be?
Who Should Be Sent to Therapy?

- Burns crossing joints
- All hand burns
- Stiffness and mobility loss
Role of Pressure

- Compression gloves
- Scar conformers
- Silicone sheeting
When to Quit ??

• Unable to correct contraction
• Contracture worsening
• Child unable to cooperate
• Parent not capable of carrying out program
• Function and / or development severely affected
Burn scar reconstruction

- Excision and Closure
- Split Thickness Skin Graft
- Full Thickness Skin Graft
- Local Flap Coverage
- Distant Flap Coverage
Burn scar reconstruction

- Tissue Expansion
- Dermal Reconstruction
  - Alloderm®
  - Integra®
Principles

Burn Scar Reconstruction

1. The defect is always larger than you think!
Principles
Burn Scar Reconstruction

1. The defect is always larger than you think!
2. Surface contour influences the outcome.
Principles
Burn Scar Reconstruction

1. The defect is always larger than you think!
2. Surface contour influences the outcome.
3. Ratio of soft tissue to skeletal length will affect functional return.
...Burn Contracture is Synonymous with Skin Deficit
Palmar Contractures
Surface Contour

...Surface contour plays a significant role in planning reconstruction.

...Certain contours will have a higher potential for recurring contracture.

Concave vs. Convex
Concave vs. Convex

...Certain contours will have a higher potential for recurring contracture.
Concave vs. Convex
Concave vs. Convex
...a skin graft or healing wound will continue to contract until it meets an equal opposing force.

Gabbiani
Quality of burn scar
Quality of outcome

• Outcome predictable
• “I can always excise later”
• Fine joint fibrosis
• Permanent stiffness
Treatment goal
Art, Science, Commitment, Long Term Follow-up

Reconstructive Burn Surgery
Facial Reconstruction
Facial Reconstruction
Electrical
Electrical
Electrical

Pectoralis myocutaneous flap
Electrical
Electrical
Electrical
Electrical
Facial Tissue Expansion
Acute Burns of the Ear

- Minimal debride
- Sulfamylon
- No pressure
- Remove cartilage when exposed
Ear – partial loss friction burn
Ear – partial loss friction burn
Ear – partial loss friction burn

at one year
Ear – partial loss friction burn

Options
Electrical
Electrical
Electrical
Electrical
Electrical
Secondary closure - conservative
Facial Esthetic Zones
Facial Esthetic Zones
Flame burn

- Extensive facial burn
- Exposed frontal sinus
- Loss left lateral nose
- Eyelid burns
- Loss left ear
Flame burn
Flame burn

Tagliacozzi Flap
Flame burn

Gaspare Tagliacozzi circa 1595
Flame burn
Palmar Contractures

- Flexion of digits
- Shortening of palmar spread
Palmar Contractures
Palmar Contractures
Syndactyly Reconstruction
Syndactyly Reconstruction
Advanced Reconstruction

• **Goal:** functional salvage

• **Principles:**
  • Severe tissue deficiency
  • *Skeletal to soft tissue ratio* *(most important concept)*
Tissue Expansion

Composite tissue expansion:
To include dorsal skin/graft and tendon
Tendon Expansion

150% longitudinal expansion of tendon
Immediate motion after removal extensor tendon lag for 2 weeks
Expansion in Children

Sequential tendon expansion
Fixed Deformity of the Wrist
Fixed Deformity of the Wrist
Fixed Deformity of the Wrist
Outpatient Burns
Outpatient Treatment
Patient Follow-up

*Scar maturation and contraction will continue for at least one year!*
Patient Follow-up

Emotional changes will persist for a lifetime!
Changes in Burn Care

• Greater prevention
  ➢ 40% decrease in last 10 years
  ➢ Burn severity decreased from 22% to 11%

• Better understanding and control of systemic inflammatory response

• Shelf stored skin, refined growth factors, and precise excisional debridement

• Role of the noninvasive laser
From a Residents’ Application:

...her plastic surgery rotation observation:

while in the OR, she observed plastic surgeons reconstructing disfigured patients and decided that that's what she wanted to specialize in.

"Plastic surgery is precise and creative, and the reconstructive cases are all unique and difficult," she said.

"Each patient presents a new challenge, and I'm also able to develop a long-term relationship with my patients."
Opinion:

Plastic surgeons must continue to play an expanding role in both acute and reconstructive burn care.

The patients will benefit from it!
Integra®
Fixed Deformity of the Wrist
Integra®

Not exempt from contractures
Integra®

Not exempt from contractures